

Leistung im Sport – *La performance dans le sport*



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1 Symposia

1.1 Overtraining - Overreaching in Athletes

Topics: natural sciences

Keywords: overtraining, overreaching, HRV, neuromuscular fatigue

Overtraining - Overreaching in athletes

*Submitted by: **Gregoire p Millet** (university of Lausanne, Switzerland)*

This symposium aims to present the multifactorial features (biological, autonomic system and neuromuscular) of overtraining / overreaching.

All presentations will be based on practical examples and will suggest applied recommendations to scientists and coaches.

Presentations of the Symposium

Overtraining-Overreaching : definitions and state of the Literature

Gregoire p Millet

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De nombreux termes ont été utilisés pour décrire les mécanismes associés au surentraînement (overtraining) chez le sportif. Le continuum le plus abouti et le plus reconnu internationalement (Meeusen et al. 2006) consiste en trois étapes distinctes:

1. Surmenage/Dépassement fonctionnel de courte durée (functional overreaching ; FOR)
2. Surmenage/Dépassement non-fonctionnel extrême (non-functional overreaching ; NFOR)
3. Syndrome de surentraînement (Overtraining syndrome ; OTS).

La prévalence des différents états de surmenage / surentraînement sont observées chez 10-20% des athlètes élite et possèdent des similitudes étiologiques avec le syndrome de fatigue chronique. Il est important de prévenir plutôt que guérir l'OTS puisque sa récupération est particulièrement longue dans le temps (plusieurs mois) avec les conséquences professionnelles et sociales qui accompagnent cette période hors-compétition chez des athlètes professionnels. Différentes hypothèses ont été avancées pour essayer de comprendre et d'expliquer l'origine et l'évolution du processus menant au surentraînement. L'idéal étant toutefois de pouvoir évaluer l'état de fatigue d'un athlète avant que le syndrome de surentraînement ne survienne.

Le diagnostic de l'OTS a énormément progressé au cours des 10 dernières années et on met maintenant l'accent sur une approche multidisciplinaire intégrant questionnaire, entretien, approche clinique puis dans un deuxième temps seulement des examens biologiques. Il convient de s'interroger sur la place de tests d'effort sous-maximaux et d'analyses accessibles au sportif telles que la variabilité cardiaque pour compléter les procédures actuelles.

Les causes de l'OTS sont encore mal connues et il n'existe quasiment rien dans la littérature ; à part des généralités sur l'entraînement. Des pistes intéressantes en terme de planification ont été néanmoins proposées ; e.g. entraînement polarisé ; diminution de la monotonie des charges d'entraînement; individualisation de la planification à partir de données psycho-physiologiques. Paradoxalement, la formation des praticiens sportifs n'accorde qu'une place restreinte à l'étiologie du surentraînement alors que c'est à eux qu'incombe la prévention et qu'il s'agit certainement d'une des voies les plus efficaces dans la volonté de refuser le dopage.

Nous discuterons les différentes modalités de diagnostic du surentraînement

La fatigue physique étant une symptomatologie polymorphe, quel est l'intérêt pour un athlète en méforme de faire une épreuve d'effort ?

Comment prendre en compte la composante psycho-sociale du surentraînement ?

Quels sont les mécanismes sous-jacents associés au surentraînement (Hypothèse cytokinergique, sérotoninergique, GABAergique, sympatho-vagale,...)

Meeusen, R., Duclos, M., Gleeson, M., Rietjens, G., Steinacker, J., & Urhausen, A. Prevention, diagnosis and treatment of the overtraining syndrome. *Eur J Sport Science*. 2006: 6: 1-14.

Monitoring overreaching in elite athletes – 15 years of experience.

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Heart rate variability (HRV) is used for more than 15 years in sport to evaluate the fitness or fatigue levels in athletes. Among the tools proposed to assess the athlete's "fatigue," HRV analysis provides an indirect evaluation of the settings of autonomic control of heart activity. It is has been presented as a complementary tool to evaluate the functional level of the body and to diagnose an over-reaching state (Meeusen et al. 2013; Schmitt et al. 2013). Recently we have shown that HRV permits to detect and characterize the fatigue and establish a typology of different fatigues (Schmitt et al. 2016; Schmitt et al. 2015b), and individualize the training (Schmitt et al. 2016). Supine and standing HRV patterns were independently modified by "fatigue", and 4 "fatigue"- shifted HRV patterns were statistically sorted according to differently paired changes in supine (SU) and standing (ST) postures: 1. F(HF-LF-)SU_ST with a decrease in low (LFSU) and high (HFSU) frequency activities in supine and LFST, HFST in standing accompanied by an increase in heart rate (HRSU) and HRST. 2. F(LF+SULF-ST) with an increase in LFSU, and a decrease in LFST accompanied by an increase in HRST. 3. F(HF-SUHF+ST) with a decrease in HFSU, and an increase in HFST. 4. F(HF+SU) with an increase in HFSU and a decrease in HRSU (Schmitt et al. 2016; Schmitt et al. 2015b). HRV analysis is performed mainly through assessment of time-domain indices and spectral analysis. In time-domain analysis, the square root of the mean of the sum of the squares of differences between adjacent normal R-R intervals (RMSSD) measured during short (5 min) recordings in supine position upon awakening in the morning and particularly the logarithm of RMSSD (LnRMSSD) has been proposed as the most useful resting HRV indicator (Buchheit 2014). However, if RMSSD can help the practitioner to identify a global "fatigue" level, it does not allow discriminating different types of fatigue. Recent **Results** using spectral HRV analysis highlighted firstly that HRV profiles assessed in supine and standing positions are independent and complementary; and secondly that using these postural profiles allows the clustering of distinct sub-categories of "fatigue." Since, cardiovascular control settings are different in standing and lying posture, using the HRV figures of both postures to cluster fatigue state embeds information on the dynamics of control responses. Such, HRV spectral analysis appears more sensitive and enlightening than time-domain HRV indices. The wealthier information provided by this spectral analysis should improve the monitoring of the adaptive training-recovery process in athletes (Schmitt et al. 2015a).

Overreaching : a neuromuscular perspective

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In athletes, overreaching can be defined as an “imbalance between training and recovery, exercise and exercise capacity, stress and stress tolerance” (Lehmann et al. 1993) and might then lead to overtraining. This imbalance is usually associated with increased fatigue. At the neuromuscular level, fatigue is defined as a reduction in the maximal force generating capacity and can originate from the central nervous system (central fatigue) and / or from the muscle itself (peripheral fatigue). In this presentation, I will focus on the neuromuscular adjustments of overtraining / overreaching in athletes and relate these findings to the components of neuromuscular fatigue. At the central level for instance, a decrease in the free tryptophan to branched chain amino acid blood concentration ratio has been proposed as a potential mechanism for central fatigue but also a diagnostic tool for detecting overtraining in endurance athletes (Petibois et al. 2002). Furthermore, a reduction in neuromuscular excitability, defined as the minimal rectangular current pulse that produces a single contraction of reference muscles at different pulse durations, is considered as a marker of peripheral fatigue but has also been associated to overtraining in endurance runners (Lehmann et al. 1995). Finally, the role of (i) prolonged low frequency force depression (or “low frequency fatigue”) and (ii) mental fatigue (e.g. Vrijkotte et al. in press) will be discussed as possible contributors to overreaching / overtraining in athletes.

Lehmann, M., Foster, C. & Keul, J. Overtraining in endurance athletes: a brief review. *Med Sci Sports Exerc.* 25(7):854-62, 1993.

Lehmann, M., Jakob, E., Gastmann, U., Steinacker, JM. & Keul, J. Unaccustomed high mileage compared to intensity training-related neuromuscular excitability in distance runners. *Eur J Appl Physiol Occup Physiol.* 70(5):457-61, 1995

Petibois, C., Cazorla, G., Poortmans, JR. & Déléris, G. Biochemical aspects of overtraining in endurance sports: a review. *Sports Med.* 32(13):867-78, 2002

Vrijkotte, S., Meeusen, R., Vandervaeren, C., Buyse, L., van Cutsem, J., Pattyn, N. & Roelands, B. Mental Fatigue and Physical and Cognitive Performance During a Two Bout Exercise Test. *Int J Sports Physiol Perform*, in press doi: 10.1123/ijsp.2016-0797

1.2 Achtsamkeit im Leistungssport

Topics: social sciences

Keywords: Achtsamkeit, Sportpsychologie, Wirkung, Wirkungsweise, Spitzensport

Achtsamkeit im Leistungssport

Submitted by: **Philipp Röthlin** (Eidgenössische Hochschule für Sport Magglingen, Schweiz)

Achtsamkeit beschreibt die Fähigkeit, aktuelles Erleben mit einer akzeptierenden Haltung zu beobachten, ohne automatisch darauf zu reagieren. Empirische Daten ausserhalb des Sportkontexts zeigen, dass Achtsamkeit zu Verbesserungen in psychologischen Prozessen führt, welche für Athletinnen und Athleten relevant sind. Dazu gehören eine gesteigerte Aufmerksamkeit und adaptive Formen der Emotionsregulation. Das Thema wird daher auch in der Sportpsychologie stark diskutiert und im Symposium werden drei aktuelle Forschungsarbeiten dazu präsentiert. Diese beleuchten jeweils einen anderen Schwerpunkt.

Im ersten Beitrag geht es um die Frage nach der Wirksamkeit von achtsamkeitsbasierten Interventionen im Leistungssport. Es werden dazu die Resultate einer Studie gezeigt, in welcher zwei vierwöchige Interventionsprogramme (Achtsamkeit und mentales Skills Training) miteinander verglichen wurden. Der zweite Beitrag legt den Fokus auf die Selbstkontrolle als einen möglichen Wirkmechanismus von Achtsamkeit. Selbstkontrolle ist für die sportliche Leistungserbringung zentral. Mit einer Interventionsstudie wurde entsprechend der Einfluss von Achtsamkeitstraining auf die Selbstkontrolle von Athletinnen und Athleten untersucht. Im abschliessenden Beitrag geht es um die Umsetzung von achtsamkeitsbasierten Techniken im Spitzensportkontext. Dabei werden die Resultate einer achtsamkeitsbasierten Intervention präsentiert, die während den olympischen Spielen in Rio mit Volleyballreferees durchgeführt wurde.

Presentations of the Symposium

Differenzierte Wirkung von mentalem Training auf leistungsrelevante psychologische Prozesse – eine randomisierte kontrollierte Studie

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Einleitung

Die vorliegende Studie untersuchte die Wirksamkeit zweier Formen von mentalem Training, nämlich Psychologisches Skill Training (PST) und eine achtsamkeitsbasierte Trainingsform (AI). Das PST bestand in der Vermittlung vier mentaler Techniken: die Regulation der physiologischen Aktivierung und Entspannung, das Visualisieren, das Einüben von hilfreichen Selbstgesprächen und das Setzen und Auswerten von Zielen. Bei der AI lag der Schwerpunkt auf der Vermittlung von Achtsamkeit, d.h. die Fähigkeit, aktuelles Erleben mit einer akzeptierenden Haltung zu beobachten, ohne automatisch darauf zu reagieren. Die unterschiedlichen theoretischen Hintergründe der beiden Trainingsformen implizieren eine differenzierte Wirkungsweise auf psychologische Prozesse. Es wird angenommen, dass beide Formen Aspekte der Aufmerksamkeit verbessern können. Beim erfolgreichen Umgang mit Emotionen dagegen sollte die AI dem PST überlegen sein (Röthlin, Birrer, Horvath & grosse Holtforth, 2016). Diese Annahmen wurden in Form einer randomisierten kontrollierten Studie untersucht.

Methoden

96 Leistungssportler (51% weiblich, Malter = 24.29 (SD = 5.20), drei Sportarten: Unihockey, Curling, Tennis) wurden zufällig in eine PST, eine AI oder eine Wartelistekontrollgruppe (WL)

eingeteilt. Die Trainings bestanden aus vier 90-minütigen Seminaren über einen Zeitraum von 4 Wochen. Dort wurden theoretischen Inhalte und praktische Übungen vermittelt, sowie konkrete Wege eines sinnvollen Transfers in die jeweilige Sportart besprochen. Die Teilnehmenden wurden dazu motiviert, die in den Seminaren erlernten Übungen (z.B. eine Entspannung- oder Achtsamkeitsübung) zwischen den Terminen möglichst täglich zu machen.

Resultate:

Teilnehmende der AI zeigten im Vergleich zu den anderen Gruppen eine Zunahme der Achtsamkeit (Zeit*Gruppe Interaktion, $F(1, 94) = 4.88, p < .05$). Teilnehmende der PST zeigten im Vergleich zu den anderen Gruppen eine Zunahme in der Anwendung von Aktivierungs-, Entspannungs- und Zielsetzungstechniken (F 's(1,94) zwischen 4.17 – 9.27, alle $p < .05$) aber nicht von Visualisierungs- ($F(1,94) = 1.25, p = .27$) und Selbstgesprächstechniken ($F(1,94) = 1.39, p = .24$). Teilnehmende der Interventionsgruppen (PST und AI) berichten im Vergleich zur WL über eine verbesserte Aufmerksamkeit im Wettkampf/Spiel ($F(1,94) = 5.72, p < .05$) aber nicht im Training ($F(1,94) = 0.53, p = .47$). Teilnehmende der AI zeigten im Vergleich zu den anderen Gruppen einen verbesserten Umgang mit Emotionen in Form von weniger Vermeidung ($F(1,94) = 5.68, p < .05$) und mehr Akzeptanz ($F(1,94) = 7.18, p < .05$).

Diskussion

Die Programme gingen mit einer erwarteten Zunahme in der Anwendung von mentalen Techniken respektive Achtsamkeit einher. Zudem führten beide Programme zu einer verbesserten Aufmerksamkeit im Vergleich mit der WL. Im Gegensatz zu PST führt AI ausserdem zu einer Optimierung der Emotionsregulation. Die Studie stellt einen Schritt in Richtung eines differenzierten Zugangs bei der Beurteilung von sportpsychologischen Interventionen dar. Ein solcher Zugang beurteilt weniger die Frage, welcher Ansatz oder welche Trainingsform generell besser ist, sondern macht Aussagen darüber, welche Intervention für welchen Outcome unter welchen Umständen für welche Personengruppen angezeigt ist.

Röthlin, P., Birrer, D., Horvath, S., & grosse Holtforth, M. (2016). Psychological skills training and a mindfulness-based intervention to enhance functional athletic performance: design of a randomized controlled trial using ambulatory assessment. *BMC psychology, 4*(39).

SELF-CONTROL FAILURES IN PHYSICAL PERFORMANCE: DOES MINDFULNESS INDUCTION SERVE AS A STRATEGY AGAINST THE EGO DEPLETION EFFECT?

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Introduction

In sport and exercise contexts, it is highly important to control one's impulses and behavioural tendencies to meet specific goals (Englert, 2016). Athletes frequently have to deal with several demands which may deplete their limited self-control resources which may in turn negatively affect their subsequent performance in a wide variety of sports-related tasks (e.g., coordinative, psychological and physical tasks; Birrer & Morgan, 2010). Mindfulness meditation may be beneficial for mechanisms involved during self-control exertion, because it supports efficient emotion regulation, attention regulation and executive functioning (Brown & Ryan, 2003; Masicampo & Baumeister, 2007).

In our study, we investigated the effects of a short mindfulness exercise on physical performance in a state with temporarily depleted self-control strength (ego depletion; Baumeister, Tice & Heatherton, 1994). We hypothesised that a short mindfulness exercise can compensate

- at least partly - for the ego depletion effect procured by a strenuous cognitive task on physical performance.

Methods

We applied a mixed between- (ego depletion: yes vs. no) within- (two times of measurement, 7 days apart; mindfulness: yes vs. no; order counterbalanced) subjects design to test our hypothesis in a sample of N = 34 sport students (18 women; Mage = 20.85, SDage = 1.31). Ego depletion was manipulated via a well-established transcription task. For the manipulation of mindfulness, participants in the mindfulness condition performed a short mindfulness exercise, while participants in the control condition listened to an audio book. As dependent variable, participants performed a strenuous physical exercise (plank exercise) for as long as possible and we measured the respective duration at both times of measurement.

Results

Depleted participants in the mindfulness condition were able to compensate for the ego depletion effect and held the plank position as long as the non-depleted group. On the contrary, ego depleted participants' performance decreased when listening to the audio book. However, the interaction did not reach statistical significance, $F(1, 28) = 2.28, p = .142, \eta^2 = .08$.

Discussion

The Results, at least to some extent, support our hypothesis, indicating that a short mindfulness exercise can help to compensate for ego depletion related performance impairments in sport. Further studies should test longer mindfulness interventions as strategy to deal with ego depletion related impairments.

Baumeister, R. F., Tice, D. M. & Heatherton, T. F. (1994). Self-regulation failure. Why, when, and how self-control breaks down. San Diego: *Academic Press*.

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Englert, C. (2016). The strength model of self-control in sport and exercise psychology. *Frontiers in Psychology*, 7, 314.

Masicampo, E. J. & Baumeister, R. F. (2007). Relating mindfulness and self-regulatory processes. *Psychological Inquiry*, 18, 255-258.

Boosting the referees' mental skills through a mindfulness-based intervention towards Rio 2016

Mattia Piffaretti

AC&T Sport Consulting

Mindfulness-based-interventions (MBI) have been regularly used in sports over the last decade, and shown their effectiveness in particular with athletes, offering them an interesting alternative to the traditional interventions, mainly based on cognitive-behavioral models (Gardner et al., 2004). Nevertheless, this approach has hardly been used with officials, nor has it received academic attention, despite its intuitive appeal in light of the demands placed on referees in professional sports. This communication aims to fill this gap by illustrating the effects of a MBI with referees.

In response to the growing competitive pressure in international Volleyball (VB) and Beach-Volleyball (BVB), as well as to foster the quick integration of new technologies in officiating prior to the Rio Olympic Games 2016, the selected international referees followed a MBI. On

the basis of a theoretical model, which combines the stress-performance inverted-U model, with conceptual foundations of mindfulness, 36 international referees (20 VB, 16 BVB; 7 f, 29 m) were trained to recognize and welcome their emotions, deal efficiently with stress, optimize their concentration, learn mental imagery and manage their expectations. Each one of the preparation stages encompassed a workshop and a series of meetings for mental practice, over a 4-months' period. At each stage of the intervention, referees were provided with a handout of the contents, as well as with audiofiles to continue training different kinds of meditation practices.

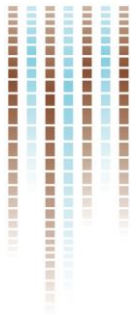
To evaluate the efficiency of the program, a mix of performance-based measures and psychological skills self-reports were used at pre and post intervention. The self-report inventories aimed at measuring the evolution of the referees' mental fitness (e.g., Anxiety and confidence – CSAI-2 Martens et al. 1990; Awareness of referees – Five Facets Mindfulness Questionnaire, Baer et al. 2006). Program impact was assessed through refereeing performance (as evaluated by referee delegates) and the degree of compliance and perceived usefulness of the program by the referees.

Results show that the officials increased their performance level, enhanced their concentration skills, and improved their general awareness. More specifically, the referees' ability to adequately respond to stress was enhanced. The qualitative assessment illustrated how referees made frequent use of the learned strategies, found them useful and were able to recognize the critical match situations where the program could help them. In particular, referees perceived mindful breathing very useful, while attentional shift, the STOP strategy, best performance imagery and refocusing plan were considered as useful. Additional measures were suggested along the program to create ideal conditions for the referees' well-being and future performance enhancement. This experience suggests that mindfulness as applied in the sports realm can be beneficial not solely to athletes, but also to referees.

Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J. & Toney, L. (2006). Using self-report assessment Methods to explore facets of mindfulness. *Assessment*, 13(1), 27-45.

Gardner, F. L., & Moore, Z. E. (2004). A mindfulness-acceptance-commitment-based approach to athletic performance enhancement: Theoretical considerations. *Behavior Therapy*, 35(4), 707-723.

Martens, R., Vealey, R. S., & Burton, D. (1990). Competitive anxiety in sport. *Human Kinetics*.



1.3 Sport science meets elite sports

Topics: natural sciences, sciences sociales

Keywords: Transfer, Sport Science, improve performance, improve training efficiency, elite sports environment

Sport science meets elite sports

Submitted by: **Wolfgang Taube** (Universität Fribourg, Schweiz)

In a first step, the current symposium provides two examples how sport science may help to improve performance and/or training efficiency in an elite sports environment. These examples underline that scientific findings have to be specifically tested for different disciplines (and performance levels) and verified for each athlete before they can efficiently be transferred and applied. In the second part of this symposium, the focus is set on the aim to improve the exchange between elite athletes, coaches, sports federations, and scientific staff. For this purpose, the tool “esi” was developed, an internet platform that links contributions from different users in order to establish a knowledge network. This network of knowledge is plastic and is able to identify centers (persons) of specific expertise.

Presentations of the Symposium

Shoes or no shoes? Static, rolling on a slope or in the flat? Evidence based conditioning exercises in ski jumping

Silvio Lorenzetti

ETH

Introduction

Training on the hill is very demanding and time consuming for ski jumping athletes. Imitation jumps off the snow, where athletes stand on a static or rolling platform in the starting position and mimic the take-off of a hill jump, provide a common alternative and it was recently found that a good correlation exists between the vertical take-off velocity during imitations jumps and the personal jump performance on the hill ($R=0.718$) [1].

Research Question

Therefore, the aim was to compare more detailed kinematic and kinetic parameters of squat jumps and various imitation jumps, performed with and without equipment with jumping performance on an instrumented slope, static and dynamic on a rolling platform either flat or with a slope.

Methods

Ten healthy male ski jumpers (age 21.2pm4.9y, 62.1pm4.1 kg, Alpen Cup to Olympic champion) performed hill jumps in Oberstdorf GER (HS106), where the kinetic and kinematic parameters were measured [2]. The same athletes performed squat jumps and static imitation jumps on a Quattrojump force plate (Kistler AG, Switzerland). Dynamic imitation jumps were performed from a rolling custom-made platform (IfB, ETH Zurich) instrumented to record the ground reaction forces. Dynamic imitation jumps were assessed on a flat as well as a slightly downward-sloping surface. Sagittal and frontal video recordings allowed assessment of upper body, lower body angle and knee joint sagittal angles, as well as a knee varus/valgus index in the frontal plane. Athletes' best trials were compared to their hill jump using correlation, root-mean-square error and a ranking system [3].

Results

The imitation jumps performed on flat ground with and without equipment, as well as the imitation jump on the slope with equipment mimicked hill jumping the best for both rankings. Rankings of dry land jumps were fairly consistent across the various kinematic and kinetic parameters.

Discussion

All the imitation jumps from the rolling platform closely mimicked hill jumping. This type of imitation jump decreases the possibility and the need to create shear forces, similar to the situation on the hill. It needs to be mentioned, that the maximal force peak on the hill is earlier than in all other jumps, probably due to differences in aerodynamic lift.

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How to serve faster in tennis: the influence of an altered focus of attention and augmented feedback on service speed in elite players

Martin Keller

Uni Fribourg

Introduction

Different approaches such as providing augmented feedback (AF), adopting an external focus of attention (EF), or grunting have been shown to directly enhance performance in recreational athletes [1-3]. Furthermore, in recreational athletes combining AF and EF (AF+EF) was superior compared to AF and EF alone [4].

Research Question

Here we test in elite tennis players the influence of AF, EF, AF+EF and an internal focus (experiment 1) and grunting (experiment 2) on service speed.

Methods

In both experiments, elite players were asked to serve to a target zone with maximum speed. Service speed was measured using a speed gun.

Results

In experiment 1, a significant main effect of condition was found ($p \leq 0.001$). Post-hoc comparisons revealed faster serves for AF compared to control serves without instruction/feedback ($p < 0.01$) and compared to EF ($p < 0.05$), whereas no significant difference was found between EF and IF ($p = 0.81$). The fastest service speeds were found in the AF condition, while the combination of AF+EF did not further promote performance. In experiment 2, players served significantly faster when grunting compared to a condition without grunting ($p = 0.03$).

Discussion

In both experiments, no speed-accuracy trade-off was found indicating that enhanced service speeds did not result in more service errors. Thus, the previously reported performance-enhancing effect of grunting in recreational players can also be found in elite players. Furthermore, AF seems most beneficial to instantly enhance performance whereas EF was less effective and did not differ from IF, providing further evidence that expertise level and task-relevant instructions mediate the influence of attentional focus on motor performance.

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Christoph Conz

ZH

Introduction

Swiss Olympic wants to improve the knowledge management for Swiss Elite Sport and has built up beside other a selflearning online platform for the exchange of knowledge and experience: esi – elitesportinsights.ch.

Methods

Esi enables all actors in Swiss Elite Sport to put specific questions and to receive answers from specialists. Besides, it links up experts, existing knowledge out of different sources and brings fields of activity together.

Results

Actually more than 1200 Experts using esi. Successfully. More than 95% of the questions are solved with a satisfaction rate by average 4.6 points (from maximum 5). The answer reaction time is approx. 30% less than 2 hours. Esi becomes used successfully as a supporting instrument for conferences, education offers and workshops. All actors in the Swiss Elite sport are informed, involved and know requested to use esi also for their proper knowledge management and the exchange within their own disciplines and peer groups. Now it should be possible to make the excellent Swiss knowledge accessible for an improving transfer and larger effects.

Discussion

Esi learns thanks to the application of artificial intelligence with every question. The more traffic and the more uses are taking place, the better esi gets. The challenge: we must bring esi to one of our everyday instruments. This is a great challenge, if we face as different the actors in the Swiss Elite sport operate.

We also must collect experiences how the interfaces to consultation sequences and 1:1 exchange situations function and how quality is also guaranteed with large amounts of content.

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1.4 Leistung im Nachwuchsfussball

Topics: natural sciences, sciences sociales

Keywords: Fussball, Nachwuchsleistungssport, Leistungsentwicklung

Leistung im Nachwuchsfussball – ausgewählte Forschungs- und Entwicklungsprojekte des Ressort Leistungssport der EHSM

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Leistung im Fussball ist Ergebnis des Zusammenspiels einer Vielzahl von unterschiedlichen physischen, psychischen und technisch-taktischen Faktoren. Dementsprechend sind für eine ganzheitliche Nachwuchsförderung im Fussball möglichst alle Faktoren zu berücksichtigen. Aus der langjährigen Zusammenarbeit zwischen dem Schweizerischen Fussball Verband (SFV) und dem Ressort Leistungssport der Eidgenössischen Hochschule für Sport Magglingen (EHSM) werden in diesem Symposium drei ausgewählte Forschungs- und Entwicklungsprojekte zum Thema Leistung im Nachwuchsfussball vorgestellt. Im ersten Beitrag wird der Zusammenhang zwischen der Ermüdungsresistenz und Messgrössen der physischen Beanspruchung bei einer fussballspezifischen Sprintaufgabe mit der aeroben Leistungsfähigkeit diskutiert. Anschliessend werden leistungsmotivationale Faktoren als möglicher Erfolgsprädiktor im Frauennachwuchsfussball dargestellt. Der letzte Beitrag stellt ein Studiendesign zur Entwicklung und Evaluation einer neuartigen Wettspielform im Kinderfussball aus der angestrebten ganzheitlichen Perspektive vor.

Presentations of the Symposium

Zusammenhang der Ermüdungsresistenz und Messgrössen der physischen Beanspruchung bei einer fussballspezifischen repetitiven, multiseriellen Sprintaufgabe mit der aeroben Leistungsfähigkeit

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Theoretischer Hintergrund

Die physische Belastung während eines Fussballspieles zeichnet sich durch einen ständigen Wechsel von Phasen hoher und tiefer Intensität aus und weist während intensiven Spielphasen die Belastungscharakteristik einer repetitiven Sprintaufgabe (RSE) auf (Girard, Mendez-Villanueva & Bishop, 2011). Die Ausprägung spezifischer Messparameter einer RSE und deren Zusammenhänge mit der aeroben Leistungsfähigkeit hängen stark von den Belastungscharakteristik der RSE und der Untersuchungsstichprobe ab (Girard et al., 2011). Bislang ist unklar, wie sich die Ermüdungsresistenz und physiologische Beanspruchungsparameter bei einer der physischen Belastungscharakteristik eines Fussballspieles (mehrere, aufeinander folgende hochintensive Belastungsphasen) entsprechenden RSE verhalten und wie stark die Zusammenhänge dieser Parameter mit der aeroben Leistungsfähigkeit sind. **Fragestellung:** Wie verhalten sich Ermüdungsresistenz und physiologische Beanspruchungsparameter bei einer fussballspezifischen, multiseriellen RSE und wie stark sind die Zusammenhänge mit der aeroben Leistungsfähigkeit?

Methode

An der Studie nahmen 21 Elite-Nachwuchs-Fussballspieler der Altersstufe U-18 teil (Alter: 16.9 ± 0.6 Jahre, Grösse: 176.1 ± 5.3 cm, Gewicht: 66.9 ± 6.9 kg). Die Studienteilnehmer absolvierten eine RSE bestehend aus drei repetitiven Sprintserien à je vier 12×12 m Shuttle-Sprints mit 10 s intraserieller und 90 s interserieller Pause. Während den interseriellen Pausen war während 50 s ein Shuttle-Lauf bei einem Tempo von $11.5 \text{ km} \cdot \text{h}^{-1}$ zu absolvieren. Bei der RSE wurde die Ermüdungsresistenz als die Aufrechterhaltung der mittleren seriellen Sprintzeit (von der ersten zur zweiten Serie (RSmaint2vs1), von der zweiten zur dritten Serie (RSmaint3vs2) und von der ersten zur zweiten und dritten Serie (RSmaint2&3vs1)), sowie physische Beanspruchungsparameter (VO_2 , Herzfrequenz (HR) und Sauerstoffsättigung in der Muskulatur (TSI)) gemessen. Die aerobe Leistungsfähigkeit wurde mittels VO_2max und der Laufgeschwindigkeit an der anaeroben Schwelle (ANS) auf dem Laufband abgeschätzt.

Ergebnisse

Während der RSE kam es zu einem Abfall der mittleren seriellen Sprintleistung (RSmaint2vs1 = $95.6 \pm 2.3\%$, RSmaint3vs2 = $98.0 \pm 2.0\%$), sowie einer Zunahme der VO_2 ($\text{VO}_2\text{Serie1} = 67.9 \pm 7.7\% \text{ VO}_2\text{max}$, $\text{VO}_2\text{Serie2} = 90.0 \pm 10.1\%$, $\text{VO}_2\text{Serie3} = 90.4 \pm 11.2\%$) und HR (HRSerie1 = $83.2 \pm 3.9\% \text{ HRmax}$, HRSerie2 = $93.0 \pm 2.6\%$, HRSerie3 = $95.2 \pm 1.5\%$). Der TSI fiel während den Sprintserien auf durchschnittlich $64.0 \pm 9.2\%$ des Ruhewerts ab und stieg während den interseriellen Pausen auf durchschnittlich $87.7 \pm 9.5\%$ an. Spieler mit einer besseren aeroben Leistungsfähigkeit zeigten während der RSE eine bessere Ermüdungsresistenz (RSmaint2&3vs1) (jeweils Zusammenhänge mit VO_2max , resp. ANS (r [95% CL], Wahrscheinlichkeiten für negativen/trivialen/positiven Zusammenhang) (0.45 [0.01, 0.74], 1/5/94%; resp. 0.60 [0.23, 0.82], 0/1/99%), eine höhere VO_2 (0.50 [0.08, 0.76], 0/3/97%; resp. 0.21 [-0.24, 0.59], 9/22/69%), sowie eine schnellere Muskelreoxygenierung während den interseriellen Pausen (0.53 [0.13, 0.78], 0/2/98%; resp. 0.47 [0.05, 0.75], 0/4/96%).

Diskussion

Im Gegensatz zu gewissen andern RSE (Girard et al., 2011), besitzt das aerobe System während einer fussballspezifischen repetitiven, multiseriellen Sprintaufgabe eine leistungsbestimmende Funktion in Bezug auf die Ermüdungsresistenz. Aerob leistungsfähigere Spieler dürften während hochintensiven Phasen eines Fussballspiels besser in der Lage sein ihre Sprint-schnelligkeit aufrecht zu erhalten.

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Leistungsmotivationale Faktoren als Erfolgsprädiktor im Nachwuchsbe- reich vom Frauenfussball: Haben Nationalspielerinnen (U-17 FNT und U-19 FNT) eine höhere Leistungsmotivation als gleichaltrige Fussball- spielerinnen?

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Theoretischer Hintergrund

Nebst physischen und technischen Faktoren wird auch der mentale Bereich im Fussball immer stärker als leistungsbestimmende Grösse betrachtet. Welche Rolle mentale Faktoren im Rahmen der Talententwicklung im Frauenfussball einnehmen, wurde jedoch bis heute erst vereinzelt untersucht (z.B. Stoeber & Bescke, 2008; Gledhill & Haarwood, 2014). In Anlehnung an

das FTEM-Model (Gulbin et al. 2013) wird in der vorliegenden Studie exploriert, ob leistungsmotivationale Faktoren für die Übertritte T3 – T4 (ins U-17 FNT) bzw. T4 – E1 (ins U-19 FNT) relevant sind.

Fragestellung

Unterscheiden sich die U17-Nationalspielerinnen von ihren gleichaltrigen Spielerinnen durch eine stärkere Ausprägung leistungsmotivationaler Faktoren? Lässt sich die Selektion in das U-19 Nationalteam auf die höhere Ausprägung leistungsmotivationaler Faktoren während der Zeit als U-17 Nationalteam-Spielerinnen zurückführen?

Methode

Im Rahmen des Projekts „Talentedwicklung im Frauenfussball“ wurden in den Jahren 2015-2017 bei Spielerinnen der Nationalteams sowie der Top-Clubs der Schweiz u.a. 12 motivationale Komponenten (Durchhaltevermögen, Einsatzbereitschaft, Anspruch an sich selber, Lernmotivation, Zuversicht, langfristige Zielsetzung, Wettbewerbshaltung, Dominanz, kompensatorische Anstrengung, Statusstreben, Aufgabenorientierung und Selbstdisziplin) mittels Online-Fragebogen erfasst. Zur Beantwortung der vorliegenden Fragestellung wurden die Jahrgänge 1998-2000 berücksichtigt und in die Leistungs-Gruppen a) erfolgreicher Übertritt U-17 zu U19 Nationalteam [n=40] b) schaffte den Übertritt in die U-19 Nationalmannschaft nicht [n=34] c) spielte nie in einem Nationalteam [n=109] eingeteilt. Die Gruppenvergleiche wurden mit einseitigen t-Test vorgenommen.

Ergebnisse

Die U-17 Nationalspielerinnen unterscheiden sich von den gleichaltrigen Spielerinnen einzig darin, dass sie einen höheren Anspruch an sich selber stellen (5.58 vs. 5.32, $t(181) = 2.29$, $p < .05$) und eine höhere Lernmotivation besitzen (5.53 vs. 5.25, $t(181) = 2.03$, $p < .05$). Im Vergleich zu den U-17 Nationalspielerinnen, die den Sprung in die U-19 Auswahl nicht geschafft haben, zeigen die erfolgreichen U-19 FNT Spielerinnen eine höhere Einsatzbereitschaft (5.53 vs. 5.25, $t(72) = 2.03$, $p < .05$), bessere Selbstdisziplin (6.10 vs. 5.63, $t(72) = 2.15$, $p < .05$), vermehrt langfristige Zielsetzungen (5.38 vs. 4.88, $t(72) = 1.85$, $p < .05$) und eine höhere Zuversicht (5.09 vs. 4.66, $t(72) = 2.08$, $p < .05$).

Diskussion

Die Resultate deuten darauf hin, dass die erfassten leistungsmotivationalen Faktoren besser differenzieren, wenn die Leistungsdichte grösser ist (Übergang U-17 FNT zu U-19 FNT). Dass sich die U-17 Nationalspielerinnen nur gering von gleichaltrigen Spielerinnen im motivationalen Bereich unterscheiden, kann darauf zurückzuführen sein, dass den technischen und physischen Faktoren in dieser Selektionsphase mehr Beachtung geschenkt wird als den motivationalen Faktoren. Eine offene Frage ist, wie sich motivationale Faktoren durch eine Kader-Selektion verändern.

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#playmore: Studiendesign einer zweijährigen kontrollierten Interventionsstudie zur Verbesserung der Wettspielform im Kinderfussball

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Theoretischer Hintergrund

Wettspielformen im Kinder- und Juniorenfussball sollen allen Athleten eine möglichst hohe aktive Spielzeit und –beteiligung, viele Ballkontakte und eine hohe Variation an Spielsituationen und Positionswechsel ermöglichen (Williams, 2005). Der Schweizerische Fussballverband (SFV) plant durch die Implementierung von neuen Wettspielformen die fussballerische Förderung im Kinder- und Juniorenfussball zu verbessern. Dies soll durch eine Erhöhung von 1) Spielbeteiligung pro Spieler, 2) Spielzeit pro Spieler, 3) Variabilität, Häufigkeit und Qualität der technischen und taktischen Spielaktionen, 4) Freude am Spiel, 5) Spielintelligenz und –kreativität gewährleistet werden. Ziel der Studie ist die Entwicklung und Evaluation einer neuen Wettspielform für die Kategorie E im Kinderfussball.

Methoden

Durchführung einer systematischen Literatursuche in den Datenbanken Pubmed, Google Scholar und EBSCO SPORTDiscus; mit den Keywords: „small sided games“, „skill acquisition“, „youth soccer“, „game development“. Dabei wurden peer-review Artikel aus internationalen Journals und Fachbücher gesichtet. Zusätzlich erarbeiteten Nachwuchsverantwortliche auf regionaler und nationaler Ebene, Trainer und Sportwissenschaftler in Fokusgruppen einen Vorschlag für eine neue Wettspielform im Kinder- und Juniorenfussball.

Ergebnisse

Die **Literatursuche** und die qualitative Auswertung der Fokusgruppen ergaben, dass neue Kleinfeld-Spielformen (z.B. 4 gegen 4) deutlich höhere aktive Spielzeit und eine höhere Anzahl an technisch-taktischen Aktionen (Ballkontakte, Pässe, Zweikampfverhalten, Torschüsse und Torabschlüsse) zur Folge haben (Silva, 2014). Die herkömmlichen Grossfeld-Wettspielformen (z.B. 7 gegen 7) bieten hingegen Vorteile hinsichtlich längerer Sprintdistanzen, höherer Maximalgeschwindigkeiten, längerer Passwege und Gesamtlaufrichtungen (Hill-Haas, 2011). Eine Pilotstudie im Kinderfussball zeigte, dass durch eine Kombination von Kleinfeld- und herkömmlicher Grossfeld- Wettspielform die Vorteile beider Spielformen genutzt werden. Als Ergebnis wird eine kombinierte Wettspielform empfohlen. Die kombinierte Wettspielform soll mit 33 Mannschaften (n= 330 Spieler) aus der 2. Spielstufe der E-Junioren evaluiert werden. Dabei dienen 16 Mannschaften als Interventionsgruppe, die die kombinierte Wettspielform über zwei Jahre hinweg durchführen. Als Kontrollgruppe spielen 17 weitere Mannschaften aus der gleichen Spielstufe die herkömmliche 7 gegen 7 Wettspielform. Die Effektivität der kombinierte Wettspielform wird im Vergleich zur herkömmlichen Wettspielform mittels Videoauswertung eines SCORE-Turniers im 6 gegen 6 Spielformat und der TIPS (Technik, Spielintelligenz, Persönlichkeit und Schnelligkeit)-Bewertung überprüft (Unnithan, 2012).

Diskussion

Das dargestellte Studiendesign soll eine Studie ermöglichen, auf deren Grundlage der SFV über eine mögliche schweizweite Implementierung der kombinierten Wettspielform entscheiden kann. Insbesondere sollen durch die kombinierte Wettspielform die Vorteile von kleinen und grossen Wettspielformen genutzt werden können und dadurch die gewünschte verbesserte fussballerische Förderung erzielt werden.

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1.5 Improving Antidoping and the Athlete Biological Passport

Topics: natural sciences

Keywords: antidoping, athlete, passport, performance, biomarker

Improving antidoping and the Athlete Biological Passport

Submitted by: **Raphael Faiss** (REDs - Research & Expertise in antiDoping sciences, University of Lausanne), **Martial Saugy** (REDs - Research & Expertise in antiDoping sciences, University of Lausanne)

The fight against doping rely today mostly on analytical Results from laboratories, under control and scrutiny form the World AntiDoping Agency.

The Athlete Biological Passport (ABP) is additionally widely accepted as a strong tool for an indirect detection of doping. While doping aims at improving athletic performance, it may alter biomarkers measured in the ABP. Conversely, variation in biomarkers observed in the ABP may coincide with improvement (or decrement) of athletic performance.

The ABP includes a hematological module since 2009 with a steroidal module introduced in January 2014. Interestingly, in the current ABP guidelines, the passport refers not only to a longitudinal profile of the athlete's biological markers but also "includes all other relevant information also comprising training and competition Results".

This symposium aims to present the recent advances in the steroidal and hematological modules of the ABP and discuss how it could be further improved by the monitoring of additional variables or biomarkers.

Presentations of the Symposium

Autologous blood transfusion, hypoxic exposure and the hematological module of the Athlete Biological Passport

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Autologous blood transfusion (ABT) is a clinical procedure frequently diverted by athletes to artificially improve performance. Currently, ABT is monitored with an individual and longitudinal follow-up of hematological parameters via the Athlete Biological Passport (ABP) intended to identify abnormal variations caused by doping against a background of normal biological variability.

The sensitivity of the haematological module of the ABP to detect abnormal fluctuation following ABT was evaluated using haematological data from a previous clinical trial performed by our laboratory. In a second time, the effect of hypoxic exposure was investigated on the haematological profile of subjects involved in Live High-Train Low altitude training camps in either hypobaric or normobaric hypoxia. Finally, potential transcriptomic biomarkers of ABT were investigated to identify the reinfusion of one's own blood.

In average, blood parameters were significantly influenced by the blood transfusion procedure with a rapid elevation of haemoglobin levels and a slower drop of reticulocytes percentage. However, when evaluating individually each volunteer, the ABP software was unable to point out any positive with a 100% specificity. On the other hand, for the hypoxia study, blood variables from the ABP elicited changes that could have been related to blood doping for some

subjects. Interestingly, transcriptomic biomarkers (ALAS2, CA1, SLC4A1) elicited a marked decrease of expression following ABT.

These results raise some concerns about the capacity of the ABP to detect autologous blood transfusion, while it confirms that altitude exposure remains a critical confounding factor for the interpretation of a haematological profile. Moreover, the repression of gene expression was more pronounced than the diminution of reticulocytes percentage following blood transfusion suggesting that they could represent potential additional biomarkers for the monitoring of ABT in sports.

Exploring blood steroidomics for the improvement of the athlete biological passport steroidal module

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The 'steroidal module' of the Athlete Biological Passport is currently achieved by GC-MS(/MS) quantification of few selected endogenous anabolic androgenic steroids (EAAS) from athletes' urines [1] and represents a key tool for the detection of steroid abuse in sport. Nevertheless, as the "urinary steroid profile" suffers from some matrix-related limitations such as enzyme polymorphism, bacterial contamination and ethanol consumption [2], new strategies have been recently proposed to improve EAAS doping detection capabilities [3]. Among these, the measurement of steroid hormones in blood matrix showed a promising ability to detect testosterone doping and interesting complementarities with the urinary module [4]. A more holistic approach, namely "steroidomics", could improve the current steroid profile. To achieve this, a new "steroidomic" workflow including 5 different steps was developed and will be discussed in the present work:

- 1) A rapid SPE-based sample preparation, capable of extracting steroid hormones as well as their phase I and phase II metabolites from serum samples;
- 2) UHPLC-HRMS method, acquiring Full Scan MS and data dependent MS/MS spectra in both positive and negative ionization modes;
- 3) Data processing including noise filtering, alignment and peak picking followed by normalization;
- 4) Ion annotation with confidence level 1 (identification confirmed with authentic standard) and 2 (identification confirmed with predicted properties) thanks to a newly created in-house steroid database (350 steroids) together with retention time prediction model [5];
- 5) Multivariate statistical analysis for highlighting most relevant features;

This workflow was then applied to serum samples obtained from a testosterone administration clinical trial, with the aim of highlighting new promising blood biomarkers of both oral and transdermal testosterone intake, similarly to what was previously done on urine matrix [6].

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Can power data in cycling contribute to an Athlete Performance Passport?

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The Athlete Biological Passport (ABP) is a testing paradigm with immense potential value in the current climate of rapid advancements in novel biomarker discovery since doping can be detected from specifically selected biomarkers. However, despite remarkable results since its implementation, athletes may adjust their doping methods to circumvent the ABP testing protocols.

The ABP was first adopted in cycling by the International Cycling Union (UCI) to provide an extended overview of the variations in hematological parameters of professional cyclists. As few modifications of the ABP have occurred since its introduction in 2009, additional parameters could strengthen its detection and deterrence potential while the new World Anti-Doping Agency code stresses the importance of the ABP and the need to further develop it to address confounding factors.

Indeed, the ABP is not limited to the longitudinal analysis of multiparametric biomarkers present in biological samples but should also include other relevant information such as the athletes' whereabouts and other parameters (e.g., performance recordings).

In cycling for instance, power output is recorded extensively throughout training and races by a vast majority of athletes. These data are then often used to define peak power profiles to monitor training/racing load and adjust training programs to reach desired peak fitness at certain moments of the season.

Performance ability can thus be evaluated and modelled scientifically, but the reliability and validity of cycling power meters used in professional cycling first needs to be evaluated. When calibrated and accurate data is obtained, a longitudinal power data profile for a cyclist, in the form of an APP may provide a useful signature of likely changes in training and performance potential.

The development of an athlete's performance (or physiological) passport (APP) may pave the way for the ABP to be strengthened, potentially increasing its sensitivity for identifying athletes with profiles indicative of doping in cycling.

Definitely, accounting for confounding factors that affect performance and integrating the latter into the ABP represents an additional concomitant challenge to the current fight against doping.

1.6 Kinder- und Jugendsport

Topics: social sciences

Keywords: Kindheit, Jugend, Sportaktivität, Vereinssport

Kinder- und Jugendsport

Submitted by: **Claudia Klostermann** (Universität Bern, Schweiz), **Vanessa Gut** (Universität Bern, Schweiz), **Elke Gramespacher** (Pädagogische Hochschule FHNW, Schweiz)

Sportlichen Aktivitäten werden vielfältige positive Wirkungen zugeschrieben, z.B. im Hinblick auf Gesundheit, Persönlichkeitsentwicklung oder soziale Integration (Breuer & Rittner, 2004). Allerdings haben nicht alle soziale Gruppen gleichermassen Zugang zu den sozialen Leistungen des Sports und das Sportverhalten variiert je nach sozioökonomischen und soziokulturellen Merkmalen, z.B. der Sozialschichtzugehörigkeit oder dem Geschlecht (u.a. Haut & Emrich, 2011; Lamprecht, Fischer, Wiegand & Stamm, 2015).

Im Symposium Kinder- und Jugendsport werden diese bislang im Sport unterrepräsentierten sowie vom Ausstieg gefährdeten Zielgruppen in den Blick genommen, und die Frage erörtert, wie Möglichkeiten geschaffen werden können, dass auch sie von den positiven Leistungen des Sports profitieren können. Hierzu werden aktuelle Forschungsarbeiten präsentiert, welche Zugangsbarrieren und Erklärungsansätze aufzeigen. Es werden sowohl unterschiedliche Kontexte und Organisationsformen des Sporttreibens als auch Erklärungsfaktoren in den Blick genommen. An Methodischen Zugängen sind sowohl qualitative als auch quantitative Studien im Symposium vertreten.

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Presentations of the Symposium

Das Bedürfnis sportlicher Mädchen danach sich im Sport „wohl zu fühlen“ – Befunde aus der Studie Girls in Sport

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Mädchen partizipieren seit Jahrzehnten immer mehr am Sport (Hartmann-Tews, 2009). Die Kinder- und Jugendberichte der Studien Sport Schweiz 2008 (Lamprecht et al., 2008) und 2014 (Lamprecht et al., 2015) aber zeigen, dass sich die Kategorie Geschlecht dennoch als beharrlicher Faktor für soziale Ungleichheit im Kinder- und Jugendsport erweist.

Die sportwissenschaftliche Geschlechtertheorie bietet für dieses Phänomen drei Erklärungsansätze: Sozialisationstheoretisch betrachtet leistet dazu die frühkindliche Erfahrung mit Bewegung und Sport einen Beitrag (Voss & Gramespacher, i.E.). Geschlechtliche Ungleichheiten im Sport(vereins-)engagement von Kindern und Jugendlichen werden mit strukturellen und

organisationalen Ursachen erklärt (Hartmann-Tews & Combrink, 2005). Und es gibt einen Zusammenhang mit anderen sozialen Differenzkategorien (Bahlke & Kleindienst-Cachay, 2017).

Die von der Laureus Stiftung Schweiz geförderte Studie *Girls in Sport* (Gramespacher et al., 2015) hat zu diesem Phänomen zwei Fragen gestellt: Inwiefern entwickeln Mädchen in ihrer Bewegungssozialisation Interessen an und Haltungen zum Sport, die (nicht) hinreichend kohärent sind mit Strukturen und Zielen des Vereinssports? Und inwiefern führen sozialisierte Verknüpfungen von Sport und Männlichkeit bei Mädchen potenziell zu Erfahrungen, die es ihnen erschweren, im organisierten Sport zu verbleiben.

In der Studie wurden acht Gruppendiskussionen geführt: fünf mit sportiven, zehn- bis vierzehnjährigen Mädchen, drei mit ebenso vielen „sportlich wenig aktiven“, nur im obligatorischen Sport in der Schule aktiven, Mädchen desselben Alters. Die Transkripte wurden rekonstruktiv ausgewertet (Bohnsack, 2007).

Vereins erfahrene Mädchen artikulieren primär ein Bedürfnis nach vorurteilsfreier sozialer Anerkennung, die ihren sportlichen Kompetenzen, Talenten und ihrer Person gelten und von ihren Trainer_innen und Peers kommen soll. Sportliche Mädchen suchen als Ko-Konstrukteure ihrer Umwelt nach Chancen, Geschlechterverhältnisse im Sport „herzustellen“.

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Profile motivationaler und volitionaler Merkmale sowie deren Zusammenhang mit unterschiedlichen Aspekten des Sportverhaltens von Jugendlichen

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Theoretischer Hintergrund

Jugendliche sind eine wertvolle Zielgruppe zur Förderung sportlicher Aktivitäten, da in dieser Altersgruppe eine starke Abnahme des Sportverhaltens zu beobachten ist (Lamprecht, Fischer, Wiegand, & Stamm, 2015). Zusätzlich steht das Sportverhalten in der Jugend mit dem lebenslangem Sportverhalten in Zusammenhang. Individuelle Unterschiede in relevanten Einflussfaktoren des Sports führen jedoch dazu, dass die Effizienz von Massnahmen zur Förderung sportlicher Aktivitäten stark variiert (Bryan et al., 2011). Daher wird vermehrt gefordert, zielgruppenspezifisches Wissen zu generieren, um passende Interventionen zu konzipieren. Diese Forderung führt zu einem Wechsel der Forschungsperspektive - weg von einem variablen- hin zu einem person-orientierten Ansatz. Bei diesem Ansatz steht die Betrachtung von homogenen Subgruppen und die Wechselwirkungen von Variablen innerhalb dieser Subgruppen im Fokus (Bergman & Lundh, 2015). Bisher wurde der person-orientierte Ansatz bei der Untersuchung zentraler motivationaler und volitionaler Merkmale des Sportverhaltens (Biddle, Atkin, Cavill, & Foster, 2011) im Jugendalter vernachlässigt.

Fragestellung

Daher war das Ziel der vorliegenden Studie (1) unterschiedliche motivationale und volitionale Profile bei Jugendlichen zu identifizieren und (2) zu untersuchen, wie die unterschiedlichen Profile mit verschiedenen Aspekten des Sportverhaltens zusammenhängen.

Methode

Schweizer Schülerinnen und Schülern der 9. Klasse (N = 1155, Mage = 15.3, SDage = 0.7, 53% weiblich) wurden einmalig zu motivationalen Merkmalen (Absichtsstärke, sportbezogene Selbstkonkordanz) und zu volitionalen Merkmalen (sportbezogene Selbstwirksamkeit, Handlungsplanung) befragt. Um Jugendliche mit ähnlichen Profilen zu gruppieren, wurden latente Profilanalysen durchgeführt. Zusätzlich wurde das Sportvolumen und daraus abgeleitet Sportaktivitätskategorien (inaktiv, teils-aktiv, genügend aktiv) sowie verschiedene weitere Aspekte des Sportverhaltens (Wettkampfteilnahme, sozialer und organisationaler Kontext) erfasst.

Resultate

Insgesamt konnten fünf unterschiedliche Motivations- und Volitionsprofile bei den Jugendlichen identifiziert werden: (1) «Die demotivierten Planlosen», (2) «Die planlosen Absichtsstarken», (3) «die Unterdurchschnittlichen», (4) «die Unterdurchschnittlichen», und (5) «die Überdurchschnittlichen». Betreffend des Sportverhalten unterscheiden sich die Profile in Bezug auf die Sportaktivitätskategorien (inaktiv, teils-aktiv, genügend aktiv) (χ^2 (df = 8) = 531.204, $p < .001$) sowie in diversen weiteren Aspekten des Sportverhaltens (soziale und organisatorische Kontext, Wettkampfteilnahme).

Diskussion

Die Befunde verweisen auf die Notwendigkeit eines person-orientierten Ansatzes, um zielgruppenspezifisches Wissen zur Förderung sportlicher Aktivitäten bei Jugendlichen zu gewinnen. Zukünftig sollte untersucht werden, wie die unterschiedlichen Profile längerfristig mit dem Sportverhalten in Zusammenhang stehen.

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Herkunftsspezifische Handlungsorientierungen und ihre Bedeutung für die Sportaktivität junger Menschen

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Einleitung

Trotz vielfältiger Bemühungen der Sport- und Bewegungsförderung allen Menschen den Zugang zum Sport zu gewährleisten, bestehen nach wie vor soziale Ungleichheiten. Die Sportaktivität Jugendlicher wird beispielsweise von der sozialen Herkunft und dem Elternhaus beeinflusst (Lamprecht, Fischer, Wiegand & Stamm, 2015). Gerade Kinder und Jugendliche von Eltern mit geringerer Bildung haben deshalb deutlich geringere Chancen von den positiven Potenzialen des Sports zu profitieren. Es stellt sich deshalb die Frage, wie die geringere Sportbeteiligung von Jugendlichen von Eltern mit geringerer Bildung zu erklären ist.

Theoretischer Ansatz

Ausgehend von individuell gestaltbaren Handlungsrahmen wird im Sinne der Lebensstilforschung der Zugang zum Sport als individuelle Präferenzsetzung betrachtet, die in Zusammenhang mit lebensstil-, milieu- und kulturspezifischen Mustern steht (Thiel & Cachay, 2003). Entsprechend sind jene vermittelnden Instanzen in Betracht zu ziehen, auf deren Grundlage sich individuelle Präferenzsetzungen und letztlich sportbezogenes Handeln vollzieht (Nagel, 2003). In der vorliegenden Studie wird der Blick auf sportbezogene Handlungsorientierungen im Sinne grundlegender Überzeugungen gerichtet, die im direkten Zusammenhang zum Sportverhalten stehen (z.B. Sportverständnis, Einstellungen zur Freizeit, Zusammenhang zwischen Sport und Gesundheit). Angesichts der zentralen Fragestellung ist zu überprüfen, inwieweit statusspezifische Unterschiede hinsichtlich dieser sportbezogenen Handlungsorientierungen bestehen und inwiefern diese die Sportaktivität junger Menschen beeinflussen.

Methode

In 36 Schweizer Kommunen (kriteriengeleitete Auswahl) wurden 15- bis 30-jährige Einwohner/innen ($N = 4039$, Alter: $M = 21.48$ Jahre, $SD = 4.64$) mittels einer Online-Befragung detailliert zu ihrem Sportengagement und zu sportbezogenen Handlungsorientierungen (z.B. Einstellungen zur Freizeit, Sportverständnis) befragt.

Resultate

Wie in der Sport Schweiz Studie 2014 (Lamprecht et al., 2015) zeigte sich auch in der vorliegenden Studie, dass der Anteil sportinaktiver Jugendlicher mit Zunahme des Bildungsniveaus der Eltern sinkt: Haben die Eltern nur die obligatorische Schule besucht, so ist die Chance, dass der Jugendliche sportinaktiv ist (Anteil Sportinaktiver: 27%), doppelt so hoch als wenn die Eltern eine tertiäre Ausbildung abgeschlossen haben (Anteil Sportinaktiver: 13%). Darüber hinaus sind Jugendlichen von Eltern mit tertiärem Bildungsniveau signifikant mehr Sportstunden in der Woche aktiv ($M = 4.5$, $SD = 4.1$) als Jugendlichen von Eltern mit geringerem Bildungsniveau (sekundäre Bildung: $M = 3.9$, $SD = 3.7$; primäre Bildung: $M = 3.1$, $SD = 3.5$; ohne Bildungsabschluss: $M = 2.4$, $SD = 2.7$), $F(3, 3504) = 13.04$, $p < .01$. Logistische Regressionsmodelle weisen darauf hin, dass die Sportaktivität Jugendlicher insbesondere durch sportbezogene Handlungsorientierungen erklärt werden kann. Im Vergleich zum Modell mit Berücksichtigung des Bildungsniveaus der Eltern als isolierten Faktor ($R^2 = .02$) steigt durch die Hinzunahme der sportbezogenen Handlungsorientierungen Sportverständnis, Einstellungen zur Freizeit, Zusammenhang zwischen Sport und Gesundheit die Varianzaufklärung des Modells auf $R^2 = .17$.

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1.7 The influence of Biological and Chronological Age on Motor Performance and Sports Talent in Swiss Youth Cohorts

Topics: natural sciences

Keywords: maturation, performance, talent selection, youth sport, drop-out

The influence of biological and chronological age on motor performance and sports talent in Swiss youth cohorts

Submitted by: **Oliver Faude** (Universität Basel, Schweiz)

Children and adolescents in youth sports are commonly pooled into annual age groups to account for developmental differences. There remains, however, a potential gap of up to 12 months in chronological age between individuals. Furthermore, maturational status can considerably vary between children and adolescents of the same chronological age. Differences in biological and relative age may lead to a biased view on the potential of children in a particular sport. Early-developed children may have advanced physical and cognitive abilities compared to their late-developed peers and were, thus, more likely successful in sport and be identified as more talented. In recreational sports, developmental disadvantages may contribute to early adverse experiences with and drop-out from sports. The proposed symposium aims at getting insights on the influence of chronological and biological age on motor performance and sports talent in large youth cohorts of different performance levels.

Romann et al. analysed relative age effects in all sports included in the Swiss talent development program (18'859 youth athletes). Javet et al. investigated the interrelationship between relative and biological age in 342 under-15 soccer players. Finally, Rössler et al. studied the effects of chronological and biological age on motor performance in 2'562 first-graders.

Presentations of the Symposium

A national analysis of relative age effects in Swiss talent development across all sports

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Introduction

Relative age effects (RAEs) result in performance discrepancies between children and youth within one selection year (Cobley, Baker, Wattie, & McKenna, 2009). This generates consistent participation inequalities, selection biases and may lead to a drop out of potential talents. The aim of this study was to investigate RAEs across all sports of the national Swiss talent development program (STDP).

Methods

In this study, 18'859 (age range 5 to 20 y; female N = 5'353; mean age: 14.8±2.5 y and male N = 13'506; mean age: 14.4±2.4 y) youth athletes of 70 sports who participated in the 2014 competitive season were evaluated. All data were obtained from the national database of STDP. The sample was subdivided by sex, Olympic vs. non-Olympic sports and regional vs. national level selection (NLS, N=2464). The year was divided into four birth quarters (Q1: Jan.

to Mar.; Q2: Apr. to Jun.; Q3: Jul. to Sept.; Q4: Oct. to Dec.). Odds ratios (ORs) and 95% confidence intervals (CI) were calculated for the comparison Q1 vs. Q4.

Results

In the whole STDP sample, youth athletes born in Q1 were 1.84 (95% CI 1.74, 1.95) for males, and 1.35 (95% CI 1.24, 1.47) for females times more likely to be selected than athletes born in Q4. Olympic sports showed higher ORs (males: 1.93 (95% CI 1.82, 2.05), females: 1.37 (95% CI 1.25, 1.5), than non-Olympic sports (males: 1.10 (95% CI 0.89, 1.31), females: 1.17 (95% CI 0.91, 1.5)). RAEs were higher in male NLS (OR 2.40 (95% CI 1.42, 1.97)) and were similar in female NLS (OR 1.30 (95% CI 1.08, 1.57)) compared to the lower selection level. NLS in Olympic sports showed higher ORs for males (2.54 (95% CI 2.11, 2.97)) and for females (1.34 (95% CI 1.09, 1.64)) than non-Olympic sports (males: 1.18 (95% CI 0.69, 1.82), females: 1.14 (95% CI 0.72, 1.8)).

Discussion & Conclusion

In the national Swiss talent development program, RAEs are evident for males and females in most sports. These results support existing literature demonstrating that popular Olympic sports show higher RAEs than non-Olympic sports and that RAEs are higher in males than females (Cobley et al., 2009). Higher selection level showed higher RAEs only for males. RAEs reflect a type of developmental barrier that may be preventable by implementing appropriate solutions in the future (Romann & Cobley, 2015). Especially for a small nation like Switzerland, with correspondingly few sport talents, any future reduction of RAEs may provide a substantial performance enhancement at elite senior level.

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Interrelationship of biological and relative age in talent selections in Swiss youth soccer

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Introduction

In youth sports, grouping by chronological age is the usual procedure for separating young athletes into age-related training and competition groups. However, individuals in the same age category can differ by as much as 1 year in relative age (RA) and by 4 years in biological age (BA) (Malina, Bouchard, & Bar-Or, 2004). Variations in performance are highly dependent on RA and BA especially during the transition into and during male adolescence (Malina, Coelho e Silva, & Figueiredo, 2012). The aim of the study was to analyse the interrelationships of RA and BA and their influence on the ratings of coaches in the talent selection process.

Methods

In total, 342 players (age 13.9 ± 0.3) were recruited from under-15 national selection days between 2013 and 2017. BA, as an indicator for maturity, was estimated by skeletal age (SA) and the Tanner-Whitehouse 3 classification. SA was taken from radiographs of the left hand and used to classify players as early, normal and late developed (Malina, et al., 2012). Birth dates were categorized in quartiles (Q) (e.g. Q1: Jan. to Mar.; Q4: Oct. to Dec.). In a second step the interrelationship of BA and RA on coaches' ratings of the players' technical skills, game intelligence, personality and speed (TIPS) were analysed.

Results

The SA of soccer players was 13.9 ± 1.1 years, and did not differ significantly from chronological age. Interrelationships of RA and BA showed a large overrepresentation ($OR > 3.00$) of players with high RA and normal or early development. Players with low RA who are late developed showed a large underrepresentation. In the respective maturity categories coaches' ratings of TIPS differed significantly. In particular, late developed players had significantly higher ratings in technique and lower ratings in speed.

Discussion & Conclusion

The study shows that the distribution of biological maturity differs largely in birth quartiles. Players who have low RA (Q4) are mainly early or normal developed. Players of Q4 who are late developed might be deselected in previous selection levels. In addition to physical performance tests (Malina, et al., 2012), ratings of technique seem to be biased by BA. Therefore a better comprehension of the interrelationship of BA and RA in talent selection procedures could hold significant implications for athlete development.

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Motor performance of first-grade school children is affected by relative age and maturity

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Introduction

Competition categories in most youth sports are based on age groups with discrete cut-off dates. This creates age-related advantages for some children, and in turn disadvantages for others. This phenomenon is described as the "relative age effect" (RAE) and is specifically known from high-level sport (Cobley et al. 2009). Maturity has also been described as a crucial factor for athletes' performance (Malina et al. 2000). We investigated whether the time of birth as well as maturity also affect motor performance in first-grade primary school children.

Methods

In a large-scale cross-sectional study, first-grade pupils (6.5 to 7.8 years) of 26 primary schools in the canton Basel-Stadt (Switzerland) underwent anthropometric measures and motor performance tests (20m sprint, jumping sideways, balancing backwards, and 20m shuttle run). We investigated the influence of relative age and maturity (i.e. predicted age at peak height velocity (APHV)) on motor performance. We used multilevel linear mixed effects models accounting for clustering on school level. Statistical analyses were performed using R.

Results

In total, 1,258 girls and 1,304 boys participated in the study. The mean age was 7.2 (SD 0.27) years, body height was 124.1 (SD 5.3) cm, and body mass was 23.8 (SD 3.1) kg. Being one year older resulted in better performance: lower sprint times by -5.9% (95%CI -7.5%, -4.4%) in girls and -7.4% (95%CI -9.2%, -5.5%) in boys, better jumping performance by 14.8% (95%CI 8.7%, 20.8%) in girls and 15.2% (95%CI 8.4%, 21.9%) in boys, better balance performance by 8.1% (95%CI 1.0%, 15.2%) in girls as well as better shuttle run performance by 13.7% (95%CI 5.5%, 22%) in girls and 26.4% (95%CI 16.8%, 36%) in boys. Reaching predicted APHV one year later (i.e. being later maturing) resulted in 5.0% (95%CI 2.6%, 7.3%) worse sprint times in girls and 8.4% (95%CI 5.3%, 11.4%) in boys. In contrast, balance performance was better in these later maturing girls by 25.2% (95%CI 14.7%, 36%) and by 35.6% (95%CI 19.7%, 51.5%) in boys.

Discussion & Conclusion

Our analysis revealed that relatively younger school children (born late after the cut-off date) are systematically disadvantaged regarding different aspects of motor performance. Similar effects have previously been shown in athletes (Gil et al. 2014). This might explain why drop-out rates in sport of relatively younger athletes are higher. In our study, a higher predicted APHV (i.e. being later maturing) affected sprint performance negatively and balance performance positively. Data from young high-level athletes show that biological maturation is positively associated with motor performance (Malina et al. 2000). A better balance performance, however, in later maturing children might be explained by the fact that a smaller body height (i.e. lower centre of mass) is beneficial for balance tasks.

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1.8 Leistungen von und in Sportorganisationen

Topics: social sciences

Keywords: Sportorganisationen, organisationale Leistungen, Sportvereine, Sportverbände, Integrationsleistungen

Leistungen von und in Sportorganisationen

Submitted by: Siegfried Nagel (Universität Bern, Institut für Sportwissenschaft)

Der Sport hat in den vergangenen Jahrzehnten stark an Bedeutung gewonnen und erbringt in vielen Bereichen gesellschaftspolitisch relevante Leistungen, z.B. durch die Förderung der körperlichen Leistungsfähigkeit und Gesundheit, der ganzheitlichen Bildung sowie des sozialen Zusammenhalts. Hierbei spielt der organisierte Sport in der Schweiz mit seinen rund 19000 Vereinen eine wichtige Rolle. Ziel des Symposiums ist es, organisationale Leistungen im Sport aus unterschiedlichen Perspektiven zu beleuchten.

Im ersten Beitrag von Lamprecht, Bürgi & Stamm wird auf der Grundlage aktueller Daten zu Schweizer Sportvereinen ein Überblick zur ihren spezifischen Leistungen (z.B. Sportangebote, Jugendarbeit, Integration, Wertevermittlung) gegeben, die nicht nur für die Vereine selber, sondern auch aus gesellschaftlicher Perspektive von Bedeutung sind.

Der zweite Beitrag von Adler, Nagel & Schlesinger setzt sich spezifisch mit Integrationsleistungen im Vereinssport auseinander und zeigt anhand einer aktuellen Untersuchung, dass Sportvereine einen wichtigen Beitrag zur sozialen Integration, insbesondere auch von Menschen mit Migrationshintergrund leisten können.

Gesellschaftliche Leistungen von Sportorganisationen erfordern organisationale Ziele und Erfolgsgrößen. In ihrem Vortrag stellen Bayle & Clausen konzeptionelle Überlegungen vor, wie in Non-Profit-Organisationen im Sport, vor allem in Verbänden, mit der Frage der Kennzeichnung und Messung von (organisationaler) Leistung umgegangen wird.

Presentations of the Symposium

Die Leistungen der Schweizer Sportvereine

Markus Lamprecht, Rahel Bürgi, Hanspeter Stamm

Observatorium Sport und Bewegung Schweiz Lamprecht & Stamm Sozialforschung und Beratung

In der Schweiz sorgen 19'000 Sportvereine für ein vielfältiges und breites Sportangebot. Das Angebot umfasst über 150 Sportarten auf den unterschiedlichsten Leistungsstufen und erreicht damit einen Viertel der Schweizer Wohnbevölkerung im Alter von 5 bis 75 Jahren. Die Sportvereine sind die Träger des Wettkampfsports und organisieren eine Vielzahl von Sportveranstaltungen. Sie sind aber auch für den Breiten-, Freizeit- und Gesundheitssport verantwortlich. Besonders viel leisten Vereine im Kinder- und Jugendsport. 62 Prozent der 5- bis 14-Jährigen sind Mitglied in einem Sportverein.

Die Leistungen der Sportvereine beschränken sich aber nicht nur auf den Sport. Im Sportverein finden Menschen unabhängig von Alter, Geschlecht, Nationalität oder sozialer Herkunft eine Heimat und treffen sich bei sportlichen und geselligen Anlässen. Sportvereine übernehmen damit Sozialisations- und Integrationsaufgaben und sorgen für den sozialen Kitt in der Gesellschaft.

Der Beitrag gibt nicht nur einen Überblick über die verschiedenen Leistungen, welche die Vereine für den Sport und die Gesellschaft erbringen. Er zeigt auch die Bedingungen, unter welchen diese Leistungen möglich sind, und wo die Vereine an ihre Leistungsgrenzen stossen. Da sind einerseits die 335'000 Ehrenamtlichen, die sich freiwillig und weitgehend unentgeltlich für den Verein engagieren. Ihre Zahl ist in den letzten Jahren noch gestiegen, gestiegen sind aber auch die Schwierigkeiten bei ihrer Rekrutierung. Andererseits sind die Vereine auf die Unterstützung der öffentlichen Hand angewiesen. Insbesondere die Sportanlagen werden in aller Regel von den Gemeinden und Kantonen überaus kostengünstig zur Verfügung gestellt, was für die Vereine unverzichtbar ist.

Der Beitrag analysiert die Leistungen der Schweizer Sportvereine auf der Grundlage der nationalen Verbands- und Vereinsstudie aus dem Jahr 2016. Dazu wurden alle 86 Swiss Olympic angeschlossenen Sportverbände sowie eine repräsentative Stichprobe von 5335 Sportvereinen befragt. Die Studie wurde vom Bundesamt für Sport, von Swiss Olympic und von der Schweizerischen Gemeinnützigen Gesellschaft finanziert. Sie ist Teil des europäischen Forschungsprojekts Social Inclusion and Volunteering in Sports Clubs in Europe (SIVSCE), das von ERASMUS, dem wissenschaftlichen Förderprogramm der Europäischen Union (EU), unterstützt wird.

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Integrationsleistungen in Schweizer Sportvereinen

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Einführung:

Sportvereine spielen innerhalb integrationspolitischer Debatten eine wichtige Rolle, da sie die soziale Integration von Menschen mit Migrationshintergrund (MH) fördern können. Dabei stellt sich jedoch die Frage, inwieweit sich Vereine mit dieser Thematik auseinandersetzen und die vermuteten Integrationsleistungen tatsächlich erbringen. Zur Bearbeitung dieser Problemstellung sollen auf der Grundlage einer Mehrebenen-Heuristik sowohl die Ziele und strukturellen Rahmenbedingungen auf Vereinsebene als auch die wahrgenommene Integration der Mitglieder untersucht werden. Die Analyse der sozialen Integration in Sportvereinen erfolgt dabei entlang der Dimensionen sozialer Integration von Esser (2009).

Methodik:

Basierend auf einem Forschungsdesign, welches Individuums- und Organisationsebene simultan berücksichtigt, wurden mittels schriftlicher Fragebögen 50 Sportvereine und 780 Sportvereinsmitglieder (MAlter= 21.0 Jahre; ♀: 37.7%; Immigrierte: 38.2%) im deutschsprachigen Raum der Schweiz untersucht. Unter den Vereinen der Sportarten Fussball, Basketball, Kampfsport, Turnen, Berg- und Schneesport weist knapp die Hälfte einen Migrantanteil von weniger als 10% und die andere Hälfte zwischen 11-75% auf. Die Vereine variieren in ihrer Vereinsgrösse zwischen weniger als 350 Mitglieder und über 350 Mitglieder sowie in ihrem Gründungsalter (ca. 20 % ≤ 20 Jahre).

Resultate:

Die Sportvereine sich hinsichtlich der Frage der sozialen Integration wie folgt charakterisieren: Für ca. 60% ist «Offenheit gegenüber allen Bevölkerungsgruppen» ein sehr wichtiges Ziel; 48% haben Ehrenamtliche mit MH; Diskriminierung und gravierende Probleme infolge kultureller Vielfalt treten kaum auf. Mehrheitlich existieren keine speziellen Sport- und aussersportlichen Angebote für Immigrierte, interkulturelle Weiterbildungen werden selten besucht, nur in Einzelfällen kooperieren Sportvereine mit J+S oder Schulen.

Insgesamt sind Sportvereinsmitglieder unabhängig vom Migrationsstatus in breitem Umfang relativ gut sozial integriert. Dabei ähneln sich Immigrierte der dritten Einwanderungsgeneration und Einheimische. Gleichwohl weisen Immigrierte der ersten Generation in drei Dimensionen geringere Werte auf als die dritte Generation und Einheimische. Herkunftsspezifische Unterschiede zwischen den immigrierten Mitgliedern lassen sich nicht klar festmachen. Es bestehen sportartspezifische Unterschiede, insofern immigrierte Mitglieder in Turn- und Kampfsportvereinen stärker integriert sind als in Fussballvereinen. Erste Analysen zur Erklärung der Unterschiede deuten darauf hin, dass ein höherer Migrantenanteil, eine aktive Integrationsarbeit sowie in- und externe Kommunikation über Integrationsthemen günstige Strukturmerkmale von Vereinen für die soziale Integration ihrer Mitglieder darstellen. Hingegen scheinen Alter und Grösse der Vereine keinen Einfluss zu haben.

Diskussion:

Diese Studie zeigt, dass der organisierte Sport einen wichtigen Beitrag zur sozialen Integration, insbesondere von jungen Menschen mit MH, leisten kann. Gleichwohl bedarf es integrativer Bemühungen auf Mitglieder- und Vereinsebene. Sowohl Immigrierte ausserhalb West-, Nordeuropas, Nordamerikas als auch solche der ersten Generation werden dabei nicht von allen Sportarten gleichermassen erreicht. Integrationsförderliche Aktivitäten der Vereine erfolgen bisher selten proaktiv. Somit besteht in diversen vereinsstrukturellen Handlungsfeldern weiteres Potenzial, um die soziale Integration von immigrierten Mitgliedern zu erhöhen. In weiterführenden Analysen werden Vereins- und Mitgliederdaten gleichzeitig berücksichtigt.

Referenzen:

Esser, H. (2009). Pluralisierung oder Assimilation? Effekte der multiplen Inklusion auf die Integration von Migranten. *Zeitschrift für Soziologie*, 38, 358–378.

Measuring and managing the performance of sport organisations : challenges for the future

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Sport organisations (e.g. clubs, federations) have increasingly evolved into hybrid organizations (Bayle & Robinson, 2007). This is one of the reasons for performance measurement and management being so difficult to implement and steer. Several questions arise from this situation: what are the theoretical, Methodological and empirical frameworks currently used for performance measurement and management in sport organisations? Which principles and management tools need to be developed in the future to ensure sport organizations' special features are being taken into consideration?

The presentation proposes a state of the art of these questions. How to define and measure performance/(global) success of NSGBs and sport organisations in general? Can governance and management explain the performance of sport organisations? We will try to answer to these questions.

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1.9 Unterrichtsqualität als Bedingung für (Lern-) Leistungen im Sport

Topics: social sciences

Keywords: Lehrevaluation, Lernleistungen, Sportunterricht, Vereinssport

Unterrichtsqualität als Bedingung für (Lern-)Leistungen im Sport

Submitted by: **Sara Seiler** (Bundesamt für Sport, Magglingen)

Das Thema Unterrichtsqualität hat in den vergangenen Jahren stark an Relevanz gewonnen. Diskutiert werden insbesondere die Fragen nach den spezifischen Kriterien sowie Verfahren, um die Qualität von Sport und Sportunterricht zu erfassen. Dabei steht der Zusammenhang zwischen den (Lern-)leistungen der Schüler und Schülerinnen bzw. Sportler und Sportlerinnen mit der Qualität der Lehr-Lernprozesse im Zentrum. Zur Beschreibung der Unterrichtsqualität wird sich zumeist an den in den Bildungswissenschaften gängigen drei Dimensionen Klassenführung, Schülerorientierung und Aktivierung orientiert.

Der Beitrag von Herrmann et al. stellt die Entwicklung und Validierung eines Instruments zur Erfassung der drei Dimensionen vor, welches zur Evaluation der Sportpraxis (hier: Schneesport) eingesetzt wurde.

Im Beitrag von Büchel steht die Frage der Abhängigkeit einzelner Prozessmerkmale aus den Unterrichtsdimensionen mit motivationalen Merkmalen der Lehrpersonen im Zentrum.

Seiler et al. liefern ein Beispiel für Evaluationspraxis im Schweizer Vereinssport. Vorgestellt wird ein Qualitätssicherungskonzept mit externen Beobachtern, welche anhand eines Beobachtungsbogens, der ebenfalls auf den drei Dimensionen der Unterrichtsqualität basiert, den Trainern und Trainerinnen ein Feedback geben.

Presentations of the Symposium

Prozessmerkmale des Sportunterrichts und die Bedeutung fachbezogener motivationaler Orientierungen von Lehrerinnen und Lehrern

Sonja Büchel

PH St. Gallen

Einleitung:

In diesem Beitrag wird von Befunden der Unterrichtsforschung ausgegangen, die zeigen, dass die Qualität des Unterrichts sowie die Lehrperson die zentralen Grössen darstellen, um die Leistung der Lernenden zu beeinflussen (Seidel & Shavelson, 2007). Dabei wird der Wahrnehmung von Unterrichtsprozessen durch die Lernenden in Bezug auf die Förderung der Motivation und den Kompetenzerwerb eine wichtige Bedeutung zugeschrieben (Prenzel et al., 2001). Wie die Qualität der Unterrichtsprozesse im Fach Sport wahrgenommen wird, hängt stark von der Lehrperson und deren Kompetenzen ab (Baumert & Kunter, 2011). So dürften Unterrichtsprozesse auch von motivationalen Orientierungen der Lehrperson abhängig sein, welche explizit als Teil der professionellen Kompetenz betrachtet werden und das Verhalten und Handeln der Lehrperson stark beeinflussen (Schiefele, 2008). Dieser Beitrag geht deshalb der Frage nach, inwieweit Prozessmerkmale des Sportunterrichts von motivationalen Merkmalen der Lehrperson abhängig sind.

Methode:

Die Daten wurden in einem Querschnittsdesign erhoben. Im Rahmen des Projekts „Sportunterricht in der Volksschule“ wurden sportunterrichtende Lehrpersonen der Primar- (N=55; 58% weiblich) und der Sekundarstufe I (N=51; 49% weiblich) sowie deren Schülerinnen und Schüler (N=1912; 58% weiblich) zum Sportunterricht befragt. Die Konstruktvalidität der erfassten Merkmale (Unterrichtsmerkmale und Merkmale der Lehrperson) wurde mittels Faktorenanalyse geprüft. Aufgrund der geschachtelten Datenstruktur wurden Mehrebenenanalysen durchgeführt, um Zusammenhänge zwischen den wahrgenommenen Prozessmerkmalen (Unterrichtsqualität) und Variablen der Lehrperson (motivationale Orientierungen) zu untersuchen.

Ergebnisse:

Die Konstrukte konnten empirisch adäquat erfasst werden. Die internen Konsistenzen der Unterrichtsmerkmale ($.67 \leq \alpha \leq .78$) und jene der motivationalen Orientierungen der Lehrperson ($.60 \leq \alpha \leq .88$) sind durchgängig zufriedenstellend.

Grundsätzlich zeigt sich, dass die Wahrnehmung der Unterrichtsmerkmale von fachbezogenen motivationalen Merkmalen der Lehrperson abhängig ist. Eine differenziertere Betrachtung macht deutlich, dass sich motivationale Voraussetzungen der Lehrperson v.a. in Prozessmerkmalen manifestieren, die gemäss der Theorie (Helmke, 2009) auf eine indirekte Förderung des Lernens bzw. auf die Lernbereitschaft bei Lernenden abzielen (z.B. Unterrichtsklima). Unterrichtsmerkmale, die eher auf die direkte Förderung des Lernens (Informationsverarbeitung) abzielen (z.B. Zielorientierung), zeigen sich hingegen als unabhängig von motivationalen Lehrpersonenmerkmalen.

Diskussion:

Die Ergebnisse lassen die Annahme zu, dass fachbezogene motivationale Orientierungen von Lehrpersonen, vermittelt über wahrgenommene Unterrichtsprozesse, stärker motivational-emotionale Lernprozesse auf Schülerebene beeinflussen und weniger die direkte Informationsverarbeitung (kognitive Lernprozesse) tangieren. Die Annahme wäre weiterführend zu prüfen.

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Evaluation der Unterrichtsqualität im Schneesport

Christian Herrmann, Marina Wältli, Harald Seelig, Uwe Pühse

Universität Basel, Departement für Sport, Bewegung und Gesundheit

Einleitung:

Die Unterrichtsforschung zeigt, dass weniger die Verwendung spezifischer Unterrichtsmethoden die Leistungen der Lernenden beeinflussen, als vielmehr die Qualität des Unterrichts. Dabei ist die Wahrnehmung der Unterrichtsqualität durch die Lernenden besonders bedeutsam für die Lernleistung und Motivation im Unterricht. Die fachübergreifenden Modelle der Unterrichtsqualität wurden auf das Fach Sport angepasst (Herrmann, Seiler & Niederkofler, 2016) sowie die Entwicklung und Validierung eines ökonomisch einsetzbaren Erhebungsinstruments zur Evaluation der Unterrichtsqualität im Schneesport angestrebt. Darüber hinaus wurden Prädiktoren der Unterrichtsqualität auf Ebene der Lehrenden und der Lernenden identifiziert.

Methode:

Das validierte Instrument von Herrmann, Seiler, Pühse und Gerlach (2015) wurde ergänzt, sprachlich vereinfacht und auf den Kontext Schneesport angepasst. Die entwickelten 27 Testitems erfassen neun zentrale Unterrichtsmerkmale (z. B. Verständlichkeit, Zeitnutzung). Es wurde in einer Studie mit $N = 378$ Studierende (59 % männlich; $M = 23.50$ Jahre, $SD = 3.49$) und deren $N = 62$ Lehrenden (75 % männlich; $M = 32.75$ Jahren, $SD = 9.71$) aus zehn Hochschulen im Rahmen universitärer Schneesportkurse erprobt. Mittels Faktorenanalysen wurde die psychometrische Qualität des Testinstruments geprüft. Mittels Mehrebenenanalysen wurde der Zusammenhang der wahrgenommenen Unterrichtsqualität mit Variablen der Lehrenden (z. B. Qualifikation im Schneesport) und Lernenden (z. B. Interesse am Schneesport) untersucht.

Ergebnisse:

Die neunfaktorielle Struktur des Instruments konnte mit einer guten Modellanpassung ($CFI = .97$, $RMSEA = .034$, $SRMR = .046$) bestätigt werden. Die internen Konsistenzen der Unterrichtsmerkmale waren durchgängig zufriedenstellend ($.60 \leq \alpha \leq .92$).

Es zeigte sich, dass das Interesse (z. B. kognitive Aktivierung: $\beta = .25$) und das Könnensniveau (z. B. Zeitnutzung: $\beta = -.22$) der Lernenden in einem differentiellen Zusammenhang mit den Unterrichtsmerkmalen standen. Während die Qualifikation der Lehrenden in einem Zusammenhang mit einzelnen Unterrichtsmerkmalen stand (z. B. Disziplin: $\beta = .25$, Zeitnutzung: $\beta = .33$), bestanden mit der Gruppengrösse nur geringe Zusammenhänge.

Dabei wurde der Schneesportunterricht von den Lehrenden und Lernenden unterschiedlich wahrgenommen. Die Zusammenhänge zwischen der Unterrichtswahrnehmung der Lehrenden mit denen der Lernenden liegen lediglich bei $.01 \leq \beta \leq .39$.

Diskussion:

Mit dem Instrument kann die Unterrichtsqualität über neun Unterrichtsmerkmale differenziert und valide evaluiert werden. Im Vergleich der Unterrichtswahrnehmung durch die Lernenden und Lehrenden steckt besonderes Potential zur Unterrichtsentwicklung.

Literatur:

Herrmann, C., Seiler, S., Pühse, U. & Gerlach, E. (2015). „Wie misst man guten Sportunterricht?“ – Erfassung der Dimensionen von Unterrichtsqualität im Schulfach Sport. *Zeitschrift für Sportpädagogische Forschung*, 3(1), 6–26.

Herrmann, C., Seiler, S. & Niederkofler, B. (2016). „Was ist guter Sportunterricht?“ – Dimensionen der Unterrichtsqualität. *Sportunterricht*, 65(3), 7–12.

Evaluation der Unterrichtsqualität im Vereinssport

Seiler Sara, Rudin Matthias, Steinegger Andreas

Bundesamt für Sport, Magglingen

Einleitung:

Im Rahmen des Sportförderungsprogramm „Jugend und Sport“ (J+S) sind in der Schweiz jährlich 575'000 Kinder und Jugendliche aktiv. Um die Qualität dieser Angebote zu evaluieren werden jährlich 600 Trainings in allen Kantonen von ausgebildeten J+S-Experten und Expertinnen besucht. Zur Realisierung und praktikablen Umsetzung der Trainings-besuche wurde ein Beobachtungsbogen entwickelt. Dieser orientiert sich an Kenntnissen der Erziehungswissenschaft und der pädagogischen Psychologie zu Fragen der Unterrichtsqualität (vgl. Frei, 2016). Der Bogen beinhaltet 20 Items, die sich mit den Qualitätsmerkmalen guten Unterrichts, wie sie u. a. von Helmke (2010) bekannt sind, vergleichen lassen. Sie lassen sich entsprechend der Dreigliederung der Unterrichtsdimensionen zur Beschreibung und Erfassung der Tiefenstruktur des (Sport-)Unterrichts (Herrmann, Seiler & Niederkofler, 2016) zuordnen. Ziel dieses Beitrages ist es, den Beobachtungsbogen und die Umsetzung der Besuche vor Ort als Evaluationsmethode vorzustellen und zu diskutieren.

Methode:

Die Auswahl der zu besuchten J+S-Angebote erfolgt zufällig. Allen Schweizer Kantonen wird ein Kontingent für eine bestimmte Anzahl an Beobachtungen zugewiesen. Die Ausschöpfungsquote belief sich 2016 auf 69.8%. Dies führt zu einer randomisierten Stichprobe, die nur schwer Rückschlüsse auf spezifische Angebotsgruppen (z. B. Kindersport vs. Jugendsport, Freizeitgruppen vs. Leistungsgruppen) ermöglichte. Die Auswertung aller Besuche im vergangenen Jahr erfolgte mittels einer deskriptiven Beschreibung der 557 durchgeführten Beobachtungen. Darin sind Beurteilungen von Angeboten aus 48 verschiedenen Sportarten vertreten. Im Gesamten zeigt sich eine äußerst positive Bewertung der besuchten J+S-Angebote. Dies spricht auf den ersten Blick für eine gute Unterrichtsqualität. Der Mittelwert der siebenstufigen-Skala über alle 20 Kriterien beträgt 6.0 (SD im Mittel = .95) bei einer kleinen Streuung (SD nie >1.34). Allerdings wird die gesamte Skala nur von wenigen Beobachtern ausgenutzt, was zu einer stark links-schiefen Verteilung führt, was wiederum aufgrund der Antinomie der Zielsetzung der Beobachtungsbesuche ausgelöst worden sein könnte.

Ergebnisse:

Aus den freiwilligen Kommentaren zum Besuch geht hervor, dass diese von den Angebotsleitern sehr geschätzt wurden. Der Besuch diente als Supervision von der gerne profitiert wurde. Die erste Zielstellung kann daher als erreicht betrachtet werden.

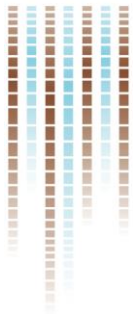
Diskussion:

Inwiefern die Datenqualität für die Optimierung der Aus- und Weiterbildung reicht, bleibt noch offen. Schwierigkeiten stellten sich für die Experten bei der Beobachtbarkeit einzelner Punkte dar, welche nur in seltenen Situationen auftraten. Außerdem deckten sich unterschiedliche Begriffsverständnisse auf, welche die Objektivität der Ergebnisse gefährdeten. Zu diskutieren bleibt, inwiefern Theorien und Methoden der Unterrichtsforschung auf vereinsportliche Settings übertragen werden können respektive ob Vereinsaktivitäten und Sportunterricht dieselben Qualitätsmerkmale verfolgen.

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1.10 Hemoglobin Mass and Endurance Performance in Elite Sport

Topics: natural sciences

Keywords: Hemoglobin mass, Endurance performance, Limiting factor, Adolescence;

Hemoglobin mass and endurance performance in elite sport

Submitted by: **Jon Wehrli** (Swiss Federal Institute of Sport Magglingen, Section for Elite Sport, Switzerland.)

Performance and maximal oxygen uptake (VO_{2max}) in endurance sports is mainly limited by the oxygen supply to active muscle. Since total amount of hemoglobin (Hbmass) determines in large part the oxygen transport capacity of the blood, Hbmass is a main limiting factor for endurance performance. The importance of a high Hbmass in endurance athletes is also shown by the problem of blood doping in elite sport. It is well known, that senior elite endurance athletes are characterized by about 35% higher Hbmass than untrained individuals. From a sport practical point of view, therefore several key-questions arise: 1) Does Hbmass in senior endurance athletes increase with endurance training over years? 2) Does Hbmass increase more in adolescent endurance athletes with a high load of endurance training than in control subjects between age 16 and 18.5 yrs? 3) Does normobaric and hypobaric altitude training in senior athletes evoke similar Hbmass responses and is there a substantial inter-individual variability in Hbmass response? In the three presentations of our session, these key-questions will be answered and an outlook for further investigations in this relevant field for endurance performance will be addressed.

Presentations of the Symposium

Hemoglobin mass does not change over years in Swiss senior male elite endurance athletes

Jon Wehrli, Anna Hauser, Severin Troesch, Thomas Steiner

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Theoretical Background

In aerobic sport disciplines – such as cross-country skiing or mountainbiking - a main important factor determining aerobic performance is the total amount of hemoglobin, hemoglobin mass (Hbmass). Since endurance athletes are characterized by an about 30-40% higher Hbmass than untrained subjects, the question arises if this is due to endurance training over years (yrs) or other factors like genetic predisposition. Very little is known about the Hbmass changes with training over yrs. From cross sectional data from athletes at age 23 and age 28 (2) as well as Hbmass data measured over one training year (1), it can be hypothesized there is no relevant Hbmass increase over yrs (3).

Research Question

Does Hbmass in Swiss national team endurance athletes change with several yrs of endurance training?

Methods

We retrospectively filtered body weight related Hbmass values (CO-rebreathing), measured during standard performance testing of the Swiss national cross-country and mountain bike teams twice a year, with the athlete inclusion criteria: male, age > 23 yrs, minimum measurement duration three years and/or at least six measurements. 22 Athletes fulfilled the criteria and were included in the analyses. The average number of measurements was 10.8 ± 4.5 over a period of 5.1 ± 2.1 yrs. For every athlete mean of the two first and mean of two last measurements were compared and an individual linear model for the development of Hbmass with age was fitted. Individual models were combined to one linear model by averaging all individual slopes and axis sections. All values are mean \pm SD.

Results

There was no difference in mean absolute Hbmass (1058 ± 93 vs 1069 ± 93 g; $p=0.48$) and mean relative Hbmass (14.49 ± 0.88 vs 14.64 ± 0.97 g/kg bodyweight; $p=0.32$) between pre- and post-measurements. The mean linear model was: $\text{Hbmass} = 0.009 \pm 0.12 \cdot \text{age} + 14.3 \pm 3.2$.

Discussion

Our results show, that for elite endurance athletes older than 23 yrs no substantial increase in Hbmass can be expected with sea-level training over the years despite high training loads usually accomplished by these athletes.

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Effect of endurance training on the development of hemoglobin mass in male adolescent endurance athletes

Thomas Steiner, Jon Wehrlin

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It is well known, that adult elite endurance athletes are characterized by about 30-40% higher hemoglobin mass (Hbmass) than untrained subjects (1). However, it is unclear, whether this is due to endurance training, a better genetic predisposition of the athletes combined with a selection process, or other factors (2). Interestingly, Hbmass at age 16 years (yrs) is reported to be not different between endurance athletes and untrained subjects (3).

Research Question

Does Hbmass increase more in adolescent endurance athletes with a high load of endurance training than in control subjects between age 16 and 18.5yrs?

Methods:

We measured Hbmass (CO-rebreathing) in 10 Swiss National Team endurance athletes (AG: cross-country skiers and triathletes) as well as in 12 age matched non endurance training controls (CG) every 0.5 yrs six times from age 16 to age 18.5yrs (T1 - T6) with the optimized carbon monoxide re-breathing technique.

Results

Hbmass increased ($p < 0.001$) in the AG and was 797 ± 96 g (T1), 826 ± 110 g (T2), 852 ± 114 g (T3), 876 ± 120 g (T4), 897 ± 116 g (T5) and 902 ± 123 g (T6) as well as in the CG ($p < 0.001$) from 766 ± 95 g (T1) to 797 ± 90 g, 833 ± 100 g (T3), 845 ± 94 g (T4), 855 ± 95 g (T5) and 868 ± 98 g (T6). There were no differences between the groups in the initial Hbmass level and in the rate of increase per year between the AG ($5.2 \pm 2.1\%$) and the CG ($5.6 \pm 4.7\%$). These rates of increase were highly individually different and ranged between 2.5 and 9.3% in the AG and between 1.2 and 16.9% in the CG. Correlation between increase in Hbmass and increase in body weight was $r = 0.81$ ($p < 0.01$). Body weight related Hbmass increased ($p < 0.05$) during the measurement period from 12.7 ± 1.0 g/kg (T1) to 13.1 ± 1.3 g/kg (T6) in the AG as well as from 12.1 ± 0.9 g/kg (T1) to 12.6 ± 0.7 g/kg (T6) in the CG ($p < 0.05$).

Discussion

Hbmass increases in male adolescents between age 16 to 18.5 yrs. The increase in Hbmass is strongly correlated with the increase in bodyweight, but also body weight related Hbmass slightly increases at this age. The increase rates of Hbmass seem to be highly individually different in athletes as well as in untrained controls, while the amount of endurance training has virtually no influence on the development of Hbmass. Other unknown factors like the individual genetic predisposition may be responsible for these different increase rates among the subjects at this age. An estimation of a male athlete's Hbmass level as a senior seems therefore not possible before the end of growth (before 20 yrs).

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Hemoglobin mass response to normobaric and hypobaric altitude training in senior male athletes

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Theoretical Background

One main physiological adaptation to altitude training is an increase in hemoglobin mass (Hbmass). Recently, a meta-analysis has calculated that an increase in Hbmass of $\sim 1.1\%/100$ h of hypoxic exposure at ≥ 2100 m can be expected (1). During the last decades, several types of altitude training have been developed, which can be performed under either hypobaric hypoxia (HH) or normobaric hypoxia (NH). Whether NH and HH can be used equally for an altitude training camp on Hbmass adaptations is still unclear.

Research Questions

Does normobaric and hypobaric altitude training evoke similar Hbmass responses and is there a substantial inter-individual variability in Hbmass response?

Methods

To compare mean and individual Hbmass responses during an 18-day live high-train low (LHTL) altitude training camp in either NH or HH, we designed a randomized matched controlled (n=28) (2) and a crossover (n=15) (3) study with endurance athletes. To more precisely quantify the individual Hbmass response to altitude training, we implemented error-reducing duplicate Hbmass measures. Furthermore, the hypothesis that athletes with a high initial Hbmass starting an altitude sojourn will have a limited ability to further increase their post-altitude Hbmass in endurance and team-sport athletes (n=58) was tested (4).

Results

Hbmass increased similarly in HH (+4.4% and +4.5%, $p < 0.001$) and in NH (+4.1% and +3.8%, $p < 0.001$) following an 18-day LHTL camp. A wide range of individual Hbmass responses to altitude exposure was observed, i.e., individual responsiveness (individual variation free of technical noise) was $\pm 0.9\%$ in HH and $\pm 1.7\%$ in NH. While there was no relationship ($r = 0.02$, $p = 0.91$) between absolute initial Hbmass (g) and percent absolute Hbmass increase, a moderate relationship ($r = -0.31$, $p = 0.02$) was detected between initial relative Hbmass (g/kg) and percent relative Hbmass increase.

Discussion

The findings indicate that hypobaric and normobaric LHTL camps evoke similar mean Hbmass increases. Among the mean Hbmass change, there was a notable variation in individual Hbmass responses between athletes, indicating the importance of individual evaluation of Hbmass responses to altitude training. Lastly, it was shown that even athletes with higher initial Hbmass can reasonably expect Hbmass gains post-LHTL.

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2 From Science to Practice

2.1 Section for Elite Sport SFISM

Authors: Wehrlin JP, Maier T, Müller B, Steiner T, Horvath S, Birrer D, Bruhin B, Mösching F, Romann M, Lorenzetti S, Mäder U.

Introduction:

During the last decades, scientific support of elite athletes and sport federations has become an important pillar for success at important international competitions. In this workshop, three different presentations show, how scientific research was implemented in the work with elite athletes.

Content

Part I: From mathematical models to informed equipment choices for Olympic cycling athletes
The ratio between a cyclist's power output and the resistance hindering his forward motion determines the resulting speed. To accurately measure power output we developed a novel calibration method (Maier, Schmid, Müller, Steiner, & Wehrlin, 2017) that is now incorporated into our regular services for National Team athletes. Accurate power output measurements allowed us to validate a model of the movement of a cyclist for off-road use and to quantify the rolling resistance of different mountain bike tyres (Maier, Müller, Schmid, Steiner, & Wehrlin, 2018). Based on these results, the later Olympic Champion successfully changed his preferred wheel setup. Currently, we investigate new technologies to lower off-road rolling resistance further.

Part II: Action-orientation after failure in football: How to measure and how to change it
Failures are part of the game. However, some players start ruminating (state-orientation) after failure instead of refocusing on the game and their task at hand (action-orientation). To examine the relevance of action- and state-orientation in the football setting efficiently, we used a simple way to shorten and adapt an existing questionnaire (Horvath & Röthlin, 2017). We validated the new six items tool with different female football samples (Horvath & Birrer, 2018). In contrast to state-orientation, action-orientation was related to positive characteristics, e.g. higher motivation, less negative emotions, more confidence. Based on these findings we developed a program to explain and train action-orientation on the football field.

Part III: The Olympic skicross start 2018 – Direct data and video feedback for olympic athletes
In Skicross (SX) it is crucial to choose the right strategy at the start. More than 80% of all men and women who are in first position at the first gate have been qualified for the next heat (Argüelles, De la Fuente, Tarnas, Dominguez-Castells, 2011). In collaboration with the Sportbiomechanic Group of the Swiss federal institute of Technology Zurich the Swiss Skicross Team developed an instrumented start ramp (ISR) with integrated force measurement handles (to measure force at the gate), time keeping system and two high speed video cameras. Pervious to the Olympic Games 2018 the Swiss Ski cross team reproduced the start ramp of Pyeongchang 2018 in Saas-Fee and instrumented with the ISR. During two days, all athletes could test all different strategies with instantaneous feedback of all measured parameters. Based on those data the athletes could improve their individual start strategy for the Olympic Games 2018.

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2.2 High Performance Management

A.C. Weber, M. Mrkonjic and B. Bosshard, Swiss Federal Institute of Sport Magglingen

High performance management is an emerging and multidisciplinary field of study that combines both a reflection on the factors that influence sporting success on the international competition scene and the factors that impact on the development of sport policies (Sotiriadou & De Bosscher, 2017). It investigates manageable meso- and micro- determinants reflecting the prevailing socio-economic conditions within a country, for example, the level of development of (national) sports organisations or athlete's training and performance environment. It assumes, in particular, that nations that aim to perform and increase their sporting success at international level have to manage their elite sport system in a rational and strategic manner, especially through targeted funding (Weber, De Bosscher & Kempf, 2017). This has led, for instance, to a prioritization of the most efficient sports (in terms of return on investment in medal wins) or the nationally most important, traditional sports.

In Switzerland, the promotion and development of high performance sport by the federal government is relatively recent. Although the honourable representation of the country in international competitions is highlighted in the 1960s (Chappelet & Mrkonjic, 2011), it is only throughout the last two decades that this topic has become one of its policy priority in the field of sport. This has been formalized in the Federal Act on the Promotion of Sport and Exercise (2011), in the "Concept of the Confederation on elite sport" (2013) and in the related "Action plan of the Confederation on the promotion of sport" (2016). From there, the country has seen a proliferation of policy decisions and actions that have been able to manage the sports system in a high performance perspective and where research (e.g. Kempf *et al.*, 2014) has been able to give substantial support (Confédération suisse, 2013). Building on this context, this session aims to present and discuss key research-driven policy initiatives in Switzerland with a specific focus on financing, ethics and infrastructures.

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2.3 Applied Sport Science

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Sportarten sind klassische Anwendungsfelder sportwissenschaftlicher Forschung und der Erwerb von Wissen und Fertigkeiten in verschiedenen Sportarten ist fester Bestandteil eines sportwissenschaftlichen Studiums in der Schweiz. Solche Lehrveranstaltungen werden oft als Praxisveranstaltungen ausgewiesen und je nach Hochschule in unterschiedlicher Weise mit sogenannten Theorieveranstaltungen verknüpft. Auch an der diesjährigen Jahrestagung der Schweizerischen Gesellschaft für Sportwissenschaft (SGS) richteten sich einige Workshops direkt an „Praxisdozierende“. In diesem Arbeitskreis soll die Frage diskutiert werden, ob diese Trennung in Praxisdozierende und Theoriedozierende überhaupt sinnvoll ist? Am Beispiel des Dozentenverbands Geräteturnen und Akrosport der Schweizer Hochschulen (GAS) wird aufgezeigt, dass sich Dozierende in den Anwendungsfeldern der Sportwissenschaft bisher eher ausserhalb der SGS über ihre Anliegen und Kenntnisse im Vermitteln und Erforschen ihrer Sportart austauschen. Der Arbeitskreis lädt ein, diese Tatsache kritisch zu debattieren und stellt sich der Frage, ob und allenfalls wie die SGS auch für solche Dozierende eine produktive (Austausch-)Plattform bieten kann oder soll.

3 Oral Session

3.1 Overload & Injury Prevention

Topics: natural sciences

Keywords: Overreach athletes fatigue baroreflex HRV

Overload blunts baroreflex and parasympathetic activity only in overreached athletes

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Background: Baroreflex is a vital mechanism regulating arterial blood pressure (ABP), it is considered an indicator of cardiovascular health. Baroreflex sensitivity (BRS) is a quantification of the speed of ABP corrections by automatically increasing or decreasing heart rate (HR) through an arc reflex. The fastest the corrections, the more sensitive BRS and the better the cardiovascular health and vice-versa.

Objective: Changes in training load modify BRS. Thus, BRS assessment may allow the detection of overreaching. Heart rate variability (HRV) is commonly used to diagnose overreaching and monitor athletes' responses to training. The goal of this study was to assess BRS and HRV changes, in two groups of athletes responding either negatively (functional overreaching, FOR) or positively (acute fatigue, AF) to similar training overload.

Design: Fifteen athletes performed 2-wk baseline (BSL) training followed by 3-wk overload (+45%; OVL) and 2-wk recovery (-20%; RCV).

Methods: HRV, training load and subjective fatigue according to questionnaires were measured daily. HRV was assessed using an orthostatic test, calculating the root mean square of successive RR differences (RMSSD), power in the low-frequency (LF, 0.04 – 0.15 Hz) and high-frequency (HF, 0.15 – 0.4 Hz) bands. BRS, submaximal exercise (3 times 5 min run at 80% of maximal heartrate) and maximal 3-km run performances were measured at the end of each period. BRS was assessed using the "sequence Method" (gold standard) providing a direct interpretation of the causal link between blood pressure and heart rate.

Results: Based on their performance change during OVL, 8 athletes were diagnosed as FOR (2.1 ± 0.7% performance decrease) and 7 as AF (4.2 ± 1.3% performance increase). Submaximal performance did not significantly change in OVL while it increased in AF (7.4 ± 2.4%) Subjective fatigue was increased in FOR athletes during OVL. BRS and parasympathetic activity increased in AF but not in FOR athletes during RCV. Specifically, RMSSD, HF and BRS were higher in the AF group compared to the FOR group (all $p < 0.05$). But those differences were significant during recovery only.

Conclusion: Three weeks of similar training overload can induce either performance enhancement or overreaching. The changes in submaximal exercise and maximal performances and in subjective fatigue were the fastest-responding parameters that distinguished the two groups of athletes during OVL. Training overload blunted the increase in BRS and in parasympathetic activity in FOR only. Most of the differences in BRS were observed during the recovery period. However, BRS does not appear to be more sensitive parameter than HRV for early monitoring of responses to training.

Topics: natural sciences

Keywords: Long-distance running, magnetic resonance imaging, overuse injury, lower extremity muscles

Overuse injury detection by magnetic resonance imaging (MRI) of the lower extremity muscles during the Trans European Footrace

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Background: Overuse injury is a growing problem in today's athletic sports (1). Most of these injuries are severe and can cause a long period of absence from normal training (2). However, effective preventive assessment techniques concerning elite athletes are still missing. Magnetic Resonance Imaging (MRI) is an excellent method to diagnose changes, pathologies and injuries of the skeletal muscle mass and can precisely assess the volume of single muscles and/or functional muscle groups (3). Therefore, MRI might be a key component in the preventive assessment to find vulnerable elite athletes before injury occurs.

Aim: The development of a reliable method to assess the changes in muscle volume as well as structural intramuscular changes using MRI. Can we differentiate between subclinical muscle edema, muscle hypertrophy and muscle hypotrophy in ultra-endurance athletics?

Methods: 22 ultra-endurance athletes with a mean (standard deviation) age of 50.3 (9.6) years received a MRI-scan on up to six time points during the 2009 Trans European Footrace, a transcontinental, multistage ultramarathon covering 4'486 km on 64 consecutive days. T1-weighted MRI sequences as well as diffusion-weighted MR sequences were obtained on a portable 1.5 Tesla MRI unit (Magnetom Avanto™ mobile MRI) which was mounted on a mobile 45to MRI-trailer. We performed manual muscle segmentation of functional muscle groups of the lower extremity and quantified their volume on the T1-weighted images using the software ITK-Snap (Version 3.4.0, 1998-2016) (4). Subsequently, we matched the MR-Volumetry of the T1w-images with water sensitive diffusion-weighted imaging sequences and calculated the values of the apparent diffusion coefficient (ADC). ADC-maps were used to quantify intra- and extracellular water diffusion and content.

Results: Preliminary data of eight runners show a decrease of muscle volume of all muscle groups during the TEF. Water diffusion and water content increased significantly across all muscle groups. Muscle volume was negatively correlated with changes in ADC-values.

Discussion: Our study shows different signs of overuse injury in athletes participating in the TEF by means of MRI. The analysis method presented is easy to use and able to detect changes in muscle volume and subclinical muscle edema in MR-images. Muscle volume together with ADC-values might be an early and sensitive indicator of subclinical muscle damage and can possibly help prevent overuse injuries in elite athletes.

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Topics: natural sciences

Keywords: Compliance, Injury, Prevention, Football, Children

The Moderating Effect of Compliance on the Efficacy of the Injury Prevention Program 11+ Kids

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Background: Physical inactivity has arisen as one of the major challenges of today's society and its prevention has received increasing attention. It is now considered important to motivate people to live an active life starting in childhood. Football (soccer) is one of the most widespread sports among youth (Lamprecht et al., 2014). Unfortunately, it entails a considerable risk of injury to the musculoskeletal system, especially to the lower extremities. Injuries could present a stumbling block for lifetime engagement in physical activity. Therefore, prevention of injuries is at the center of research focus (Faude et al., 2013). Injury prevention programs have been developed to tackle the issue (Rössler et al, 2017). Compliance to these programs is a corner stone to their efficacy, but this has so far not been investigated in children.

Aim: This study aims to quantify the compliance's influence on the efficacy of the injury prevention program "11+ Kids" among players aged 7 to 12 years.

Method: As part of a cluster-randomized controlled trial injury incidences were compared between the participants of the intervention group with low (LC), medium (MC) and high compliance (HC) as well as to the control group (CON) utilizing hazard ratios. Participants of the intervention group (IG) performed "11+ Kids" as warm-up whereas the control teams (CG) followed their regular training regime. It was also quantified how many injuries could potentially be prevented by additional trainings per month. Coaches and staff entered exposure times and injuries into an online-tool. Anthropometric data was gathered from the parents by questionnaire.

Results: Data were obtained from 3895 participants (IG: 2066; CG:1829) with a mean age of 10.8 (SD: 1.4) years. The HC group had 50% fewer injuries compared to LC and 54% less injuries compared to CON, but no significant difference was found compared to the MC group. The MC group sustained 38% fewer injuries compared with CON but not significantly less than LC. No difference was observed between LC and CON. Additional session of "11+ Kids" were associated with a significantly reduced injury incidence.

Conclusion: The compliance to the injury prevention program "11+ Kids" plays an important role for the efficacy of the program. Frequent use of the program seems advisable to maximize its efficacy. Based on the findings of this study, it is suggested that the program is used at least four times per month.

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3.2 Perception in Team Sports

Topics: social sciences

Keywords: decision making, pass, soccer, team sports, environment

Estimating effects of perceptual information and associative knowledge on passing decisions in real-world and scenario conditions

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Introduction

Findings from scenario-based investigations indicate that athletes use perceptual information of the current game situation and associative knowledge about their team members to decide where to play the ball (Steiner, submitted). Open passing lanes, loose defense by opposing players, spatial proximity to the ball carrier and positions in front of the ball carrier are perceptual information that increase team member's odds ratio (OR) to receive passes. Associative knowledge about a team member's high soccer-related skills additionally increases the OR for passes to this team member. While the effects of the perceptual information have been replicated with real game data, it is yet untested whether the effect of associative knowledge generalizes to real world passes. The aim of this study is to estimate the relative effects of athletes' associative knowledge about their team members on passing decisions in real world competitions and game scenarios.

Methods

Twenty-eight male athletes ($M = 24.13$ years, $SD = 4.91$) playing in the 1. League of the Swiss Football Federation (SFV) participated in the study. 170 passes were analyzed. All passing situations were graphically illustrated. Athletes looked at the graphic scenarios and stated to what team member they would pass the ball. They then rated their team members on the SFV's four TIPS items (technique, game intelligence, personality, quickness). The items served as indicator items for a latent variable representing the athletes' associative knowledge about their team members. Variables about the openness of passing lanes to team members, their defensive coverage by opposing players, their spatial proximity to the ball carrier and their position to the ball carrier (in front vs. behind him) were computed. Binary logistic regressions were run to estimate the effects of the perceptual information and the associative knowledge on passing decisions in real and scenario conditions.

Results

Associative knowledge showed significant effects on passing decisions in real and scenario conditions ($OR = 1.95$; $OR = 1.84$, both p 's $< .05$). Pseudo R^2 measures were low for both models ($NK = 0.009$ and 0.007). When the variables representing perceptual information about the current game situation were introduced in the regression model, the effects of the associative knowledge disappeared. In the real condition, open passing lanes, spatial proximity and positions in front of the ball carrier significantly related to passing decisions ($OR_{palane} = 1.83$, $p < .05$; $OR_{sprox} = 0.07$, $p < .001$; $OR_{pos} = 3.34$; $p < .001$; $NK = 0.164$). In the scenario condition, all variables representing perceptual information had significant effects on passing decisions ($OR_{palane} = 4.79$, $p < .001$; $OR_{sprox} = 0.19$, $p < .001$; $OR_{pos} = 3.87$; $p < .001$; $OR_{decov} = 1.22$, $p < .05$; $NK = 0.171$).

Discussion/Conclusion

Passing decisions seem to depend more on perceptual information about the current positioning of the team members than on the athletes' associative knowledge about their team members, both in real game situations and in corresponding game scenarios.

Reference

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Topics: natural sciences

Keywords: team sports, soccer, decision-making, covert attention, interview

Testing the functionality of peripheral vision in a mixed-Methods football field study

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Introduction

In football, experts are expected to make better use of peripheral vision to simultaneously monitor a number of players (Davids, 1984, Williams & Davids, 1998). However, there is no study so far, in which the relevance of peripheral vision was investigated in complex football game situations. Consequently, a mixed-methods field study in football with 3 vs. 3 football situations that demand processing peripheral information was created and football players with different levels of expertise were tested in terms of decision-making and interviewed about their perceptual strategies.

Methods

By use of a mixed- methods approach, 10 high-skilled and 10 low-skilled players were tested in 32 different game play scenarios. The participants played the position of the central defender in 3 vs. 3 situations and were instructed to prevent the attacking team from scoring a goal. Peripheral-processing demands were manipulated, for example, in 1 vs. 1 or give and go situations with relevant events off the ball where the run of another attacker must be detected for correct decisions. In order to measure the participant's use of peripheral information, the participants were equipped with a GoPro head camera that allowed analysing the number of players in their field of view 0.5s before the manipulated event. An additional scene camera, which was located at 3.5m height behind the goal, was used to examine the percentage of correct action responses. In addition, after every second situation interviews were conducted to assess underlying perceptual strategies. As dependent variables, response accuracies and the number of players in the field of view were analysed with independent t-tests.

Results

High-skilled players outperformed the low-skilled players in decision-making with 83.5 % (SD = 13.88) correct responses compared to 55.5 % (SD = 7.21) correct responses, $t(1,18) = 5.66$, $p < .01$, $d = 2.53$. For the number of players in the field of view, no significant differences were found between the two skill groups, $t(1,18) = 0.78$, $p = .44$, $d = 0.38$.

Discussion

The results show, that high-skilled players outperform low-skilled players in game situations that require the use of peripheral vision. However, since groups did not differ concerning the number of players in their visual field, these differences might be explained by attention rather than gaze differences. The analyses of the interviews revealed that this process might be supported by optimal positioning as evidenced by statements like "I tried to have all relevant players in my visual field" or "I positioned myself in a way that allowed me to perceive actions of other players". In future research, eye-tracking will be used to directly examine the location of gaze and to analyse the dynamics of information processing.

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Topics: natural sciences

Keywords: gaze behavior, motor learning, quiet eye, task-solution space, inhibition hypothesis

Why longer is better: Investigating the "efficiency paradox" of the Quiet Eye phenomenon.

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It has been consistently reported that experts show longer quiet eye (QE) durations than near-experts and novices (Vickers, 2007). However, this finding is rather paradoxical as motor expertise is characterized by an economization of motor-control processes than by a prolongation in response programming, a suggested explanatory mechanism of the QE phenomenon (Mann et al., 2016). Therefore, an alternative explanation suggesting an inhibition of non-optimal task solutions over movement parametrization was proposed (Klostermann, 2014). According to this inhibition hypothesis, the longer QE is explained by experts' great extent and high density of experienced task-solution space. In the current study we tested the extent prediction of the inhibition hypothesis by comparing the QE-duration gains in groups that trained a far-aiming task with a small number (low-extent) vs. a large number (high-extent) of task variants. It was expected to find longer QE-durations in posttest and retention test for the high-extent group.

Methods

Forty sport science students learned an underhand-throwing task in which retro-reflective balls were thrown at virtual target disks presented at a life-sized screen. Overall, eight intervention sessions with in total 768 training trials were conducted. The participants were tested in pretest, posttest, and retention test (32 test trials each). Throwing performance (radial error, mm) and QE-duration (defined as the final fixation at the target before movement initiation, ms) were assessed with a motion capture system (Vicon T20, 200 Hz) and an integrated eye-tracker (EyeSeeCam, 220 Hz). The dependent variables were analyzed with a 2 (intervention group) x 3 (time of measurement) ANOVA with repeated measures on the last factor and paired-samples t-tests.

Results and Discussion

Both groups showed superior throwing performance in posttest and retention test compared to pretest, $F(1.37, 36.95) = 29.45, p < .05, \eta^2 = 0.52$, and longer QE-durations in posttest compared to pretest. However, QE-durations dropped to baseline values at retention (all p s $< .05$, all d s > 0.58). Finally, the expected additional gain in QE-duration for the high-extent group was not found and thus, the assumption of long QE-durations due to an extended task-solution space was not confirmed. The findings were (by tendency) more in line with the density explanation of the inhibition hypothesis because the low-extent group showed slightly longer QE-duration in posttest and retention test when compared to the high-extent group. This density argument suits research revealing a high specificity of motor skills in experts (Keetch et al., 2008) thus providing options for future research on the paradoxical relation between the QE and motor expertise.

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3.3 Exercise is Medicine I

Topics: natural sciences

Keywords: high-intensity interval training, running, cycling, oxygen uptake

Varying load-distribution during high-intensity interval training (HIIT) in cycling and running: effects on cardiorespiratory parameters.

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Background: A popular HIIT session to improve cardiorespiratory fitness of already well-trained individuals is the so-called 4x4, consisting of four 4-min bouts at near-maximal intensity interspersed by 3 min of active recovery. As the magnitude of training-related adaptations are believed to depend on the relative intensity of exercise and thus the associated level of physiological responses, manipulating the session in order to elicit higher physiological perturbations at the same exercise intensity could therefore optimize the training stimulus. Therefore, this study aimed to test whether the cardiorespiratory strain of a traditional session of HIIT (4x4-TRA) compared with a session of similar duration and average load, but with decreasing power within each intense bout (4x4-DEC; known to elicit higher oxygen uptake [VO₂][1]) was similarly different between protocols in cyclists and runners.

Methods: 12 cyclists (1 female, age 28±4 years, VO₂max 62.5±6.4 ml.kg⁻¹.min⁻¹) and 13 runners (4 females, age 30±4 years, VO₂max 56.7±3.9 ml.kg⁻¹.min⁻¹) performed – following familiarization sessions – a 4x4-TRA and 4x4-DEC session in randomized order, while Oxygen consumption, CO₂-production, and heart rate were monitored. PO was set at 85% of peak PO of an incremental test and was constant during 4x4-TRA whereas it started at 40 W (2 km/h) higher than average and finished at 40 W (2 km/h) lower than average within each bout of the 4x4-DEC session. Duration of the initial stage of 4x4-DEC was 60 s, subsequent stages 30 s. The average load was adjusted during familiarization to ensure it was the highest tolerated.

Results: Average VO₂ during the four bouts, expressed as a percentage of VO₂max, was higher in 4x4-DEC compared with 4x4-TRA in cycling (88.4±4.0% vs. 86.0±5.0%, p=0.006) but not in running (90.3±4.2% vs. 90.1±3.9%, p=0.71). The ratio of average VO₂ for 4x4-DEC over 4x4-TRA was significantly higher for cycling (1.03±0.03 vs. 1.00±0.03 for running, p=0.04). Average heart rate during the four bouts was higher during 4x4-DEC compared with 4x4-TRA for both cycling and running (4.4±2.5 and 2.0±3.1 beats.min⁻¹, both p<0.05), and a similar response was seen for pulmonary ventilation (8.4±8.2 and 4.9±3.3 L.min⁻¹ higher for 4x4-DEC vs. 4x4-TRA for cycling and running respectively, both p<0.01) and average blood lactate concentration (0.7±0.8 and 0.7±1.0 mmol.L⁻¹ higher for 4x4-DEC vs. 4x4-TRA for cycling and running respectively, both p<0.05). No differences were noted for perception of leg and respiratory effort while perception of breathlessness was significantly higher in cycling during 4x4-DEC in compared with 4x4-TRA (2.5±2.6 vs 1.9±2.3 points [0-10 VAS scale], p<0.05).

Conclusion: Higher levels of physiological perturbations were achieved during 4x4-DEC sessions in both cycling and running, however, these differences were more prominent in cycling, thus making it a more attractive modality for a future training intervention.

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Topics: natural sciences

Keywords: stiffness, elastic energy, recovery, external work

Effect of the elastic energy and pendular recoveries on the energy cost of walking in obese adults

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Theoretical Background: Recent studies have reported a higher net energy cost of walking (NetCw) in obese compared to lean individuals when is expressed per kilogram of body mass (1). However, the metabolic cost of the biomechanical factors involved in this extra cost of walking should have end in a higher metabolic rate than the observed 10% (2). Some authors have hypothesized that this may be due to an improvement in the pendular transduction of kinetic energy into potential energy and viceversa (recovery), as it was shown in African women (3). However, this increase was not found in obese adults (4). Therefore, compared to lean, obese individuals may optimize the storage and release of elastic energy during walking [assessed by vertical stiffness (5)] to minimize the increase in energy cost of walking.

Purpose: The aim of this study was to investigate and compare the energy-saving mechanisms in walking (i.e., recovery and vertical stiffness) and their influence on the energy cost of walking in obese versus lean individuals.

Methods: Net energy cost of walking (NetCw), spatiotemporal parameters, external work (Wext), net locomotor efficiency, mechanical energy saved via pendulum (Recovery), vertical stiffness (Kvert) and elastic potential energy (EE) were computed for thirteen lean (L; 29.0±5.8 yr; BMI: 21.9±1.5 kg.m⁻²) and thirteen obese subjects (O; 32.7±7.9 yr; BMI: 33.8±2.5 kg.m⁻²), matched for age and height, during walking at five speeds (0.56, 0.83, 1.11, 1.39, 1.67 m.s⁻¹). The body weight shift (gWT) and the difference between the maximal ground reaction force of the front and back leg (Deltamax) were calculated via individual limb **Method**.

Results: No significant difference was found between groups in relative (per kg of body mass) NetCw (P=0.13). Relative Wext+ was higher in L than in O (P=0.03) with a significant difference at 1.11, 1.39 and 1.67 m.s⁻¹ (P≤0.003). Similar Recovery was found between groups (P=0.35), but significantly higher values in O than in L at 1.39 and 1.67 m.s⁻¹ (P≤0.01) were obtained. No differences were found between groups in relative Kvert (P=0.11) and EE (P=0.41). Net locomotor efficiency was significantly higher in L than in O (P=0.02) with a significant difference found at 1.11, 1.39 and 1.67 m.s⁻¹ (P≤0.03).

Conclusion: These results reveal that obese adults may rely more on the pendular mechanism, rather than on the storage and release of elastic energy, to decrease the amount of Wext+ and, therefore, limiting the increase in the metabolic cost of walking in these individuals.

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Topics: natural sciences

Keywords: Neuropathy, exercise, physical activity, symptom reduction, oncology

Balance training and whole-body vibration have the potential to reduce relevant symptoms of Chemotherapy-induced peripheral neuropathy – a randomized controlled trial

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Background

Chemotherapy-induced peripheral neuropathy (CIPN) is a highly prevalent and clinically relevant side-effect of chemotherapy. The symptoms severely diminish patients' quality of life and are a decisive limiting factor for medical therapy, consequently affecting the clinical outcome. To date, evidenz for effective treatment options is lacking. Recent results have shown that specific exercise interventions have an underestimated potential and could be very promising to target relevant symptoms.

Patients and Methods

We conducted a prospective, four-armed, randomized, controlled trial, to evaluate the effects of sensorimotor- (SMT) and whole-body vibration training (WBV) on patients with a neurologically confirmed CIPN. Participants N=40 (N=30 patients and N=10 healthy controls) were randomized into one of the intervention groups or a control group and matched by gender and age with a healthy control. The intervention groups participated in the supervised exercise regime twice a week for six weeks. Primary endpoint was the reduction of CIPN related symptoms (peripheral deep sensitivity, Achilles- (ASR) and Patellar tendon reflex (PSR), proprioception, sense of position and lower leg strength). Secondary endpoints were nerve conduction velocity and amplitude, balance control, quality of life and CIPN-related pain.

Results

Patients exercising, experienced improvements in sensory and motor symptoms of CIPN. Significant intergroup differences were found for the tendon reflexes (ASR $P=.017$ and PSR $P=.020$), peripheral deep sensitivity ($P=.010$) and pain ($P=.043$). Furthermore, tendencies were found regarding the subjective improvement of symptoms ($P=.075$) and two subscales of the EORTC-QLQ-C30 questionnaire: Pain ($P=.054$) and dyspnea ($P=.054$). The **Results** for the SMT group were superior over WBV regarding the tendon reflexes, and a tendency regarding the subjective report of symptoms, while WBV was superior concerning pain.

Conclusion

SMT and WBV behold a large potential of high clinical relevance, to reduce CIPN-related symptoms and can be considered feasible and safe for patients with CIPN (compliance 97,5%, no Adverse events).

3.4 Sport Management

Topics: social sciences

Keywords: Rechtsform, Sportorganisationen, professionalisiertes Management, Clusteranalyse

Vom Sportverein zur Aktiengesellschaft: Ist die Rechtsform massgeblich für professionalisiertes Management?

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Einleitung

Obwohl in einigen Sportarten Nonprofit Organisationen (NPOs) und Forprofit Organisationen (FPOs) miteinander konkurrieren (z.B. Tennis, Schneesport), wurden bisher lediglich die Leistungen von NPOs und FPOs miteinander verglichen, nicht aber deren Managementstrukturen (Nowy, Wicker, Feiler, & Breuer, 2015). Es wird angenommen, dass NPOs, die in Konkurrenz mit FPOs stehen, sich vermehrt dienstleistungsorientiert aufstellen müssen, was wiederum die Anforderungen an das Management erhöht (Maier, Meyer, & Steinbereithner, 2016). Dabei stellt sich die Frage, ob und wie sehr sich Management-Praktiken zwischen NPOs und FPOs unterscheiden.

Schweizer Skischulen (SSS) zeichnen sich durch eine Vielfalt an verschiedenen Rechtsformen aus, vom Verein bis zur Aktiengesellschaft. Daher eignen sie sich gut für einen Vergleich unterschiedlicher Rechtsformen und professionalisiertem Management. Professionalisiertes Management beinhaltet dabei das Einstellen von bezahlten Mitarbeitern, strategisches Management und das Verwenden von formalisierten Management-Instrumenten und -Dokumenten. Das Ziel der Studie ist es, Management-Praktiken zwischen verschiedenen Rechtsformen zu vergleichen und deren Einfluss auf die Leistung der jeweiligen Skischule zu untersuchen.

Methode

Die Daten wurden mittels einer Online-Befragung erhoben, welche durch den Dachverband Swiss Snowsports an alle 151 SSS versendet wurde. Die Stichprobe besteht aus 71 SSS (47%); davon sind 26 Sportvereine, 13 Genossenschaften, sieben Einzelunternehmungen, 11 Gesellschaften mit beschränkter Haftung (GmbHs), 11 Aktiengesellschaften (AGs) und drei andere Rechtsformen. Die SSS wurden mittels hierarchischer Clusteranalyse gruppiert, um sogenannte Management-Typen zu identifizieren. Dabei wurde das strategische Management, Formalisierung von Instrumenten und Dokumenten sowie bezahltes Personal analysiert. In einem nächsten Schritt wurde die Verteilung der Rechtsformen auf die Management-Typen untersucht und zuletzt spezifische Leistungsmerkmale verglichen (z.B. Umsatz, Zielerreichung).

Ergebnisse und Diskussion

Die Analyse ergab vier Management-Typen. Der erste Typ zeichnet sich durch einen hohen Anteil ehrenamtlicher Mitarbeiter aus, wobei das strategische Management und die Formalisierung durchschnittlich ausfallen. Der zweite Typ enthält SSS mit vielen bezahlten Mitarbeitern in der Geschäftsleitung und überdurchschnittlicher Formalisierung. Der dritte Typ zeigt überdurchschnittliche Werte im strategischen Management und hinsichtlich Formalisierung, trotz einer geringen Anzahl bezahlter Mitarbeiter in der Geschäftsleitung. Der vierte Typ zeigt durchwegs wenig professionalisiertes Management.

Der erste Typ mit einem hohen Anteil ehrenamtlicher Mitarbeiter besteht hauptsächlich aus Sportvereinen, während der dritte Typ mit stark professionalisiertem strategischen Management und hoher Formalisierung fast alle AGs enthält. Abgesehen von dieser Auffälligkeit sind

die Unterschiede zwischen den Rechtsformen eher gering. Bemerkenswerterweise sind viele Sportvereine (NPOs) offensichtlich in der Lage, ihre Organisation ähnlich professionell zu führen wie die FPOs. Hinsichtlich der Leistungsmerkmale unterscheiden sich die vier Typen hauptsächlich in der Zufriedenheit mit der Zielerreichung, dem Preis der Unterrichtslektionen und dem Umsatz. Die Sportvereine schneiden dabei nicht schlechter ab als die FPOs. In diesem Zusammenhang scheint die Rechtsform hinsichtlich professionalisiertem Management weniger entscheidend zu sein, als bisher angenommen wurde.

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Topics: social sciences

Keywords: Political Governance, Switzerland, International Sport Organisations

The political governance of international sport organisations in Switzerland

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Introduction

An emerging body of literature investigates the relations between public authorities and sport organisations under a political governance or “governance as steering” approach (see, for example, Garcia, 2011 or Gowthorp, Toohey, and Skinner, 2016). It puts emphasis on policy decisions and actions (e.g. moral pressure, financial incentives, dialogue) that seek to steer (rather than control) the behaviour and operations of sport organisations in order to achieve a range of socially desirable outcomes. This contribution aims to analyse the relations between the Swiss public authorities and international sport organisations (ISOs).

Methods

Building on literature on sport governance and policy, this contribution proposes a model that illustrates the decisions made and actions taken in the country to host ISOs on its territory. It offers a qualitative analysis of policy documents (e.g., laws, regulations, decisions) published by public authorities.

Results

Based on the subsidiarity principle, the role of the three political levels of Swiss federalism is to steer the sport system (Chappelet & Mrkonjic, 2011; Bayle 2017). Public authorities create the best conditions for the Swiss sport system to perform. ISOs are embedded in this system. Like national sport governing bodies, they are historically incorporated as associations and benefit from a flexible legal framework and attractive tax regime. From the mid-1980s and building on existing attractive geographical, economic and political conditions, the country has put in place a number of targeted actions that seek to steer the decision of ISOs to incorporate or remain in Switzerland with the belief that their presence would have a sporting (sport participation) and/or a non-sporting impact such as economic development or nation branding.

Discussion

Switzerland managed to attract and maintain a constellation of ISOs on its territory. It is explained in part by independent factors and the implementation of a balanced and targeted “policy mix” at horizontal and vertical levels. The quality of the model is discussed, namely in the light of the relations between public authorities and national sport governing bodies.

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Topics: social sciences

Keywords: Sportinnovation, Innovationstreiber, Sportmanagement

Innovationstreiber im Sport: sechs Fallbeispiele

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Einleitung

Die Ausarbeitung des Vorsprungs im Sport wird durch Ausreizung der Produkte, Prozesse, Dienstleistungen und Athleten immer wie schwieriger (Müller, 2008). Diversen Studien zufolge liegt die allgemeine Misserfolgsquote bei Innovationen bei bis zu 80% (Vahs & Brem, 2015). Zum Thema Management von Sportinnovationen gibt es wenige wissenschaftliche Untersuchungen (Ratten, 2016). In unserer Studie werden Akteure, die den Innovationsprozess positiv oder negativ beeinflussen, Innovationstreiber genannt, untersucht. Basierend auf Müller (2008) werden diese unterteilt in Athleten und Trainer, Produzenten/Hersteller, Lieferanten/Importeure, Öffentlichkeit (beispielsweise Austragungsorte, Forschungsinstitute, Experten) und Regulation (wie internationale und nationale Sportverbände, Politik). Folgende **Fragestellungen** werden mit sechs Fallbeispielen aus dem Kunstturnen (Sprungtisch und Boden), Tennis (Tennisschläger und Tennissaite) und Mountainbike (29-Zoll-Rad und Enduro) geprüft: Welche Akteure beeinflussen die Innovation in positiver oder negativer Weise? Ist das Verhalten der Akteure von der Marktattraktivität abhängig?

Methode

Ein Überblick über die Thematik wurde mittels Dokumentenanalysen im Bereich Innovationsentwicklungen in den einzelnen Sportarten geschaffen. Je nach Fallbeispiel fanden qualitative Interviews oder eine Datenerhebung mittels Fragebogen statt. Dabei wurden Athleten und Trainer, Produzenten, Öffentlichkeit (Austragungsorte, Forschungsinstitute, Experten) und Regulation (internationale und nationale Verbände) befragt. Ein Raster wurde verwendet, um die Fallbeispiele zu vergleichen. Dabei wurden die Auslöser, die Akteure und die Innovationstreiber betrachtet. Zudem wurde die Marktattraktivität, unterteilt in Anzahl J+S-Sportler, Publikumsinteresse, Breitensportmarkt und Umsatzstärke in der Schweiz, miteinbezogen.

Ergebnisse

Die Zusammenarbeit im Dreieck Athlet-Trainer-Produzent war bei der Entwicklung neuer Innovationen im Kunstturnen (Sprungtisch und Boden) intensiv und entscheidend. Im Mountainbike (29-Zoll Rad und Enduro) und im Tennis (Tennisschläger und Tennissaite), wo die Marktattraktivität grösser als im Kunstturnen ist, unterstützten die Athleten die Produzenten. Die Öffentlichkeit war positiver Innovationstreiber, wenn diese als Austragungsort oder als Forschungsinstitut beteiligt war (Sprungtisch, Boden, Enduro). Die Regularien verhielten sich in den Fallbeispielen unterschiedlich. Die internationalen Verbände erschienen als positive Innovationstreiber, wenn es um das Themen Athletensicherheit oder Sportart-Attraktivierung ging (Sprungtisch). Waren weder die Natur des Sports noch die Sicherheit oder Fairness tangiert, verhielten sich die Verbände neutral, unterstützten aber die Produzenten bei Unsicherheiten (Boden, Tennisschläger, Tennissaite, 29-Zoll-Rad). Der internationale Sportverband trat im Fall Enduro als negativer Innovationstreiber auf, während nationale Verbände unterstützten oder sich neutral verhielten.

Diskussion

Die Fallbeispiele geben einen ersten Eindruck betreffend die Verhaltensweise der Akteure bei Sportinnovationen. In allen Fällen waren Athleten und Produzenten positiv im Innovationsprozess involviert. Daraus lässt sich ableiten, dass Innovationen zum Scheitern verurteilt wären,

wenn Athleten und Produzenten nicht bei der Entwicklung und Diffusion unterstützen. Die Regularien traten mit Ausnahme des Falles ‚Enduro‘ erst in Aktion, wenn Fairness, Athletensicherheit oder die Natur der Sportart nicht mehr gewährleistet war. Es wird vermutet, dass im Fall Enduro andere Komponenten entscheidend waren. Es scheint, dass die Produzenten in Sportarten mit hoher Marktattraktivität aktiver auftreten. Diese Aussagen müssen noch mit weiteren Beispielen abgetieft werden.

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3.5 Exercise Performance in Winter Sports

Topics: social sciences

Keywords: Olympic Winter Games, comparing performance measures, market share, Spearman's rho coefficient

Measuring performance at the Olympic Winter Games: Comparing different performance measures from a Swiss perspective

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Research Background and Aim: Different measures are applied to analyse elite sport performance of nations at the Olympic Games, such as number of medals, or market share of medals/diplomas (De Bosscher, Heyndels, De Knop, Van Bottenburg, & Shibli, 2008; Shibli, De Bosscher, Van Bottenburg, & Westerbeek, 2013). In practice, Swiss Olympic prioritizes resources between disciplines by analysing, amongst other things, the number of medals/diplomas won, whereas when analysing the development of the nation's performance at the Games over time, market share is used (SwissOlympic, 2013). However, to date there is no study analysing different performance measures for different research purposes. The aim of this study is to detect differences in the performance indices applied and to identify a suitable measure to rationalise the prioritization of resources amongst sports.

Research Method: The performance of Switzerland, Austria, Canada, Finland, Sweden, Norway, and the Netherlands at the 2014 Sochi Games is analysed per discipline (i.e. 15), as measured by a) total number of medals won, b) number of diplomas won, c) market share of total medals won, and d) market share of diplomas won. Additionally, two new indices are introduced: market share of e) contestable medals, and f) contestable diplomas (see Weber, Kempf, Shibli, & De Bosscher, 2016). The performance data is derived from the Gracenote Sports database and the number of contestable medals/diplomas from the explanatory competition books published by the IOC. To detect differences between these indices, we apply the two-sided Spearman's rho coefficient.

Results and Findings: In contrast to the high correlations found in existing research between different measurements of success (De Bosscher et al., 2008), in this sport by sport analysis, the correlation values vary notably. Our interpretation of the identified differences between market share of medals/diplomas and contestable medals/diplomas, is that the first is suitable to compare a nation's overall performances over time, while the latter is more suited to comparing performance in a specific sport over time. However, when prioritizing resources amongst sports, these relative indices are less suitable than absolute indices, because the number of medals/diplomas won includes information on the market size for medals, and therefore includes best the number of winning possibilities. This distinction is particularly valid for that are strong in many disciplines.

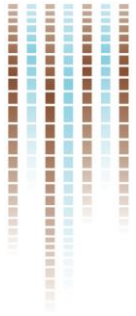
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Topics: natural sciences

Keywords: Datenanalyse, Modellierung

Vorhersage von Treffern in Biathlonwettkämpfen mit maschinellem Lernen

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Theoretischer Hintergrund

Schiessfehler in Biathlonwettkämpfen wirken sich bedeutend auf das Schlussklassement aus. Der erschwerende Effekt der vorangehenden körperlichen Belastung sowie biomechanische Einflussfaktoren auf die Trefferquote wurden bereits untersucht (Hoffman, Gilson, Westenburg, & Spencer, 1992; Sattler, Buchecker, Gressenbauer, Müller, & Lindinger, 2017). Allerdings ist bisher unbekannt, ob und wie genau sich einzelne Treffer und Fehlschüsse vorhersagen lassen. Für automatische Vorhersagen eignen sich Algorithmen aus dem maschinellen Lernen, welche komplexe Zusammenhänge aus gegebenen Daten generalisieren, um Vorhersagen für neue Fälle zu berechnen (Bauer & Kohavi, 1999).

Fragestellungen

- A) Welche Faktoren beeinflussen die Trefferquoten in Biathlonwettkämpfen?
- B) Wie gut lassen sich zukünftige Treffer und Fehlschüsse mit maschinellem Lernen vorhersagen?

Methode

Wir aggregierten und untersuchten Daten von 118'300 Schüssen aus vier Wettkampfsaisons (2012/13 bis 2015/16) mittels explorativer Datenanalyse und trainierten verschiedene Vorhersagemodelle aus dem maschinellen Lernen mittels zeitsegmentierter Kreuzvalidierung. Als Basismodell diente eine logistische Regression mit einer Eingangsvariablen. Zusätzlich wurden zwei komplexe Modelle verwendet: ein Boosting-Modell basierend auf Entscheidungsbäumen und ein künstliches neuronales Netzwerk. Mit den finalen Modellen berechneten wir Vorhersagen für 34'340 zukünftige Schüsse der nächsten Wettkampfsaison (2016/17).

Ergebnisse

- A) Tiefere Trefferquoten zeigten sich in den Disziplinen Sprint und Verfolgung verglichen mit den Disziplinen Einzel und Massenstart ($p < 0.01$, Cohen's $h = 0.14$). Im Stehendschiessen war die Trefferquote tiefer als im Liegendschießen ($p < 0.01$, $h = 0.15$). Im Vergleich zu den anderen Schüssen in der gleichen Position zeigte der erste Liegendschuss und der fünfte Stehendschuss eine tiefere Trefferquote ($p < 0.01$, $h = 0.08$ und $p < 0.05$, $h = 0.05$).
- B) Das Boosting-Modell prognostizierte zukünftige Treffer und Fehlschüsse mit einer Fläche unter der ROC-Kurve von 0.62, 95% VI [0.60, 0.63], leicht besser als das künstliche neuronale Netzwerk (0.61, [0.60, 0.62], $p < 0.01$) und die logistische Regression (0.60, [0.59, 0.61], $p < 0.01$, Eingangsvariable: vorgängige positionsspezifische Trefferquote).

Diskussion

Die Trefferquote im Biathlon variiert zwischen den Disziplinen, den Schiesspositionen und den Schussnummern einer Serie. Die vorgängige positionsspezifische Trefferquote eines Athleten oder einer Athletin ist aber der wichtigste Faktor, um einzelne Treffer vorherzusagen. Ein grosser Zufallseffekt bleibt bestehen, den auch komplexe Modelle nicht relevant verringern können: Die Anzahl der Fehlschüsse eines Athleten oder einer Athletin pro Wettkampf variiert zufällig um ca. 1-2 Schüsse.

Im Training sollte somit primär die allgemeine Trefferquote in beiden Schiesspositionen unter wettkampfnahen Bedingungen optimiert werden, evtl. mit einem besonderen Fokus auf dem ersten Liegendschuss und dem letzten Stehendschuss. Echtzeitvorhersagen der Trefferwahrscheinlichkeiten einzelner Schüsse könnten zudem Wettkampfübertragungen bereichern.

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Topics: natural sciences

Keywords: Beobachtungsinstrument; Strukturgleichungsmodell

Empirische Modellierung eines Technikleitbildes im alpinen Skisport

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Einleitung

Hinsichtlich der Ableitung und Präzisierung von Techniksollwerten und deren situationsbezogenen, individuellen Ausprägungen auf der Basis von Technikleitbildern besteht ein weitreichender Forschungsbedarf (Krombholz, 2009; Neumaier & Krug, 2003). Die aus einem personenunabhängigen Technikleitbild abzuleitenden Techniksollwerte weisen in Abhängigkeit von den situativen Bedingungen sowie den personellen Voraussetzungen, eine gewisse Bandbreite auf, welche vor allem im alpinen Skilauf deutlich erkennbar wird.

Methode

Es handelt sich um eine Feldstudie zum Techniktraining mit 283 Sportstudierenden von 8 Universitäten. Diese wurden während universitärer Schneesportkurse zwei Mal im Abstand von 2 Stunden videografiert (Technik: Kurven mit kleinen Radien). Die Auswahl der Bewegungsmerkmale basiert auf den aktuellen Lehrplänen des Skilehrwesens und wurde anschliessend in Form eines Video-Analyserasters mit definierten Merkmalsausprägungen durch ein Experten-Rating festgelegt und mithilfe einer Objektivitäts-/Reliabilitätsprüfung überprüft. Die interne Validität wurde u. a. durch die eindeutige Operationalisierung der zu betrachtenden Bewegungsmerkmale gewährleistet (Experten-Rating). Mittels Faktorenanalysen mit ordinalem Schätzer wurde die Zuordnung der Beobachtungsmerkmale zu übergeordneten Bewegungskategorien untersucht und hinsichtlich deren faktoriellen Validität geprüft.

Ergebnisse

Nach einer systematischen Itemselektion konnten die vier latente Faktoren Körperhaltung, Skistellung, Skisteuerung und Spurbild mit jeweils drei Items identifiziert werden. Das vierfaktorielles Modell erreichte eine gute Anpassung an die Daten (CFI = .99, RMSEA = .065). Die Interkorrelationen der Faktoren lagen bei $.58 \leq r \leq .76$. Zum zweiten Messzeitpunkt konnte diese Struktur repliziert werden (CFI = .99, RMSEA = .063). Weiterhin konnte die zeitliche Messinvarianz bestätigt werden (CFI = .99, RMSEA = .040), welche sich durch eine hohe Stabilität ($.78 \leq \beta \leq .93$) der Faktoren auszeichnete.

Diskussion

Es ist gelungen über Beobachtungskriterien die Bewegungsstruktur beim Fahren von Kurven mit kleinen Radien valide zu bestimmen. Das entwickelte Beobachtungsinstrument kann u. a. genutzt werden, um die Skitechnik kriteriengeleitet zu beurteilen.

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3.6 Translational Research & Development

Topics: natural sciences

Keywords: Studienplanung, Schule, Gesundheitsförderung, Umgang mit Behörden

Hürden und Tücken der Forschung: Von der Forschungs-idee bis zur Implementierung der gewonnenen Erkenntnisse in der Gesellschaft – Erläuterungen am Beispiel der KISS- und der Sportcheck-Studie

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Hintergrund

Dieser Beitrag soll als anwendungsorientierter Erfahrungsaustausch zwischen den sportwissenschaftlichen Arbeitsgruppen der Schweiz dienen. Wir möchten unsere Erfahrungen, die wir anhand zweier Nationalfondsstudien (KISS- und Sportcheck-Studie) im Bereich Bewegungs- und Gesundheitsförderung im Setting Schule gewonnen haben mit dem Publikum teilen und im Austausch Lösungsansätze für eventuell auftretende Probleme bei der Kommunikation vor und nach der Datenerhebung und der Implementierung der Forschungserkenntnisse in die Gesellschaft diskutieren.

Methoden

Die KISS-Studie war 2004 die erste Interventionsstudie der Schweiz im Bereich der Fitness und körperlichen Aktivität bei Kindern und Jugendlichen (Kriemler et al., 2010; Zahner et al., 2006). Neben sportmotorischen Tests wurden bei 7- und 11-jährigen Kindern auch medizinische Tests, z.B. Knochendichte, Knochenmineralgehalt, Blutuntersuchungen, etc. gemacht. Diese Tests wurden vor und nach einer 1-jährigen Bewegungsintervention in und ausserhalb der Schulzeit durchgeführt. Nach 4 Jahren erfolgten Follow-up-Untersuchungen.

Die Sportcheck-Studie umfasst eine alljährliche Durchführung von sportmotorischen Tests bei allen Kindern der 1. Primarklasse im Kanton Basel-Stadt mit dem Ursprungsziel den freiwilligen Schulsport zu verbessern und quartierspezifischer zu gestalten. Diese Tests werden in enger Zusammenarbeit mit dem Sportamt Basel-Stadt durchgeführt. Neben den sportmotorischen Tests wurden in den Jahren 2014, 2016 und 2017 zusätzliche medizinische Tests, z.B. Messungen der Gefäss- und Rückengesundheit, Lungenfunktion, etc. durchgeführt (Imhof, Faude, et al., 2015; Imhof, Zahner, Schmidt-Trucksass, Faude, & Hanssen, 2015). Im Jahre 2018 wird zudem zum ersten Mal ein Follow-up bei den Kindern der 5. Klasse, vier Jahre nach der Erstuntersuchung von 2014, durchgeführt.

Resultate und Diskussion

Im Fokus der Diskussion stehen unter anderem: der Umgang mit Ethikkommissionen, dem Bundesamt für Gesundheit, politischen Behörden (Regierungsrat und Volksschulleitung), Schulleitungen/Rektoraten, Lehrerschaft, Abwarten, Eltern, Kindern, Interessensgruppen (z. B. Pädiater), Presse etc.

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Topics: social sciences

Keywords: Bewegte Schule; Strategieentwicklung; Bildungspolitik

Strategieentwicklung «Bewegte Schule» im Kanton Bern: Zwischen wissenschaftlicher Orientierung und bildungspolitischer Passung

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Theoretischer Hintergrund und Fragestellung

Die fehlenden gesetzlichen Grundlagen für die Sportförderung im Schul-, Breiten- und Leistungssport im Kanton Bern haben den Gesamtregierungsrat veranlasst, eine Gesamtstrategie „Sport Kanton Bern“ in Auftrag zu geben. Ein Teil dieser Gesamtstrategie umfasst die Strategieentwicklung im Bereich «Bildung und Sport», welche mitunter den Aspekt der Bewegten Schule fokussiert. In Anlehnung an das Konzept der Bewegten Schule (z. B. BASPO, 2013; Donnelly & Lambourne, 2011) können Schulen durch die Initiierung von Bewegungs- und Sportaktivitäten lebensweltnaher gestaltet werden. Dadurch leisten sie einen wesentlichen Beitrag zur ganzheitlichen Bildung. Um dieses Ziel zu erreichen, sollen schulische und auserschulische Sport- und Bewegungsaktivitäten angeboten und unterstützt werden. Ziel des Projekts „Bildung und Sport“ ist, mit den Bildungspartnern und Anspruchsgruppen sportwissenschaftlich und fachdidaktisch gestützte Grundlagen für eine Strategie „Bildung und Sport“ für alle Schulstufen zu konsolidieren.

Methoden

Expertinnen und Experten wurden in Rahmen eines Workshops gebeten, auf Fachliteratur (u. a. EDK, 2010) und verwaltungsinterne Vorarbeiten gestützte Umsetzungsmassnahmen für eine nachhaltige Etablierung der «Bewegten Schule» auf allen Schulstufen auf deren Güte einzuschätzen und anzupassen. Das resultierende Dokument wurde anschliessend dem Expertenpool zur Prüfung und Ergänzung hinsichtlich der verschiedenen Ebenen der Umsetzung vorgelegt. Zudem wurde das Expertengremium eingeladen, spezifisch je Umsetzungsebene Angaben zu notwendigen Ressourcen und umsetzungserleichternden Anreizsystemen zu formulieren sowie die Massnahmen zu priorisieren. Die Erkenntnisse dieser Expertenbefragung diente als Grundlage für die nachfolgende Schulleitendenbefragung (N=145). Im zweisprachigen Online-Fragebogen wurden die Schulleitenden stufenspezifisch zu 27 Massnahmen der «Bewegten Schule» befragt. Es ging darum einzuschätzen, inwiefern diese Massnahmen erwünscht und künftig realisierbar sind. Der Rücklauf betrug 42% ohne regionale und schulstufenspezifische Verteilungsunterschiede.

Ergebnisse

Aktuell zeigt sich im Kanton Bern, dass stufenübergreifend viele Umsetzungsformen der «Bewegten Schule» im Schulalltag realisiert sind. «Bewegter Unterricht» wird im Kindergarten und auf Primarschulstufe oft umgesetzt, allerdings ab Sekundarstufe I eher selten, obschon der Wunsch nach mehr Impulsen des «Bewegten Unterrichts» vorhanden ist. Die Verankerung von Bewegungs- und Gesundheitsförderung im Schulleitbild ist aktuell auf allen Stufen (exkl. Berufsfachschulen) kaum Tatsache, jedoch künftig erwünscht. Schulleitende auf Primarschulstufe und Sekundarstufe I äussern zudem den Wunsch nach zusätzlichen Sportlektionen im Rahmen des Angebots der Schule.

Diskussion

Die Befunde der Schulleitendenbefragung deuten darauf hin, dass die entwickelten Massnahmen relevant sind für eine zukünftige Etablierung der «Bewegten Schule» im Kanton Bern. Bemerkenswert ist der Ausbauwunsch eines Freifachs Bewegung und Sport auf Volksschulstufe. Weiter ist das erkannte Interesse an Konzepten des „Bewegten Unterrichts“ für die Sekundarstufe I und II spannend. Denn bis anhin galten bewegungsfördernde Aktivitäten im

Schulalltag ab Sekundarstufe I als weniger bedeutungsvoll, was oft mit schulstrukturellen Schwierigkeiten oder entwicklungspsychologischen Bedürfnissen begründet wird (vgl. Laging, 2001).

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Topics: social sciences

Keywords: Jugend+Sport, Evaluation, Coaching Skills

J+S: Besuche von Leiterpersonen vor Ort

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Hintergrund

Seit 1972 bildet das Sportförderprogramm des Bundes „Jugend und Sport“ (J+S) in einer Kaskade über J+S-Expertinnen und Experten J+S-Leiterpersonen aus, welche Trainings mit Kindern und Jugendlichen in über 70 verschiedenen Sportarten durchführen. Die 5- bis 20-Jährigen erhalten eine sportartspezifische Ausbildung, mit der sie zu lebenslangem Sport befähigt werden sollen. Zudem bildet die Jugend von J+S die Basis für den Leistungssport in der Schweiz. Neben der direkten Subventionierung der Trainingsorganisatoren werden jährlich über 500 Leitende im Unterricht durch Experten besucht.

Ziel der Besuche ist in erster Linie die J+S-Leitenden in ihrer Freiwilligenarbeit zu unterstützen. Das konstruktive und wertschätzende Feedback soll die Leitenden in ihrer Leitertätigkeit stärken und ihre Coaching-Skills, also das Handlungswissen für ein optimales Training, wo nötig weiter verbessern. Daneben sollen die Besuche der Programmleitung helfen, J+S zu optimieren.

Fragestellung

Die Beobachtungsdaten sollen einen ersten Überblick über die Coaching-Skills der J+S-Leiterpersonen geben. Wie bewerten die J+S-Experten den Unterricht der Leitenden? Gibt es Unterschiede zwischen den Sportarten?

Methode

Zur Erfassung der Beobachtungen wurde ein Beobachtungsbogen entwickelt und eingeführt. Dieser basiert auf Erkenntnissen der Sportunterrichtspsychologie und Pädagogischen Psychologie zur Thematik des „guten Sportunterrichts“ bzw. „der guten Sportleiterperson“ (Frei, 2016) und erfasst Punkte, welche guten Unterricht auszeichnen. Die J+S-Experten beurteilen dafür die Leiterperson auf einer Skala von 1 (Kennzeichen eines schlechten Trainings) bis 7 (perfektes Training). Der Beobachtungsbogen weist eine gute Reliabilität (Gwet's AC2 = 0.706) auf.

Die Expertenbeurteilungen werden deskriptiv ausgewertet und anhand nicht-parametrischer Verfahren auf Gruppenunterschiede getestet.

Ergebnisse

Die Bewertungen der 865 besuchten Trainings waren im Schnitt sehr hoch ($m = 6.04$, $SD = 0.95$). Bei den Punkten Emotionalität der Teilnehmenden, Zielerreichung, Individualisierung, kognitive Aktivierung, Sicherheit und Situationsadäquatheit der Bezugsnorm zeigten sich statistisch signifikante Unterschiede zwischen den Leitenden unterschiedlicher Sportarten. Unterschiede gab es in der effektiven Lernzeit, der Teilnehmerorientierung, dem Grad der Lenkung, dem Humor, der Individualisierung und kognitiven Aktivierung, je nachdem, ob die Leitenden in Sportarten unterrichten, in welchen oft professionelle Trainer angestellt sind (z. B. Tennis, Golf, Kampfsport) oder Trainings durch ehrenamtliche Leitende erfolgt (z. B. Fussball, Geräteturnen, Leichtathletik). Die Experten schätzten die Möglichkeit, J+S-Trainings zu besuchen und die Leiterpersonen persönlich zu unterstützen und zu beraten.

Diskussion

Die hohen Durchschnittswerte der Beurteilung der Leiterpersonen lassen auf hohe Coaching-Skills schliessen. Erste Hinweise auf Unterschiede je nach Ausbildungsdosis der Leiterpersonen können helfen, die Ausbildung bei J+S zu optimieren. Ein Expertenbesuch des J+S-Trainings mit einem Feedback anhand theoretisch fundiert gesetzter Gütekriterien für guten Unterricht ist ein erster Schritt zur Unterstützung der Leiterpersonen vor Ort, der auch sehr geschätzt wird.

In Zukunft soll die direkte, persönliche Unterstützung der Leiterpersonen durch zwei konsekutive Besuche noch intensiviert werden. Zudem wird sich zeigen, ob eine Schulung der Experten die Trainings-Beurteilungen kalibrieren und das Verständnis für die einzelnen Beobachtungssitems schärfen kann, bzw. ob die Beurteilungen differenzierter ausfallen oder nicht. Eine Validierung des Beobachtungsbogens wird angestrebt, um eine valide Diagnose der Coaching-Skills zu ermöglichen.

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3.7 Exercise is Medicine II

Topics: natural sciences

Keywords: exercise epidemiology; cardiorespiratory fitness; metabolic diseases; fatty liver; pre-diabetes.

Associations between hepatic enzymes, sedentary time, physical activity and cardiorespiratory fitness in a large population based-cohort.

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Background: Non-alcoholic fatty liver disease (NAFLD) is the most prevalent liver disease in industrialised countries, affecting ~30% of the adult population. The hepatic enzymes, alanine aminotransaminase (ALT) and gamma glutamyl transferase (GGT) are associated with NAFLD, and independently predict type 2 diabetes, and the risks of developing hypertension, and cardiovascular disease.

Sedentary behaviour (sitting, lying down) is a risk factor for cardio-metabolic diseases (including NAFLD, cardiovascular disease) and elevated ALT and GGT, independent of physical activity (PA). Recent studies have shown that high cardiorespiratory fitness (CRF) attenuates the negative association between sedentary time and cardiovascular disease risk independent of physical activity. However, whether high CRF has a similar protective effect on hepatic health is not known.

Aim: This study examined the potential modifying effects of CRF and PA on the association of sedentary time with markers of hepatic disease (elevated ALT and GGT), in a large population-based cohort of adults. We hypothesized that high age- and sex-specific CRF levels would attenuate the negative effects of and sedentary time on ALT and GGT, independent of physical activity.

Methods: A cross-sectional analysis from a large population-based cohort study was conducted. Participants were included if alcohol consumption was within recommendations (rec). Self-reported sedentary time data during a regular day (awake hours) was divided into three sex-specific and equally sized groups (<4, 5 to <7, and ≥7 hours/day). CRF was estimated (eCRF) using a previously validated non-exercise model (1), and three age and sex specific groups of eCRF were established. Elevated ALT and GGT were defined as the highest sex- and age- specific tertiles. Using logistic regression analyses, adjusted odds ratios (OR) and 95% confidence intervals (CI) were estimated for the association of sedentary time with elevated ALT and GGT, as well as for the potentially modifying effects of PA and eCRF. Models were corrected for confounders such as age, smoking status, alcohol consumption, non-fasting glucose, HDL-cholesterol, blood pressure and body mass index.

Results: The cohort included 16'640 participants (52% female). The likelihood having elevated ALT and GGT was increased by 2% and 4%, respectively, for each additional hour of sitting. It was increased by 11% and a 27%, respectively, for each 1MET (1 metabolic equivalent, 3.5 ml/kg/min) decrement in eCRF. In combined analyses, compared to the reference group (high eCRF, ST<4h/d, and PA≥rec), individuals with low eCRF had increased likelihood of having raised ALT (by 84%; OR, 1.84; CI 1.2-2.8) and GGT (2.08; 1.4-3.2), even if they had ST<4h/d

and $PA \geq rec$. In contrast, high-eCRF was protective even in those with $ST > 7h/d$ and $PA < rec$ (ALT:1.18; 0.96-1.44).

Conclusions: High levels of eCRF attenuate the negative effect of prolonged sedentary time on hepatic enzymes, independent of meeting PA recommendations. Guidelines for the management of NAFLD should incorporate recommendations to improve CRF.

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Topics: natural sciences

Keywords: physical activity tracking; health promotion; metabolic diseases; fatty liver; pre-diabetes.

A score of 100 PAI (Personal Activity Intelligence, a novel metric for physical activity tracking) attenuates the association between sedentary time and non-alcoholic fatty liver.

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Background and aims: Non-alcoholic fatty liver disease (NAFLD) is highly prevalent and is an independent predictor of type 2 diabetes and cardiovascular diseases (CVD). Prolonged sedentary time (ST) is a risk factor for cardio-metabolic diseases and NAFLD. A novel metric for physical activity (PA) tracking named Personal Activity Intelligence (PAI) has recently been developed. It is a PA score quantified by monitoring heart rate patterns, and therefore taking into account the added benefits of performing higher intensity activities on health. A score of ≥ 100 weekly PAI is associated with a reduced risk of CVD death (independent of meeting current PA recommendations) (1) and attenuates the negative association between ST and CVD risk (2). However, whether ≥ 100 weekly PAI has a similar protective effect on hepatic health is not known. The aim of this study was to examine the potential modifying effect of PAI on the association of ST with NAFLD, in a large population-based cohort of adults. We hypothesized that performing ≥ 100 PAI would attenuate the negative relationship between ST and NAFLD.

Methods: A cross-sectional analysis of 16,561 adults (52% female) was conducted. Individuals with alcohol consumption above recommendations were excluded. Self-reported ST during a regular day were divided into three sex-specific tertiles (<4 , 5 to <7 , and ≥ 7 h/d). Weekly PAI scores were calculated using a published algorithm, which takes into account age, sex, resting heart rate and age-predicted maximum heart rate. NAFLD status was estimated using a validated model (Fatty Liver Index, FLI). Using logistic regression analyses, adjusted odds ratios (OR) and 95% confidence intervals (CI) were estimated for the association of ST with FLI, as well as for the potentially modifying effect of meeting 100 weekly PAI.

Results: Prevalence of NAFLD was 35.8%. Individuals with ST >7 h/day had a 39% (OR, 1.39; CI, 1.19-1.61) higher likelihood of having NAFLD compared to those with <4 h/day. Individuals who were inactive (0 PAI) had a 56% (OR, 1.56; CI, 1.35-1.81) greater likelihood of having NAFLD compared to those who achieved ≥ 100 PAI/week. Combined analyses revealed that performing ≥ 100 PAI/week attenuated the adverse effects of ST on NAFLD. Compared to the reference group (≥ 100 PAI/week and <4 h/day ST), sedentary individuals (>7 h/day ST) not achieving ≥ 100 PAI/week had an 86% (OR, 1.86, CI, 1.48-2.33) higher likelihood of having NAFLD, while sedentary individuals (>7 h/day ST) who managed to achieve ≥ 100 PAI were protected (OR, 1.22; CI, 0.97-1.57).

Conclusions: Achieving a score of 100 PAI weekly attenuates the adverse effects of ST on liver health. Monitoring PAI could be a useful novel strategy to protect against NAFLD.

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Topics: natural sciences

Keywords: KINETICS, EMG, FRONT SQUAT, BACK SQUAT, OVERHEAD SQUAT

Muscle activity and co-activation of trunk muscles in different types of stable and unstable squatting in healthy adults

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INTRODUCTION

Different types of squat exercises under stable and unstable conditions are widely applied in fitness and rehabilitation training to improve or maintain individual performance levels. Trunk muscles and spinal stability are considered key factors of load support during squat exercises. Varying levels of stability can notably affect core muscle activity [1,2] and training impacts. Thus, the purpose of this study was to examine whether different types of squat exercises under stable and unstable conditions alter trunk muscle activation and lumbar spine curvature.

METHODS

Healthy females (N = 6, age: 29.4 (SD 9.0) y, height: 169 (6) cm, body mass: 64.0 (7.1) kg) and males (N = 6, age: 28.8 (8.0) y, height: 178 (3) cm, body mass: 76.2 (6.6) kg) completed four repetitions of each squat type (back squat (BS), front squat (FS) and overhead squat (OS)) in a randomized order under stable and unstable conditions, barefoot, with additional external loads (female 12.5 kg / male 20 kg). An internal knee angle of 100° at the lowest point (turning point) and a 2 s up and 2 s down phase were required. After stable, unstable trials were performed, heels off the ground by standing on a 1.6 cm high wooden board.

Surface electromyography of internal (IO) and external oblique (EO), rectus abdominus (RA) and erector spinae (ES) was recorded during each squat type and normalized to maximal voluntary isometric contractions performed in crunch and prone plank positions. 3-D motion capture of squat exercises was determined with markers placed on lower limbs, hip, spine, thorax and shoulder. Spine curvature was evaluated by measuring the angle between specific spinal segments. Two (condition: stable vs. unstable) × three (type: BS, FS, OS) repeated measures ANOVAs were calculated for each muscle, body sway and spine curvature at different squatting positions. The outcome measures were to evaluate trunk muscle activity, lumbar spine angle and body sway for the different squatting conditions.

RESULTS AND DISCUSSION

For all muscles significant condition-effects ($p < 0.02$) with large effect sizes were observed for different squatting positions for EO and ES. Significant differences between stable and unstable squatting were mainly observed for EO and ES. Spinal curvature showed significant condition effects at all movement positions. COP during the downward phase showed increased motion in the stable compared to unstable underground ($p \leq .001$).

CONCLUSIONS

Trunk muscle activity is altered by performing different types of squatting exercise. However, only EO and ES seemed to respond with higher muscle activation under unstable standing conditions compared to stable conditions. As squat conditions also influences spinal curvature and COM motion, the implications for the prescription of squat exercises to be performed during athletic training has to be considered differentiated with respect to trunk loading and trunk muscle activation.

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3.8 Gender Differences

Topics: social sciences

Keywords: Geschlechtersegregation, Leistungsklassen, Gender Verification, Geschlechterordnung

Leistungsklasse Geschlecht – umstrittene Grenzziehungen, soziale Ausschlüsse und Hierarchisierungen

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Den Leistungssport kennzeichnet bis heute eine rigide Geschlechtersegregation. In den meisten Sportarten können soziale Akteur_innen nur als eindeutige Männer und Frauen an den Start gehen respektive dann, wenn sie entlang sportspezifischer Kriterien ihre legitime Teilnahme in der Leistungsklasse der Frauen oder der der Männer unter Beweis stellen. Begründet wird die Geschlechtersegregation mit dem Prinzip der Chancengleichheit und dem Schutz der Sportlerinnen. Nur wenn Frauen in einer eigenen Wettkampfklasse an den Start gehen, so die von Sportorganisationen postulierte Annahme, sei ihre gleichberechtigte Teilhabe gesichert und die Möglichkeit, sportliche Erfolge zu feiern, überhaupt gegeben.

Aus einer soziologisch-geschlechtertheoretischen Perspektive fragt der Vortrag nach der Funktion und Plausibilität der Leistungsklasse Geschlecht und der damit einhergehenden Notwendigkeit, zwischen Männern und Frauen eindeutig zu unterscheiden. Mit dem Ziel die Produktion und Reproduktion von Geschlechterdifferenzen im Sport sowie deren sozial ordnende Wirkung genauer zu beleuchten, knüpft der Vortrag an bisher vornehmlich angloamerikanische Debatten über das so genannte «level playing field» im Sport an (vgl. McDonagh/Pappano 2008, Milner/Braddock II 2016, Sullivan 2011). Er erörtert den Zusammenhang von Leistung und Geschlecht und zeigt auf, dass und wie die Geschlechtersegregation des Sports soziale Ausschlüsse und Hierarchisierungen bedingt und legitimiert. Als Analysegrundlage dienen dem Vortrag aktuelle Bestimmungen und Reglements des IOC und der IAAF sowie Urteile des Internationalen Sportgerichtshofs (CAS); darunter die sogenannten «Hyperandrogenism Regulations» und «Transgender Guidelines» sowie der 2014 veröffentlichte Schiedsspruch des CAS im Fall der indischen Läuferin Dutee Chand (vgl. Court of Arbitration for Sport 2014, IAAF Press Release 2017, International Olympic Committee 2015).

Vor dem Hintergrund der skizzierten Analysen plädiert der Vortrag abschliessend für eine dezidierte Auseinandersetzung sportwissenschaftlicher Forschungen mit Fragen der Chancengleichheit im Sport - und dies nicht nur auf einer empirischen, sondern insbesondere auf einer epistemologischen Ebene.

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Topics: social sciences

Keywords: journalisme, sport, émotions, genre, féminisation

Des récits vibrants dans les pages sportives : la place des émotions dans le journalisme sportif

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On voit se développer au sein de la presse sportive suisse romande – notre terrain de recherche – une écriture « féminine » qui se caractérise par une approche plus humaine et émotionnelle. Cette dernière se démarque du traitement habituel de l'information sportive privilégiant davantage les faits et une analyse technico-sportive. Certaines femmes journalistes, soucieuses d'une contribution féminine singulière à leur rubrique, exploitent délibérément ces modes de traitement « féminins » de l'information. Mais leur essor doit néanmoins également à la mobilisation commerciale des compétences journalistiques « féminines » (Van Zoonen, 1998) et de l'« économie émotionnelle féminine » (Hochschild, 1979) par les entreprises de presse. C'est justement cette croyance et la volonté en un journalisme « féminin » qui est à l'origine d'une féminisation des rubriques sportives de la presse quotidienne romande depuis les années 2000. Cependant, alors que la « compétence émotionnelle » est souvent pensée comme féminine dans le journalisme, le travail émotionnel prend une configuration tout à fait spécifique dans cette spécialité journalistique. Notre enquête (observations participantes au sein de deux quotidiens romands, 24 entretiens auprès de journalistes de sport, analyse d'un corpus de 4817 articles de presse sportive) montre que si les femmes s'intéressent aux à-côtés du spectacle sportif en faisant preuve d'une démarche compassionnelle, les hommes valorisent un partage des émotions sportives et des interactions sur le mode de la passion sportive où, en qualité d'experts, ils se doivent de juger la (contre-)performance sans faire preuve d'empathie. Cette segmentation sexuée du travail émotionnel des journalistes peut s'expliquer à la fois en termes de socialisations différenciées des hommes et des femmes et d'effets des contraintes professionnelles. Elle contribue à un rapport de domination des hommes sur les femmes dans le journalisme sportif de la presse suisse.

Topics: social sciences

Keywords: person perception; emotional expression; dominance and submissiveness; stereotypes; football

Influences of Stereotypes on the Relation Between Nonverbal Behaviour and Team Confidence in Football

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Theoretical Background. Previous research on nonverbal behaviour (NVB) in the sport performance setting (Furley, Moll, & Memmert, 2015; Greenlees, Leyland, Thelwell, & Filby, 2008) has shown that NVB might be among the most important factors influencing emotions and team confidence within sport teams. Even when objective performance information was included as another potential factor influencing the person perception process the NVB-effect remained large (Seiler, Schweizer, & Seiler, 2017). However, research on NVB so far has not considered the influence of subjective performance information such as gender stereotypes on the soccer abilities of men and women although stereotypes seem to be crucial for the person perception process (see Kunda & Thagard, 1996, for a review).

Research Question. The aim of the present research was to investigate whether the effects of nonverbal behaviour (NVB) on team outcome confidence in sports decrease when subjective performance information transported through gender stereotypes is added.

Method. Using video footage of football players as stimulus material, two experiments were designed (Experiment 1 with sports science students, N = 59, and Experiment 2, N = 59, with members of a football club) to examine the effects of both NVB and subjective performance information on team outcome confidence.

Results. In both experiments, a 2 x 2 gender [male vs. female] x NVB [dominant vs. submissive] repeated measures ANOVA was conducted to test the influence of gender. The results of Experiment 1 showed that from the teammate's perspective, the NVB-effect remained large when gender is included. However, gender also had a significant influence on team outcome confidence. When the potential teammate was a woman, team outcome confidence was generally lower than when the teammate was male. Still, the interaction between NVB and gender was not significant, meaning that the influence of gender was not sufficiently large that it reversed the influence of NVB. The results from the opponent's perspective were reversed. Even in Experiment 2 in which the stereotype was more present the NVB-effect remained strong.

Discussion. Our results are in line with previous research on person perception and NVB in sports as they suggest that several factors have an influence on the person perception process but also that the NVB-effect remains large even when further information is provided.

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3.9 Exercise Performance in Summer Sports

Topics: natural sciences

Keywords: Cycling, athletes, circadian rhythm

Influence of light exposures on cycling performance in elite endurance athletes

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Background: Sports competitions often take place in the late evening to reach a broad audience, although this is not the time of peak performance for most athletes (Facer-Childs et al., 2015). In a previous study we showed that light can improve cycling performance in a positive dose-response relationship in athletes (Knaier et al., 2016).

Aim: The aim of this study was to assess the effect of different light exposure modalities on cycling performance and melatonin levels in elite athletes.

Methods: Male athletes with a median (interquartile range) age of 23 (21; 29) years performed a cardiopulmonary exercise test on a bicycle ergometer to determine maximum oxygen uptake (VO₂max). Seven days later participants were randomly allocated to either bright light (BRIGHT) (n=23), blue monochromatic light (BLUE) (n=22) or a control light condition (CONTROL) (n=24) and exposed to light for 60 minutes immediately prior to a 12-minute all-out time trial. Light exposure started at 17 hours after each individual's midpoint of sleep (median time: 9:17 pm). During the test session, six saliva samples were collected in 30 minute intervals to determine melatonin concentration. Multivariate analysis with adjustment for VO₂max was used to evaluate differences in work performed between the groups.

Results: The median (interquartile range) VO₂max (in ml/kg/min) was 64 (61; 66) in BRIGHT, 60 (57; 66) in BLUE and 62 (59; 65) in CONTROL. Compared to participants in CONTROL the adjusted difference in work performed during the time trial was 4.1 kJ (95% confidence interval [CI] -4.5, 12.7) in BRIGHT and -1.2 kJ (95% CI -9.8, 7.5) in BLUE. However, the amount of exposure to non-image forming light (i.e. melanopic light) was positively associated with the performance gain during the time trial, defined as the ratio of the performance in the first and last minute of the time trial. In detail, a tenfold increase in the exposure to melanopic light was associated with a performance gain of 8.0% (95% CI: 2.6, 13.3). This increase was also associated with a melatonin decrease of -0.9 pg/ml (95% CI -1.5, -0.3).

Discussion: In elite athletes exposure to bright or blue light did not significantly improve maximum cycling performance at a time of the day that is relevant in sport competitions. However, the estimated difference of 4.1 kJ between BRIGHT and CONTROL might present an important advantage justifying further studies. Further, we found first evidence that exposure to melanopic light in the evening, which strongly activates the human circadian timing system, enables elite athletes to better maintain performance across a time trial.

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Topics: natural sciences

Keywords: Athletic performance, monitoring training, high-intensity interval training

Are competition success and time trial performance related to training patterns in elite orienteering athletes?

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Introduction

Competitive elite athletes train hard for many hundreds of hours a year to achieve specific goals, such as medals at world championships. Orienteering is a complex sport in which the athletes train physical, cognitive, and tactical components (Creagh & Reilly, 1997). The aim of the present study was to detect training patterns, which might enhance orienteering athletes' chances of achieving their physical performance and competition goals.

Methods

The participating athletes submitted their training diaries and gave permission to assess their medical files, including the annual 5000 meter time trial performance test **Results**. Competition success was assessed by the individual World Cup ranking. Data of 15 Swiss elite orienteering athletes during their competition year of age 23 years were analyzed to investigate the effect of training patterns on competition success. To assess the influence of training patterns on competition success and athletic performance, multiple linear regressions were performed.

Results

The athletes trained on average 9.1 ± 1.7 training sessions per week with a total duration of 9.0 ± 1.3 hours of athletic training and 0.9 ± 0.3 hours of regeneration training per week. Multiple linear regressions revealed that five variables were significant predictor variables of competition success (World Cup points) and seven variables significantly predicted athletic performance (5000 meter time trial). Female gender, higher frequency of training sessions, longer orienteering duration, higher proportion of high-intensity interval training within total running, and a fast 5000 meter time trial performance positively predicted World Cup points within this group of athletes and explained 72.7% of the observed variance in competition success. Male gender, lower frequency of training sessions, longer total training duration, longer total running duration, shorter orienteering duration, shorter high-intensity interval training, and higher proportion of high-intensity interval training within total running were significant predictor variables of a fast 5000 meter time trial performance. These variables explained 97.4% of the observed variance in individual athletic performance.

Discussion

In this homogeneous group of nationally and internationally successful Swiss orienteering athletes, certain training patterns seem to be beneficial for competition success and athletic performance. Duration of orienteering, total frequency, proportion of high-intensity interval training within total running, and gender remained in both regression analyses in the final model. To conclude, in orienteering it is an advantage to be a fast runner, indicated by the influence of the predictive variable 5000 meter time trial performance on competition success. However, other factors not necessarily beneficial for the 5000 meter time trial performance are also important, such as longer duration of orienteering, higher training frequency, and higher proportion of high-intensity interval training compared to total running training time.

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Topics: natural sciences

Keywords: exercise testing, training, performance, running, lactate minimum test

Half-marathon and 10k running performance prediction in men and women based on the heart rate-based lactate minimum test

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Introduction:

Some years ago, the so-called heart rate-based lactate minimum test (LMT-HR) developed at our institute (Strupler et al., 2009) revealed a high correlation between lactate minimum (LM) and the maximal lactate steady-state (MLSS) in wheelchair racing (Perret et al., 2012), which makes this test suitable to determine individual training intensity zones. However, it remains still unclear, if this test is also suitable to estimate endurance race performance in able-bodied sports such as running. Thus, the aim of the present study was to investigate, whether 10k and half-marathon performance can be predicted based on a LMT-HR in male and female runners over a wide range of performance levels.

Methods:

30 participants (13 male / 17 female) performed a LMT-HR on a treadmill according to the protocol of Strupler et al. (2009). Additionally, they completed a 10k and a half-marathon race at the highest possible pace on a flat track on two separate occasions at least 5 days apart. During these races, runners were regularly informed about the distance covered, but were not aware of race pace or heart rate. For statistical analysis Spearman correlations for speed data at LM versus average speeds during the 10k and half-marathon run were calculated for male and female runners separately.

Results:

The present study included 13 men (age: median [minimum; maximum] 38y [25;47]; height: 181cm [170;186]; body mass: 75.0kg [63.0;86.0]; VO₂peak: 54.1ml/min/kg [42.3;66.0]) and 17 women (age: 33y [24;44]; height: 167cm [161;180]; body mass: 58.0kg [50.0;70.0]; VO₂peak: 51.4ml/min/kg [41.1;61.2]). Race times for the 10k ranged between 36:02min and 56:36min and for the half-marathon between 79:36min and 128:59min, respectively. Highly significant correlations between speed at LM vs. 10k speed in men ($r=0.875$; $p<0.001$) and women ($r=0.916$, $p<0.001$) as well as between speed at LM vs. half-marathon speed (men: $r=0.873$, $p<0.001$; women: $r=0.924$, $p<0.001$) were found.

Discussion:

Results of the LMT-HR allow an accurate prediction of 10k and half-marathon race performance in male and female runners based on a single exercise test. Thus, in daily clinical practice the LMT-HR seems to be a very useful tool for sport scientists and coaches not only to determine individual training intensity zones but also to estimate the actual athletes' running performance potential over a wide range of fitness levels.

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3.10 Performance & Strength

Topics: natural sciences

Keywords: Olympisches Luftgewehrschiessen, Sensorgewehr, NachwuchsathletInnen, Kompensationsmechanismen

Präzisionsleistungen im (Luftgewehr-)Schiessen: kompensatorische Effekte der Kraftproduktion bei Schweizer NachwuchsathletInnen

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Präzisionsleistungen im (Luftgewehr-)Schiessen wurden im letzten Jahrhundert in einer Vielzahl wissenschaftlicher Arbeiten untersucht. Dabei wurden unterschiedlichste Variablen mit vermutetem Einfluss auf die Schussleistung in den Blick genommen. Die Untersuchung der behaupteten Wirkmechanismen selbst blieb jedoch in der Regel aus – sicher nicht zuletzt zu begründen durch die messmethodischen Schwierigkeiten einer ausreichend genauen Positionsbestimmung des Gewehrs. Im Rahmen eines mehrjährigen Kooperationsprojektes mit dem Schweizer Schiesssportverband wurde eine mechanische Wirkungskette hergeleitet, die eine Untersuchung solcher mündungsschwankungsbegründender Mechanismen strukturiert ermöglicht und in einen kausalen Zusammenhang einbindet (u.a. Kredel, Tartaruga, Siegenthalter & Hossner, 2014). Die Besonderheit dieses Ansatzes liegt darin, dass sich die Analysen nicht auf blosse Zusammenhänge zwischen potentiellen „distalen“ Einflussgrößen (bspw. Konzentrations- oder Gleichgewichtsfähigkeit) und summativen Leistungskennziffern (bspw. Schussresultat in Ringen) beschränken, sondern dass resultierende Abweichungen vom Zielscheibenzentrum auf Position und Ausrichtung des Gewehrs und diese wiederum auf das Gewehr ausgeübte Kräfte und Momente zurückgeführt werden können. Diese vollständige Betrachtung der Wirkungskette wird als relevant erachtet, da sich Fehler aufgrund „distaler“ Varianzen keineswegs linear über die folgenden Schritte fortpflanzen müssen, sondern vielmehr von – ggf. sich sogar kompensierenden – Interaktionswirkungen auszugehen ist.

Zur empirischen Untersuchung dieser Wirkungskette wurde ein Prototyp eines Sensorgewehrs zur Erfassung dynamischer Messgrößen zwischen Athlet und Gewehr (Kräfte und Drehmomente an Schulterkappe, Backenaufgabe, Griff und Handaufgabe) entwickelt. Mit dem entwickelten Instrumentarium gewonnene Befunde zeigten auf, dass sich Schweizer Elite-AthletInnen im Olympischen Luftgewehrschiessen von Schweizer Near-Elite-AthletInnen im Gruppenvergleich insbesondere in geringerer absoluter Kraft und geringerer Kraftstreuung, v.a. an der Schulterkappe, unterscheiden. Auf Basis dieser Resultate wurde der Prototyp des Sensorgewehrs weiterentwickelt und vervielfältigt sowie in Verbindung mit einer Diagnostik- und Trainingssoftware für die Anwendung im Nachwuchs- und Spitzensport reif gemacht. Zusätzlich zu den bisherigen PISTE-Diagnostik-Umfängen konnten mit diesem Instrumentarium im Rahmen eines BASPO-geförderten Projektes nun erstmals für je 40 Schüsse gewehrnahe, dynamische Kennziffern (Sensorabtastrate 1000 Hz) von 36 Schweizer NachwuchsathletInnen erhoben werden.

Schussbasierte PCA-Analysen über die insgesamt 24 Sensordimensionen zeigen, dass mehr als 85% der gesamten Kraft-/Drehmoment-Varianz mit den ersten drei Faktoren der PCA erklärt werden können. Untersucht man jedoch die damit aufgespannten Cluster in Bezug auf unterschiedlich gute Schussleistungen, so haben diese kaum Erklärungsgehalt. Erste multivariate Analysen (UV: Schussleistungsgruppen operationalisiert durch horizontale/vertikale Abweichungen vom Scheibenzentrum, AV: 12 Kräfte / 12 Drehmomente) deuten jedoch auf schussleistungserklärende Unterschiede in der Kraft-/Drehmomentproduktion hin, die betragsmässig jedoch wesentlich kleiner sind als die Varianz auf den PCA-Faktoren. Mit diesem – mit

aktuellen Befunden zur „optimalen Kontrolle“ in Einklang stehenden – Ergebnis wird deutlich, dass sich schon in gewöhnlichen Kennziffern starke Interaktionen zwischen einzelnen Dimensionen zeigen, die kompensatorische Effekte in Bezug auf die nachfolgenden Elemente der Wirkungskette aufweisen. Somit erscheint eine wirkungsketten-vernachlässigende Untersuchung von Effekten distaler Einflussgrößen auf die Schussleistung wenig erfolgsversprechend. In einem nächsten Schritt werden die aufgedeckten Zusammenhänge detailliert und mit der Gewehrbewegung in Verbindung gebracht.

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Topics: natural sciences

Keywords: Elektromyostimulation, Krafttraining, Kniebeugemuskulatur, Trainingsintervention, Kraftdiagnostik

Verbesserung der Kraft- und Leistungsfähigkeit der Kniebeugemuskulatur sowie der Hamstring/Quadriceps-Ratio durch dynamisches Elektromyostimulationstraining

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Theoretischer Hintergrund: Ganzkörper-Elektromyostimulationstraining (GK-EMS) gewinnt im Leistungssport zunehmend an Bedeutung. Im Gegensatz zu willkürlichen Muskelkontraktionen und mechanischen Stimulationsformen werden durch EMS motorische Einheiten zusätzlich perkutan aktiviert (Paillard, 2008). Trotz heterogenen Einsatzes EMS-spezifischer Stimulationsparameter in der Praxis, wird zur Verbesserung der Kraft- und Leistungsfähigkeit eine Stimulationsfrequenz von ≥ 60 Hz, eine Impulsbreite von 200-400 μ s und ein Duty Cycle von 50% empfohlen (Filipovic et al., 2012). Trainingsstudien sind in diesem Kontext bislang kaum durchgeführt worden. Der aktuelle Beitrag fasst alle aktuellen Untersuchungen der Arbeitsgruppe zum dynamischen GK-EMS-Training im Hinblick auf Kraft- und Leistungsverbesserungen der Beinmuskulatur zusammen. Aufgeführt werden ausschließlich Daten von randomisiert-kontrollierten Trainingsstudien mit einer Mindestinterventionsdauer von 6 Wochen bzw. 12 EMS-Trainingseinheiten.

Fragestellungen: 1. Verbessert ein submaximales und dynamisches GK-EMS-Training Kraft- und Leistungsparameter der Beinmuskulatur? 2. Treten Verbesserungen der Beinmuskulatur infolge eines dynamischen GK-EMS-Trainings muskelspezifisch auf?

Methode: An 5 verschiedenen Interventionsstudien nahmen insgesamt 50 Probanden teil, 12 weibliche Probandinnen und 38 männliche Probanden (21 LeistungssportlerInnen mit Kaderstatus verschiedener Sportarten, 29 Sportstudierende). Die Probanden wurden in jeder einzelnen Studie randomisiert einer EMS-Gruppe (EMS) bzw. einer Kontrollgruppe (KON) zugewiesen und für eine gemeinsame Auswertung zusammengefasst (EMS; n=30; Alter: $21,0 \pm 4,2$ Jahre; Gewicht: $73,9 \pm 9,5$ kg; Größe: $1,77 \pm 0,1$ m) (KON; n=20, Alter: $19,7 \pm 4,0$ Jahre; Gewicht: $72,3 \pm 9,9$ kg; Größe: $1,80 \pm 0,1$ m). Beide Gruppen führten über mindestens 6 Wochen (12 Sessions) ein identisches dynamisches Trainingsprogramm mit kraft- und sportartspezifischen Utilisationsübungen durch. Im Unterschied zur Kontrollgruppe erhielt die EMS-Gruppe bei allen Interventionsübungen zusätzliches GK-EMS. Vor (Prä) und nach (Post) der jeweiligen Trainingsintervention wurden Daten isometrischer und dynamischer leistungsdiagnostischer Testverfahren (Leg Extension (LE), Leg Curl (LC), Leg Press (LP)) erhoben.

Ergebnisse: Signifikante Gruppen (EMS vs. KON) \times Zeit (Prä zu Post) Interaktionseffekte konnten sowohl für die isometrische Maximalkraft (F_{max}) [N] am Testgerät Leg Curl ($p=0,01$; $\eta^2=0,38$) als auch für die dynamische Hamstring/Quadriceps-Ratio (LC/LE) ($p=0,02$; $\eta^2=0,15$) gezeigt werden. Mittels Post-Hoc-Tests zeigt sich bei der EMS-Gruppe eine signifikante isometrische Maximalkraftzunahme beim Testgerät LC (Prä zu Post) von +12% ($\eta^2=0,38$).

Keine signifikanten Gruppen \times Zeit Interaktionseffekte konnten hingegen für die F_{max} bei den Testgeräten LE ($p=0,07$; $\eta^2=0,09$) und LP ($p=0,96$; $\eta^2=0,01$) sowie für die dynamische Leistung bei allen Testgeräten ($p>0,05$; $0,01<\eta^2<0,06$) gefunden werden.

Diskussion: Die Ergebnisse dieser Arbeit weisen darauf hin, dass sich die isometrische Maximalkraft in Folge eines GK-EMS-Trainings insbesondere muskelspezifisch zugunsten der

Kniebeugemuskulatur verbessert. Desweiteren konnte die dynamische Hamstring/Quadriceps-Ratio durch EMS verbessert werden. Diese EMS-bedingten Verbesserungen scheinen von Bedeutung, da der Kniebeugemuskulatur insbesondere bei Verletzungen in Spiel- und Sprintsportarten eine besondere Rolle zukommt. Weiterführend sollte untersucht werden, inwieweit ein Transfer dieser erworbenen Kraftverbesserungen in sportartspezifische Bewegungsanforderungen ermöglicht werden kann.

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Topics: natural sciences

Keywords: movement analysis, load condition, resistance training, back kinematics

Pulling Exercises for Strength Training and Rehabilitation: Movements and Loading Conditions

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Introduction:

For athletes, an insufficient trunk muscle strength is not only unable to protect the spine and the surrounding structures from mechanical stress, but also decreases the ability to transfer the power and speed generated by the limbs [1]. The loading and motion of the trunk is already known for classic back exercises such as deadlifts, good mornings [2] and back extensions [3], but a detailed analysis of different pulling exercises is lacking.

Research Question:

Therefore the aim was to assess the kinetics and kinematics of complementary back muscle exercises with different external loading directions.

Methods:

Fifteen healthy subjects were analyzed using a 3D motion capture system. The pulley machine was equipped with a load cell for force data acquisition. A set of 8 repetitions for selected pulling exercises were performed with different extra loads normalized to bodyweight: lat pull-down (25% and 50% BW extra load), lat pulldown with 45° incline (10% and 25% BW), seated cable row (25% and 50% BW) and upright row (10% and 25% BW) in a standing position.

Results:

The 45° lat pulldown yielded the greatest sagittal ROM in the shoulder joint. The upright row exhibited the greatest ROM in the frontal plane and the least ROM in the transverse plane.

The minimum and maximum curvature angle in the thoracic and the lumbar spine were larger during the upright row than during the other exercises. Furthermore, during the upright row, the sagittal moment in the shoulder joint is opposed to the other movements in the direction of retroversion.

Discussion:

Full ROM has been associated with greater strength and muscle gain [4] and therefore the variants of the lat pulldown could be considered as superior to the other exercises regarding the shoulder joint ROM. For the ROM of the lumbar spine segment relative to the thoracic segment, no significant differences were observed among the exercises.

The different loading patterns of the selected exercises indicated, that these exercises allow a complete back workout and could be included in a lower back pain prevention program or a strength training routine. But due to the higher lumbar curvature observed during upright rows, it is not advisable for patients with back pain to perform upright rows.

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3.11 Exercise is Medicine III

Topics: natural sciences

Keywords: reproducibility, instrumented climbing hold, SEM, CoV, piezoelectric force sensors, bouldering, performance

Acute effects and their reliability of aerobic exercise on executive function in seniors

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Background Aging is accompanied by a decline of executive function. Aerobic exercise training causes moderate improvements of cognitive domains (i.e. attention, processing, executive function, memory) in seniors. Most conclusive data are obtained from studies with dementia or cognitive impairment. However, confident detection of exercise training effects requires adequate between-day reliability and low day-to-day variability obtained from acute studies, respectively. These absolute and relative reliability measures have not yet been examined for a single aerobic training session in seniors. **Methods** Twenty-two healthy and physically active seniors (age: 69 ± 3 y, BMI: 24.8 ± 2.2 , VO_{2peak} : 32 ± 6 mL/kg/bodyweight) were enrolled in this randomized controlled cross-over study. A repeated between-day comparison [i.e., day 1 (habituation) vs. day 2 & day 2 vs. day 3] of executive function testing (Eriksen-Flanker-Test, Stroop-Color-Test, Digit-Span, Five-Point-Test) before and after aerobic cycling exercise at 70% of the heart rate reserve [$0.7 \times (HR_{max} - HR_{rest})$] was conducted. Reliability measures were calculated for pre, post and change scores. **Results:** Large between-day differences between day 1 and 2 were found for reaction times (Flanker- and Stroop Color testing) and completed figures (Five-Point test) at pre and post testing ($0.002 < p < 0.05$, $0.16 < \eta^2 < 0.38$). These differences notably declined when comparing day 2 and 3. Absolute between days variability (CoV) dropped from 10 to 5% when comparing day 2 vs. day 3 instead of day 1 vs. day 2. Also ICC ranges increased from day 1 vs. day 2 ($0.65 < ICC < 0.87$) to day 2 vs. day 3 ($0.40 < ICC < 0.93$). Interestingly, reliability measures for pre-post change scores were low ($0.02 < ICC < 0.71$). These data did not improve when comparing day 2 with day 3. During inhibition tests, reaction times showed excellent reliability values compared to the poor to fair reliability of accuracy. **Conclusion:** Notable habituation to the whole testing procedure should be considered as it increased the reliability of different executive function tests. Change scores of executive function after acute aerobic exercise cannot be detected reliably. Large intra- and inter-individual of responses to acute aerobic exercise in seniors can be presumed.

Topics: natural sciences

Keywords: Spiroergometrie, VO₂max, Ausbelastung, Senioren

Ausbelastungskriterien der Spiroergometrie bei Senioren: Limitationen und Perspektiven

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Hintergrund: Die Spiroergometrie gilt als Goldstandard zur Bestimmung der kardiorespiratorischen Leistungsfähigkeit. Um die maximale Sauerstoffaufnahme (VO₂max) zu erreichen, ist eine Ausbelastung notwendig. Zur Beurteilung der Ausbelastung kann der Goldstandard, das Levelling-Off der VO₂, nur begrenzt angewandt werden, da die erwartete Sauerstoffaufnahme protokoll- und personenspezifisch errechnet werden muss. Der Vergleich des Levelling-Offs zwischen unterschiedlichen Studien ist daher mit keiner einheitlichen Formel möglich. Deshalb haben wir die sekundären Kriterien Respiratory Exchange Ratio (RER), die Laktatkonzentration bei Abbruch (La), die maximale Herzfrequenz (HFmax), sowie die subjektive Intensität nach Borg (RPE) herangezogen. Das Ziel dieser Arbeit war es, evidenzbasierte Ausbelastungskriterien basierend auf der aktuellen Literaturlage für Senioren zu definieren und diese anhand der vorliegenden Stichprobe zu überprüfen.

Methode: Die Gesamtstichprobe umfasste 38 Aktive Gesunde (AG), 33 Inaktive Gesunde (IG) und 80 Inaktive Personen mit kardiovaskulärem Risiko (IR) im Alter von 50-80 Jahren. Alle Probanden absolvierten eine Laufbandspiroergometrie bis zur subjektiven Erschöpfung. Das Rampenprotokoll wurde individuell an die Leistungsfähigkeit angepasst. Von den Kriterien RER, La, HFmax, sowie RPE wurden Grenzwerte aus der Literatur herausgesucht und anhand der Vier-Felder-Tafel an der vorliegenden Stichprobe auf ihre Anwendbarkeit getestet.

Ergebnisse: Zur Beurteilung einer heterogenen Stichprobe von älteren Personen schlagen wir folgende Ausbelastungskriterien vor: RER ≥ 1.1 nach Pescatello et al. (2014), La an Alter und Geschlecht angepasst (50-64 Jahre: w: ≥ 5.0 mmol/l, m: ≥ 6.0 mmol/l, ab 65 Jahre: w: ≥ 3.5 mmol/l, m: ≥ 4.0 mmol/l) nach Edvardsen et al. (2014), 95% der vorhergesagten HFmax ($207 - 0,8 \times \text{Alter}$) nach Tanaka et al. (2001) und RPE_{max} ≥ 18 . Basierend auf diesen Grenzwerten für RER erreichten 96.4% der AG, 100% der IG und 97.1% der IR Gruppe den entsprechenden Wert. Die Grenzwerte für die Laktatkonzentration erreichten 82.1% der AG, 84.6% der IG und 81.8% der IR Gruppe. Die Grenzwerte für die HFmax erreichten 88.9% der AG, 85.6% der IG und 73.5% der IR Gruppe. RPE ≥ 18 wurde von 100% der AG, 84.5% der IG und 76.5% der IR Gruppe erreicht.

Diskussion: Die oben beschriebenen Grenzwerte sind in der Lage, eine Ausbelastung bei Senioren mit unterschiedlicher Leistungsfähigkeit zu quantifizieren und sowohl den falsch positiven als auch den falsch negativen Fehler gegenüber bisherigen Empfehlungen zu minimieren. Diese Grenzwerte zur Beurteilung einer Ausbelastung sollten anhand weiterer Datensätze bei Sportlern und Patienten mit verschiedenen Leistungsstufen geprüft werden. Zukünftige Studien sollten sich mit einem einheitlichen Bewertungssystem befassen um auf Basis vorhandener Grenzwerte verlässliche Aussagen über die Ausbelastung treffen zu können.

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Topics: natural sciences

Keywords: eccentric, feasibility, coronary artery disease, implementation, cycling

PROGRESSIVELY INCREASING POWER OUTPUT DURING AN ECCENTRIC CYCLING TRAINING PROGRAM: A FEASIBILITY STUDY IN HEALTHY SUBJECTS AND CORONARY HEART DISEASE PATIENTS

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Introduction

Eccentric cycling (EC), compared to concentric cycling, induces lower cardiorespiratory and perceptual responses at same power output. However, eccentric contractions may induce muscle damage and leg muscle pain. Interestingly, it has been shown that the completion of a preliminary EC session limits the development of muscle damage and leg muscle pain during subsequent sessions. The aim of this study was to test the feasibility of an EC training program involving a progressive increase in power output following a preliminary EC session.

Methods

30 healthy (HEA) subjects (56±10 yr) and 15 coronary heart disease (COR) patients (59±11 yr) without alteration of ejection fraction (>45%) volunteered in this study. Participants performed 4 sessions (25 min) of EC. During the first session, the intensity was fixed at the power output developed at the first ventilatory threshold (measured in a preliminary session during concentric cycling). Then, power output was increased by 25% per session. The first and second sessions were interspaced by 1 week, and the subsequent sessions were interspaced by 3 days. During the EC exercise, ratings of perceived exertion (RPE) and power output were recorded. Leg muscle pain and blood CPK concentration were measured 48h after each session.

Results

HEA : During the first session, mean power output was 49.9±12 % of peak power output (PPO) and RPE was 10.1±2.1. During the fourth session, mean power output was 79.9±19.8 % PPO and RPE was 9.5±2.5. Blood CPK concentration peaked (218±237 UI/L) after the first session and then decreased following the other sessions. Leg muscle pain was clinically relevant (value > 40 mm on the visual analog scale) mainly following the first session.

COR: During the first session, mean power output was 56.6±7.4 % PPO and RPE was 10.2±2.6. During the fourth session, mean power output was 110.7±21.8 % PPO and RPE was 11.3±3.6. Blood CPK concentration peaked (150±82 UI/L) after the fourth session and remained lower than the clinical relevance (>200 UI/L). Leg muscle pain was clinically relevant mainly following the first session. A high inter-subject variability was observed for perception of leg muscle pain for both HEA (range = 0-9) and COR (range = 0-6).

Discussion

As leg muscle pain was clinically relevant only following the first session and blood CPK concentration remains at low values following all sessions, our Results confirms the feasibility of progressively increasing power output during an EC training program. However, the high inter-subject variability in leg muscle pain suggests the need of individualizing EC training program based on participants leg muscle pain perception. Finally, as the adherence to training program could be limited by high perceived effort during physical exercise, our low RPE values reported from the first session to the fourth session provide promising Results for the use of EC in training program.

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3.12 Burnout & Sleep Quality

Topics: natural sciences

Keywords: Schlaf, Sport, Schlafqualität

Effects of evening exercise on sleep quality in healthy subjects: a systematic review and meta-analysis

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Background: Current recommendations advise against exercising in the evening because of potential adverse effects on sleep [1]. The aim of this systematic review was therefore to investigate the extent to which evening exercise affects sleep quality and whether variables such as exercise intensity or timing before bedtime would modify the response.

Methods: A systematic search was performed in PubMed, Cochrane, EMBASE, PsycINFO and CINAHL databases, including reference lists of articles and reviews. Studies evaluating sleep quality after a single session of evening physical exercise (< 4 h before bedtime) compared to a non-exercise control in healthy adults were included. Year and language were not restricted. All pooled analyses are based on random effect models. Moderator analyses were performed using a Q test for categorical variables and linear meta-regression for continuous variables.

Results: The search yielded 7633 References, of which 23 (with a total of 275 subjects) were included. Exercise ended 0.12 h – 4.0 h before bedtime. Compared to control, evening exercise significantly increased REM latency (+7.7 min; 95% CI [0.6,14.7]; n=19) and slow wave sleep (SWS) (+1.3%; 95% CI [0.1,2.6]; n=16), while it decreased stage 1 sleep (-0.9%; 95% CI [-1.5,-0.3]; n=19). Moderator analyses revealed that higher temperature at bedtime and a higher level of physical stress (exercise intensity relative to baseline physical activity) were associated with lower sleep efficiency (b=-11.6%; SE=5.0; p=0.020; -3.2%; Q=4.4, df=1, p=0.036) and more wake after sleep onset (WASO; b=+37.6 min; SE=19.2; p=0.0495; +21.9 min; Q=4.1, df=1, p=0.044). Compared to cycling, running was associated with less WASO (-12.7 min; Q=4.3, df=1, p=0.037). No other effect reached statistical significance.

Conclusion: Exercise performed in the evening does not seem to negatively affect sleep quality during the subsequent night, in fact rather the opposite. Increases in SWS and decreases in stage 1 sleep suggest an increased proportion of restorative sleep after exercise in the evening, similar to exercise performed during the day [2]. Analysis of moderator variables suggests that sleep efficiency might be impaired after 'stressful' exercise and/or exercise that increases core body temperature, possibly due to increased wake time after sleep onset. Of note: The low quality of several studies, substantial heterogeneity between studies, and the small number of comparisons for some outcomes limits the generalizability and validity of the current findings.

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Topics: social sciences

Keywords: burnout; eeg; sleep; stress; students; Swiss Olympic; young elite athletes

Differences in subjective and objective sleep in young elite athletes with high versus low burnout levels

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Theoretical Background: Burnout among elite athletes is a common phenomenon with negative consequences for athletes' performance and well-being (Gustafsson, Madigan, & Lundkvist, 2017). Researchers have suggested that athlete burnout may in part be due to an imbalance between stress and recovery (Kellmann, Kölling, & Pelka, 2017). Moreover, the relationship between sleep, recovery and performance has been identified as a crucial frontier in high-performance athletics (Samuels, 2008). Despite this knowledge, research on the association between burnout and sleep has remained sparse. Therefore, the purpose of the present study was to test whether young elite athletes with high versus low burnout levels differ in subjectively and objectively assessed sleep parameters.

Methods: Participants were recruited from Swiss Olympic Sport classes. Originally, 257 athletes (M=16.82, SD=1.44; 63% boys) participated in the study. At least 52 students were needed to detect significant group differences (alpha: 0.05, power: 0.80, f=0.40). Assuming 10% non-recordings), 29 students with high burnout scores (>4 on the Shirom-Melamed Burnout Measure) and low burnout scores (values <3) were selected (matched for age, sex, educational **Background**, individual/team sport). Finally, 55 athletes with valid data were included (high burnout: n=29, low burnout: n=26). To assess subjective sleep, participants reported their insomnia symptoms and dysfunctional sleep-related cognitions (rumination, focusing). Moreover, a one-channel sleep EEG device (Somnowatch[®], Randersacker, Germany) was applied. Sleep polygraphs were visually analysed by two experience raters (Rechtschaffen & Kales, 1968). Sleep efficiency, sleep duration, sleep onset latency, number of awakenings, REM sleep, were stage 1-4 sleep were examined.

Results: Athletes with low versus high burnout levels did not differ with regard to sex, education, team/individual sport, and age ($p > .05$). Large group differences occurred in the univariate ANOVAs for subjective sleep, indicating that athletes with high burnout scores report significantly poorer sleep and more dysfunctional cognitions than peers with low burnout levels ($p < .001$, η^2 from .161 to .270). Regarding objective sleep, no group differences were found for any of the parameters ($p > .05$).

Discussion: Among young elite athletes, high burnout symptoms are often paralleled by insomnia symptoms and dysfunctional sleep-related cognitions. The fact that more than 10 percent of athletes reported clinically relevant burnout symptoms is a cause of concern. Although no causal inferences can be drawn from our cross-sectional data, it is possible that sleep problems exacerbate the negative consequences of stress because they impede recovery processes. Promoting sleep hygiene might be a promising avenue to prevent poor sleep and burnout symptoms among young elite athletes.

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Topics: social sciences

Keywords: physical activity, stress-buffering effects, occupational stress, IPAQ, Burnout

Moderate-to-vigorous physical activity moderates the relationship between occupational stress and burnout symptoms among Swiss workers

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Theoretical Background: Various studies over the last 40 years have shown that regular physical activity can counteract possible health-related impairments in times of high stress. This phenomenon is called the "stress-buffering effect" of physical activity (Gerber & Pühse, 2009). Although work-related stress is a well-documented burden for workers (Gerber & Schilling, 2017), there are still few studies that specifically examine the stress-reducing effects of physical activity against the background of occupational stress theories. This shortcoming is addressed in the present study. Thus, the main goal is to examine whether moderate-to-vigorous physical activity (MVPA) moderates the relationship between occupational stress and symptoms of burnout in a sample of Swiss workers.

Methods: To recruit Swiss workers aged about 40-45 years, we employed the following procedure: Undergraduate students were asked to provide the contact address of six to twelve people (no relatives) who would be willing to take part in an online survey. In total, the students suggested 756 potential participants (407 men; on average 8.7 suggestions per student). Written informed consent was obtained from all participants, and the local ethics committee approved the study. After two reminders, 311 adult workers (age: $M=42.64$ years, $SD=14.02$; 51.8% males, all participants with $\geq 50\%$ employment rate) completed the online survey (41.1% response rate). Occupational stress was assessed with the Effort-Reward Imbalance (ERI) Scale, and the Job Content Questionnaire. The latter assesses an imbalance between job-related demands and control (JDC). MVPA was measured with the International Physical Activity Questionnaire (IPAQ-Short Form). Burnout symptoms were measured with the Shirom-Melamed Burnout Measure. Two-way interactions were analysed with hierarchical regression analyses, separately for each stress measure.

Results: After controlling for age, sex, education, full/part time employment, marital status, caregiving responsibilities, nocturnal shift work, smoking, and use of psychotropic medication, occupational stress and physical activity were associated with self-reported burnout symptoms ($p < .05$) in the following way: While higher stress scores were associated with increased burnout symptoms (ERI: $\beta = .36$; JDC imbalance: $\beta = .28$), higher physical activity indices were related to lower burnout levels ($\beta = -.32$). Finally, a significant 2-way interaction was found between occupational stress and MVPA ($p < .05$), both for the ERI-model ($\beta = -.14$) and the JDC-model ($\beta = -.11$), showing that if exposed to high stress, participants with higher IPAQ-SF scores report lower burnout symptoms than participants with low physical activity levels (1.2 and 1.6% of variance explained by interaction beyond main effects).

Discussion: Our findings confirm that regular physical activity may have the potential to offset the negative consequences associated with high occupational stress. Due to the cross-sectional nature of the study, no causal Conclusions can be drawn. Moreover, a positive selection

bias may have occurred due to the recruitment Method. Given these limitations, more research is warranted based on longitudinal data and more representative samples.

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4 Mini Oral Session

4.1 Mini Oral Session I

Topics: natural sciences

Keywords: high-intensity interval protocol, hematopoietic stem and progenitor cell mobilization, VO₂, oxidative stress

Hematopoietic stem and progenitor cell number after two different high-intensity interval protocols

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Background:

Acute physical exercise mobilizes hematopoietic stem and progenitor cells (HSPCs) from bone marrow to the circulation. Moreover, circulating HSPC number was found to be directly related to $\dot{V}O_2$ max in an incremental test¹. Although the exact exercise-induced mechanisms affecting circulating HSPC number have not yet been elucidated², exercise-induced oxidative stress was found to increase circulating HSPC number 10 min after exercise³. To assess the degree to which VO₂ during an exercise session and associated exercise-related oxidative stress might be related to HSPC mobilization, we compared HSPC mobilization after a conventional high-intensity interval training (HIIT) session (4min high intensity with 3min low in-between), with a protocol of similar duration and average power but decreasing power-profile within the 4-min intense exercise (DECT), thought to yield a different VO₂-profile. The specific aims were therefore 1. to assess changes in HSPC number following a HIIT or DECT session, 2. to evaluate a possible relationship of mobilized cells with VO₂.

Methods:

17 healthy subjects (10 runners, 7 cyclists) participated in the study. During both DECT and HIIT, average speed/power of intense phases was 85% of maximal speed/power from a previous incremental test. Before and after each exercise session, 23 ml of blood were withdrawn for stem and progenitor cell analysis. CD34⁺/45dim cell number was assessed by flow cytometry. A mixed-model ANOVA and Spearman's correlation were used for statistical analysis.

Results:

Circulating HSPCs decreased below baseline 10 min after both HIIT and DECT ($p < 0.001$, $p < 0.01$ respectively) without interaction between groups. Interestingly, baseline HSPC number was related to HSPC decrease after exercise ($\rho = -0.62$, $p < 0.001$, $n = 33$, two-tailed test). Average VO₂ showed a trend to be higher in DECT ($p = 0.08$, one-tailed t-test), while individual HSPC-decreases were significantly related to the average VO₂ during the intense phases of the exercise session ($\rho = 0.35$, $p < 0.05$, $n = 33$, one-tailed test).

Discussion and Conclusion:

The unexpected decrease of HSPCs 10 min after both exercise sessions might reflect exercise-induced cell apoptosis or cells being recruited into tissue for regenerative purposes, possibly starting already during the low-intensity phases of exercise. A trend towards difference in VO₂ between groups and the significant relationship of session-specific VO₂ with the change in HSPC numbers, but no exercise-induced difference in HSPCs between groups might question oxidative stress as main mobilization mechanisms and warrants further research.

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Topics: natural sciences

Keywords: mini trampoline, rebounding, rebound exercise, cardiovascular exertion, oxygen consumption

Rebounding - an alternative and effective low-impact form of cardiorespiratory exercise

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Background: Finding motivating, low-threshold forms of physical activity (PA) is of great importance especially for inactive, overweight individuals who often lack the motivation to start and adhere to regular PA (1,2). Modern mini trampoline rebounding with the joint-friendly trampolines and trainings that often take place in group settings while incorporating arm and leg movements to music may be a motivating alternative form of PA that seems well-suited for inactive, overweight individuals. Even for well-trained individuals, finding alternative low-impact forms of aerobic exercise can be quite relevant when high-impact activities can no longer be performed due to joint or musculoskeletal injuries.

Aim: To examine the cardiorespiratory exertion during various mini trampoline exercises of different intensities in two target groups and to assess if these exercises can produce exercise intensities for both target groups that concur with current exercise guidelines.

Methods: Physically healthy participants between 18 and 55 years were recruited for the two different characteristic subgroups (Group A: normal-weight, endurance-trained individuals; Group B: inactive, overweight subjects) and participated in two measurement appointments and three short training sessions in between measurement appointments. The primary outcome was the $\dot{V}O_{2peak}$ for each of the six mini trampoline exercises relative to the VO_{2peak} as established during an all-out exercise test on a bike ergometer during the first measurement appointment. Secondary outcomes were mean VO_2 as well as maximum and mean heart rate.

Results: The six mini trampoline exercises generated median $\dot{V}O_{2peak}$ values that ranged from 42% to 81% of the bike ergometer $\dot{V}O_{2peak}$ in the endurance-trained athletes and from 58% to 87% in the overweight subjects depending on exercise. VO_{2mean} values during the six mini trampoline exercises lay between 35% and 69% (endurance-trained athletes) and between 48% and 71% (overweight subjects) in relation to the bike ergometer $\dot{V}O_{2peak}$. Mean heart rate likewise lay in a range that can be categorized as moderate-to-vigorous aerobic exercise for both groups. A moderate-to-strong correlation (0.658 to 0.875, depending on exercise) between bike ergometer $\dot{V}O_{2peak}$ and mini trampoline $\dot{V}O_{2peak}$ was found for all six mini trampoline exercises.

Discussion: Selected mini trampoline exercises of different intensities have the potential to generate exercise intensities that are suitable for cardiorespiratory fitness-improving training in different target groups while the intensities that concur with established exercise guidelines. Because users can self-adjust their exercise intensity, the mini trampoline allows for an effective workout for different users with different fitness levels.

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Topics: natural sciences

Keywords: physical activity measurement, accelerometer, step counting, smartphone, walking; validity

Accuracy of smartphones to measure steps during various walking conditions

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Background: Activity trackers have been shown to motivate inactive individuals to become more physically active (1). In recent years, especially wrist-worn activity trackers have increasingly gained popularity because of their greater wearing comfort compared to hip-worn devices, while the thereby improved wear-time compliance is indispensable for an accurate physical activity (PA) assessment (2,3). A new and promising approach is daily PA tracking via smartphone. Modern smartphones are by default equipped with accelerometers and built-in PA-tracking apps and the fact that there are approximately two billion smartphone users worldwide (4) makes them a potentially excellent tool for PA assessment if proven to be accurate.

Aim: To examine the accuracy of popular smartphone accelerometer applications and a consumer activity wristband to detect steps during various walking conditions while assessing the impact of different phone positions on the accuracy of step detection.

Methods: Twenty volunteers from two different age groups (Group A: 18-25 years, n=10; Group B 45-70 years, n=10) were equipped with three iPhone SE smartphones (placed in pants pocket, shoulder bag, and backpack), one Samsung Galaxy S6 Edge (pants pocket), one Garmin Vivofit 2 wristband, and two ActiGraph wGTX+ devices (worn at wrist and hip) while walking on a treadmill at four pre-defined walking speeds (1.6, 3.2, 4.8, and 6.0 km/h) and completing an outdoor walking course at a self-chosen walking speed. All smartphones included the accelerometer applications Runtastic Pedometer, Accupedo and Pacer in addition to the built-in apps Apple Health and Samsung S Health. Video observation was used as gold standard. Validity was evaluated by comparing each device with the gold standard using mean absolute percentage errors (MAPE).

Results: The MAPE of the iPhone SE (for all phone positions) and of the Garmin Vivofit was small (<3) for treadmill walking ≥ 3.2 km/h as well as for free walking during the outdoor walking course. The Samsung Galaxy and hip-worn ActiGraph showed a small MAPE only for treadmill walking at 4.8 and 6.0 km/h and for free walking. The wrist-worn ActiGraph showed a high MAPE (17-47) for all walking conditions.

Discussion: The iPhone SE including all used apps and Garmin Vivofit 2 are suitable tools to be used for step counting in various walking conditions. The phone's position does not impact the accuracy of step detection, which substantially improves the versatility for physical activity assessment in clinical and research settings.

