ABSTRACTS

NO. 1 INVITED TALKS

Behringer MF, Skatschek C

Anabolic stimuli for muscles
1. GOETHE UNIVERSITY, Institute of Sport Sciences, Sports Medicine & Exercise Physiology, Frankfurt/Main

The skeletal musculature is characterized by an extraordinary adaptability. It is well known that a low level of physical activity, such as bed resting, leads to the loss of muscle mass, whereas regular training stimuli are accompanied by hypertrophy of the muscles. What is unclear, however, is which stimulus qualities are crucial for triggering muscle growth. It was assumed for a long time that high mechanical loads were required for this muscular adaptation. In fact, some evidence suggests that eccentric contractions are more effective to induce hypertrophy, when compared to other contraction types. Since eccentric contractions are placing greater mechanical stress on the muscle fibers, this seems to support the assumption of high mechanical forces to be necessary as an anabolic signal. However, more recent studies show that hypertrophic effects can also be achieved with comparatively low intensities. In combination with blood flow restriction (BFR), intensities of 30% (or even lower) of the one repetition maximum have been proven to be sufficient to induce muscle strength and mass gains.

These results indicate that, besides mechanical stress, other stimuli, such as metabolic stress, are able to stimulate muscle growth. For example, it is assumed that the intracellular accumulation of osmotically active metabolites such as lactate causes an influx of water into the muscle fibers, which triggers cell growth via an hitherto unknown mechanism. Other stimuli, such as stretching of the muscle cell and muscular damage, are also discussed as anabolic signals. However, it should be taken into account that the boundaries between the different stimuli may overlap. For example, muscle swelling can frequently be observed after both, exercise induced muscle damage and metabolically demanding exercises with intra cellular metabolite accumulation. Overall, the current data suggests that there are different possible pathways for inducing training-related muscle growth, which gives trainers and conditioning specialists more options to design hypertrophy training plans.

NO. 2 INVITED TALKS

Bloch W

Epigenetics and sport - Training keeps our genes „young“
1. GERMAN SPORT UNIVERSITY COLOGNE, Department of Molecular and Cellular Sport Medicine

Throughout life, our tissues and organs change in many ways. This affects the cells and the connective tissue, which, among other things, is associated with impairing the regeneration and preservation of tissues and organs. Such long-term alterations are associated with changes in gene activity and availability that control these processes. Such long-term modification in gene activity are called epigenetic changes, which are mainly due to specific modulations that are responsible for the packaging of DNA in chromatin.

In doing so, the responsible hits and the DNA are modified. It is part of the aging process and can affect the aging process. There are now a number of examples that prove that genes are “turned on or off” by epigenetic modulation in old age which can be influenced through training.

Thus, e.g. Tumor-suppressing genes are kept active by active physical activity and inflammatory genes are kept inactive. In addition, the growth behavior of cells and the transformation of tissues are epigenetically regulated and there are at least a number of indications that suggest the influence of physical activity and training here as well. Even our largest “organ” - skeletal muscle is affected by epigenetic modifications in the course of life. This concerns both the muscle fiber and the satellite cells important for their regeneration.

However, the epigenetic modifications due to physical activity are not limited to the skeletal musculature, and concern e.g. also the adipose tissue and the brain. This raises the question of the right training for the maintenance of optimal bone function not only in the skeletal muscle. How and what regulates endurance and strength training epigenetically. In addition, the question arises how training must be optimally designed to keep our genes, young as a prerequisite for maintaining the muscles and their function. The current knowledge of epigenetic effects of endurance and especially strength training is presented.

NO. 3 INVITED TALKS

Brinkmann C

New training programs for type 2 diabetic patients – which one best suits which kind of patient?
1. IST UNIVERSITY OF APPLIED SCIENCES DÜSSELDORF
2. GERMAN SPORT UNIVERSITY COLOGNE

Developing training programs that are effective in managing type 2 diabetes mellitus and that are associated with high adherence to training is a major challenge. New approaches such as regular exergaming, EMS training, hypoxia training or intensive interval training go beyond the classical approaches, and their usefulness has been shown to have positive effects on clinical variables. Effectiveness and efficiency, but also feasibility and personal preferences should be criteria for selecting a suitable form of training for type 2 diabetic patients.

NO. 4 INVITED TALKS

Bäsch D, Schumacher K, Graunacher U

Reactive strength training as an integral part of fitness training
1. CARL VON OSSIETZKY UNIVERSITY OF OLDENBURG, