7th International Congress

MOUNTAIN SPORT & HEALTH

Updating Study and Research from Laboratory to Field

9-10 November 2017

Rovereto (TN) – Italy

PROGRAMME

and

BOOK OF ABSTRACTS
partnership:
WELCOME

Mountain and Health is an amazing couple which turn to be joined by Sport in an active life perspective. There are a number of different fields, ranging from the top high-level performance to the promotion of health and wellbeing that find a specific development in this framework.

Indeed they are also an intriguing laboratory for the better understanding of the nature of the responses to physical effort in order to address the correct approach to fitness increase through appropriate exercises program and sports.

Mountain, Sport, & Health aims at offering an updated and stimulating panorama, from laboratory experimental studies to the application on day to day practice, on different topics related to mountain sports activities and their impact on human performance and health.

This sixth edition of the congress aspires to be an appointment for scientists, trainers, mountain experts, students strongly engaged in sharing knowledge and experiences on their, currently running or future, sport and mountain studies.

We wish all the participant a very interesting and pleasant experience here in Rovereto.

Professor Federico Schena
**SPEAKERS**

*(in alphabetic order)*

**PROGRAMME**

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THURSDAY, 9 NOVEMBER

8.30 – 9.00 Registration

Thematic session 1 – Adaptations to training (with/without hypoxia)

9.00 – 9.30 Pasqualina Buono (Napoli) – Molecular adaptation induced by training in skeletal muscle: influence on human health and longevity

9.30 – 10.00 Laurent Mourot (Besançon, FRA) – Training in hypoxia: for better or for worse?

10.00 – 10.15 Aldo Savoldelli (Rovereto) – Interaction between hypoxia exposure and exercise intensity

10.15 – 10.30 Letizia Rasca (Milano) – “BEEt On Alps”: Ergogenic Effects Of Dietary Nitrate Supplementation At High Altitude


10.45 – 11.00 Coffee break

11.00 – 11.30 Official opening

11.30 – 12.30 KEYNOTE LECTURE

Russell S. Richardson (Utah, USA) – Exercise is the Fountain of Youth: Metabolic and Vascular Evidence

12.30 – 13.30 Lunch

Thematic session 2 – Sport, education and dual career

13.30 – 13.50 Francesca Vitali (Verona) – Supporting dual career and employability of active and former elite athletes: Italian contributions to B-WISER project

13.50 – 14.10 Nicola Petrone (Padova) – The ISEA Winterschool in Sports Engineering: a successful synergy between engineers, sport scientists, sport companies

Dual Career projects:

14.10 – 14.25 Floriana Cova (Trento) University of Trento: UniTrento dual career programs

14.25 – 14.40 Caterina Rota (Verona) University of Verona: Academic Coach

14.40 – 15.40 KEYNOTE LECTURE

Carlo Reggiani (Padova) – Response of skeletal muscles to life and activity at high altitude

15.40 – 16.00 Coffee break

Thematic session 3 – Incoming Olympic sport

16.00 – 16.30 Eivind Wang (NOR) – Blood flow and oxygen uptake during forearm exercise: Implications for rock climbing performance

16.30 – 16.50 Maurizio Fanchini (FASI – ITA) – Research and Sport climbing. Where we come from and where we are going.

20.00 Congress Dinner
**FRIDAY, 10 NOVEMBER**

Thematic session 4 – Physiology

9.00 – 9.30  
Fabio Esposito (Milano) – Effects of acute passive stretching on anaerobic and aerobic performance  

9.30 – 10.00  
Mark Rakobowchuk (CAN) – Vascular health, eccentric exercise and the involvement of microvesicles

10.00 – 10.30  
Silvia Pogliaghi (Verona) – Laboratory-derived measures of critical intensity: what’s new?  

10.30 – 11.00  
Coffee break

11.00 – 12.15  
Thematic session 5 – Endurance Sport

11.00 – 11.30  
Stefan Lindinger (AUT) – Benefits of drafting in cross-country skiing

11.30 – 11.50  
Chiara Zoppilli (Rovereto) – Kinematics during Marcialonga Ski Marathon: gender and fatigue.

11.50 – 12.10  
Gianluca Vernillo (Milano) – A call for standardised procedures in the study of running economy in ultra-marathon

12.15 – 13.00  
Lunch

13.00 – 14.00  
Poster Session

Thematic session 6 – Technology in Sports

14.00 – 14.30  
Francesco Biral (Trento) – Modelling and optimisation of sport performance: exploiting wearable technologies and AI

14.30 – 15.00  
Francesca Pizzini (Verona) – Explore the exercising brain: Neuroradiological technics and applications

Thematic session 7 – Outdoor activities for health

15.00 – 15.40  
Federico Schena (Verona) – How to match scientific prescription and health outcomes in a daily life perspective

15.40 – 16.00  
Raffela Rosa (Verona) – Can Nordic Walking improve motor abilities in people with cognitive impairments?

16.00 – 16.20  
Matteo Bonato (Milano) – A program of moderate physical activity for people living with HIV

16.30 – 17.30  
CeRISM Lab visit with “Aperitivo” and closing remarks

20.30  
Special event – in Italian– free entry (Sala Filarmonica, corso Rosmini Rovereto)  

“Vincersi – il film” Documentary movie on a team of Blind Climbers
MODELLING AND OPTIMIZATION OF SPORT PERFORMANCE: EXPLOITING WEARABLE TECHNOLOGY AND AI

Biral F.1, Zignoli A.1, Bertolazzi E.1, Fornasier A.2, Laursen P.1, Pellegrini B.2, Schena F.2

1Department of Industrial Engineering University of Trento2CeRISM Research Centre University of Verona
2Sports Performance Research Institute NZ, Auckland University of Technology

Recent technological advances in miniaturised wearable biosensors, microelectronics and low power wireless communications have boosted the collection of huge amount of biomechanical, physiological data that can be stored and processed locally in portable computational devices (such as smart phones and watches) and/or transferred to cloud storage systems. The availability of this big data is still largely unexplored. Data can be used in two ways: a) to describe and interpret complex physical phenomena identifying underlying patterns and relationships, b) to predict the behaviour of the system in response to inputs and/or change of parameters. Mathematical models are the main tool to achieve the above goals and they are widely used in the sport sciences (e.g. exercise physiology, energetic of locomotion) and engineering disciplines (optimal control, AI) to describe the behaviour of measurable variables or to forecast variables hard to be collected. Additionally, predictive models are the key ingredient for optimisation processes and methods.

In the recent years, our research group has been using models as tool to improve our understanding of exercise physiology and for sport performance optimization.

Bioenergetic models have been developed to describe the metabolic response to cycling exercise, in terms of oxygen consumption and blood lactate concentration. An optimal control algorithm has been applied to the developed models to automatically calculate the exercise profile that could elicit the desired metabolic response. Coaches and practitioners can use such tools to prescribe and design training protocols in a more systematic and data based reasoning. More work is needed to prove the proficiency of such tools in every day practice.

Equations of motion of a cyclist coupled with rider’s energetic requirements and optimal control predicted the best trajectory in a last-km sprint on a 2D track. The solution was found to be a balance between the maximal velocity that the cyclist could sustain in the turns and the power that the virtual rider was able to deliver. Predicted values were compared to experimental data provided by elite athletes. Although in good agreement, more work is needed to refine model predictions and to include important characteristics of the real sprint such as interference and cooperation with other riders.

Human physiology is a complex system with many interlaying variables. Emerging AI technologies, like machine learning and deep neural networks, have been demonstrated to be able to discover the underling relationships. For example, we applied AI to predict the cardiopulmonary test (CPET) data. Our goal was to find the best descriptor for oxygen consumption dynamics during high-intensity cycling. The neural networks we developed are able to predict oxygen consumption values from past power, cadence, heart rate and respiratory frequency data. This new technology is not promising only in terms of VO2 data forecasting, but also for CPET diagnostic.

With our research, we wanted to provide new theoretical basis and mathematical integrated tools for the scientific community. Without a mathematical model, measured data cannot be discussed critically and converted to useful information. However, the quality of a model in terms of accuracy and reliability strongly depends on quality of experimental data that mostly miss of clinical validation. More collaboration between model developers (like engineers and mathematicians) and sport scientists (like researchers, coaches) is needed to provide high quality models.

REFERENCES
A PROGRAM OF MODERATE PHYSICAL ACTIVITY FOR PEOPLE LIVING WITH HIV

M. Bonato1, V. De Zan2, L. Galli2, G. Merati1,2, G. Pavel4, P. Cinque4, A. La Torre1

1Department of Biomedical Sciences for Health, Università degli Studi di Milano, Milan, Italy
2Department of Infectious Disease, San Raffaele Scientific Institute, Milan, Italy
3Centre of Sport Medicine, Don Carlo Gnocchi Foundation, Milan, Italy
4Department of Pathophysiology and Transplantation, Università degli Studi di Milano, Milan, Italy

INTRODUCTION
People with HIV are living longer since the introduction of combined antiretroviral therapy (cART). However, chronic HIV infection is associated with low-level inflammation and increased risk of chronic diseases and mortality. It has been demonstrated that physical activity improved health and quality of life in the general population and in other vulnerable populations. Therefore, we investigated the effects of moderate intensity exercise on metabolic and inflammatory markers in HIV-infected treated persons.

METHODS
In order to assess the feasibility of a program of moderate physical exercise in HIV infected people we initially designed a 12-week pilot study with 3 sessions per week of a grouped and coach-supervised moderate physical activity consisting of brisk walking, with or without 30 min circuit-training strength exercises. Assessments at baseline (BL) and week 12 (W12) included anthropometric assessment; lipid and glucose blood profile, soluble and cell inflammatory markers. This study provided relevant information for the design of a subsequent and larger multicentre 16-week clinical study of a moderate intensity training program consisting of walking or jogging three times/week for 60 minutes. In this study, an initial coach-supervised period of 4 weeks, was followed by 12 weeks where participants were instructed to train independently and we tested the use of a mobile application to encourage engagement to exercise by providing motivational inputs, and therefore adherence, and, as a consequence, to improve physical fitness. At BL and week 16 (W16), patients underwent measurement of cardio respiratory fitness (CRF), body composition, laboratory analyses and soluble inflammatory markers.

RESULTS
In the first pilot study 49 patients were included and 35 (71%) completed the program, with a median adherence to the sessions of 67%. Participants walked a median distance of 122 km in 12 weeks (5040 m each session) at a median exertion of 66% HRmax. We observed, in parallel with improvement of physical fitness and of some morphometric measures, substantial improvements of cholesterol profiles and inflammatory markers. Most changes did not differ substantially between participant who did or did not also performed the strength exercise or between women and men. In the second study 37 subjects have been screened so far and 28 have started the program. Ad interim analysis of this first group of patients showed a median adherence of 100% during the initial coach supervised period, and 70% during the independently training period, despite use of the mobile application, with 15/28 (54%) who trained for at least 50% of the sessions. Data were assessed in the whole group and separately in patients who trained for >50% (group A, n=15) or <50% (group B, n=13) of the sessions. Significant improvements were observed in group A participants of CRF, body composition, laboratory and inflammatory markers, but not in group B.

CONCLUSIONS
Brisk walking, with or without strength exercise, could improve physical fitness, lipid profile and inflammatory markers in chronic HIV infection. However, adherence is key to improve physical fitness and metabolic and inflammatory parameters, but seems to be low when not strictly supervised. For this reason, strategies to improve adherence to physical exercise are needed to achieve health benefits in this population.

REFERENCES
ADAPTATION INDUCED BY TRAINING IN SKELETAL MUSCLE: INFLUENCE ON HUMAN HEALTH AND LONGEVITY

A. Mancini1,2, D. Vitucci3, G. Labruna3, E. Imperini3, M.B. Randers4,5, J.F. Schmidt6, M. Hagman6, T.R. Andersen6, R. Russo7, S. Orrù1,2, P. Krstrup6,8, F. Salvatore3, P. Buono1,2,3

1 Dipartimento di Scienze Motorie e del Benessere, Università Parthenope, Naples, Italy;
2 CEINGE-Biotechecologie Avanzate, Naples, Italy;
3 IRCSS SDN, Naples, Italy;
4 Copenhagen Centre for Team Sport and Health, Department of Nutrition, Exercise and Sports, University of Copenhagen, Denmark;
5 Aalborg Football Club, Aalborg, Denmark,
6 Department of Sports Science and Clinical Biomechanics, SDU Sport and Health Sciences Cluster (SHSC), Department of Sports Science and Clinical Biomechanics, Faculty of Health Sciences, University of Southern Denmark, Odense, Denmark,
7 Orthopaedic and Trauma Unit ”Dei Pellegrini Hospital”, Naples, Italy; 8Sport and Health Sciences, College of Life and Environmental Sciences, St. Luke’s Campus, University of Exeter, Exeter, UK.

PURPOSE
We investigated whether lifelong football training affects the expression of healthy longevity-related muscle molecular markers.

METHODS
Biopsies were collected from the vastus lateralis muscle of 10 lifelong football-trained men (68.2±3.0 years old) and of 10 active untrained healthy men (66.7±1.3 years old). Gene and protein expression was measured by RTqPCR on RNA and by western blotting on protein extracts from muscle biopsies, respectively.

RESULTS
The expression of AMPKα1/α2, NAMPT, TFAM and PGClα, which are markers of oxidative metabolism, and MyHC β isoform expression was higher in the muscle of football-trained men versus untrained men. Also citrate synthase activity was higher in trained than in untrained men (109.3±9.2 vs 75.1±9.2). These findings were associated with a healthier body composition in trained than in untrained men (body weight:78.2±6.5 vs 91.2±11.2 kg; body mass index [BMI]): 24.4±1.6 vs 28.8±4.0; fat%: 22.6±8.0 vs 31.4±5.0%) and with a higher maximal oxygen uptake (VO2max: 34.7±3.8 vs 27.3±4.0 mL/min/kg). Also the expression of proteins involved in DNA repair and in senescence suppression (Erk1/2, Akt and FoxM1) was higher in trained than in untrained men. At BMI- and age-adjusted multiple linear regression analysis, fat percentage was independently associated with Akt protein expression, and VO2max was independently associated with TFAM mRNA and with Erk1/2 protein expression.

CONCLUSIONS
Lifelong football training increases the expression of key markers involved in muscle oxidative metabolism, and in the DNA repair and senescence suppression pathways, thus providing the molecular basis for healthy longevity.

REFERENCES
UNITRENTO DUAL CAREER PROGRAMS

Cova F.

University of Trento, Italy

In 2011 the University of Trento launched the first experiment in Italy of a dual career program: TOPSport.

TOPSport provides high level athletes with tools and services that support them in combining their sport and academic commitments.

The University of Trento has also two additional dual career programs: UNI.Team (providing an athletic program and academic support to athletes in specific disciplines) and TOP Team (a sort of TOPSport program, organized in collaboration with some of the most important sport teams of Trentino).

CYCLING EFFICIENCY AND TIME TO EXHAUSTION ARE REDUCED AFTER ACUTE PASSIVE STRETCHING ADMINISTRATION

Esposito F.

Department of Biomedical Sciences for Health, University of Milan, Milan, Italy.

The aim of the study was to assess the effects of acute passive stretching on cycling efficiency during an exercise of heavy intensity. After maximum aerobic power (\(V'O_2\text{max}\) ) assessment, nine active males (24±5 yrs; stature 1.71±0.09 m; body mass 69±7 kg; mean±SD) performed tests at 85% of \(W'85\) until exhaustion, with and without pre-exercise stretching. During tests, we measured gas exchange, metabolic and cardiorespiratory parameters. With stretching no differences in \(V'O_2\text{max}\) occurred (3.64±0.14 vs 3.66±0.07 l/min for stretching and control, respectively). During \(W'85\), pre-exercise stretching: i) decreased time to exhaustion (tlim) by 26% (P<0.05); ii) increased average \(V'O_2\) by 4% (3.24±0.07 and 3.12±0.07 l/min in stretching and control, respectively; P<0.05); and iii) reduced net mechanical efficiency (enet) by 4% (0.185±0.006 and 0.193±0.006 in stretching and control, respectively; P<0.05). Although acute passive stretching did not have an effect on \(V'O_2\text{max}\), tlim and enet during heavy constant load exercise were significantly affected. These results are suggestive of an impairment in cycling efficiency due to changes in muscle neural activation and viscoelastic characteristics induced by stretching.

RESEARCH AND SPORT CLIMBING, WHERE WE COME FROM AND WHERE WE ARE GOING

Fanchini M.,

Research department, FASI (Italian Federation Sport Climbing)

Sport climbing is a competitive activity that is performed on artificial environments. Boulder, lead and speed are the different competitive disciplines. Milestones in sport climbing can be considered the first competition in 1985 in Bardonecchia (Italy) and the First World Championship in Frankfurt (Germany) in 1991. The birth of the International Federation of Sport climbing (2007) and its recognition by the International Olympic Committee (2010) prepared the way to the admission of sport climbing to the Olympic Games of Tokyo 2020. Meantime competitions increase their popularity in terms of participants, audience and live stream events. The increase of popularity and the number of training facilities can be considered the main reasons of the increase of climbing performance (i.e. climbing level) as well as the development of a proper training methodology. Research in sport climbing has increased in the last two decades and different topics have been investigated (mainly sport science, orthopaedics, physiology, and
psychology). To provide insights of what are the most useful training methods, not only quantity but also the quality of the studies should be assessed. Results coming from studies with high risk of bias are of limited usefulness. Unfortunately the small number of level I studies (systematic reviews and randomized controlled trials) published in sport science climbing are of unclear or high risk of bias therefore their results should be considered with caution. Furthermore, the Olympic format assumes that all athletes will compete in all disciplines and medals will be assigned after the overall ranking. Therefore, in order to support athletes, studies should address new research questions as for example the definition of the new conceptual model of the performance (Olympic format), the monitoring of the activities and recovery strategies as well as training methods through high quality studies.

**BENEFITS OF DRAFTING IN CROSS-COUNTRY SKIING**

Stefan Lindinger³, Vesa Linnamo², Keijo Ruotsalainen², Per Skoglund, Mats Ainegren³

¹Sports Tech Research Centre, Department of Quality Technology, Mathematics and Mechanical Engineering, Mid Sweden University, Östersund, Sweden
²Neuromuscular Research Centre, Faculty of Sport and Health Sciences, University of Jyväskylä, Finland.
³Department of Food and Nutrition and Sport Science, University of Göteborg, Sweden

**BACKGROUND AND AIM**

In view of the fact that more and more cross-country ski competitions are carried out with mass start, it has high relevance to examine how much force and energy cross-country skiers can save by drafting. Thus, the aim of this project was to investigate the importance of drafting and air drag in double poling cross-country skiing.

**METHODS**

8-10 skiers of each gender, competing on international level, are participating in the study carried out in the wind tunnel at Sports Tech Research Centre, Mid Sweden University. Two skiers are roller skiing at the same time on a very large treadmill, one skier in the front and the other skier behind (drafting), using the double poling technique on low to high speeds ranging from 3 to 6m/s for females and from 4 to 7m/s for males. When this is done, the two skiers change places and the same protocol is repeated. The headwind is set according to skiing speed, simulating natural conditions. Both skiers are measured simultaneously, where dependent variables are oxygen uptake ($\text{VO}_2$), respiratory exchange ratio (RER), efficiency and propulsive force from ski poles. The air drag for both positions, front and drafting, is calculated from the difference between propulsive force in the ski poles minus the roller ski rolling resistance.

**RESULTS**

The study is still in progress, therefore the full results are not available yet. Figure 1 shows, however, an example from one subject how $\text{VO}_2$ is influenced by the skiing position and speed.

![Figure 1. Oxygen uptake in front and rear position at different skiing speeds](image)

**CONCLUSION AND PRACTICAL APPLICATION**

It is clear that drafting in double poling has a huge positive influence on skiing economy. How this will be seen in the cycle characteristics and force production will be analyzed soon. This will give new insights for tactical perspectives and may also influence how the training on treadmill when simulating natural skiing should be conducted.
TRAINING IN HYPOXIA: FOR BETTER OR FOR WORST?

Mourot Laurent

EA3920-Prognostic Markers and Regulatory Factors of Heart and Vascular Diseases, and Exercise Performance, Health, Innovation Platform, Univ. Bourgogne Franche-Comté, Besançon, France; Tomsk Polytechnic University, Tomsk, Russia

It is well known that hypoxia reduces the performance of aerobic exercise. On the other hand, adaptations associated with altitude acclimatization are linked with exercise performance and thus hypoxia is considered an important facilitator for training adaptations. With athletes, exercise in hypoxia could be successfully used to improve the performance when at altitude. On the contrary, using hypoxia to improve performance at sea level appears more uncertain. In the past few years, the use of hypoxic exercise training has been challenge as a potential promising therapeutic tool, especially with obese individuals/patients with metabolic syndrome. However, well controlled clinical studies are needed as unfavorable effects of hypoxia have also been documented such as an increase in inflammatory markers and decrease of endothelial function. Before using such training modalities with patients, it is mandatory to evaluate the balance benefit-risk.

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- Woolcott O et al. Inverse association between diabetes and altitude: a cross-sectional study in the adult population of the United States. Obesity (Silver Spring, Md.) 22(9) 2014 2080-2090

THE ISEA WINTERSCHOOL IN SPORTS ENGINEERING: A SUCCESSFUL SYNERGY BETWEEN ENGINEERS, SPORT SCIENTISTS, SPORT COMPANIES

Petroni Nicola,

Department of Industrial Engineering University of Padova, Italy

The International Sports Engineering Association (ISEA) is the association of engineers interested to sports technology: among its fundamental aims, there is the educational effort, oriented to give to future Sports Engineers, and to sport scientists in general, the widest and richest opportunity to learn, apply and develop the engineering approach applied to the sport practitioners and equipments.

Following the experience of ISEA Summer schools, held early on in Italy and Chemnitz, on 2011 we proposed to ISEA board the organization of the first ISEA Winterschool, to be held in San Vito di Cadore, Italy, with the twinned organization of the University of Padova and Technical University of Chemnitz. Proff. Petroni (IT), Odenwald (D), Senner (D) and Strangwood (UK) took part to the first experience: we hosted 25 students coming from 6 different countries from around the word. In addition, 8 tutors were involved for the organization of practical sessions and some industry representatives came to sponsor the event. The students were divided into 5-6 groups of 5-6 students, following the intentional criterion of mixing the student nationality and background to foster the exchange of experiences and new collaborative relations. To each group, a research question was assigned to be addressed in the four following days.
The format of the event was the combination of theoretical lectures read by professors active in the field of Sports Engineering, technical sessions, with the application of sensors to wintersport equipments and data acquisition systems for a “hands-on” approach, and field test sessions, when equipments and data collection systems prepared by students were be used in the slopes.

The time span of the Winterschool was typically of 5 days: field tests were performed on the first two days, whereas data collection was carried out until the afternoon of the fourth day, when each group was asked to present their assigned project. Teachers and industry representative acted as a jury to rank the groups and award the Winterschool best group presentation.

Over the years (2011-2016), Winterschool topics changed, from measurement systems to research methods, equipment performance, biomechanics and wintersport safety issues: as well, a number of colleagues joined the team of teachers, bringing their expertise and instrumentation to perform the tests. A key factor for the success of Italian experience was the logistic support from the University of Padova, Department of Forestry Sciences: the lectures and practical sessions took place at the Center for Forestry Researches in San Vito di Cadore, equipped with a lecture hall, several laboratory rooms and a small flat for the accommodation of tutors in self catering. This, together with the voluntary contribution of teachers, the coverage of teachers travel costs by the University of Padova, some support from ISEA association allowed to lower the registration cost for students, covering only their accommodation at the Hotel Park des Dolomites and Hotel Dolomiti, located at walking distance from the University Centre.

Results of this experience are several: from 2011 to 2016 a total number of 180 students from more than 10 countries took part to the school. Their background ranged from Sports Engineering to Mechanical Engineering, from Aerospace & Bioengineering to Sports Sciences. Several of them carried on a master project or a PhD focusing on Sports Engineering afterwards. Some of the group pilot tests were completed by the teachers and subsequently published as research or conference papers. Scientific collaborations between teachers lead to common test sessions and further publications. Erasmus agreements were set and student exchanges took place between Universities involved in the collaboration.

We believe that the experience can be extended to other countries and other fields of sports, such as athletics, cycling or ball sports, with the important result of building the sports engineers and scientists community towards a wide network of collaborative relations.

EXPLORE THE EXERCISING BRAIN: NEURORADIOLOGICAL TECHNICS AND APPLICATIONS

Pizzini F.,

Scuola Medicina e Chirurgia, Department of Neurosciences, Biomedicine and Movement Sciences, University of Verona, University of Verona, Italy

LEARNING OBJECTIVES

Explain the most fundamental aspects and techniques of Neuroradiology and their main applications in studying post training brain plasticity.