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Topics: natural sciences

Keywords: hepatic cirrhosis, exercise therapy, high-intensity interval training, advanced liver disease; safety, feasibility.

Is high-intensity interval training safe and feasible in patients with hepatic cirrhosis? A case-study.

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Introduction: Non-alcoholic steatohepatitis (NASH) is a chronic liver condition characterised by elevated liver fat (steatosis), inflammation, hepatocyte ballooning with varying degrees of fibrosis. NASH can progress to liver cirrhosis, which is irreversible and potentially life-threatening. Liver cirrhosis is associated with cardio-metabolic disturbances, severe fatigue, elevated liver enzymes, lower quality of life, and poor physical function. Low cardiorespiratory fitness (CRF) is related to poorer health outcomes, and may contribute to an increased risk of peri- and post-operative complications after liver transplantation (1) (which is the only curative option for decompensated cirrhosis). Therefore, interventions aimed at improving CRF in patients with liver cirrhosis are warranted. The few exercise interventions conducted to date, have consisted of low-to-moderate intensity continuous training (MICT). In other populations, high-intensity interval training (HIIT) has been shown to be superior for improving CRF and cardiovascular health compared to MICT. However, whether HIIT is safe and feasible in patients with liver cirrhosis remains unknown.

Methods: A patient with NASH-related, histologically confirmed (Brunt F4) liver cirrhosis (female, 58 years), plus co-morbid obesity (BMI=47.00kg/m²) and type 2 diabetes (HbA1c 6.9%), underwent 12 weeks of supervised HIIT. The HIIT intervention consisted of 4 bouts of 4 minutes (4x4) at 85-95% peak heart rate (HR_{peak}), interspersed with 3 minutes at 50-60% HR_{peak} 3 times per week on treadmill, while maintaining usual habitual physical activity and diet. In weeks 1 to 3, an increasing number of high-intensity bouts (1x4, 2x4 and 3x4, respectively) was prescribed. Training progressed to the full 4x4 protocol by week 4. Adherence to the exercise sessions and prescribed HR-zones were calculated from training logs. Assessments at baseline and 12 weeks included a graded exercise test on treadmill to determine peak oxygen consumption (V'O_{2peak}), clinical and biochemical measures of liver function and cardiometabolic risk, Physical Activity Enjoyment Scale (PACES) and health-related quality of life (Chronic Liver Disease Questionnaire).

Results: No adverse events occurred. Adherence to the exercise sessions was 100% and adherence to the prescribed HR was 87%. V'O_{2peak} remained stable (17.6 vs 16.7 ml/kg/min), while peak power output slightly increased (1% higher grade). Fatigue levels remained unchanged, and HIIT was rated as enjoyable (PACES, 89%). The hepatic enzymes alanine aminotransferase and aspartate aminotransferase decreased (from 43 to 35 U/L, and from 41 to 34 U/L, respectively). Clinically relevant improvements in cardio-metabolic profile were observed (fasting glucose from 7.7 to 5.7 mmol/L; and blood pressure from 139/78 to 124/72 mmHg) in the absence of significant weight loss (126.6 to 125.5 kg) or reduction in waist circumference (133.4 to 132.0 cm).

Conclusions: This case-study demonstrates for the first time that HIIT can be safely adhered to and enjoyed by patients with liver cirrhosis. Despite no changes in CRF, HIIT lead to clinically meaningful improvements in cardio-metabolic profile. This suggests that HIIT is safe, feasible, and beneficial for patients with liver cirrhosis.

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Topics: natural sciences

Keywords: exercise is medicine, obesity, lifestyle-intervention, intra-hepatic lipids, ectopic fat

Effects of a 16 week lifestyle intervention and of an acute bout of 1h moderate intensity exercise on intrahepatic lipids of obese men

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Background and Aims: Intrahepatic lipids (IHL) accumulation is a critical marker of metabolic dysfunction (1), and has been shown to predict type 2 diabetes independent of the metabolic syndrome. Dietary energy restriction has been demonstrated to reduce IHL, while results from exercise training programs have not been uniform (2). Little data is available on the effect of a real-life lifestyle intervention on IHL in non-diabetic obese individuals, and the relationship between changes in IHL and in cardiorespiratory fitness ($\dot{V}O_2\text{max}$) is unclear. Further, the effect of a lifestyle intervention on the utilisation of IHL during acute exercise is unknown. The aim of this study was to assess the effect of an acute bout (1 h) of moderate-intensity aerobic exercise on IHL content in obese men before and after 4 months of lifestyle intervention comprising dietary energy restriction and aerobic exercise training.

Methods: 18 non-diabetic obese men (body mass index 36.8 ± 3.5 kg/m²) underwent magnetic resonance spectroscopy testing to assess IHL content before and after a 16-week lifestyle intervention comprising dietary calorie restriction and exercise training. At both time points, the change in IHL content in response to an hour of cycling at the intensity corresponding with each participant's maximal whole-body rate of fat oxidation (Fatmax) was evaluated (3). Fatmax was determined via indirect calorimetry during a graded exercise test on a cycle ergometer.

Results: The lifestyle intervention led to weight loss (-10.0 ± 5.4 kg, $p < 0.001$), decrease in visceral adipose tissue ($-28.9 \pm 18.0\%$, $p < 0.001$), as well as to improvements in $\dot{V}O_2\text{max}$ ($+5.2 \pm 3.4$ mL/kg/min, $p < 0.05$), maximal fat oxidation rate ($+0.19 \pm 0.22$ g/min, $p < 0.05$), and insulin sensitivity (29% decrease in homeostasis model assessment score, $p < 0.05$).

IHL decreased by 54.1% in response to the lifestyle intervention, from 23.2 ± 17.9 to $9.3 \pm 10.3\%$ ($p < 0.001$). This decrease in IHL was correlated with the improvement in $\dot{V}O_2\text{max}$ both when expressed relative to body weight ($r = -0.64$, $p = 0.005$) or relative to fat-free mass ($r = -0.62$, $p = 0.003$). In response to acute exercise (1-hour cycling at Fatmax), no change in IHL content was observed either before (23.2 ± 17.9 vs $23.0 \pm 16.9\%$, $p > 0.05$) or after the lifestyle intervention (9.3 ± 10.3 vs. $9.3 \pm 9.8\%$, $p > 0.05$).

Discussion/Conclusion: In summary, a real-life lifestyle intervention comprising dietary energy restriction and exercise training led to a marked decrease in IHL in non-diabetic obese men. The reduction in IHL in response to the intervention was associated with improvement in $\dot{V}O_2\text{max}$, independent of changes in body composition. This highlights the importance of exercise training aimed at improving cardiorespiratory fitness in the management of common metabolic dysregulations of obesity such as fatty liver disease. During acute exercise, no decrease in IHL in response to acute exercise was observed.

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Topics: natural sciences

Keywords: Cardiorespiratory Fitness, Vascular Phenotype, Healthy Aging, Swiss Cohort

COMplete-Health: Cardiopulmonary Exercise Testing and Vascular Phenotype in Healthy Subjects across the Age Span

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Background:

The distinction between healthy aging and a premature occurrence of cardiovascular disease is complex. With the aging process, vascular health parameters become impaired and physical fitness decreases simultaneously. To identify an accelerated reduction in physical fitness and/or early vascular aging, the understanding of the natural patterns of these biomarkers is essential. The COMplete-Health project aims to investigate several physical fitness/activity parameters and cardiovascular biomarkers in healthy subjects across the age span.

Clinical Evidence and Aims:

Cardiorespiratory Fitness (CRF) and Physical Performance with Aging

As one of the most important predictors of mortality, the reduction of CRF will be determined most accurately by cardiopulmonary exercise testing (CPET) [1]. Further, several physical performance parameters such as muscle leg power and maximal strength, the rate of force development, balance and gait performance will be assessed, which are potential determinants of CRF in aging individuals. COMplete-Health will establish physical fitness reference values for the Swiss population and will define healthy aging on a functional basis for all basic motor skills. Analysis of body composition, questionnaires and blood markers will deepen the understanding of functional changes of the aging body.

Vascular parameters, CRF, Physical Activity/Fitness and Aging

To date, only a few population-based studies analysed the association of physical fitness or physical activity with single vascular biomarkers such as pulse wave velocity, retinal diameter or flow-mediated dilation of the brachial artery. However, no study has investigated endothelial function, macro- and microvascular parameters in the same cohort together with the objective measurement of the primary motor components of movement including CPET and physical activity by accelerometry.

COMplete-Health will investigate the natural course of healthy functional (motor components) and vascular (biomarkers) aging in order to determine super-healthy aging phenotypes. The results may have a significant impact on public health policy to keep the Swiss population in good functional health across the life span.

Methods and Results

490 healthy subjects (70 per decade; 20-80+; 50% women) will be randomly recruited in Basel and the district Arlesheim (BL). Recruitment will be based on unaddressed letters. Healthy is defined as the absence of manifest exercise limiting diseases, and substantial risk factor burden.

A follow-up of COMplete-Health is planned in 5 years from the date of termination.

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Topics: social sciences

Keywords: trail running, forums, blogs, training, health, activity, communities of practice

What can we learn from amateur trail runners' activity on online spaces? A proposition of tool enhancement for following-up performance

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Prior research on ultra-endurance has shown that amateur athletes' training habits are mostly self-regulated, meaning that they are likely to participate in online community websites (Krouse et al., 2011). This phenomenon can be understood as characterizing a proper community of practice (Wenger, 1998), in which the online tools can potentially enhance learning and performance, as runners reflect with their peers on how they can better organize their own field practice. However, for intervention purposes, much remains to be done for improving these online tools to sustain a healthy and efficient approach of performance in trail running. Therefore, we focused on the knowledge we may obtain from experience-sharing blogs and forum Discussions and gathered two types of data: the forum Discussions and the blog narratives. The aim of this study was twofold: Firstly characterize the forum topics discussed by trail runners to understand the issues that emerge during actual practice. Secondly, we sought to characterize in-depth race narratives posted on blogs to identify the differences between finishers and withdrawers. 171 Discussion topics on the forum hosted by the Raidlight brand were analyzed using inductive content analysis and 28 blogs posts reporting race narratives were collected (15 blog posts reporting finishing the race and 13 reporting withdrawals). These were coded with the course-of-action Methodology. The Results of the forums distinguished two general dimensions related to training and health, and both were made up of first- and second- order themes. The Results of the blog narratives enabled to restore the succession of meaningful sequences of the race; these sequences were then labeled in function of vitality states (Rochat et al., 2017), which temporal chaining enabled to distinguish finishers from withdrawers. These Results suggested that the issues that trail runners discuss on forums are significant and the successions of questions and solutions are a fruitful means for building, enriching and adjusting their activity to cope with the constraints of their sport. The race narratives posted on blogs showed the relevance of these contents to characterize runners' critical situations they bring forth during their unfolding activity. Taken together, both forums and blogs can be designed for following-up and monitoring performance. As a practical consequence, we suggest a twofold intervention proposition: firstly, the forum Discussion management can be appropriated by specialists to sustain interactions between the scientific field and the community of practice; Secondly, we formulated guidelines to help runners write blog narratives on their past performance to (1) develop their reflective practice and (2) help sport psychologists enhance their follow-up.

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4.2 Mini Oral Session II

Topics: natural sciences

Keywords: Peripheral artery disease, supervised walking exercise, walking capacity, mouse model, muscle inflammation

Walking three or five times a week improve walking capacity to the same extent in a mouse model of peripheral artery disease.

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Purpose: Lower extremity artery disease (LEAD) is a highly prevalent disease characterized by the narrowing of arteries supplying the lower limb secondary to atherosclerosis (Fowkes et al., 2013). This condition leads to a decreased blood flow, and eventually to ischemic muscle cramping pain during exercise, resulting in walking capacity (WC) impairment. Supervised walking exercise is indicated as first line therapy to improve WC in LEAD patients (Aboyans et al., 2017). However, little information exists in the scientific literature about the optimal exercise frequency.

Aim: Compare the effects of three versus five exercise sessions/week in improving WC in a mouse model of LEAD.

Design/Methods: Hindlimb ischemia was generated in C57BL/6 apolipoprotein E knock-out atherosclerotic mice by right common iliac artery ligation (Pellegrin et al., 2014). One week post-ischemia (i.e. baseline), mice were divided into three groups: sedentary control, 3x/week exercise, and 5x/week exercise. Training consisted in treadmill walking for 7 weeks (40min/session, 20cm/sec). WC was assessed by measuring maximal walking distance using a treadmill running incremental test until exhaustion. Ischemic limb perfusion was assessed using laser Doppler imaging. Real-time RT-PCR was performed on ischemic quadriceps muscles to assess muscular inflammation status.

Results: Maximal walking distance significantly improved in 3x/week exercise (baseline: 311±67m vs. end of the study: 492±170m) and 5x/week exercise mice (267±100m vs. 491±304m). The extent of improvement did not significantly differ between the groups (3x/week: 58% vs. 5x/week: 83%). mRNA expression of pro-inflammatory cytokine IL-1B in ischemic quadriceps significantly decreased by 53% in 3x/week exercise compared to sedentary mice. CD11c/CD206 mRNA expression ratio (pro-inflammatory M1/anti-inflammatory M2 macrophage balance marker) significantly decreased in 3x/week exercise and 5x/week exercise mice compared to sedentary. No significant change in ischemic hindlimb perfusion was observed between baseline and end of the study in any group.

Conclusion: Three and five times supervised walking exercise per week are equally effective in improving WC in a mouse model of PAD. Supervised walking exercise modulates muscular inflammatory status.

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Topics: social sciences

Keywords: Implicit association, STIAT, basic motor competencies, MOBAK, MVPA

Implicit associations towards sport are correlated with basic motor competencies, but not with the amount of everyday physical activity in 11-14 years old children

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Background

Interventions with the target to increase physical activity usually focus on conscious regulatory processes and explicit attitudes. Recent research aggregated evidence, that not only explicit attitudes, but also implicit associations and attitudes influence behavior (Rebar et al., 2016). Therefore, the investigation of implicit associations has become more and more prominent. Implicit associations are spontaneous, involuntary attitudes or evaluative reactions on a non-conscious level. In the present study, we investigate if non-conscious implicit attitudes towards sports are related to basic motor competencies and everyday moderate-to-vigorous physical activity (MVPA).

Method

Participants were recruited from 3 different schools in Basel, Switzerland, and Leipzig, Germany (N=91, age 11-14 years, 57 % male). Implicit associations towards sport were measured using a computerized, reaction time-based single target implicit association test (ST-IAT). Basic motor competencies were assessed with the test battery MOBAK-5 (Herrmann & Seelig, 2017), leading to a "Self-movement" and an "Object movement" score (range 0-8). Accelerometry over the course of 7 days was used to measure MVPA in everyday life. For ST-IAT, a D-score (Blanton, Jaccard, & Burrows, 2015) was calculated, ranging from -2 to 2 with scores closer to 0 interpreted as less extreme standing on the construct of interest. Partial correlations, controlling for ST-IAT sequence, were calculated. P-values were considered statistically significant at a level of $p \leq 0.05$.

Results

Data from 6 participants were excluded due to missing values. Descriptive statistics revealed a mean (SD) D-Score of 0.08 (0.3), mean MVPA of 127 (43) minutes per day, a mean score in "Self-movement" of 3.0 (2.1) and a mean score in "Object movement" of 3.6 (1.6). Analysis of partial correlations showed significant positive correlations of ST-IAT D-score with the MOBAK scales "Self-movement" ($r(84)=.26$, $p=.017$) and "Object movement" ($r(84)=.23$, $p=.034$). No significant correlations were found with MVPA ($r(84)=.05$, $p=.676$).

Discussion

It was hypothesized that implicit associations correlate with basic motor competencies and everyday physical activity. The Results suggest that in children aged 10-14 years, basic motor competencies, but not the amount of everyday MVPA, are related to non-conscious attitudes towards sports. A possible interpretation is, that positive and negative implicit associations towards sports might develop based on one's skill level, and are less related to the actual amount of physical activity. This might be relevant for future interventions with the target to increase physical activity.

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Topics: natural sciences

Keywords: sedentary behaviour, screen time, children, wearable cameras, accelerometer

Intensities of screen and non-screen sedentary activities in Swiss children

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Background: Sedentary behaviour (SB) is recognised as one of the main health risk factors. Therefore knowledge about strategies to reduce SB is important. But so far only little is known about types and contexts of SB in children. Accelerometers can identify SB by intensity, but not the type or context in which they take place. The purpose of this study was to investigate the intensity of SBs depending on their context or type in Swiss children by means of wearable cameras.

Methods: 34 children (age: 10.48±0.63 years; 12 girls, 13 boys) wore an Autographer wearable camera and an Actigraph GT3X accelerometer during leisure time for five weekdays of free-living activities. Leisure sedentary time was identified by annotating Autographer images into categories of sedentary types or contexts following a protocol derived from the International Taxonomy of Sedentary Behaviour (Chastin 2013). Annotated categories included 10 non-screen SBs (such as reading, playing quietly, re-laxing) and 7 screen based behaviours (such as mobile phone, tablet or TV use). Mean counts per minute (mcpm±SD) within sedentary activity types were calculated using time-aligned ActiGraph data and classified by the SB threshold of 100 mcpm.

Results: Autographer images and the associated Actigraph data from 38 days and 18 children were taken into account for analysis. In total, 1227 episodes of sedentary categories were annotated. 29 % of all images were not categorized as they were not codable or did not show a SB. 62% of the images were annotated as a non-screen sedentary activity and 9% of the images were annotated as screen based behaviours. Based on the accelerometer data, only iPod, tablet use and writing were correctly classified by the 100 mcpm cut point as SB. All other "SBs" (92%) were categorised as light activities. The mean duration of episodes varied greatly between the different categories. Using a tablet (duration 15.39±11.84 min), computer use (13.47±14.42 min) and playing or listening to music (11.30±11.15 min) were the longest episodes while relaxing, sitting, talking (4.37±7.42 min), household (3.70±4.27 min) and personal care (2.83±4.68 min) were the shortest episodes.

Discussion: Screen based activities showed to be the longest sedentary activities in children. However, the activity level when performing SBs greatly differed depending on the type and context so that a great percentage of activities that were classified as SB based on the camera data can nevertheless be considered as light activities based on the accelerometer data. This questions whether the threshold for SB of 100 mcpm that was previously defined for adults may also serve as a cut point for children or whether activities that might be regarded as SB in adults do not necessarily have the same characteristics in children.

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Topics: natural sciences

Keywords: advanced glycation end products, physical activity, physical inactivity, children, obesity

Influence of physical activity and fitness on advanced glycation end-product accumulation in children

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Introduction

Advanced glycation end-products (AGEs) accumulate in patients with cardiovascular disease[1]. Physical inactivity and obesity have been shown to be associated with an increased accumulation of AGEs in adults [2,3]. Physical fitness has been shown to influence the glycolytic pathway. In our study, we aimed to investigate whether physical fitness and activity are associated with AGEs accumulation in children.

Methods

In this cross-sectional study, 1089 primary school children (aged 7.2±0.4years) were screened for AGEs (skin autofluorescence (AFR)), cardiorespiratory fitness (20m shuttle run), physical activity (questionnaire), body mass index (BMI) and blood pressure (BP) by standardised procedures. Group comparisons were performed either in clinical categories or in quartiles using univariate analysis of variance (ANOVA). Association of AFR with physical activity/fitness and cardiovascular risk factors was performed by use of regression analysis.

Results

Shuttle run stages were associated with higher accumulation of AGEs [-0.033(95% CI: -0,041; -0,024) measuring units (mu)/ unit shuttle run, P<0.001]. Children with the highest fitness level (AFR: 0,99 +/- 0,13mu) had lower AGEs compared to unfit children (1,10 +/- 0,01mu) (P<0.001). Comparing the lowest quartile (AFR: 1.00 +/- 0,01mu) to the highest quartile (1.12 +/- 0,02mu) in sedentary behavior, an increased AGEs accumulation was found in inactive children (P<0.001). BMI was associated with AGEs accumulation (p=0.042), but the positive association was not independent of age and gender (p=0.089). Blood pressure was not associated with AGEs in our cohort(p=0.593).

Discussion/Conclusion

Both physical fitness and low physical inactivity are associated with lower levels of subcutaneous AGEs. Since AGEs are associated with an impaired glucose metabolism and increased cardiovascular risk in adults, physical fitness in young children seems to play an important role in the prevention of metabolic disease during childhood. The reduction of AGEs may be a key mechanism by which exercise improves cardiometabolic health in children.

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Topics: social sciences

Keywords: Teamkognitionen, Teamkoordination, verbale Kommunikation, Entwicklung, Teamsport

Teamkognitionen im Mannschaftssport - Entwicklung impliziter und expliziter Koordinationsmechanismen durch gemeinsame Trainingserfahrungen im Kontext Nachwuchsspitzenfussball

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Theoretischer Hintergrund. Teamhandlungen (z.B. Doppelpässe) bestehen aus einer Summe von Einzelhandlungen, die idealerweise flüssig ineinander übergehen und somit gut koordiniert ablaufen. Effektive und effiziente Teamhandlungen und Teamleistungen sind u.a. abhängig von der Entwicklung von Teamkognitionen (McNeese, Cooke, Fedele & Gray, 2017). Teamkognitionen sind einerseits als geteilte oder sich ergänzende Wissensbestände über Spielsituationen, Mitspieler, Handlungsoptionen etc. oder andererseits als direkte oder indirekte Kommunikation in der Interaktion der Teamhandlung selbst zu verstehen. Insbesondere in interaktiven Mannschaftssportarten (z.B. Fussball), welche sich durch eine hohe Dynamik und Offenheit des Spielgeschehens und damit verbunden kurzen Erfassungs-, Planungs- und Entscheidungsphasen sowie grossem Zeit- und Organisationsdruck charakterisieren lassen, werden Teamkognitionen als essentiell erachtet. Einer impliziten Koordination der Einzelhandlungen, welche auf geteilten und sich ergänzenden Wissensinhalten beruht, wird gegenüber einer expliziten Koordination, die auf verbaler Kommunikation basiert, insofern einen Mehrwert zugeschrieben, dass sie ohne zusätzliche kognitive Kosten vonstattengehen kann und ein schnelles und anstrengungsloses Zusammenspiel, einen Spielfluss erlaubt. Der Entwicklung geteilter Wissensbestände bzw. eines gemeinsamen Teamspielverständnisses innerhalb interaktiver Sportarten ist deshalb Rechnung zu tragen. Diese Studie hatte zum Ziel, bislang fehlende empirische Überprüfungen im Kontext Teamsport anzugehen und erste feld-/praxisnahe Erkenntnisse im Spilsport Fussball zu liefern. **Fragestellung.** Generell wird angenommen, dass sich durch gemeinsame Trainings- und Wettkampferfahrungen Teamkognitionen automatisch entwickeln. Bislang liegen aber keine empirischen Befunde dazu vor. Die Studie greift diese Forschungslücke auf und untersucht, ob sich implizite und explizite Teamkognitionen durch gemeinsame Trainingserfahrungen entwickeln. **Methode.** U18 und U21 Nachwuchsspitzenfussballer (N = 40) absolvierten in Duos zu zwei Messzeitpunkten drei Testläufe auf Zeit in einer halbstandardisierten Pass-/Laufkombinationsaufgabe mit den Elementen Hinterlaufen und Doppelpass. Nach einer Einübungsphase und vor den jeweiligen Messzeitpunkten wurden per Fragebogen Wissensbestände über die eigenen und die antizipierten Handlungen des Mitspielers, sowohl als Passgeber als auch als Passempfänger, erhoben. Die Fragen ermittelten dabei die Koordinationsparameter Art und Weise der Handlung (Passschärfe und Ballverarbeitung), Lokalität der Handlung (Spielen/Annahme des Passes in den Fuss vs. Lauf) und Timing der Handlung (frühe vs. späte Ballabgabe/Ballforderung). Während der Aufgabe wurden die verbalen Kommunikationsinhalte der Spieler per Rundmikrofon aufgezeichnet. Zwischen den einzelnen Testläufen sowie den beiden Messzeitpunkten wurden die 2er Teams örtlich getrennt, um auf Planung und Absprache basierte Wissensbestände zu unterbinden. **Ergebnisse.** Die Wissensinhalte, operationalisiert als geteilte und komplementäre Übereinstimmungsindizes, nähern sich vom ersten zum zweiten Messzeitpunkt signifikant an ($\eta^2 = .19, p < .05$ bzw. $\eta^2 = .59, p < .05$). Gleichzeitig nimmt die verbale Kommunikationshäufigkeit bedeutsam ab ($\eta^2 = .19, p < .05$). **Diskussion.** Die Studie konnte zeigen, dass sich durch gemeinsame Trainingserfahrungen implizite Teamkognitionen herausbilden und sich der explizite Koordinationsmechanismus reduziert. Ein potenzieller und nachvollziehbarer Wechsel von expliziter zu impliziter Koordination der Einzelhandlungen ist dadurch angezeigt. Aufgrund eines fehlenden Zusammenhanges dieser beiden Mechanismen, muss aber davon

ausgegangen werden, dass zwei eigenständige Systeme zur Koordination von Teamhandlungen vorliegen.

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Topics: social sciences

Keywords: Lehrertraining, Unterrichtsbeobachtung, Selbstkonzept, Evaluation

Effekte einer Weiterbildung zu selbstkonzeptförderndem Sportunterricht: Erste Befunde zum Einfluss auf die Unterrichtsinszenierung der Lehrpersonen

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Ausgangslage

Die Förderung des Selbstkonzepts stellt ein wichtiges Ziel des Sportunterrichts dar (EDK, 2005). Verschiedene Interventionsstudien haben in den vergangenen Jahren gezeigt, dass sich das Selbstkonzept von Schülerinnen und Schülern durch sportliche Aktivität fördern lässt, insbesondere durch individualisierten und reflexiven Sportunterricht (Conzelmann, Schmidt & Valkanover, 2011). Allerdings wurde auch deutlich, dass eine einmalige Instruktion der Lehrpersonen nicht ausreicht, um diese zu einer langfristigen selbstkonzeptfördernden Unterrichtsinszenierung anzuleiten (Magnaguagno, Schmidt, Valkanover, Sygusch & Conzelmann, 2016). Hierfür benötigen Lehrpersonen spezifische Handlungskompetenzen, welche sich beispielsweise in Lehrertrainings erwerben lassen (Hertel, Pickl & Schmitz, 2008). Vor diesem Hintergrund interessiert, ob eine Weiterbildung zu selbstkonzeptförderndem Sportunterricht dazu führt, dass Lehrpersonen ihren Sportunterricht vermehrt nach selbstkonzeptfördernden Prinzipien gestalten und spezifische Methoden wie positiv-konstruktives Feedback, Reflexion und Individualisierung einsetzen.

Methode

Die Weiterbildung besteht aus fünf Modulen, welche über fünf Monate verteilt stattfinden. In den Modulen vertiefen Lehrpersonen unter Rückgriff auf eigene Unterrichtserfahrungen didaktisch-Methodische Aspekte einer selbstkonzeptfördernden Sportvermittlung. Mittels quasi-experimentellem Design wird der Einfluss der Weiterbildung auf die selbstkonzeptfördernde Unterrichtsinszenierung untersucht. Die Stichprobe umfasst aktuell $N = 27$ Lehrpersonen, wobei 20 Lehrpersonen in der Versuchsgruppe (70% ♀; MAlter = 37.6 Jahre; SDAlter = 9.8) und 7 Lehrpersonen in der Vergleichsgruppe sind (71% ♀; MAlter = 31.0 Jahre; SDAlter = 8.7). Die Inszenierung eines selbstkonzeptfördernden Sportunterrichts wird mit einer strukturierten und passiv teilnehmenden Unterrichtsbeobachtung erfasst. Dabei werden vor sowie nach der Weiterbildung 45 Minuten des Sportunterrichts von drei Ratern hinsichtlich der Dimensionen Reflexion, Individualisierung und positiv-konstruktives Feedback auf einer vierstufigen Likert-Skala von 1 (Unterricht ist nicht so akzentuiert) bis 4 (Unterricht ist deutlich so akzentuiert) beurteilt. Mittels zweifaktoriellen Varianzanalysen mit Messwiederholung werden die Daten ausgewertet.

Ergebnisse

Die Auswertungen zeigen, dass Lehrpersonen ihren Sportunterricht nach der Weiterbildung im Vergleich zur Kontrollgruppe reflexiver ($F(1, 25) = 12.854, p = .001, \eta^2 = .340$) und individuumsbezogener ($F(1, 25) = 7.971, p = .009, \eta^2 = .242$) unterrichten. Der Interaktionseffekt beim Feedbackverhalten fällt zu gering aus, als dass er inferenzstatistisch abgesichert werden könnte ($F(1, 25) = .753, p = .395, \eta^2 = .029$).

Diskussion

Die Ergebnisse des Beitrags stellen erste Befunde einer umfangreichen Evaluationsstudie dar. Es wird deutlich, dass die Lehrpersonen entsprechend den Zielsetzungen des Weiterbildungs-

programms vermehrt spezifische Methoden zur Selbstkonzeptförderung einsetzen. Ob die erzielten Effekte auch langfristig Bestand haben, kann zum jetzigen Zeitpunkt noch nicht beantwortet werden, da die Follow-up-Erhebungen noch nicht abgeschlossen sind.

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Topics: natural sciences

Keywords: lung function, children, physical fitness, body mass

Association of lung function with body mass and physical fitness in primary school children

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Abstract

Background: There is an increasing prevalence of obesity and pulmonary dysfunction in children worldwide. [1,2] Although lung function has been associated with childhood obesity and physical fitness, its interrelation remains unclear in young children.[3,4] We investigated the association of lung function with body mass index (BMI) and physical fitness in primary school children of Basel-Stadt (Switzerland).

Methods: In a cross-sectional approach, lung function (mobile device), BMI and physical fitness (shuttle run) were measured in a cohort of 1440 children between the ages of 6 and 8 years. Multiple linear regression and ANOVA were used for correlation and group analysis.

Results: There was a negative association between BMI and the ratio of forced expiratory volume in one second to forced vital capacity (FEV1/FVC ratio) [-0.033 (95% CI: -0.005; -0.001), $p < 0.001$] but a positive association with forced expiratory volume in one second (FEV1) [0.027 (95% CI: 0.021; 0.033), $p < 0.001$], forced vital capacity (FVC) [0.036 (95% CI: 0.029; 0.043), $p < 0.001$], peak expiratory flow (PEF) [0.044 (95% CI: 0.027; 0.061), $p < 0.001$] and forced expiratory flow at 25 to 75% (FEF25-75) [0.019 (95% CI: 0.006; 0.031), $p = 0.001$] adjusted for age, sex and 20-m shuttle run respectively. The FEV1/FVC ratio was not associated with physical fitness [-0.002 (95% CI: -0.004; 0.001), $p = 0.171$], while FEV1 [0.017 (95% CI: 0.007; 0.026), $p = 0.001$], FVC [0.019 (95% CI: 0.008; 0.030), $p = 0.001$], PEF [0.054 (95% CI: 0.028; 0.081), $p > 0.001$] and FEF25-75 [0.026 (95% CI: 0.006; 0.046), $p = 0.010$] were positively correlated to fitness when adjusted for age, sex and BMI.

Conclusion: The FEV1/FVC ratio decreases with increasing BMI due to a disproportional increase of FEV1 and FVC with increasing BMI. Lung function is associated with physical fitness in young children, however, FEV1/FVC does not seem to be the ideal lung parameter for cardiopulmonary health screening in school children.

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4.3 Mini Oral Session III

Topics: natural sciences

Keywords: motor control, motor performance, central fatigue, repetitive movements, neuroimaging

Supraspinal contributions to motor slowing

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It has been demonstrated that performance of repetitive movements tends to deteriorate over time [1]. A similar phenomenon has been revealed for movements executed at submaximal force levels. For example, 7-9s of finger tapping at the maximal voluntary rate is sufficient to induce a significant performance decrease [2]. We have previously shown that this phenomenon of motor slowing cannot be explained by peripheral or muscular fatigue at or distal to the neuromuscular junction by using peripheral nerve stimulation. With the present series of experiments, we show that breakdown in performance happens at the level of the brain. In a multimodal approach, we performed three different experiments using electroencephalography (EEG), transcranial magnetic stimulation (TMS) and functional magnetic resonance imaging (fMRI) to shed light into the brain mechanisms involved in motor slowing.

All experiments compared short periods of finger tapping (10s tapping followed by a 30s break) to motor slowing evoked by longer periods of finger tapping (30s tapping followed by a 30s break). In general, tapping for 30s resulted in significant motor slowing when the first 10s were compared to the last 10s.

In Exp. 1 we applied EEG in 17 subjects and showed that EEG alpha power was strongly reduced immediately after tapping but recovered during the subsequent 30s of rest. Importantly, alpha rhythm was significantly more suppressed after 30s than after 10s of tapping (rmANOVA, tapping*time interaction; $p < 0.05$).

In Exp. 2 we used TMS in 13 subjects and found that short interval intracortical inhibition (SICI) was strongly increased immediately after tapping but recovered during the subsequent 30s rest. Analogous to the alpha rhythm, SICI was significantly larger after 30s than after 10s tapping (linear mixed effects model, tapping*time interaction; $p < 0.05$).

In Exp. 3 we measured fMRI in 25 subjects to test whether motor slowing involves brain areas beyond primary motor cortex. We found that motor slowing leads to a significant increase in activation of a complex motor network involving primary motor cortex, premotor cortex and supplementary motor area (tapping*time interaction, $pFWE < 0.05$).

Our Results provide evidence that supraspinal rather than peripheral processes are associated with motor slowing, which is typically observed when sub-maximal movements are repeated over a longer time interval. Moreover, both EEG alpha rhythm and SICI measured during rest immediately after tapping dissociated the 30s from the 10s-tapping condition, which suggests that motor slowing leads to a breakdown of inhibition at the supraspinal level. We speculate that this breakdown reflects a decrease in surround inhibition, which leads to increased co-contractions of agonistic and antagonistic muscles and consequently to motor slowing. This

breakdown of inhibition in turn is compensated by an overall activity increase of the motor system.

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Topics: social sciences

Keywords: Physical activity promotion, telephone coaching, participants' adherence, SMS prompting

Participants' Adherence and Perception of the Individually Tailored Physical Activity Promotion Program Movingcall©: Effects of Telephone-Based Coaching and Prompting.

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Introduction

Lifestyle interventions including individually tailored program components, behaviour change techniques (BCT) [1], personal coaching and regular prompting are considered effective means to sustainably promote physical activity (PA) [2]. Web-based PA interventions suffer from high dropouts and it is not clear, which intervention components can be feasibly adopted in practise. To enable a better understanding of individually meaningful program components we analysed participant's perception and adherence to our telephone-based PA promotion program.

Methods

291 initially inactive participants (age: 20 to 65 y) were randomly assigned to three different intervention arms of a 6-months lasting PA promotion program: A minimal intervention group (control) received one written PA recommendation. The remaining groups received 12 telephone coachings with additional SMS that prompt behavioural change (prompting) or a coaching alone (coaching). The program consists of ten evidence-based and individually tailored BCTs. All participants had access to a personal activity profile (www.movingcall.com). The SIMPAQ interview [3] was used to assess self-reported PA. Participants' perception was assessed by a 4-point Likert-scale online questionnaire. Adherence was measured by a) active edits on the activity profile and b) the amount of people lost to post assessment. This preliminary analysis refers to 237 participants that received the online questionnaire and 167 that have completed intervention.

Results

Included participants (31% male) were 43 (SD: 11) y of age and had a BMI of 25.7 (5.4) kg/m². 62 (99) min/week of moderate PA were self-reported. Over 90% of the prompting and coaching groups and 23% of the control group rated the program "supportive" in order to reach personal PA goals. 71% of the participants in the prompting, 66% of the coaching and 28% of the control group report that they have "increased their PA". Additional SMS prompts were rated "supportive" (91%). However, prompting did not reveal additional benefit on the program satisfaction. In all groups, "problem solving" (67%), "goal setting (behaviour)" (57%) and "review behaviour goal(s)" (55%) were rated as important to change PA. However specific action planning and advice on how to include PA in everyday live were most often labelled as the most important advice for regular PA. Participants in the coaching groups showed more homepage-edits (prompting 22, coaching 21 per month) compared to participants in the control group (10 per month). Dropout rate was higher in control (19%) but similar in the coaching (8%) and prompting (7%) group.

Discussion

Telephone coaching for PA promotion is well accepted by Swiss adults but additional SMS prompts do not increase participants' satisfaction with the program or self-rated PA. Participants emphasise the importance of "action planning", "problem solving" and "goal setting".

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Topics: natural sciences

Keywords: shoulder, isokinetics, swimming

Shoulder muscular imbalance as a risk factor for shoulder injury in swimming: a prospective study

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Background: Shoulder rotator muscles imbalance has been reported as a risk factor for injury in overhead athletes, but the predictive value of this parameter remains unclear in swimmers.

Objective: 1/ to characterize individual parameters associated with shoulder rotator muscle imbalance in a cohort of high-level adolescent swimmers; 2/ to assess the predictive value of this imbalance with respect to shoulder injuries.

Method: participants from a high-level training pole participated in 2 identical evaluation sessions before and after the season. Anthropometric data, training habits, performances and previous injuries were collected. They benefited a standardized clinical exam and performed a bilateral concentric and eccentric isokinetic test of shoulder internal (IR) and external (ER) rotator muscles. A longitudinal follow-up was performed to collect injuries and training time loss.

Results: Eighteen swimmers completed the 1st session. Those reporting previous injuries had a significantly greater IR range of motion (57.9° vs 50.9°, $p < 0.05$). Peak torque did not differ between dominant and non-dominant shoulder, and were positively associated with age for both muscle groups and contraction mode ($p < 0.01$). The functional ratio (ERecc/IRconc) significantly decreased with years of practice ($R = 0.54$; $p < 0.05$). Thirteen swimmers completed the follow-up, Peak torque significantly increased throughout the season for IR and ER only in concentric mode ($p < 0.05$). The functional ratio significantly decreased ($p < 0.05$), with a pre-season value < 0.68 being associated with a higher relative risk for shoulder injury (RR=4.5, 95% CI: 1.33-15.28; $p < 0.05$).

Conclusion: Rotator muscle imbalance was associated with years of practice and modified throughout the season in this cohort. A pre-season functional ratio below 0.68 appears to be a risk factor for subsequent shoulder injury.

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Topics: natural sciences, sciences sociales

Keywords: Talent, Potenzial, Leistungsvoraussetzungen, Diagnostik, Nachwuchsleistungssport

Kann man Potenzial messen? Entwicklungsgemäße Leistungsdiagnostik in den leichtathletischen Wurfdisziplinen

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Im Deutschen Leichtathletik-Verband (DLV) wurden lange hauptsächlich Leichtathleten in die Nachwuchskader berufen, die herausragende Wettkampfleistungen erzielten. Dabei war den meisten Trainern bewusst, dass Faktoren, wie der Status der Geschlechtsreife oder das Trainingsalter das Ergebnis massiv beeinflussen können. Es herrscht Konsens, dass die erfolgreichsten Nachwuchsathleten nicht notwendigerweise auch diejenigen sind, die über das größte Potenzial für zukünftige Spitzenleistungen verfügen (Wulff et al., 2013).

Um die Kluft zwischen dem Wissen „Potenzial und Leistung sind nicht gleichzusetzen“ und dem Tun „Nur die leistungsstärksten Athleten werden in die Kader berufen“ zu überwinden sollte ein neues durchgängiges und transparentes Auswahlkonzept erarbeitet werden. Neben der Wettkampfleistung sollten konstitutionelle, konditionelle, koordinativ-technische und psychosoziale Leistungsvoraussetzungen, das Entwicklungstempo und die sportliche Biographie der Athleten einbezogen werden (Buekers et al., 2015; Hohmann, 2009). Außerdem stellte der Verband die Anforderung, dass die Auswahlinstrumente disziplinspezifisch ausdifferenziert sind, den aktuellen Kenntnisstand der Talentforschung widerspiegeln und praxistauglich eingesetzt werden können - eine Quadratur des Kreises?

Der Prozess war auf die Nachwuchsbundestrainer, deren Bedürfnisse, Wünsche und Erwartungen ausgerichtet. Sie waren permanent am Veränderungsprozesses (human-centered design) beteiligt:

1. Beobachten und Verstehen

Im ersten wichtigen Schritt wurde die Ausgangslage in den Disziplinen ausführlich analysiert. Welche Leistungsvoraussetzungen sind relevant und welche Tests kommen in welchen Altersklassen zum Einsatz? Welche auswertbaren Daten liegen schon vor? Welche Vorstellungen und Erwartungen haben die Trainer? Was brauchen sie für die Umsetzung der neuen Ideen?

2. Aufgaben definieren und Ideen sammeln

Nach dem Abgleich der aktuellen Situation mit dem Erkenntnisstand der Wissenschaft wurden Aufgaben gemeinsam mit den Trainern definiert, um den fundierten Vorstellungen Schritt für Schritt näher zu kommen.

3. Instrumente weiter oder neu entwickeln

Für Leistungsvoraussetzungen, wie z.B. die Psyche oder koordinative Fähigkeiten, sollten neue Testverfahren entwickelt werden. Für etablierte, insbesondere sportmotorische Tests und Technikbewertungen wurden die Durchführungs- und Auswertungsstandards vereinheitlicht und fixiert.

4. Testen und Feintuning

Im Jahr 2016 wurden alle Verfahren mit ca. 150 15- bis 18-jährigen Kaderathleten erstmalig getestet. Im Nachgang tauschten Trainer und Wissenschaftler die Erfahrungen aus und nahmen Modifizierungen vor. 2017 hat der DLV in den Kaderbildungsrichtlinien festgeschrieben, welche Leistungsvoraussetzungen in den Altersklassen wie getestet werden müssen. So ist es den Trainern möglich, auch Athleten ohne nennenswerte Erfolge in die Kader zu berufen.

Beginnend mit dem Jahr 2017 werden die Nachwuchsleistungssportler von 15 bis 19 Jahren mindestens 2 mal pro Jahr standardisiert getestet.

5. Evaluieren

Der DLV betrachtet die wissenschaftlich gestützte Evaluation in Zukunft als einen wesentlichen Faktor für die Optimierung der Erfolgchancen bei internationalen Meisterschaften (DLV, 2017). Das wichtigste Merkmal für das Gelingen dieses Vorhabens ist sicher, ob die entwickelten oder modifizierten Testverfahren bei der Potenzialeinschätzung helfen können. Die Analyse der prognostischen Validität, d.h. wie gut sich die Prognose durch die spätere Leistungsfähigkeit bestätigt, steht aus.

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Topics: social sciences

Keywords: Karrierende, Leitfaden, Spitzensport, Sportpsychologie, Transition

Leitfaden zur optimalen Unterstützung von Spitzensportlerinnen und –sportlern beim Karrierende

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Theoretischer Hintergrund:

Karriereübergänge sind ein wichtiges Thema in sportpsychologischen Beratungen, da sie potenzielle Stolpersteine in der Entwicklung eines Athleten darstellen können. Wenig Beachtung fand bisher die Transition aus dem Sportlerleben in eine nachsportliche Karriere. Ziel des hier vorgestellten Leitfadens ist es, Sportpsychologinnen und Sportpsychologen, welche Athletinnen und Athleten in dieser Lebensphase beraten, ein evidenzbasiertes systematisches Vorgehen zu ermöglichen.

Methode:

Basierend auf einer Literaturrecherche wurde ein Interviewleitfaden zur Arbeit mit Athletinnen und Athleten in der Phase des Karriererücktritts zusammengestellt. Diese basieren auf dem Arbeitsmodell von Küttel et al. (2017), dem holistischen Lebensspannenmodell von Wylleman & Lavallee (2004) und dem FTEM (Foundations, Talent, Elite, Mastery) Modell von Gulbin et al. (2013). Gemäss Küttels et al. Arbeitsmodell sind drei Bereiche für eine erfolgreiche Transition zu berücksichtigen: tief wahrgenommene Anpassungsprobleme in unterschiedlichen Lebensbereichen, eine kurze Dauer im Anpassungsprozess und eine hohe Zufriedenheit mit der Transition. Das Lebensspannenmodell schlägt fünf zu berücksichtigende Ebenen in der Transition von Athletinnen und Athleten vor (Sport, psychische sowie psychosoziale Entwicklung, Ausbildung/Beruf; Finanzen). Diese wurden mit den zehn Entwicklungsphasen aus dem FTEM Modell kombiniert. Aufgrund der Literaturrecherche wurden vor dem Hintergrund dieser drei Modelle Theorien, Modelle und Erkenntnisse zum Karrierende gesichtet. Prädiktoren für die Qualität der Transition sind gemäss der Literatur Anforderungen der Transition, mögliche Ressourcen und Barrieren, Charakteristiken des Individuums, der Karriere, des Karriereendes und des Umfeldes.

Ergebnisse:

Basierend auf diesen Erkenntnissen wurde ein Ablaufschema mit relevanten Fragen entworfen, welche eine Sportpsychologin oder ein Sportpsychologe im Beratungsprozess zur Begleitung des Karriereendes einsetzen könnte. Beispielfragen daraus sind: Was waren deine Karrierehighlights? Was waren deine Karriereziele? Wie zufrieden bist du mit deiner sportlichen Karriere? Wie unterstützend nimmst du dein sportliches und privates Umfeld wahr? Trittst du freiwillig zurück? Ziel der Arbeit in der Phase des Karriererücktritts sollte sein, Anpassungsprobleme zu minimieren, die Dauer des Prozesses zu verringern und die Zufriedenheit mit der Transition zu erhöhen.

Diskussion:

Richtlinien zur Begleitung des Karriereendes sollten daher ganzheitlich sein und die Entwicklung der Athletinnen und Athleten in ihrer ganzen Lebensspanne berücksichtigen.

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Topics: social sciences

Keywords: Nachhaltigkeit, Regionalentwicklung, Standortförderung

Wissenschaftliche Belegung des Modells zur „Standortförderung durch Sport“

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Theoretischer Hintergrund

Es gibt bereits sehr viel Literatur über die Nachhaltigkeit von Sportevents (u.a. Müller, H. et al., 2008). Im Rahmen einer Nachhaltigkeitsstudie für die mögliche Kandidatur der Olympischen Spiele in Graubünden 2022 wurden verschiedene Bereiche formuliert, welche durch den Mega-Event tangiert würden: Infrastruktur, Innovation & Technologie, Netzwerk & Businessplattform, Medien & Image, Tourismus, Sport & Excellence, Gesellschaft & Kultur, Umwelt & Landschaft (Rütter, H. & Stettler, J. 2013). Demgegenüber findet sich jedoch kaum Literatur zu den allgemeinen Auswirkungen von Sportangeboten auf eine Region und wenn ja, dann in Form von Wertschöpfungsanalysen (Brunner, 2012).

Fragestellung

In diesem Projekt soll nun die Nachhaltigkeit weiterer sportlicher Angebote untersucht werden. Das Modell „Standortförderung durch Sport“ veranschaulicht die wechselseitigen Wirkungen, welche in der Regionalentwicklung durch Sport entstehen. Das Modell wurde ursprünglich für einen Dienstleistungsauftrag entwickelt (Wetzel, C. et al., 2013) und vermehrt verwendet (Näf et al., 2017; Bosshard et al., 2017). Es besagt, dass Sport in jeglicher Form einem Standort zur Förderung in folgenden Bereichen verhilft: Angebote & Dienstleistungen, Events & Wettkämpfe, Ausbildung & Betreuung und Infrastruktur. Diese Bereiche würden sich gegenseitig ergänzen und fördern. Der Vorteil des Modells ist, dass es sich auf die Wechselwirkungen zwischen verschiedensten sportlichen Angeboten (Anlagen, Anlässe, Kurse, Wettkämpfe etc.) übertragen lässt. Ziel dieser Untersuchung ist es nun, dieses Modell wissenschaftlich zu belegen.

Methode

Das Projekt basiert auf Sekundärforschung, in welcher sämtliche Schnittstellen der oben erwähnten Bereiche mit Sport untersucht werden. Ein weiterer Zweig bilden die Erfahrungen eigener Berichte und Dienstleistungen und mögliche Konsequenzen der dort getroffenen Entscheidungen. In einem weiteren Schritt soll eine Literaturrecherche erfolgen.

Ergebnisse

Eine Erkenntnis ist, dass die mit dem Sportangebot verbundene Infrastruktur ein zentrales Anliegen von Seiten der Auftraggeber ist. Dies zeigte sich bei der Strategieberatung des Engadin Skimarathon, in welcher als Folge des Prozesses, die Marathon-Strecke neu das ganze Jahr hindurch gekennzeichnet werden soll (Näf et al., 2017). Somit tritt ein Wiedererkennungseffekt auf, der Kunden in Sommersportarten wie Wandern, Joggen oder Mountainbike anlockt. Auch im Rahmen der Potentialanalyse zur Entwicklung einer Sport- und Eventhalle in Saas Grund (Bosshard, B. et al., 2017) wurde die Infrastruktur als wichtigster Trigger für Sport genannt, da sie für verschiedene sportliche Angebote und den Schulsport gebraucht werden könne.

Diskussion

Die Untersuchung hat gezeigt, dass das Zusammenspiel der oben genannten Bereiche im Modell „Standortförderung durch Sport“ vorhanden ist. In einem nächsten Schritt gilt es, die Effekte einer Sportinfrastruktur auf die weiteren Bereiche zu quantifizieren.

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Topics: social sciences

Keywords: eating disorders, guidelines, fitness centre, prevention

Approaches of fitness-centre employees to suspicions of eating disorders in clients.

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Theoretical Background:

Eating disorders are a category of psychological disorder which have serious health consequences, and are particularly persistent and difficult to treat. This is to some extent due to the fact that sufferers often conceal the disorder (Smink, van Hoeken, & Hoek, 2012), and certain indicators, such as a slender frame and rejection of unhealthy food, are perceived as socially desirable (Hesse-Biber, Leavy, Quinn, & Zoino, 2006). Exercising is a further behaviour which may appear healthy, but is often taken to an unhealthy level by sufferers of eating disorders (Shroff et al., 2006). Excessive exercise may take place in fitness-centres (Duncan, 2009); consequently, informing fitness-centre employees about behaviours which may be symptomatic of eating disorders could be an important step in prevention.

Research Questions:

The aim of this study is to investigate whether a sample of fitness-centre employees have experienced situations in which they suspect that clients might be training excessively due to an eating disorder, and whether they are aware of any guidelines addressing this issue.

Methods:

Qualitative interviews were carried out with 7 fitness-centre employees. Guidelines for professional fitness-centre employees were also searched for content regarding this issue.

Results:

All respondents reported having experienced situations in which they felt a client was training excessively due to an eating disorder. Employees reported concerns that the client would react poorly, suffer psychological distress, or that they were behaving intrusively, as factors holding them back from confronting clients about their training behaviour. None of the employees consult guidelines on this issue, although the guidelines identified in this study specifically address how to approach clients in these situations.

Conclusions:

The suggestion that eating disorder sufferers engage in excessive exercise, sometimes in fitness centres, was supported by this study; all respondents reported at least one instance in which they suspected this behaviour. Guidelines aimed at addressing this issue exist, but these were not consulted by our respondents, in most cases because they were unaware of them. Fitness-centre employees may therefore need targeted education about warning signs and strategies to approach such clients. This may be a measure which could improve the safety and ultimately the wellbeing of sufferers of eating disorders.

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5 Young Investigator Award

5.1 Finalists

Topics: natural sciences

Keywords: motor control, repetitive movements, central fatigue, performance enhancement, reward

Reward improves motor performance by modulating motor network activity

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1. Introduction

There is strong evidence that reward can motivate individuals to exert high levels of physical effort and thus, invigorate certain movements (Pessiglione et al., 2008; Bonnelle et al., 2015; Manohar et al., 2015). However, the neurophysiological mechanism underlying these processes is still largely unknown. Performance on a continuous motor task, such as maximal skipping or sprinting typically decreases after a certain number of repetitions unless one is highly motivated and continuously increases effort. Previous studies have also demonstrated that finger tapping of a predefined sequence at submaximal and maximal speeds significantly decreases after approximately 20 s of sustained effort (Rickard et al., 2008; Arias et al., 2015; Bächinger et al., 2017, in preparation). This decrease in performance, which we refer to as “motor slowing”, cannot be explained by changes at or distal to the neuromuscular junction (i.e. M-wave, peak-twitch-force) (Bächinger et al., 2017, in preparation) or at the spinal level (Arias et al., 2015; Madrid et al., 2016). Instead, our experiments provided evidence that supraspinal processes are responsible for motor slowing in repetitive movements. More specifically, we observed strong dis-inhibition of the motor cortex but it is unclear whether this is maladaptive (e.g. reflecting a breakdown of surround inhibition leading to higher co-contraction) or beneficial for the task (i.e. motor cortex increases its output to prevent even stronger slowing).

To answer this question, conditions where participants were rewarded for good tapping performance were compared to unrewarded tapping. We investigated (i) whether reward attenuates motor slowing, (ii) whether the observed changes are reflected by neurophysiological electroencephalography (EEG) markers measuring cortical activity, and (iii) whether cortical or subcortical areas respond to reward when brain wide neural activity is measured with functional magnetic resonance imaging (fMRI).

2. Methods

We performed two separate experiments to investigate the neurophysiological effects of reward on motor slowing. In both experiments, a computer screen instructed participants to tap as fast as possible with their dominant index and middle finger (i.e. go!) and to relax during breaks (i.e. fixation cross). In the middle of the trial, a monetary reward or neutral cue appeared on the screen. The EEG experiment included three distinct conditions (10 trials per condition): i) short tapping (10 s), ii) long tapping (30 s) + reward (i.e. 1 Swiss Franc coin), and iii) long

tapping (30 s) + neutral cue (i.e. grey circle). In the fMRI experiment we used a full factorial design.

2.1 Behavioural data

We calculated the inter-tapping interval for either 10 s bins (EEG) or 5 s bins (fMRI) averaged across all trials from each condition. For statistical analysis, we used a linear mixed-effects model with the factors time and condition.

2.2 EEG experiment

We tested thirty-four healthy participants (mean age = $27 \pm$ s.d. 7 years, 77% female, all right-handed) using the behavioural paradigm described above combined with EEG (256 channels). After a standard pre-processing procedure involving band-pass filtering and automatic removal of eye-blinks and movement artefacts with independent component analysis, EEG data was bandpass filtered (8-12 Hz), rectified and smoothed to investigate changes in alpha amplitude (4 bins of 5 s) during recovery post motor slowing. For statistical analysis, we used a linear mixed-effects model with the factors time (4) and condition (short tapping, long tapping + reward, long tapping + neutral cue).

2.3 fMRI experiment

Motor slowing in combination with fMRI was measured in twenty-eight participants (mean age = $26 \pm$ s.d. 6 years, 64% female, all right-handed). The general procedure was similar to the EEG experiment, except that participants were familiarized with the experimental task and scanning environment beforehand.

Pre-processing was performed using SPM12 and consisted of realignment, segmentation, normalisation and spatial smoothing with default parameters. The first-level fixed-effects model for each subject included 54 regressors of interest (i.e. bins of 5 s for all tapping conditions and breaks, get ready cue, movement parameters (regressors of no interest)). All conditions were then convolved with a canonical hemodynamic response function to account for the hemodynamic delay. The regressors of interest were contrasted against an implicit baseline and contrast estimates were entered into second-level random-effects analysis across participants. The second-level analysis focused on identifying brain regions where activity changed over the course of motor slowing and exhibited differences between the reward and neutral conditions.

3. Results

3.1 Reward improves motor performance

The main result of both experiments was that motor slowing occurred during the long tapping condition, however, this effect was significantly attenuated by reward (linear mixed-effects model, $p < 0.001$, EEG long tapping + reward last bin = 114 % of first bin \pm 3 %, EEG long tapping + neutral cue last bin = 126 % of first bin \pm 2 %, fMRI long tapping + reward last bin = 110 % of first bin \pm 2 %, fMRI long tapping + neutral cue last bin = 130 % of first bin \pm 5 %, m. \pm s.e.). Thus, our participants could voluntarily overcome slowing when rewarded.

3.2 Reward modulates alpha-band power

Alpha-band power was strongly reduced during tapping but recovered during the break. Accordingly, the statistical analysis (linear mixed-effects model) revealed a significant main effect of time ($p < 0.001$) for the electrode overlying the contralateral motor cortex (M1). Interestingly, there was a significant condition effect ($p < 0.001$) with alpha-band power being highest for short tapping ($1.004 \mu\text{V} \pm 1.121$, m. \pm s.e.), at a medium level for long tapping + neutral cue ($0.990 \mu\text{V} \pm 1.121$, m. \pm s.e.) and at the lowest level for long tapping + reward ($0.946 \mu\text{V} \pm 1.121$, m. \pm s.e.). Thus, alpha synchronisation was still suppressed during the break following tapping and this suppression was particularly strong after rewarding trials.

3.3 Reward increases motor network activity

First, we identified a typical sensorimotor network consisting of contralateral M1, premotor areas, striatum, bilateral supplementary motor area (SMA), and cerebellum, which was strongly activated during tapping (whole brain analysis, p FWE < 0.05). Specifically, we found increased activity in SMA and premotor areas during motor slowing (main effect of time, whole brain analysis, p FWE < 0.05). Second, we showed that reward further increases activity within primary motor cortex and cerebellum (small volume correction, time *condition, sphere 8 mm, p FWE < 0.05).

4. Conclusion

Our Results demonstrated that motor slowing can be significantly reduced by reward. This attenuation of the motor slowing phenomenon is linked to decreased alpha activity observed over primary motor cortex (i.e. suggesting stronger cortical dis-inhibition), which most likely reflects increasing activity of cortical and subcortical motor areas. These Results are consistent with recent theories proposing that reward has a general motivational effect, which is most likely signalled by dopamine, a neurotransmitter known to be essential for increasing response vigour and for overcoming internal costs of movement control (Beierholm et al., 2013; Manohar et al., 2015). Furthermore, our Results support the hypothesis that increasing activity in the motor network is at least partly beneficial for maintaining high tapping speed. Our findings stress the importance of cortical control when performing fast, repetitive movements. They suggest that maintaining high movement frequencies requires increasing effort even for sub-maximal movements, a process that might benefit from deliberate practice. Additionally, our findings exhibit interesting parallels to patients suffering from slow movements due to Parkinson's disease, where dopaminergic neurons in the midbrain progressively degenerate.

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Topics: natural sciences

Keywords: Evoked force, Extra force, H reflex, M wave, sustained EMG activity

Transcutaneous electrical nerve stimulation (TENS) curtails the spinal recruitment effect of wide pulse, high frequency neuromuscular electrical stimulation (WPHF NMES)

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Introduction

The effectiveness of neuromuscular electrical stimulation (NMES) protocols, which vary in pulse width and intensity is proportional to the evoked force [1]. Wide pulse, high frequency (WPHF) NMES (pulse duration: 1 ms; stimulation frequency: >80 Hz) is thought to increase the electrically evoked sensory volley travelling to the central nervous system via large diameter afferents and reflex activation of motor units in the spinal cord compared with conventional NMES (<400 μ s, 15-40 Hz) [2, 3]. The extra forces evoked by WPHF NMES can reach up to five times the level evoked with conventional NMES [2]. Possible explanations include activation of persistent inward currents (PICs) in spinal neurons and temporal summation of excitatory postsynaptic potentials (EPSPs), which amplify motor output to a given synaptic input (e.g. a bout of WPHF NMES) [2, 4-7].

High frequency transcutaneous electrical nerve stimulation (TENS, various intensities and patterns, 50-250 μ s, >40 Hz) is used for neuronal pain management [8-11]. It induces anti-hyperalgesia by activating endogenous inhibitory systems and altering neural processing of sensory information at the spinal cord level [9, 12]. Since this may be accompanied by effects on postsynaptic potentials and PICs [13-15], it raises the question: "does TENS modulate the mechanical and muscle electromyographic (EMG) responses to WPHF NMES?" We therefore evaluated the effect of TENS on the mechanical and EMG responses to WPHF NMES and hypothesized that TENS would reduce the evoked force during a bout of WPHF NMES.

Methods

In a randomized counterbalanced crossover study design, 10 healthy participants (8 men and 2 women, mean \pm SD, 27 \pm 3 years, 175 \pm 7 cm, 72 \pm 8 kg) took part in two trials. Plantar flexor force and soleus EMG responses to a bout of WPHF NMES were assessed before (Pre) and after (Post) a period of rest (Rest trial) and TENS (TENS trial).

First, soleus muscle H-reflex recruitment curves were obtained to determine stimulus intensity where peak to peak H-reflex amplitude was largest (IHmax). We then used M-wave recruitment curves to determine the stimulus intensity where no further increase in peak twitch force nor in soleus M-wave amplitude were observed despite a current increase of 20 mA. This intensity was then increased by 20 % (IMmax) to ensure supramaximal stimulation [7]. After warm-up participants then performed 2-3 x ~4 s long maximal voluntary contractions (MVCs) with the plantar flexors.

The stimulation intensity required to evoke a force of 5 % MVC was then determined by delivering 1 s WPHF NMES trains (1 ms, 100 Hz) over the triceps surae (IWPHF). After a 1 min rest period, the first bout of WPHF NMES started (Pre). It consisted of 3 WPHF NMES (1 ms, 100 Hz) trains with work and rest periods of 20 s and 40 s respectively [7]. Stimulation intensity was kept constant during the 3 contractions. At the end of the 3 induced contractions (~10 s after the last evoked contraction), 3 single stimuli at IHmax and 1 at IMmax (Pre) were delivered.

Participants then remained seated (Rest trial) or received TENS (TENS trial) for 15 min. High frequency TENS was delivered over the triceps surae (pulse duration 50 μ s; decreasing stimulation frequency from 150 Hz to 50 Hz over 2 s followed by an increase from 50 Hz to 150 Hz over 2 s) at an intensity above sensory threshold but below motor threshold [8, 10]. Then after \sim 30 s, 3 single stimuli at IHmax and 1 at IMmax were delivered (Post). This was followed by the second bout of WPHF NMES (Post).

Force time integral (FTI, area under the force trace), and sustained EMG activity were quantified for each WPHF NMES bout. To assess sustained EMG activity, soleus EMG root mean square (RMS) was quantified over a 500 ms interval from the final stimulation artefact for each WPHF NMES contraction and normalised by the RMS of the maximal EMG activity recorded during the highest MVC [7]. Presence of sustained EMG activity was used to indirectly highlight the presence of PICs [2]. Resting soleus Hmax was normalized by Mmax to quantify spinal excitability [16].

Changes in FTI, sustained EMG activity and Hmax/Mmax ratio were calculated for each trial as $\Delta = \text{Post} - \text{Pre}$. Wilcoxon signed rank tests were performed to determine differences between trials. Spearman's correlation was calculated between Δ FTI and Δ sustained EMG activity in each trial. Statistical significance was set at $p < 0.05$. Data are presented as median (25th percentile and 75th percentile).

Results

Despite expected large inter-individual variability in evoked forces [7], there were significant differences between trials in Δ FTI (Rest trial +13 (-7 and 45) %, TENS trial -50 (-83 and -6) %, $p = 0.0098$) and Δ sustained EMG activity (Rest trial +3 (-5 and 20) %, TENS trial -9 (-40 and 4) %, $p = 0.0059$). There was no significant difference in Δ Hmax/Mmax ratio between trials ($p = 0.1484$).

There was a significant positive relationship between Δ sustained EMG activity and Δ FTI for the TENS trial ($r_s = 0.95$, $p = 0.0001$) but no relationship between Δ sustained EMG activity and Δ FTI for the Rest trial ($r_s = 0.285$, $p = 0.4271$).

Discussion

TENS over the triceps surae reduced the extra evoked force during a bout of WPHF NMES. Since the proposed underpinnings of WPHF NMES evoked force are activation of PICs and/or temporal summation of EPSPs [2, 4, 6, 7], TENS may affect one or both of these [9]. The change in evoked force after TENS was strongly associated with the change in sustained EMG activity, suggesting TENS reduced PIC activation by WPHF NMES [9, 14, 15]. Despite these changes being independent from changes in Hmax/Mmax ratio, reduced temporal summation of EPSPs (only occurring with consecutive stimuli) following TENS might also play a role [6]. In summary, our results reinforce the hypothesis of large neuromodulatory plasticity of the response to a bout of WPHF NMES [5].

Significance and future research

Here we show for the first time that the evoked force during a bout of WPHF NMES can be manipulated (albeit reduced) using a high frequency TENS protocol. Since effectiveness of NMES for neuromuscular rehabilitation is proportional to the force evoked during training [1], modulation of spinal cord circuitry that increases motoneuron excitability might amplify the central contribution to WPHF NMES evoked forces and would open new possibilities for neuromuscular rehabilitation. Thus, it remains open whether different TENS protocols could modulate spinal cord dynamics to increase motoneuron excitability.

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Topics: social sciences

Keywords: Chronic intervention, classroom-based physical activity, executive functions, academic achievement

The effects of different physical activities on children's executive functions and academic achievement. A chronic intervention study.

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Introduction

Children derive cognitive benefits from both acute and chronic physical activities (PA). Most studies assessed the effect of quantitative aspects of PA, based on intensity and duration considerations. Since it is known that not all forms of PA benefit cognition equally, also qualitative aspects of PA (e.g. exercise types) are gaining attention (Diamond, 2015; Pesce & Ben-Soussan, 2016). Previous chronic studies particularly focused on aerobic physical activities without regard for the cognitive demands inherent in the performed aerobic PA (Schmidt et al., 2015). It is ambiguous whether cognition benefit from the "pure" aerobic activity in terms of increased heart rate or enhanced aerobic fitness, or from the achieved cognitive efforts to perform a specific aerobic exercise. How exercise interventions influence children's cognition and especially executive functions (EF) in terms of specific characteristics is largely unknown and only rarely has been published. Since executive functions are strongly related to academic achievement (Diamond, 2013), recommendations in terms of the qualitative aspects of PA are not only a recent focus in the field of research, but also important from a practical point of view, for example in the educational setting and in particular for designing school-based PA programs targeting an effective promotion of cognitive performance.

Method

The aim of the present study was to examine the effects of three qualitatively different chronic PA interventions on executive functions in primary school children. It was hypothesized that a combination of cognitive engagement and physical exertion of physical activity breaks would have a stronger impact on children's EF than one of these factors alone.

A total of 142 children aged between 7 and 9 years ($M = 7.91$, $SD = .40$; 54.9 % girls) were allocated to a 20-week classroom-based PA program with either a) a high level of physical exertion and high cognitive engagement (combo group), b) with high physical exertion but low cognitive engagement (aerobic group), and c) with high cognitive engagement and low physical exertion (cognition group). Executive functions (updating, inhibition, shifting) and academic achievement (mathematics, writing and reading) were measured in a pre- and post-test. In the main analyses, ANCOVAs were conducted using the pre-test as covariate. The level of significance was set at $p < .05$ for all analyses.

Results

To test the main hypotheses of the study, the three groups were compared regarding their change in the different EF subdimensions between pre- and post-test. The three separate ANCOVAs revealed that the change in updating ($F(2, 138) = .16$, $p = .866$, eta square = .002) and inhibition ($F(2, 138) = .68$, $p = .507$, eta square = .010) did not differ significantly between the three groups. However, the change in shifting differed significantly between the groups ($F(2, 138) = 4.68$, $p = .011$, eta square = .064), with post-hoc tests revealing a stronger improvement in the combo group compared to the aerobic group ($p = .003$), but not compared to the cognition group ($p = .176$). The aerobic and cognition group did not differ from each other ($p = .095$).

For academic achievement, the pre-post changes in mathematics differed significantly between the three groups ($F(2, 138) = 7.34$, $p = .001$, eta square = .054), with post-hoc tests

revealing both the combo group ($p = .001$) and the cognition group ($p = .002$) to have a greater impact on children's mathematic performance compared to the aerobic group. The two cognitively engaging interventions did not differ from each other ($p = .901$). No changes between pre- and posttest in reading ($F(2, 138) = 1.46, p = .236, \eta^2 = .021$) and writing ($F(2, 138) = 1.26, p = .287, \eta^2 = .018$) were observed.

Discussion

The aim of the present study was to investigate the effects of three qualitatively different PA interventions with distinguishable degrees of cognitive engagement and physical exertion on children's EFs. It was hypothesized that a combination of both would have a stronger impact on children's EF than one of these factors alone. In summary, the results showed (1) that the two cognitively challenging interventions enhanced children's mathematic performance more than the aerobic group intervention and (2) that only the combo group intervention fostered pronounced increases in children's shifting performance. The two EF subdimensions updating and inhibition as well as the academic performance (reading and spelling) remained unaffected. To bring up a suitable theoretical framework, which can explain the current findings, the strength model of self-control revised by Audiffren and André (2015) needs to be addressed: Self-regulation and executive functions share effort as a resource to perform stressful or attentional demanding task such as cognitively challenging physical activities. If children engage in behaviors requiring a lot of effort, the cognitive resource is depleted in a subsequent task. However, the training hypotheses postulates in analogy to a muscle, that the self-control capacity decreases after an acute, but increases after chronic exercises. An overload of cognitive capacities performing cognitively engaging physical activity may lead to an immediate decrease but increases after recovery through a chronic intervention. Two previous studies (Jäger et al., 2015; Schmidt et al., 2015) investigating acute as well as chronic effects of cognitive engaging physical activity on children's EF underline these suggestions.

Both cognitive challenging PA interventions (combo group and cognition group) showed an increased mathematic performance after the 20-week intervention. This result is not surprising with respect to the successful enhancement of shifting performance for the combo group. Particularly shifting, seem to enhance mathematic performance as shown by Yeniad and colleagues (2013). The relationship between shifting and mathematic performance can be explained by gains of shifting abilities, which are in turn needed to perform in different problem-solving strategies: shift flexibly attention to relevant tasks and to move back and forth between different types of tasks. Hence, these requirements are needed, when trying to solve a complex math problem.

Like any study, the present study has certain limitations, which need to be addressed. The assessment of EF using only one task for each EF subdimension was probably not ideal but with respect to ecologically valid implementations and high time exposedness for children, it was the only way to test all three subdimensions together. However, including all three EF dimensions is a benefit to give a concrete practical advice. The results suggest promoting particularly shifting performance through classroom-based PA. Further, the current study lacks of an adjusted individual level of cognitive engagement and physical exertion during the physical activity breaks. A cognitive under- or overload might be prevented by examining in advance relevant individual characteristics in sport-specific cognitive expertise, gross motor coordination and physical fitness (Pesce, 2009). Consequently, a personally fitted intervention for each subject would be possible. However, due to room and time limitations, implementing an individualized cognitive and physical level is a challenge for future studies, especially for chronic classroom-based PA interventions.

In conclusion, only a combination of PA with a high amount of cognitive engagement leads to a stronger improvement in EFs, although not all EF subdimensions seem to be affected equally. Shifting as one EF domain and its relatedness to academic achievement seems to be

sensitive with regard to cognitive engaging physical activities within the preadolescent period and should be focused in future classroom-based PA interventions.

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Topics: social sciences

Keywords: ADHD; active video gaming; physical exercise

Exergaming intervention to foster executive functions in children with attention deficit hyperactivity disorder: Results from a randomized controlled trial

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Introduction

Attention deficit hyperactivity disorder (ADHD) is one of the most frequent disorders in childhood. The key symptoms of ADHD – impaired attention, hyperactivity and impulsivity – are associated with an increased risk of long-term academic and social impairments (1). Since pronounced ADHD symptoms are frequently associated with executive functions (EFs), an explanation for the development of these symptoms is seen in a primary deficit in the EFs (2). Although deficits can be reduced through medication, possible side effects, low compliance and unknown long-term sequelae call for alternatives to improve EF deficits.

Exercise is known to have a positive effect on EFs. This has frequently been demonstrated with healthy children (3). However, in children with ADHD there is limited empirical evidence. The existing intervention studies mostly detected positive effects on cognitive performance (4), with mixed physical exercises (including several different activities such as running, coordination tasks and ball games) having the highest efficacy and broad transfer effects. Although based on only few studies, this underlines the importance of cognitively challenging physical exercise.

The level of cognitive challenge included in physical exercise is important with regard to benefits for EFs (5). This notion is based on the theoretical assumption that, cognitively challenging PA such as coordinative exercise pre-activates brain regions used to control higher-order cognitive processes, leading to a better performance after PA (5). Considering that children with ADHD frequently drop out of traditional sports programs (6) and often display deficient motor skills/control in addition to a functional deficit in their EFs (7), physical exercise characteristics targeting motor learning, might be even more important for this population.

Therefore, the aim of this randomized controlled trial (RCT) was to examine the effects of an exergame intervention (characterized by both high physical and high cognitive demands) on EFs in children with ADHD. Exergaming is a portmanteau of “exercise” and “gaming”, extending the gaming experience to the entire body. Exergaming helps to combine physical and cognitive challenges in a gamified fashion. Initial investigations have yielded promising

Results (8), suggesting that exergaming could serve as an intervention for promoting health-related outcomes such as EFs.

Methods

Using a parallel pre-post study design, 51 children between 8-12 years were randomly assigned to an exergaming or a waiting-list control group [for more information see (9)]. Seven children (six from the exergaming group) discontinued the study and did not participate in the post-test, resulting in 44 remaining participants. The exergame intervention was carried out using the Xbox Kinect. For 8 weeks, children were supposed to train three times a week for at least 30 minutes with “Shape UP” (Ubisoft, Montreal, Canada), which has been shown to be cognitively and physically challenging [cf. (8)]. The training program was introduced in a supervised first training session, and data on physical exertion and perceived cognitive challenge [8] were gathered. As primary outcome, the core EFs were measured using computer-based

tests before and immediately after the interventional period. Updating performance was measured using the color span backwards task; inhibition and shifting using an adapted Flanker and Simon Task (10). In addition, as secondary outcome, the sport motor performance was assessed using the “Deutscher Motorik Test 6-18 (DMT)”(11). As revealed by independent t-tests, Background variables [age, gender, ADHD symptoms and BMI] and pre-test values of dependent variables did not differ between groups ($p > .05$). ANCOVAs (using the pre-test values as covariates) were used to compare EFs and sport motor performance between groups.

Results

According to diaries, participants in the exergaming group trained on average 2.43 times (for in total about 90 minutes) per week. The mean heart rate during the supervised first training session was $M = 143.46$ bpm ($SD = 10.84$) and children rated exergaming to be more cognitively challenging than video watching ($t = 3.48$, $p = .001$). Regarding EF performance after the interventional period, the exergaming group showed faster reaction times in the Flanker task in congruent ($F(2, 41) = 4.10$, $p = .049$, $\eta^2p = .091$) and shifting trials ($F(2, 41) = 4.48$, $p = .040$, $\eta^2p = .099$) than control. In the Simon task, the exergaming group showed faster congruent trials ($F(2, 41) = 5.57$, $p = .023$, $\eta^2p = .120$) and overall task performance ($F(2, 41) = 4.71$, $p = .036$, $\eta^2p = .103$). No significant effects were detected on other trials of cognitive tasks, nor on updating or accuracy ($p > .05$). Regarding sport motor performance, the exergaming group showed a significantly better performance than control ($F(2, 41) = 8.21$, $p = .007$, $\eta^2p = .167$) after the interventional period.

Discussion

This is the first study to investigate the effects of cognitively and physically demanding exergaming on EFs in children with ADHD. Results show that exergaming is able to enhance EFs with regard to inhibition and shifting performance. In addition, a positive effect on sport motor performance could be observed.

Regarding the main Results, it seems evident that exergaming can improve EFs. This is in line with the limited empirical evidence on beneficial effects of traditional physical exercise for cognitive performance in children with ADHD (12) and with the larger evidence on healthy children (3). Exergaming therefore seems to be a promising approach to foster EFs in children with ADHD and might serve as an adjunct to future treatment. However, it remains unclear whether physically and cognitively challenging exergaming is superior to cognitive or physical exercise training alone. Comparing all three might be an interesting issue for future studies.

In the current RCT, improvements in inhibition and shifting but no effects on updating were found. These Results are partly in line with a recent meta-analytic review of physical exercise in ADHD (12). The authors indicated that the most consistent effects of physical exercise seem to be on inhibition and updating, and Results are unclear with regard to shifting. Correspondingly, in the current study inhibition improved. However, non-correspondingly shifting was enhanced and no significant effect could be detected on updating. These Results might be explained by the characteristics of the used exergame: For successful task execution, fast reactions and focused attention are necessary, whereas updating is needed to a smaller extent.

An improvement in sport motor performance could be detected in the current study. This might be particularly important for children with ADHD because (a) children with ADHD have difficulties taking part in traditional sports programs and not dropping out of these (6); (b) they spend more time playing sedentary video games (13); and (c) the majority has deficits in EFs and in motor skills (7). New Methods are therefore needed to place the focus on health promotion through sports, and in particular to encourage children and adolescents who are overtaxed by traditional programs.

In Conclusion, these are first encouraging Results indicating that exergaming might in future serve as tool to enhance EFs in children with ADHD. In particular, it could be a safe environment for clinical patients suffering from cognitive deficits (e.g., ADHD, pediatric cancer survivors) to increase their physical activity level and replace sedentary screen time. However, with regard to drop-out rate, customized exergames including improvements in child appropriateness, cognitive as well as physical challenge seem warranted.

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Topics: social sciences

Keywords: talent selection, football, subjective coach assessment, motor performance diagnostics, prognostic validity

Prognostic validity of a subjective coach assessment and motor performance tests for talent selection in football: science boosts coaches' eye!

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Introduction

Talent selection in football is an inevitable consequence of limited resources within clubs and national federations. Whenever it comes to this undesired necessity of selecting the most promising football talents for any development program, sport science advocates the use of multidimensional approaches [1]. This means that an evaluation of young football talents based on the single dimension of current competitive performance is insufficient to determine a player's potential for future performance. It would rather be necessary to consider various endogenous (e.g., motor performance, biological age, psychological features) and exogenous (e.g., social support, characteristics of training history) predictors of relevant areas, which should ensure a more precise prediction of future performance [2].

Whilst there is undoubted benefit of multidimensional models for talent selection from a theoretical point of view, there seems to be a lack of knowledge according to their practical application [3]. First, some of the potential dimensions of interest cannot be operationalized in an evidence-based way, which could be taken into account for the use in a quantitative decision-making process within talent selection (e.g., social support or training history). Second, the procedure of integrating single measures from several dimensions to an overall assessment is challenging as well as vigorously debated [4]. Therefore, no unified understanding of delivering applicable solutions for overall assessments from multidimensional data has evolved yet.

Resulting from these methodological limitations according to the use of multidimensional approaches for talent selection, clubs and national federations typically reduce the complexity of their assessments to fewer or single dimensions. Most frequently, they rely on subjective coach assessments solely [5]. Within several talent development programs, objective data from motor performance diagnostics is added [6]. In doing this simplification, there is uncertainty about the value of these two dimensions for decision-making about the future of young players. For that reason, the current research investigates the prognostic validity of the subjective coaches' eye and objective measurements from motor performance diagnostics and compares their usefulness for talent selection in football against each other.

Methods

The sample consists of 122 talented football players (all born in 1999), from several regional youth squads throughout Switzerland (including 16 players with at least one nomination for the Swiss U17 national team; 13.1%). During the season 2012/2013 (U14 age category) all of the players took part in a test battery consisting of nine tests to determine motor performance: dribbling and agility, ball control, shooting, juggling (all from [7]), YoYo-IR1 [8], core-strength endurance [9] and counter movement jump as well as 40m-sprint. In addition, club coaches carried out a visual scale estimation procedure to rate players' current game performance (visual scale between 0 and 100). With a concordance coefficient of $r_{tt}=.89$ ($n=140$) the inter-rater reliability for this subjective coach assessment can be described as satisfactory [10].

Data analysis used binary logistic regressions (BLR) from SPSS (version 24) and receiver operating characteristics (ROC) from MedCalc to determine the capability of a) the subjective

coach assessment, b) the motor performance tests, and c) a combination of those two to identify later U17 national team players three years before (at U14 age category). Within this procedure, BLR first calculated the likelihood for each individual to be categorized as U17 national team player. Afterwards this likelihood was used to create a ROC. The area under the curve (AUC), as an index for measuring the quality of ROC, and its standard error were finally used to compare the ROC models against each other [11]. In addition to this immediate statistical comparability of the model quality, ROC enhances the statistics from BLR by the descriptive reference to sensitivity and specificity, better known as proportion of correctly selected talents and correctly deselected non-talents in terms of talent selection. Finally, ROC creates the possibility to ensure the most efficient selection threshold (known as Youden Index, which maximizes the sum of sensitivity and specificity), as an additional benefit over BLR.

Results

According to the Results of the BLR analysis, all three models are significant and show model fits (Nagelkerkes R²) from .38 to .62 (subjective coach assessment: $\chi^2=28.2$, $df=1$, $p<.01$, $R^2=.38$; motor performance tests: $\chi^2=39.9$, $df=9$, $p<.01$, $R^2=.52$; combined model: $\chi^2=49.7$, $df=10$, $p<.01$, $R^2=.62$). Further the AUC [95% confidence intervals] for the subjective coach assessment reaches .86 [.78; .92], the one for motor performance tests shows .91 [.85; .96] and the combination of both dimensions displays an AUC of .94 [.88; .98]. The nonparametric approach of comparing AUCs [11] indicates a significant higher AUC of the combined model, compared to the subjective coach assessment ($p=.02$). Further comparisons of AUC do not show any differences (coach assessment vs. motor performance tests: $p=.31$, motor performance tests vs. combined model: $p=.32$). The subjective coach assessment model uses its most efficient selection threshold from ROC by picking 36 out of the total 122 players, containing 13 correctly identified U17 national team players (sensitivity: 81.2%; specificity: 78.3%). The model from motor performance diagnostics selects 25 players, 13 of them were correctly identified national team players (sensitivity: 81.2%; specificity: 88.7%). Finally, the combined model bets only on 24 players, containing 14 true-positive national team and 10 false-positive non-national team players within (sensitivity: 87.5%; specificity: 90.6%).

Discussion

The common subjective coach assessments of talent development programs in football [6] seem to be a powerful tool for talent selection in terms of prognostic validity. Around 80% correctly selected talents and correctly deselected non-talents show the ability to buffer the biggest problems of the unwanted selection. On the other hand, the use of scientific and objective motor performance diagnostics further boosts the value of coaches' eye to a remarkable extent. Whilst there is no significant difference between the models of single predictors, the combined model is able to take almost 90% correct decisions three years before the selection to U17 national team and outperforms the subjective rating. Although prognostic validity of coach assessments [5] and motor performance diagnostics [7] have already been researched, the head-to-head comparison of the two most common assessments in talent selection within youth football adds value to the scientific Discussion.

Furthermore, the current Results seem to be ambiguous in relation to earlier presented beliefs in benefits from multidimensional approaches [1]. On the one hand, the single use of subjective coach assessments or motor performance diagnostics shows already substantial prognostic validity to predict the U17 national team membership of fourteen-year-old players. Contrariwise, integrating both predictors by means of simple BLR into a two-dimensional decision led to a noticeable improvement of decision quality. Therefore, a benefit of even more appropriate, presumably nonlinear statistical Methods for handling data from multiple dimensions for overall assessments in talent selections seems to be indicated. Although first steps in this direction have already been taken (e.g., person-oriented Methods [2, 4]), there is the need to further develop these Methods and make them more applicable to practitioners in the

field (clubs and federations). This may contribute to a further improvement in deciding about the potential of young sporting talents future performance.

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6 Young Investigator Award

6.1 Mini Oral Session

Topics: natural sciences

Keywords: Cooperative hand movements, reflex response, neural coupling, automatic gain control, stroke rehabilitation

Cooperative hand movements: Automatic gain control of neural coupling

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Introduction

Cooperative hand movements are frequently used in activities of our daily living including opening a bottle, cutting bread or winding up a blind. In these movements both upper limbs have to cooperate, that is, the force executed by one limb has to be equally counteracted by the other limb to successfully accomplish the task. The interest in those bimanual cooperative hand movements has just arisen recently despite the vast literature of non-cooperative bimanual movements (for review: Swinnen, 2002). Dietz and colleagues (2015) could show that cooperative hand movements are controlled by a task-specific neural coupling mechanism which is not inherent in other bimanual tasks. This neural coupling was shown to be reflected in bilateral reflex responses in forearm muscles after unilateral nerve stimulation suggesting an involvement of both hemispheres in the control of each hand. Interestingly, it is partly preserved in chronic stroke patients. Bilateral reflex responses were shown to occur when the non-affected arm was stimulated but not after stimulation of the affected arm (Schrafl-Altarmatt and Dietz, 2016). Here it is suggested that unaffected sensorimotor pathways compensate for the damaged structures and are strongly involved in the control of the paretic limb in post-stroke patients. Thus, training with cooperative hand movements might strengthen unaffected sensorimotor pathways which lead to a more optimal recovery of upper limb function. This makes cooperative hand movements a promising tool in neurorehabilitation.

Research Question

Previous studies investigating the task specific neural coupling in cooperative hand movements always used similar movement resistances (20% of maximal voluntary contraction) and velocities (0.75Hz). However, it is unclear how the neural coupling in cooperative hand movements is affected by different movement demands. Thus the aim of the present study was to evaluate the effect of movement resistance and movement velocity on the neural coupling. This could provide valuable information when cooperative hand movements are used in a training approach. There is evidence from earlier studies showing that the amplitude of stretch reflexes are closely related the background muscle activity reflecting an automatic gain control (Marsden et al., 1972; Matthews, 1986). It was suggested to be a servo action to rapidly compensate for external perturbations. In the present study it was expected that the task specific contralateral reflex responses are functionally coupled to the behavior of ipsilateral reflex responses seen in previous studies (Marsden et al., 1972; Marsden et al., 1976; Matthews, 1986) i.e. an increased movement demand is hypothesized to be accompanied by enhanced contralateral reflex responses.