BODY

Neuroradiology combines a broad spectrum of imaging methods and techniques for evaluating Central Nervous System (from the use of X ray to Magnetic Fields).

Structural and functional brain changes are principally detected by Magnetic Resonance (MR) volumetric acquisitions (3D), diffusion (fiber tracking), BOLD, perfusion sequences and spectroscopy. The goal of using these MRI techniques is to reach a correct clinical diagnosis and prognosis, but they could be also applied in research settings and provide new insights in neuroscience knowledge. Many functional and structural MRI studies are now focusing on brain plasticity after physical training brain and they can suggest how,
why and when motor exercises could change our brain. During this lecture, some studies will be presented as only early illustrations of this relatively new field, which has great potential due to the impact that sports could have on cognitive performance and health.

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- Lee J.S. et al., Combined effects of physical exercise and education on age-related cortical thinning in cognitively normal individuals, Nature (2016)

LABORATORY- DERIVED MEASURES OF CRITICAL INTENSITY: WHAT’S NEW?

Pogliaghi Silvia

Department of Neurosciences, Biomedicine and Movement Sciences, University of Verona, University of Verona, Italy

Among the landmarks or “thresholds” that define exercise intensity domains, the critical intensity demarcates heavy yet sustainable exercise and severe, unsustainable exercise. This index predicts exercise tolerance and performance, is highly sensitive to training and provides an accurate, individualised basis for exercise prescription across different populations.

The literature contains numerous, confusing and inconsistent “critical thresholds”, defined in operational terms. We have recently demonstrated that many of these thresholds occur at an identical metabolic intensity, suggesting a common physiological mechanism and providing evidence for the interchangeability of methods. Furthermore, we have developed and validated two new “field” tests for critical intensity determination. The interchangeability of “threshold” indexes and the availability of newly developed valid, simple, submaximal, cost-efficient and time-efficient methods to determine critical intensity may provide exercise physiologists, sport scientists and clinicians with a number of options for determining and monitoring the limits of tolerable endurance exercise and for exercise prescription.

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VASCULAR HEALTH, ECCENTRIC EXERCISE AND THE INVOLVEMENT OF MICROVESICLES

Rakobowchuk M.

Thompson Rivers University, British Columbia, Canada

The vasculature of healthy and diseased populations can be modified through traditional exercise training methods like continuous concentric cycling and many studies suggest mechanotransduction as a key regulator through the activation of endothelial nitric oxide synthase in large arteries. The microcirculation also adapts with capillary proliferation and increased tortuosity, which enhance oxygen and nutrient delivery. Recently, circulating extracellular vesicles have been described after exercise as potential intercellular cargo constructs capable of delivering various proteins, lipids, mRNA and microRNA to other cells. Two of the most abundant extracellular
vesicles, microvesicles (MVs) and exosomes, are more plentiful in the blood following a bout of exercise. However, the stimuli that induce their appearance, and their impact on endothelial cell function remains poorly understood. Finally eccentric exercise, which is a potentially useful training stimulus in functionally limited populations, has not been studied in relation to MV responses.

In a series of studies, we have been unraveling the effects of various types, and intensities of exercise on the appearance of MVs and their impact on endothelial cell function. Using unilateral, whole-body, concentric and eccentric exercise we have isolated potential stimuli that may modulate this unique method of intercellular communication.

Healthy males completed three studies involving 1) whole body concentric cycling of differing intensities 2) whole body or unilateral concentric exercise or 3) either 45 minutes of eccentric or concentric cycling at matched absolute metabolic rates. Each study examined the effects of intensity, muscle mass and adrenergic responses, or mechanical loading respectively upon platelet and endothelial derived MV appearance in blood. Additional cell culture studies examined the effects of MVs on endothelial cell function.

Across the manipulations, venous plasma platelet derived MV concentrations were consistently increased and intensity dependent responses were induced by both large and small muscle mass intense incremental exercise. Also, the response was similar with eccentric and concentric cycling. Response dynamics were consistently rapid with increases during exercise and a return to basal concentrations by one hour of recovery. There were relationships with shear stress and adrenergic responses to exercise, but not with inflammatory markers and acute phase proteins. Endothelial derived plasma MVs concentrations were unaltered by any condition except intense whole-body exercise under heat stress conditions, however this increase was due to hemoconcentration. When in vitro assessments of platelet derived MVs were made, endothelial cells were more proliferative, migrated more to chemotactants, and created more tubule like structures. These experiments all suggest a pro-angiogenic response and potential novel mechanism of adaptation with exercise.

“BEET ON ALPS”: ERGOCENIC EFFECTS OF DIETARY NITRATE SUPPLEMENTATION AT HIGH ALTITUDE

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INTRODUCTION

Dietary nitrate supplementation is now recognized to be an important source of nitric oxide, via the alternative nitrate-nitrite-nitric oxide pathway, and its ergogenic effects have been reported. Several studies have demonstrated that this supplementation reduces oxygen consumption (VO2) during moderate-intensity exercises and improves time to exhaustion during heavy-severe intensity exercises in normoxia and may also have ergogenic benefits in acute hypoxia (1). Acute and chronic exposure to altitude (normobaric hypoxia) (2) impairs physical performance (3) and may change nitric oxide bioavailability (4).

AIMS

This study aimed to investigate the effects of dietary nitrate supplementation on oxygen cost of exercise and exercise tolerance during a prolonged sojourn at high altitude.

METHODS

14 subjects (28±6 years, 11M 3F) participated in a double-blind randomized crossover study at Casa8 hut (3269m a.s.l). Following 5 days of acclimatization, each subject was supplemented for 3 days with beetroot juice (2x70mL/day, 8.4mmol nitrate/day [BR]) or
placebo (PLA). At the end of each supplementation period, subjects performed: i) a 8 min moderate-intensity (MOD) constant work rate exercise and ii) a severe-intensity (SEVERE) constant work rate exercise up to exhaustion on both cycle- and arm-ergometer.

RESULTS
After 3 days of permanence at high altitude, and before supplementations, plasma [nitrate] and [nitrite] reached the peak value that was significantly higher than sea level values (36.0±13.2 vs 9.1±5.8 μM and 325.0±69.8 vs. 744.7±324.6 nM) (p<0.05). Plasma [nitrate] was significantly higher after BR than after PLA (309.9±153.7 vs. 253±119.7 μM, p<0.001). Plasma [nitrite] was also affected by BR compared to PLA (966.5±386.4 vs. 490.0±150.3 nM, p<0.01). In MOD, oxygen consumption was significantly reduced in BR vs. PLA in both cycling (1.776±0.292 vs. 1.875±0.300 L*min⁻¹, p<0.01) and arm cranking (0.989±0.224 vs. 1.023±0.236 L*min⁻¹, p<0.05). In SEVERE, V'O₂ was significantly lower in BR than in PLA after 6 min of exercise in both cycling (2.588±0.424 vs. 2.686±0.438 L*min⁻¹, p<0.01) and arm cranking (1.905±0.418 vs. 1.989±0.414 L*min⁻¹, p<0.05). Time to exhaustion was 9% longer in BR vs. PLA during cycling (785±180 vs. 715±235s, p<0.05) and 23% longer during arm cranking (655±243 vs. 808±152s, p<0.05). Interestingly, the two subjects with the highest level of aerobic fitness did not respond to dietary nitrate supplementation only during cycling.

CONCLUSIONS
This study shows that dietary nitrate supplementation reduces oxygen cost during moderate-intensity exercise and improves severe-intensity exercise tolerance during prolonged exposure to hypobaric hypoxia in exercises involving different muscle mass (cycling and arm-cranking). Moreover, ergogenic effects of dietary nitrate supplementation at high altitude during cycling seem to be affected by training status.

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RESPONSE OF SKELETAL MUSCLES TO LIFE AND ACTIVITY AT HIGH ALTITUDE
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At high altitude the barometric pressure falls, challenging oxygen delivery to the tissues. Thus, whilst hypoxia is not the only physiological stress encountered at high altitude, low arterial P(O2) is a sustained feature, even after allowing adequate acclimatization.

Acute hypoxia has no significant impact on anaerobic contractile performance of skeletal muscle in vivo. The maximal voluntary contraction (MVC), force-frequency relation, and contraction and relaxation times are unaffected by hypoxia. Central motor drive and electro-mechanical coupling are also not affected. However, endurance during sustained voluntary contractions is reduced.

In acute condition, and even after acclimatization to hypoxia, the arterial oxygen partial pressure remains low and the supply of oxygen from capillary to mitochondrion is impaired. Mitochondrial respiration and aerobic capacity are thus limited, whilst reactive oxygen species (ROS) production increases. With prolonged exposure to extreme high altitude a loss of muscle-mitochondrial density has been reported to occur. At more moderate altitude, decreased respiratory capacity may occur without changes in mitochondrial volume density; fat oxidation is down-regulated and aerobic ATP regeneration is impaired. This has a significant impact on endurance performance.
In addition, long term exposure to hypoxia has been shown to influence protein metabolism with a predominance of proteolytic processes on protein synthesis. The subsequent muscle atrophy can also impair muscle contractile performance during a prolonged sejour at high altitude.

EXERCISE IS THE FOUNTAIN OF YOUTH: METABOLIC AND VASCULAR EVIDENCE

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As long ago as 4th Century B.C., there have been tales of sacred, restorative waters, with Alexander the Great said to have come across the “healing river of paradise”. Such legends have surfaced in numerous and quite desperate locations such as Japan, the Canary Islands, Polynesia, and England. Even today people are touting miracle cures and miracle waters, however the real Fountain of Youth is likely not a mysterious hidden water source at all, but, rather has been in clear view, for to all to see: Exercise is the Fountain of Youth. This lecture will highlight several examples of the metabolic and vascular evidence that support this claim.

CAN NORDIC WALKING IMPROVE MOTOR ABILITIES IN PEOPLE WITH COGNITIVE IMPAIRMENTS?

Rosa R.

ANWI - associazione Italiana Nordic Walking

Health conditions and physically inactive lifestyle of young people with intellectual disability increase the risk of non-communicable diseases. However, increasing physical activity has been shown to improve health outcomes.

Recent researches are proving that Nordic walking cause several benefits on heart rate, exercise capacity, energy expenditure and maximal oxygen consumption in a wide range of people. It is promoted as a safe and efficient exercise with numerous health benefits, suitable for all ages and for various diseases.

Two pilot projects have been carried out by a team of specialists in NW to evaluate the effects of this physical activity on young people with cognitive impairments. Some physiological, functional and psychological parameters have tested at the beginning and at the end of the project.

Significant results have been achieved on static and dynamic balance, muscular flexibility, motor coordination and gait cycle during walking. Moreover, the anxiety level, substantially decreased. The intervention has therefore allowed a better quality of life.

REFERENCES

UNIVR - ACADEMIC COACH PROGRAMME

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Based on a strategic issue at international and national level - the Dual Career -, this paper allows me to report on the Academic Coach programme. Moving towards a dual career culture, the University of Verona aims to play an active role through this new proposal and its tailored actions.

Student-athletes face multiple challenges in matching sporting and academic commitments and specific programmes involving academic mentoring are a real support in achieving dual careers.

Academic Coach is a programme drawn up thanks to a coordination formed by the University Sports Centre (CUS), University Sports Committee of the University of Verona and ESU Verona, and is addressed to students enrolled in the University of Verona who, parallel to their studies, are also engaged in sports careers as athletes participating in international and/or national competitions at the highest levels.

The programme aims to support the right to study and the right to practice sports for student-athletes. Academic Coach is a major path fostering the development of a good university career, guaranteeing support for study and its organization thanks to the dedicated action of peer-tutors who also have the role of coaches, guiding and motivating student-athletes. The programme is therefore based on the identification of student-athletes and the identification of students or new graduates with the role of peer-tutor coaches, and is achieved thanks to the financing of tutoring assignments. In order to identify student-athletes and peer-tutor coaches, calls for applications have been drawn up.

Academic Coach programme deals with a structured methodology. The proposal involves two consecutive phases, an initial pilot action and the in-progress phase which represents the programme in its final version; the proposal sets out participation requirements for the attendees; it provides training courses for peer-tutor coaches and sets out follow-up meetings to enhance and monitor their work and to review the strategy of intervention with the student-athletes; it also includes an empirical part consisting of gathering data and an intermediate and final qualitative evaluation.