Methods

In fifteen healthy subjects (age: 27.0 ± 6.2 years; 10 female/5 male), EMG reflex responses to unilateral ulnar nerve stimulation were recorded in forearm extensor muscles of both sides during cooperative hand movements. We chose three velocities (0.5Hz, 0.75Hz and 1Hz) which were performed against three resistances (10%, 20% and 30% of maximal voluntary contraction (MVC)). Therefore, nine conditions were performed in total. For these tasks a device was used that allowed counteractive rotations of handles by rhythmic alternating wrist flexion and extension. The handles were connected with a mechanical resistance to create a cooperative movement setting. The ulnar nerve of the right arm was stimulated 10 times every 3-8s during each of the conditions. Stimulation intensity (SI) was set at 150% of motor threshold (MT - first visible twitch of the abductor digiti minimi muscle). Stimulations consisted of a 200Hz train of four biphasic pulses of 1ms duration separated by 2ms. EMG activity of extensor carpi radialis muscle of both forearms was recorded (1500Hz), filtered (band pass 10Hz-10kHz) and post-processed as previously described (Schrafl-Altmetz and Dietz, 2016). The root mean square (RMS) of the rectified signal in the time window between 75ms and 135ms after stimulation onset was calculated. This time period is known to include the main components of the contralateral reflex response (i.e. N2, P2) (Dietz et al., 2015). The RMS of the rectified reflex response was further normalized to the Background activity -30ms to -10ms pre-stimulation. For data analysis, the absolute and the normalized RMS values of the reflex responses were grouped for the different movement conditions (i.e. for each velocity the RMS values of the three resistances performed against this particular velocity were averaged, and vice versa, for each resistance the RMS values of the three velocities performed against this particular resistance). Data in the Results are given as median and interquartile range (IQR, 25th-75th percentile).

Results

Data was analyzed from all fifteen subjects. The analysis of reflex responses was focused on the forearm extensor muscles contralateral to the stimulation site as a marker for the neural coupling mechanism. Distinct reflex responses were present during all conditions in the forearm muscles contralateral to the site of nerve stimulation. Wilcoxon signed ranked tests revealed that RMS values of the reflex response differed significantly from those of the Background EMG in all conditions (all $p < 0.01$). The absolute RMS values of the reflex responses grouped for the three velocities and resistances increased significantly from 0.5Hz (51.2, 36.2 – 61.8 μV) to 0.75Hz (56.4, 47.3 – 79.8 μV) ($p = 0.014$) and from 0.5Hz to 1Hz (64.7, 55.7 – 83.6 μV) ($p = 0.014$). The RMS of the reflex responses grouped for the three resistances increased significantly from 10% MVC (42.4, 31.7 – 59.5 μV) to 20% MVC (65.6, 52.2 – 70.3 μV) ($p = 0.014$), from 10% to 30% ($p = 0.0005$) and from 20% to 30% MVC (72.4, 55.5 – 98.3 μV) ($p = 0.007$). When the reflex amplitudes were normalized to the Background activity, Friedman tests revealed no significant difference between the resistances ($p = 0.42$) or velocities ($p = 0.93$).

Discussion

The two main Results of the present study were that (i) the size of the contralateral reflex responses increased in parallel with the Background activity with higher movement demands (i.e. the ratio of reflex response to Background activity remained constant) and (ii) distinct contralateral reflex responses were observed even during cooperative hand movements executed with minor resistance and velocity. There is evidence that ipsilateral reflex responses after mechanical perturbation are related to the prestimulus muscle activity (Marsden et al., 1976; Stein et al., 1995). We could show for the first time that the idea of an automatic gain control occurs also to reflexes contralateral to the side of stimulation. Thus, we propose that the neural coupling mechanism in cooperative hand movements is involved in the exact matching of forces between the upper limbs since any force disbalance between limbs would prevent the successful accomplishment of a cooperative bimanual task. An interesting finding is that clear

contralateral reflex responses occurred in every movement condition even with minor resistance and velocity. This suggests that the neural coupling is a robust non-threshold mechanism which seems to occur in any movement demand.

In Conclusion these findings could have an impact in neurorehabilitation since even with a minor movement velocity and cooperative resistance, a functional neural coupling occurs which could make cooperative hand movements an effective training tool also in severely affected patients.

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Topics: natural sciences

Keywords: Ischemia, hypoxia, preconditioning, repeated sprint, blood perfusion

Separate and combined effects of ischemic and hypoxic preconditioning on repeated sprint ability.

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Introduction

Remote ischemic preconditioning (IPC) is a therapeutic approach that has been developed to attenuate the damage incurred by ischemia-reperfusion injury [12]. This Method was originally investigated for inducing adaptations in order to protect a given organ against a future similar or greater stress event(s) [3] and has also been used in the athletic field with success. Specifically, it has been reported that IPC improved endurance performance between 1-8% [1,8]. Recent findings also reported a beneficial effect of IPC on repeated sprint ability (RSA) performance with a mean power output improvement by 2-3% for the three first sprints of a set of twelve 6-s repeated cycling sprints with 30-s of passive recovery between each sprint, when compared to a placebo condition [11]. However, IPC is likely to have different effects on performance depending on the duration ratio (sprint/recovery) or the intensity of exercise, among other factors, since no benefit was observed following IPC on alactic anaerobic test (six 6-s sprints at: 0.9, 1.0, 1.1, 1.2, 1.3, and 1.4 Nm kg⁻¹ of body weight interspersed with 2 minutes active recovery and 3 minutes of passive rest), on Wingate sprint (30-s) [10], or sprints repetition in team sports (five 6-s maximal effort sprints, each interspersed by 24-s recovery) [7]. Recent studies from our lab reported a beneficial effect of repeated sprint training in hypoxia (RSH) on RSA performance mediated by an increased blood perfusion in the active muscles [5,6] likely induced by a compensatory vasodilation for compensating the hypoxia-induced decrease in oxygen content [11][12]. It is however unknown if acute similar mechanisms could occur after hypoxic preconditioning (HPC). The aim of the present study was to compare the effects of IPC vs. hypoxic (HPC) or hypoxic-ischemic (HIPC) preconditioning on RSA performance and physiological responses such as: Oxygen uptake, muscle activation (electromyography), oxygenation (change of deoxyhaemoglobin (Δ [HHb]) and total haemoglobin (Δ [tHb]), index of blood perfusion) during RSA. We tested the hypothesis that IPC and HPC would induce a higher power output at the beginning of the RSA set associated with a better blood perfusion in exercised muscles. We also hypothesised that IPC and HPC would have a greater effect on untrained population (UT) than trained cyclists (T) since subjects were split into two groups to investigate the different preconditioning effects on training status. Another hypothesis was that HIPC would be too demanding (greater stress) and would lead to a deleterious performance, compared to control condition.

Methods

In a randomized, single blind, crossover study, 18 healthy male subjects (age [mean \pm SD = 25 \pm 2 years, body mass = 71 \pm 8 kg, height = 180 \pm 5 cm) participated in the current study. Subjects were then split in two groups: trained (T, n = 8) and untrained (UT, n = 10) based on weekly cycling training hours (>10 vs. < 1 h.week⁻¹). Subjects performed a familiarization visit and four different trials in a randomized order separated at least by 48 h. Subjects performed four different preconditioning phases of 40 min, consisting of 4 x 5 min periods of cycling with 1.5 W·kg⁻¹ resistance (107 \pm 11 W) at 85 rpm interspersed with 5 min of passive recovery. Subjects performed four separate randomized trials: Either with bilateral leg occlusion at 30 mmHg in normoxia (Control/C) or in normobaric hypoxia (HPC, FIO₂, 13.6%) (Everest Summit II Generator, Hypoxico Inc, New York, NY, USA), at 60% of relative total occlusion pressure

(T: 206 ± 17 ; UT: 188 ± 12 mm Hg, Hokansson Inc., Bellevue, WA, USA) in normoxia (IPC) or in hypoxia (HIPC). Following 40 min of passive rest, subjects performed a repeated sprint ability test consisting of 8 x 10-s cycling sprints with 20-s of passive recovery (Lode Excalibur Sport Ergometer, Lode B.V., Netherlands). During repeated sprints, power output, oxygen uptake (OxyconPro Jaeger, Viasys Healthcare GmbH, Hoechberg, Germany), electromyography using MP36 hardware (Biopac Systems Inc., Santa Barbara, CA), vastus lateralis oxygenation via near-infrared spectroscopy (PortaMon, Artinis, Zetten, The Netherlands), arterial oxygen saturation (8000Q2 Sensor, Nonin Medical Inc., Amsterdam, The Netherlands), blood lactate concentration (Lactate Scout, SensLab, GmbH, Leipzig, Germany), rating of perceived exertion with Borg scale, and heart rate (Polar RS400, Kempele, Finland) were recorded. A three way ANOVA (sprint x condition x group) on SPSS (version 22.0, IBM, USA) was performed for repeated sprint variables. Otherwise, a two-way ANOVA (condition x group) was used for mean values of all sprints.

Results and Discussion

None of the three preconditioning conditions induced an ergogenic or deleterious effect on repeated sprint performance compared to control condition in both groups. The trained group performed at a higher mean power output than UT during RSA (780 ± 57 vs. 692 ± 93 W; $P < 0.001$). IPC induced a greater $\Delta[\text{HHb}]$ ($P < 0.001$) compared to C and HPC in T, suggesting a greater oxygen extraction in the exercising muscle during repeated sprints. HPC induced a larger $\Delta[\text{tHb}]$ ($P < 0.001$) compared to all other conditions in T. UT showed a greater $\Delta[\text{tHb}]$ during RSA ($P < 0.001$) in IPC (-3.4 ± 0.8 μm), HPC (-5.4 ± 1.1 μm) and HIPC (-4.1 ± 1.2 μm) compared to C (-1 ± 1.5 μm), showing a greater muscle perfusion during RSA. This improved perfusion is in line with previous RSH mechanisms [5] and might improve therapeutic treatment in patients, for instance, those with lower limbs obliterating arteriopathy. While none of the preconditioning conditions enhanced repeated sprint performance in either group (T and UT), it seems that the hemodynamic response, such as blood perfusion, tended to be more significant in HPC condition for both groups. All preconditioning strategies increased blood perfusion in UT, which is in line with one of the hypothesis that UT would better respond to preconditioning. The present study also showed that effects of preconditioning were different depending on the population [9]. Future studies assessing HPC and HIPC are necessary to provide further insight haemodynamic responses, such as muscles de/oxygenation and blood perfusion, during repeated sprints and its potential beneficial effects on maximal performance in different population.

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Topics: natural sciences

Keywords: occlusion, BFR, oxygenation, RSA, altitude

Comparison of perfusion and deoxygenation between legs and arms during repeated cycling sprints with combined systemic hypoxia and blood flow restriction

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INTRODUCTION: Performing repeated sprints in hypoxia has been shown to decrease performance as well as reduce the ability to repeat maximal short sprints [1]. In addition to the development of muscle fatigue, arterial oxygen desaturation and cerebral deoxygenation (systemic hypoxemia [2]) are important determinants of the reduction in motor unit activity [3]. Exercise combined with blood flow restriction (BFR) induces local accumulation of metabolites, muscle deoxygenation, and ischemia [4], whereas normobaric hypoxia (decreased oxygen fraction of ambient air) leads to compensatory vasodilation [5] and muscle deoxygenation. Thus, there are similar (deoxygenation) but also different mechanisms (ischemia versus vasodilation) between BFR and systemic hypoxia. Additionally, there is a specific interest to investigate the increased variations in muscle perfusion (Δ [tHb]) from repeated sprint training which may improve the vascular conductance and potentially improve the waste metabolite removal during recovery [6]. Increased perfusion has been observed after 6-8 sessions of repeated sprint training in hypoxia (RSH) in both legs (cycling exercise [6]) and arms (double poling [7]). It is yet unknown of this mechanism in BFR vs. RSH conditions. Until now, no research has investigated repeated sprint exercise with BFR or the combination of RSH and BFR in either the legs or arms. Therefore, the aim was to compare the changes in muscle and cerebral de/reoxygenation during leg- and arm-cycling repeated sprints with combined systemic hypoxia and BFR.

METHODS: Seven recreationally active participants (five men and two women; 26.6 ± 2.9 yr, 74.0 ± 13.0 kg, 177 ± 9 cm, $14.1 \pm 4.9\%$ body fat) completed two sets (leg- then arm-cycling) of four randomized testing visits including simulated altitude near sea-level (~ 380 m, FIO₂ 20.9%, N) and ~ 3800 m (FIO₂ $13.3 \pm 0.4\%$, H) using a normobaric hypoxic chamber, as well as BFR at 0% and 45% of total occlusion [e.g., pulse elimination pressure determined from seated rest using Doppler ultrasound of the femoral or brachial artery (legs, 45%, 92.4 ± 14.2 mmHg; arms, 45%, 95.3 ± 15.9 mmHg)] using cuffs placed bilaterally on the proximal limbs (leg cuff: 11 x 85 cm cuff size, 10 x 41 cm bladder size, SC10D; arm cuff: 4x70cm cuff size, bladder size 3x41cm, D.E. Hokanson Inc., Bellevue, WA, USA). Each session began with a 12-min warm-up followed by two 10-s sprints and the repeated cycling sprint (10-s sprint: 20-s recovery) test to exhaustion on the same cycling ergometer (Lode Excalibur Sport Ergometer, Lode B.V., Netherlands) with the torque factor set at 0.8 and 0.4 Nm·kg⁻¹ for leg- and arm-cycling, respectively. Measurements included power output, muscle (vastus lateralis and biceps brachii) and prefrontal oxygenation (near-infrared spectroscopy, delta (Δ) corresponds to the difference between maximal and minimal values), peak oxygen uptake (VO_{2peak}), pulse oxygen saturation (SpO₂, %), maximal heart rate (HR_{max}, bpm), and rating of perceived exertion (RPE) from the Borg scale (6-20). Changes in deoxyhemoglobin (Δ HHb), total hemoglobin (Δ tHb), and tissue saturation index (Δ TSI, %) were obtained on both the muscle and pre-frontal cortex (PortaMon, PortaLite; Artinis). Additionally, the analysis was normalized to the duration of the set to exhaustion; i.e. percentage of sprints performed (i.e., 20, 40, 60, 80, 100%), and a linear interpolation was calculated when there was a fractional number of sprints.

RESULTS: Over all conditions, the number of sprints was lower with arms than with leg-cycling (-56%; 7.6 ± 3.8 vs 17.5 ± 12.3 sprints; $p < 0.001$) with a 58% lower mean power (316 ± 118 vs 543 ± 127 W; $p < 0.001$). This lower repeated sprint performance was performed with a similar peak oxygen uptake (2547 ± 407 arms vs 2551 ± 504 ml·min⁻¹ legs, NS) and a 5% lower HRmax in the arm (171 ± 5 vs. 180 ± 10 bpm; $p < 0.001$). The RPE for breathing was 8% (15.9 ± 2.0 vs 17.4 ± 2.1 , $p < 0.05$) less and respiratory exchange ratio (RER) 13.7% lower (1.00 ± 0.08 vs 1.16 ± 0.11 , $p < 0.001$), whereas SpO₂ was 7.5% greater (93 ± 5 vs $86 \pm 10\%$; $p < 0.001$) with arms. Greater changes were demonstrated across sprints in the arms than legs for all oxygenation parameters of the muscle tissue ($[\Delta \text{HHb}]$, $[\Delta \text{tHb}]$, and TSI). As the severity of the conditions (N0, N45, H0, H45) increased, the number of sprints and total work were progressively reduced ($p < 0.001$). VO_{2peak} and SpO₂ were lower in hypoxia than in normoxia ($p < 0.001$), and both variables demonstrated that H0 was lower than N45, $p < 0.01$, and the combination H45 was lower than N45, $p < 0.05$). Hypoxic conditions resulted in lower RPE for the limbs than BFR conditions (H0 compared with N45, $p < 0.01$). Changes in $[\text{HHb}]$ were greater in N45 than H0 ($p < 0.05$) and about 38% greater in arms versus legs ($p < 0.001$). The N45 condition elicited greater changes in $[\text{tHb}]$ than all other conditions ($p < 0.001$) which was about 26% greater in arms versus legs ($p < 0.001$). Additionally, the changes in muscle TSI were lower (muscle tissue desaturation) with the combined condition H45 ($p < 0.001$) with a 30% greater change in arms versus legs. Greater changes in TSI ($p < 0.001$) were also found for the pre-frontal cortex in the N45 condition, when compared with both N0 and H0. Throughout the sprints, there were greater changes in muscle oxygenation parameters ($[\Delta \text{HHb}]$, $[\Delta \text{tHb}]$, and TSI) as the sprints continued ($p < 0.05$), which were observed independently of the condition.

DISCUSSION/CONCLUSION: Repeated sprint performance was lower with arm- than with leg-cycling, even though there was a similar VO_{2peak} indicating that participants were always performing maximally. Interestingly, there was a greater SpO₂ found in the arms when measured at the level of the earlobe. This greater SpO₂ during arm-cycling may be due to the smaller size of muscle mass involved in the exercise and possibly tissue perfusion, as the partial pressure of oxygen may be different in the arms and legs. There may be limb differences due to the oxygen unload in the peripheral muscle tissue due to the rate of oxygen consumption/extraction. Previous researchers have suggested that greater blood flow is needed in the arms than the legs to provide adequate oxygen delivery, as there is generally lower oxygen extraction in the arms. Further, these researchers speculate that the lower oxygen extraction by the arms as a compensation of greater perfusion in the arms versus legs [8]. Greater perfusion was also observed since there were greater changes in $[\text{tHb}]$ in the arms, indicating greater blood volume and likely greater perfusion to the muscle tissue during BFR conditions (N45 greater than all conditions) placing a challenge on the vascular system. However, this is only speculative as perfusion involves not only the blood volume but also as a function of time and the amount of muscle mass. Performance was decreased in hypoxia due to lower VO_{2peak} and SpO₂ indicating an inadequate convective oxygen delivery, which also demonstrated an impairment between BFR and hypoxia alone, and an even greater deficit when combined (H45). Meanwhile exercise continued towards exhaustion despite greater deoxygenation with both hypoxic and BFR conditions, though greater in the latter. Muscle tissue saturation was greatly impaired in the combined condition (H45) further demonstrating the combined challenge of BFR and hypoxia for oxygen delivery. Furthermore, BFR greatly impaired the cerebral tissue saturation, possibly indicating a strong autoregulation of increased cerebral blood flow to maintain oxygen delivery and task continuation. This mechanism could partially contribute to greater performance decrement and is likely regulated by changes in the partial pressure of arterial oxygen. These mechanisms are speculative and therefore further research is warranted.

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Topics: natural sciences

Keywords: Fatigue, Spinal Cord Injuries, Biomechanical Phenomena, Wheelchairs

INSIGHTS INTO INJURY PREVENTION TO IMPROVE PERFORMANCE: THE IMPACT OF OVERGROUND WHEELCHAIR PROPULSION INDUCED FATIGUE ON WHEELCHAIR PROPULSION TECHNIQUE

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INTRODUCTION

Wheelchair propulsion has a poor mechanical efficiency and induces a high physical strain on the shoulder. Certain propulsion techniques such as propelling with greater applied forces and reduced contact time during steady state propulsion, have been related to pathology [1]. Not surprisingly, 39% of wheelchair users reported shoulder pain [2]. In order to improve performance, it is fundamental to remain injury free, especially in wheelchair users where shoulder injuries negatively affect mobility, participation and quality of life [3]. This demonstrates the need to look for means to prevent shoulder injuries in wheelchair users.

Muscles surrounding the shoulder stabilize the joint but were found to be prone to fatigue induced by wheelchair propulsion [4]. The effect of fatigue is task dependent and fatigue itself is defined as a disabling symptom in which physical and cognitive function is limited by interactions between performance fatigability and perceived fatigability [5]. A previously reported effect of fatigue induced by repetitive overhead activities includes superior humeral head migration which can cause shoulder impingement [6]. However, it is not clear how fatigue induced by overground propulsion alters propulsion technique. This project aims to determine how wheelchair users change their propulsion technique after an overground fatigue protocol. It was hypothesized that fatigue would induce a reduced performance displayed in a reduction of velocity, increased applied forces and reduced contact time.

METHODS

This cross-sectional study investigated 26 wheelchair users with a spinal cord injury. All participants completed one testing day at the Human Engineering Research Laboratories (VA Pittsburgh HealthCare System, Pittsburgh, PA, USA). Participants were on average 35.5 ± 9.8 years old and 12.0 ± 8.2 years since injury. Furthermore, 19 participants had a paraplegia, 7 participants had a tetraplegia, 19 were male and 7 were female. All participants completed a figure 8 fatigue protocol which has been described previously [7]. During the protocol, participants were required to propel as many laps as possible on a cement floor along a figure 8 course (18 meters in length) including right-and left turns, full stops, and start-up propulsion for three, four-minute intervals. In between each interval, 90 seconds of rest were provided which resulted in a total duration of 15 minutes.

Forces applied on the handrim were assessed with a SmartWheel (Three Rivers Holdings, Inc., Mesa, AZ) attached to the non-dominant side of the participant's personal wheelchair, opposite an identical wheel that did not measure kinetics. Propulsion kinetics of the first and last minute of the protocol were selected. Representing the fresh state, the first four strokes of start-up propulsion of each of the first three complete course loops of the protocol were selected. Representing the fatigued state, the first four strokes of start-up propulsion of the last three complete course loops of the protocol were selected. A two-way repeated measures

ANOVA was used to address the Research Question. The main effect of state (2 levels: fresh vs fatigue) and the interaction effect of state with number of strokes (1, 2, 3, and 4) were assessed on the following outcome measures: maximum resultant force, average contact time and velocity.

RESULTS AND DISCUSSION

The figure 8 fatigue protocol reduced performance as propulsion velocity was significantly reduced with fatigue. In line with our hypothesis, contact time was significantly reduced by 12%. However, only the first stroke of start-up propulsion showed a reduction in contact time. But this stroke could be important as wheelchair users perform on average 348 starts/stops per day [8]. Furthermore, in the 2nd, 3rd and 4th strokes, a similar amount of time was spent on the handrim with fatigue but less force was produced at a slower velocity (more specifically, a reduction of velocity by 6%, 12% and 11% in the subsequent strokes). This suggests a reduced propulsion efficiency.

In contrast with our hypothesis, fatigue significantly reduced the applied forces on the handrim in all strokes of start-up propulsion, suggesting a load saving mechanism. More specifically the applied forces were reduced by 7% in the 1st stroke, by 11% in the 2nd stroke, by 19% in the 3rd stroke and by 15% in the 4th stroke of start-up propulsion. Previous studies reported an increase in applied forces at the handrim with fatigue [9]. This discrepancy could be attributed to the constrained propulsion velocity (3 km/h) in the latter study. Furthermore, while the study of Rodgers et al. (2003) induced fatigue via an instrumented wheelchair on a roller system, the present study induced fatigue with an overground propulsion protocol that includes accelerations, decelerations, starts- and stops.

It is important to acknowledge limitations as this study does not include objective measures of fatigue nor includes injury measures. Future research is needed to investigate other variables as muscular activation patterns, scapular kinematics, etc. that could be altered with the occurrence of fatigue.

CONCLUSION

Fatigue changed the technique of start-up propulsion. Propelling with reduced applied forces could protect the shoulder, however the shorter contact time with the handrim may conversely have a negative impact. Understanding the changes in propulsion technique due to fatigue could provide insights into injury risk and improve performance.

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Topics: natural sciences

Keywords: artistic gymnastics, vault, run-up velocity, biomechanics, competition performance

The faster the better? Relationship between run-up velocity and the degree of difficulty (D-score) on vault in artistic gymnastics

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On vault in men's and women's artistic gymnastics a high run-up velocity is important for a successful execution of a difficult vault. During take-off from the springboard and vaulting table, the horizontal momentum is converted into angular and vertical momentum to facilitate an optimal second flight phase (Bruggemann, 2005; Prassas, Kwon, & Sands, 2006).

In competition, gymnasts can freely select a vault out of five different vault styles according to their skill level. Difficult vaults are assigned a high difficulty score (D-score) in the official competition rules (Code of Points) (FIG, 2013a, 2013b). The D-score is mainly influenced by the degrees of rotation around the transversal and longitudinal axes during the second flight phase. Since the final score is the sum of the D-score and the execution score, the probability of a good ranking in competition increases when a difficult vault is attempted.

Although the relationship between run-up velocity and the performance (D-score) is logical and has been assumed to exist for four decades (Bruggemann, 1979), the correlation between these factors has never been calculated with a large cohort of either junior or elite gymnasts.

Hence, the main purpose of our study was to calculate the relationship between run-up velocity and the D-score in a high level competition. The second and third aims were to show the differences between male and female athletes and between elite and junior gymnasts with regard to the run-up velocity and the D-score. To derive practical applications, the results will be used to explain the different requirements in run-up speed for the three most important vault styles Handspring (H) (forward rotating vaults), Tsukahara (T) (quarter to a half turn in the first flight phase) and Yurchenko (Y) (round-off in front of the springboard and backward handspring onto the table).

During the official competitions of the 31st European Championships in Men's and Women's Artistic Gymnastics in Bern 2016 maximal vault run-up velocity (v_{max}) was measured with a laser (LDM 301, Jenoptik, Rostock, D) for all male and female elite (M, F) and junior athletes (MJ, FJ) (M: $n = 89$; Age: $23.06 \pm 3.68y$; MJ: $n = 123$; Age: $16.86 \pm 1.17y$; F: $n = 88$; Age: $19.46 \pm 3.44y$; FJ: $n = 106$; Age: $14.52 \pm 0.59y$).

Descriptive statistics were run on all variables separately for the groups M, MJ, F and FJ and for the vaulting styles H, T and Y. Boxplots of v_{max} of the different vaults were constructed for each group to define the range of the optimal run-up velocity (lower to upper quartile) of each vault ($n \geq 3$). The relationship between run-up velocity and D-score was assessed by using Spearman's Rho. T-tests were used to determine differences between gender, age groups and vaulting styles. Significance level was set to $p < 0.05$.

In females, highly significant relationships were found between v_{max} and the D-score for all vaulting styles (F: r : 0.39 (Y) to 0.80 (H) and FJ: r : 0.48 (Y) to 0.65 (H)). The v_{max} of M and MJ correlated significantly with the D-score of T (M & MJ: $r = 0.60$) and Y (M: $r = 0.65$) but not with that of H (M: $r = 0.14$; MJ: $r = 0.31$) and Y in MJ ($r = 0.27$). Performing H and T, M and MJ reached significantly higher run-up velocities (M: + 9%; MJ: + 8%) than female gymnasts in the same category ($p < 0.05$). By contrast, the v_{max} of males and females performing Y were similar ($p = 0.20$). F and FJ athletes achieved similar v_{max} when performing H and T vaults

but F showed significantly higher v_{max} than FJ when performing Y. M athletes displayed higher v_{max} than MJ for H and T but not for Y.

The highest run-up speeds were observed in all groups performing H, whereas Y vaults were executed with the lowest v_{max} . For T vaults, the greatest difference in required run-up velocity between simple and very difficult vaults was found. T were the most common vaults in men's gymnastics but were only rarely performed by women. In contrast, Y vaults were performed most frequently by females but least by males.

The long-held assumption about a strong relationship between run-up velocity and the D-score on vault was completely confirmed in female gymnasts but was only partially true for males. Thus, it appears that it is more important for female athletes to run-up on vault with a speed that is close to their maximal sprint velocity than for male athletes.

The lack of correlations between v_{max} and D-score in males performing H is due to the generally high v_{max} required for all H vaults; even those assigned to a low D-score. Further, the different biomechanical requirements of H layout and double rotating vaults negatively influenced the relationships. Layout vaults require a high amount of horizontal velocity that is created during the run-up, but for double rotating vaults it is crucial to achieve a maximal vertical velocity (Knoll, 2004).

In men and women elite and junior athletes, the v_{max} and D-scores of T are highly correlated. Consequently, high run-up velocities are absolutely necessary when aiming to successfully perform a T vault with a high D-score. Furthermore, the quarter to a half turn in the first flight phase results in a successive hand contact on the vaulting table. Consequently, the push-off from the vaulting table is mainly performed with one arm, what makes it difficult for athletes with less upper body strength, to reach sufficient height of flight to perform a difficult vault. This might be the reason why females rarely perform T vaults.

The observed differences of v_{max} between M and MJ performing H or T can be attributed to better physical condition of M. In contrast, the run-up velocity is more or less similar between F and FJ athletes for H and T vaults. Consequently, it can be supposed that growth spurt and weight gain during puberty influences the strength-to-weight ratio (Claessens, Lefevre, Beunen, & Malina, 2006; Erceg, Delaš Kalinski, & Milić, 2014). Therefore, FJ athletes may have equal physical prerequisites for a good performance on vault than the more matured F gymnasts.

Due to the similar v_{max} of males and females performing Y, it might be assumed that women have to take higher risks when executing these technically very demanding vaults. Further, the higher v_{max} of F compared to FJ performing Y, leads to the assumption that the longer learning process enables the older athletes to acquire better technical skills. This in turn, allows the elite athletes to perform the preliminary elements with a higher velocity.

In conclusion it can be said that female athletes are the faster the better, but that males need to reach a certain minimum run-up speed to be able to perform the most difficult vaults. Moreover, the knowledge of the optimal run-up velocities for the different vaults (displayed by the boxplots of the v_{max} of each vault) is important for coaches and athletes when choosing an appropriate competition vault for each gymnast in consideration of individual's physical and technical abilities. Furthermore, it is helpful to assess the need to develop the physical qualities (strength, speed, sprint technique) in order to reach the required run-up velocity.

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FIG. (2013a). *Code de Pointage MAG (2013-2016)*. Lausanne: FIG.

FIG. (2013b). *Code de Pointage WAG (2013-2016)*. Lausanne: FIG.

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Topics: natural sciences

Keywords: heat, precooling, running, performance

Effect of competition-compatible precooling on distance running in humid heat

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Theoretical Background:

The next two major competitions in athletics will be held in Doha, Qatar (World Championships 2019) and in Tokyo, Japan (Olympic Games 2020). On both occasions, extreme environmental conditions are expected: A wet bulb globe temperature (WBGT) of ~28°C in Doha and of ~30°C in Tokyo (Murata et al., 2016), indicating “high” and “excessive” temperatures, respectively (Racinais et al., 2015). High WBGT cause a fast increase of body core temperature (CT) during exercise and therefore impair endurance performance (Nybo et al., 2014).

One commonly used means against the reduction of endurance performance induced by the rise of CT is “precooling”. It aims to delay the point where critically high CT is reached by lowering CT before the onset of exercise (Ross et al., 2013). Positive effects of precooling on endurance performance have been found, especially where different cooling modalities such as cold water immersion, cooling vests and ice slurries were combined (Racinais et al., 2015).

However, most of the existing studies on precooling have executed precooling directly before exercise-onset. They are thus hardly compatible with the regulatory restrictions before major athletics competitions. For example, long distance runners competing in track events (most importantly the 5000 m event) are obliged to arrive in the “call-room” ~30 min before the start of their race. In the call-room, no personal precooling instruments like cooling vests or baths are allowed. Before entering the call room, athletes typically are transferred from their hotel to the competition stadium. Also during transfer and subsequent warm-up, precooling is not possible without practical and regulatory restrictions. In order to implement precooling into the predetermined schedule, it would be necessary to extend the duration between precooling and the start of the race. This would likely reduce the chance of a performance benefit, as the effect of precooling could be “washed out” before the start. However, no study has investigated the effects of best-practice precooling compatible with the schedule before major athletics competitions on physiological parameters and on distance running performance so far.

Research Question:

What are the effects of competition-compatible precooling on A) body core temperature, B) heart rate, oxygen consumption and thermal perception as well as C) performance during distance running in humid heat?

Methods:

Subjects and design

Eighteen trained men (age: 29.9 ± 4.7 years, height: 179 ± 6 cm, weight: 72.3 ± 5.3 kg, $\dot{V}O_{2max}$: 61.0 ± 4.7 ml·kg⁻¹·min⁻¹) gave written informed consent to participate in the study, which was approved by the institutional review board of the Swiss Federal Institute of Sports Magglingen.

After familiarisation with heat conditions and assessment of $\dot{V}O_{2max}$ by an incremental running test, ten subjects completed two maximal running trials in randomized order: one with preceding precooling (COOL) and a control trial without precooling (CONT). Both trials were

conducted in a heat chamber set to a WBGT of $\sim 29^{\circ}\text{C}$, representing the environmental conditions in Qatar and Tokyo, respectively. Eight subjects completed a submaximal running trial after the precooling phase (Results reported elsewhere). Therefore, only CT data of these subjects was included in the present study.

Experimental procedures

The precooling protocol in COOL was designed such, that it could be directly implemented into major athletics competitions: First, 30 min cold-water immersion (22°C) starting ~ 2.5 h before the performance trial (possible in the hotel room before the transfer to the stadium). Then, 30 min (corresponding to the time during the transfer) in a cooling vest, followed by a 30 min warm-up and another 30 min (corresponding to the time in the call-room) during which a bottle of ice slurry (7 g per kg body mass) was consumed. In CONT, no precooling was undertaken.

The performance trial was a 20 min run on a motorised treadmill designed to represent the physiological load of a 5000 m track-race and to make possible the comparison of physiological parameters between conditions. The first 10 min of the trial were run with constant speed corresponding to 75% of the maximal velocity reached in the preceding $\dot{V}\text{O}_2\text{max}$ test. The second 10 min of the trial were a standard time trial, during which subjects selected their own running speed. The measure of running performance was the total distance covered in 20 min. During the performance trial, a large fan set up in front of the treadmill simulated wind speed equivalent to the current running speed.

CT at the start of the performance trial was measured by an intestinal sensor. Heart rate (HR), relative-to-bodyweight oxygen consumption (VO_2) and subjective rating of thermal perception (RTP) were measured during the fixed-speed 10 min of the performance trial.

Differences between COOL and CONT were tested using two-sided Wilcoxon signed rank tests with Bonferroni correction.

Results:

A) CT at the start of the performance trial was lower in COOL compared to CONT ($37.0 \pm 0.4^{\circ}\text{C}$ in COOL and $37.3 \pm 0.5^{\circ}\text{C}$ in CONT, 95% confidence interval (CI) of difference = $[-0.5^{\circ}\text{C}, -0.1^{\circ}\text{C}]$, $p = 0.02$).

B) HR and VO_2 were not different between COOL and CONT (95% CI of difference in HR = $[-6 \text{ bpm}, 4 \text{ bpm}]$, $p > 0.9$; 95% CI of difference in $\text{VO}_2 = [-2.2 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}, 0.7 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}]$, $p > 0.9$). RTP was lower in COOL compared to CONT (95% CI of difference $\approx [-1.0, -0.1]$, $p = 0.04$).

C) Distance covered in the 20 min performance trial did not differ between COOL and CONT ($5362 \pm 533 \text{ m}$ in COOL and $5363 \pm 544 \text{ m}$ in CONT, 95% CI of difference = $[-39 \text{ m}, 35 \text{ m}]$, $p > 0.9$).

Discussion:

The main finding of the present study was that a precooling protocol, which is compatible with major athletics competitions, can reduce CT before and RTP during exercise but does not improve running performance in a trial representative of 5000 m running competitions. This differs from the Results of previous precooling studies, which suggested that precooling could improve endurance performance in the heat (Ross et al., 2013). Regarding this contrast, two important aspects must be noted:

First, the duration between the cold-water immersion and the start of the performance trial was longer in our study than in previous studies. Accordingly, we observed a smaller difference in CT at the start of exercise (0.3°C) than for example the study of Booth et al. (1997), where runners started exercising immediately after cold-water immersion and where a TC-difference of 0.7°C was measured at the start of exercise. This presumed negative relationship between the duration from precooling to exercise-onset and the effect of precooling on CT at exercise-

onset could partially explain the lack of a positive effect of precooling on performance in the present study.

Second, the duration of our performance trial was shorter than in other studies. Since the performance-enhancing effect of precooling is thought to be dependent on exercise duration (Quod et al., 2006), the “too short” performance trial in our study could also be responsible for the absence of a beneficial effect of precooling on performance.

However, both the duration from cold-water immersion to exercise and the duration of the performance trial used in the present study closely represent reality in major athletics competitions.

We conclude that athletes competing in track events lasting no longer than ~20 min (i.e. 5000 m or shorter) cannot expect a performance-improvement by the investigated precooling intervention. The observed physiological and psychological effects (i.e. lower CT and RTP) are likely too small to trigger a relevant benefit in a 5000 m race, but could have more impact on longer races as 10000 m or the marathon. Importantly, 5000 m runners should still personally try out the different competition-compatible precooling modalities, as individual differences in the response to precooling can be expected. Like this, athletes can optimise their precooling strategies and thus their performance in the heat.

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Explosive upper-body strength in cross-country skiing: Development and evaluation of a movement-specific test concept

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Theoretical Background

Cross-country skiing performance has been traditionally characterized by high physiological capacity, such as high aerobic and anaerobic power, fractional utilization of VO₂max, energy availability and skiing efficiency (Sandbakk & Holmberg, 2017). However, recent studies have also identified an increasing demand for maximal skiing speeds, explosive and maximal force, as well as upper-body power in modern cross-country ski competitions (Hebert-Losier, Zinner, Platt, Stoggl, & Holmberg, 2016; Mikkola, Laaksonen, Holmberg, Vesterinen, & Nummela, 2010; Stoggl, Lindinger, & Muller, 2007). As a result of higher race speeds both during and at the end of sprint and distance competitions, skiers adapt their skiing technique appropriately, leading to a higher proportional use of upper-body reliant and high-speed techniques such as double poling (Sandbakk & Holmberg, 2014). Sport-specific test concepts for measuring aerobic and anaerobic capacity are well established in cross-country ski performance testing. However, corresponding performance tests in the explosive strength, neuromuscular and power domain are largely limited to lower extremities and movement unspecific upper-body exercises (e.g. pull-ups, dips). Therefore, the aim of this study was the development and evaluation of a skiing-specific upper-body strength test, allowing the measurement of explosive and maximal strength parameters during a simulated double poling movement cycle.

Research Question

Does the newly developed test concept allow the reliable measurement of skiing-specific explosive upper-body strength? What are the predictive value of explosive upper-body strength measures in terms of established cross-country skiing lab test and competition performance?

Methods

22 well trained cross-country skiers and biathletes (age: 19.9 ± 4.0 years, body mass: 71 ± 5 kg, height: 178 ± 4 cm, training volume: 559 ± 93 h/year) participated in this study. After familiarization with test equipment and protocols on the first day, skiers performed A) three trials with six different loads on the ski-specific upper-body strength device, followed by a peak power (PPSE), 30-s Wingate (WnGSE) and 3-min self-paced test (3MTSE) on a modified Concept2 ski ergometer (SkiErg; Concept2, Morrisville, VT, USA); and B) the upper-body strength test, followed by a double poling peak speed (PSTM), 3-min (3MTTM), and 3x8-min test (3x8minTM) on a treadmill using roller skis, according to previously described protocols (Carlsson et al., 2016; Sandbakk et al., 2016) on two separate days. From the upper-body strength device, peak force (PFZG), mean force (MFZG), peak power (PPZG), mean power (MPZG) and peak velocity (PVZG) were determined. External power output was continuously measured on the SkiErg and the highest recorded stroke during the PPSE was defined as peak power, while average power output was calculated for WnGSE and 3MTSE. On the treadmill, peak speed and average speed were determined during PSTM, 3MTTM, and 3x8-min test, respectively. Power output for the treadmill tests was calculated as the sum of power against gravity and friction, described by Sandbakk et al. (2016). Reliability and validity measures were calculated using Microsoft Excel spreadsheets (Hopkins, 2015, 2017). A coefficient of variation (CV) of <5% was considered desirable. The intra-class coefficient (ICC) was defined according

to a previous investigation, with ICC >0.9 = very high; 0.9 – 0.7 = high; 0.69 – 0.5 = moderate; <0.5 = poor (Roth, Donath, Kurz, Zahner, & Faude, 2017). The magnitude of correlations between strength variables and performance measures were categorized according to Hopkins (Hopkins, Marshall, Batterham, & Hanin, 2009). As a race performance indicator, both cross-country ski distance and sprint FIS-points from the 8th (2017) list were used.

Results

Test and retest analysis resulted in no significant difference between day two and three strength across variables (all $p > 0.05$). Reliability was found to be load dependent, with generally lower CV and higher ICC values for higher loads. Across all six loads, reliability varied among strength parameters, with PFZG and MFZG demonstrating high variation across loads (CV = 3.3 – 13.4%; ICC = 0.44 – 0.86), PPZG and MPZG demonstrating more consistent reliability measures (CV = 6.68 – 10.1%; ICC = 0.59 – 0.88) and PVZG showing acceptable CV and high ICC measures (CV = 2.37 – 4.47%; ICC = 0.80 – 0.89). Large to very large correlations were found between PPZG and PPSE (CC = 0.67 – 0.81), large correlations between PPZG and WnGSE (CC = 0.50 – 0.69) and moderate correlations between PPZG and 3MTSE (CC = 0.43 – 0.51). Correlations between PFZG, MFZG and performance on the Ski-Erg ranged from small to large (CC = 0.13 – 0.56). The relationship between strength measures and treadmill performance was dependent on test duration and performance measure (speed vs. power), resulting in small to very large correlations for PSTM (CC = 0.26 – 0.75), trivial to large correlations for 3MTTM (CC = 0.08 – 0.60) and trivial to moderate correlations for 3x8minTM (CC = 0.01 – 0.38). PVZG and PPZG provided a moderate to large predictive value for sprint race performance (CC = -0.43 - -0.64), whereas correlations between strength variables and distance race performance was trivial (CC < 0.1).

Discussion

The current investigation introduced a highly movement specific upper-body strength test concept for cross-country skiing. Most measures demonstrated CV > 5% and therefore need to further improve in order to implement in performance diagnostics with elite athletes. Due to the rather complex movement during the current explosive strength test, different poling strategies were employed by athletes, resulting in inconsistent force-time patterns. Reliability has been improved in a pilot study with modifications in the test protocol, instructions and analysis (CV < 5%). Velocity and power related strength variables demonstrated better reliability, which is supported by a similar study that demonstrated higher overall reliability across upper-body strength measures (CV = 1.4 – 6.8%) (Stoggl, Lindinger, & Müller, 2007). However, a somewhat less complex upper-body test mode on an inclined rollerboard was employed in that investigation. Validity depended on the strength variable, with higher predictive value for PPZG compared to PFZG and MFZG regarding SkiErg, treadmill and on-snow sprint performance. PVZG, representing the production of maximal movement velocity, was also closely related to sprint FIS-points, supporting the study by Stoggl et al. (2007). The establishment of performance reference values including both female and male skiers and different categories could increase the practical implication of the current upper-body strength concept in the Swiss National Team and provide further explanation for the performance differences between male and female cross-country skiers regarding upper-body power (Hegge et al., 2016). The authors would like to express their thanks to Swiss Olympic for the help in funding this study.

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