In addition to the aim of supporting the right to study and the right to practice sports for student-athletes, the findings of this programme will reflect the improvement in the institutional and organizational effectiveness based on the awareness of dual career, its perspectives and its dynamics.

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INTERACTION BETWEEN HYPOXIA EXPOSURE AND EXERCISE INTENSITY

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AIM

Other than maximal oxygen consumption, acute exposure to hypoxia impairs time to exhaustion (TTE) trials, with an average of −14.3% reduction every 1000 meters of altitude gain (tested at different constant altitudes below 2800 m asl). However, less is known about changes in TTE performance after an acute exposure to progressive normobaric hypoxia (PH), simulating a positive ascent, coupled with different submaximal efforts. Thus, the aim of this study was to evaluate TTE performance after exposure to PH coupled with any physical effort, a lower and a higher intensity of effort (50% of relative and absolute Peak Power Output, PPO, respectively).

METHODS

Eleven endurance-trained athletes primarily performed a ramp incremental test to obtain PPO in either normoxia (PPO-N) or hypoxia (PPO-H, FiO2 =13.4%). Subsequently, they completed a TTE at 80% of their PPO-H (TTE-H, baseline) in a non-fatigued state. Then, they performed again the same TTE after 3 randomized 60 minutes sessions characterized by a linear decrease in FiO2 from 16.2% to 13.4% (corresponding to an increase in altitude from 2000 to 3500 m asl) interspersed by at least 48 hours: (i) 60’ PH cycling at 50% of PPO-N (HN); (ii) 60’ PH cycling at 50% of PPO-H (HH); (iii) 60’ PH in a resting condition (HNoPO).

RESULTS

Peak power output decreased from 316±36 watt in normoxia to 271±19 watt in hypoxia (-14.2%, P<0.001) while VO2max (mlO2.min⁻¹.kg⁻¹) decreased from 57.6±6.3 to 46.5±3.6 (-20.6, P<0.001). After HN, TTE lasted 263±94 s. This was 37% (419±81 s, P<0.001), 31% (381±100 s, P=0.016) shorter compared to TTE-H, baseline, and HNoPO, respectively. No significant differences were found between the other sessions (P>0.05).

CONCLUSIONS

TTE (as index of endurance performance) after acute PH is more influenced by the effort intensity performed at the same altitude rather than by only the exposure to hypoxia, opening the discussion on the determinants of this impairment. Further, the present study may be useful for coaches and athletes engaged in sports involving progressive hypoxia ascents.

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“BEET ON ALPS”: DIETARY NITRATE SUPPLEMENTATION IMPROVES SKELETAL MUSCLE OXIDATIVE METABOLISM DURING PROLONGED EXPOSURE TO HYPOBARIC HYPOXIA.

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INTRODUCTION

Skeletal muscle oxidative function and exercise tolerance are affected by inspired O2 fraction. Under acute hypoxic exposure, dietary nitrate supplementation is able to attenuate or prevent the hypoxia-induced muscle metabolic perturbation according to an improved mitochondrial efficiency as well as a higher muscle perfusion and O2 delivery.

AIM

The aim of this study was to investigate the effects of a dietary nitrate supplementation on the O2 cost of cycling and gastrocnemius muscle oxidative capacity during a prolonged exposure to high altitude, a condition that affects both muscle oxidative metabolism and nitric oxide bioavailability.

METHODS

After five days of permanence at altitude (3,269m a.s.l., Casati Refuge, Italy), fourteen healthy young (28±6 yr) subjects were supplemented for three days with beetroot juice (2x70mL/day, 8.4 mmol nitrate/day [BR]) or nitrate-depleted juice (PLA) following a double-blind randomized cross-over design. At the end of both supplementation periods subjects performed a moderate-intensity (80% gas exchange threshold) constant work-rate exercise on a cycle ergometer; an evaluation of the recovery kinetics of gastrocnemius muscle oxygen consumption (mV’O2; by near-infrared spectroscopy) using repeated, transient arterial occlusions following a brief bout of plantar-flexion exercise. The time constant of mV’O2 was taken as an index of muscle oxidative capacity.

RESULTS

Plasma [nitrate] and [nitrite] were significantly higher after BR (309.9±153.7 μM and 966.5±386.4 nM, respectively) than after PLA (25.3±11.9 and 490.0±150.3). Steady-state pulmonary V’O2 during cycling was significantly lower after BR (1.78±0.29 L·min⁻¹) than PLA (1.87±0.30). Accordingly, the O2 cost of cycling was significantly lower (by ~5%) after BR than after PLA. After BR the time constant of mV’O2 was significantly lower (10.1±6.4s) than after PLA (24.7±4.4s), suggesting an improvement of muscle oxidative capacity.

CONCLUSIONS

During prolonged exposure to hypobaric hypoxia, a three-day dietary nitrate supplementation reduced the O2 cost of cycling during moderate-intensity exercise and accelerated the recovery kinetics of mV’O2, suggesting that an improved mitochondrial function may be responsible for the improved exercise efficiency.
HOW TO MATCH SCIENTIFIC PRESCRIPTION AND HEALTH OUTCOMES IN A DAILY LIFE PERSPECTIVES

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Outdoor activities ranges from the very usual walking on the sidewalk or on a country path to well-known sport as mountain bike, cross country ski or sailing but they also include more challenging kind of movement as climbing or mountain trail running. As the same time they are all considered fundamental bricks in building an active life style or in other words in developing the basis of an healthy living. If this is so we need to look for a common factor that can help us in managing several different ways of movement under the same scientific ‘umbrella’. This factor allow us to use any form of locomotion as a general way to improve fitness in any person independently form her/his age, sex and attitude, putting in the same pot sedentary subjects walking the dog and endurance athletes involved in different sport (track and road running, cross country skiing, mountain bike, skating, etc. . .).

What we need is just the knowledge of the amount of energy required for any activities. It is not only due to distance and intensity of effort but there are other different factors as positive, and negative slopes; speed, consistency of the terrains; fatigue and movement efficiency which could play an important role in the determination of the energy cost as well as the global energy expenditure requirements to complete an individual workout Modern technologies allow to conduct accurate measures of path characteristics and metabolic requirements directly on the terrain, giving us the possibility to to verify the existence of any characterizing factors.

This lecture will present the studies we have performed in the last ten years to characterize many activities in different kind of population, healthy or diseased, with the aim to create a general methodology to prescribe the correct amount of exercise, sustainable and stimulating, in order to obtain the expected fitness results and a better quality of life.

A CALL FOR STANDARDISED PROCEDURES IN THE STUDY OF RUNNING ECONOMY IN ULTRA–MARATHON

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Over the years, ultra-marathons (i.e. any event longer than the traditional marathon length of 42.195 km) have seen rising trends in participation and, further, increasingly piqued the interest of the scientific community as they are considered an outstanding model to study the adaptive responses to both extreme loads and stresses on the human body. Despite several studies documented increased in different physiological mechanisms after ultra-marathons (e.g. neuromuscular fatigue, pulmonary function etc.), the behaviour of the running economy is still debated. Here, we questioned these observed discrepancies, discussing the necessity to set up scientific standards to assess changes in the running economy during ultra-marathon. It is our opinion that the design of future studies examining the changes in \( \text{Cr} \) after an ultra-marathon can be improved by addressing four specific methodological limitations. First, consideration for the specific conditions of the ultra-marathon when designing the running protocol. Second, taking into account whether changes between pre- and post-race are consistent across individuals. Third, providing adequate familiarization sessions to reduce the effect of familiarization. Lastly, inserting a control group to reduce biased interpretation of the results.

REFERENCES

SUPPORTING DUAL CAREER AND EMPLOYABILITY OF ACTIVE AND FORMER ELITE ATHLETES: ITALIAN CONTRIBUTIONS TO B-WISER PROJECT

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Elite athletes face multiple challenges in combining their sport with education or employment. These challenges persist in the transition to a new career after their sporting one has come to an end. This is not only hard for the individual, but also a loss for society as a whole. Conversely, a successful combination of education, training or work with sport can enable an individual to reach his or her full potential in life. This is known as a “Dual Career” (DC) (Wylleman et al., 1999). DC is a complicated policy domain, which links multi-stakeholder policy domains such as education, youth, health and labor market and has to connect these towards adequate career development of talents. The exact number of athletes in need of DC services is hard to pinpoint. The definition of ‘elite athlete’ varies widely among countries and in literature. Wylleman and Rosier (2016) defined DC elite athletes as athletes facing a dual challenge (e.g., balancing sport with education or employment) and at the same time competing at national or international level. Adopting this definition, the number of DC athletes is more than 120,000 per year in EU. He conducted a study on minimum quality requirements for DC services to develop a set of requirements to function as a reference point for National DC services and facilities across the EU.

The quality by which athletes are able to combine their athletic career with their educational pathway through secondary and higher education impacts not only their educational and athletic development but also their vocational development and employability during as well as after their athletic career. The GEES (Gold in Education and Elite Sport) project developed and implemented guidelines (cfr. EU Guidelines on Dual Careers of Athletes, 2012) by focusing on the need to enhance athletes’ competences for developing their own DC pathway and the quality of DC support experts/services provided to athletes preparing, managing and/or finalizing a DC ‘education and sport’ pathway. This project described the competences, instruments and methods required by more than 5,000 young elite athletes (12 to 18 y.o.) and more than 4,000 elite athletes (18 to 25 y.o.) to successfully prepare, manage and finalize their DC ‘education and sport’ pathway and developed a profile of competences as well as instruments and methods required by DC experts/support providers working with athletes in a DC ‘education and sport’ pathway (De Brandt et al., 2017).

An holistic athlete career model representing career transitions and stages faced by athletes at athletic, psychological, psychosocial, academic/vocational, and financial levels has been proposed by Wylleman & Rosier (2016) including the occurrence of the DC ‘elite sport and employment’, the stage of retirement and the transition into the first employment during the post athletic career. Adopting this holistic model, a research is being conducting in the frame of the B-WISER (Be a Winner in Sport and Employment before and after Athletic Retirement) project in order to gain a better understanding of the challenges that elite and former elite athletes face with regard to their employability and post/post retirement employment (Alfermann & Stambulova, 2007; Wylleman et al., 2013). This study is involving stakeholders deemed to be important, elite and former elite athletes, national Olympic/Paralympic Committees and/or elite sport governing bodies, career support providers, and employers. Italian contributions to B-WISER project will be presented and practical applications of the study for stakeholders will be discussed.

REFERENCES


THE KINEMATIC EFFECTS OF LONG-TERM FATIGUE IN ELITE-LEVEL CROSS-COUNTRY SKIERS: EXPERIMENTAL SETTING AND TRACKING METHODOLOGY FOR AN ACCURATE 2-D ANALYSIS ON THE SNOW.

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AIMS

The first aim was to verify if an accurate 2-D whole body kinematic description is possible in ecological conditions; the second aim was to evaluate the whole-body kinematic effects of a long-term fatigue in elite-level cross-country skiers.

METHODS

The first 15 male and female finisher of the 44th edition of Marcialonga race were filmed twice during the 58 km-long competition (7 km after the starting line and 4 km before the arrival). The filming zones had comparable slopes and contained three parallel tracks sculpted in the snow. A 20 m portion of each track was calibrated, by positioning 5 equally spaced cones alongside the track, and the horizontal line was identified with a liquid level system. The camera was positioned about 40 m far from the middle of section of interest, perpendicularly to it. A specific calibration file was applied to the video clip of the first 10 skiers that met specific inclusion criteria for video analysis. The position of the principal body joints was identified at 100 Hz, through a semi-automatic tracking software (Tracker). A mean displacement of joints and COM was calculated considering two cycles of locomotion, in non-fatigued (PRE) and fatigued (POST) conditions. Pole kinematic was also detected to measure poling and cycle durations.

RESULTS

Pattern of joint angles and COM displacement during the cycle, as well as movement range and standard deviations were comparable to what observed in the literature during laboratory studies at similar speeds of locomotion. Decreased cycle velocity and cycle length together with increased duty factor were found by comparing PRE and POST conditions in both sexes. Cycle frequency remained constant between PRE and POST. On the contrary, specific differences between sexes were found concerning whole body kinematics as effect of long term fatigue.

CONCLUSIONS

Scrupulous calibration, filming procedures and data tracking can provide precise and reliable kinematic information while cross-country skiing in ecological conditions, with the possibility to evaluate the kinematic effects of long-term-fatigue on the field.

REFERENCES


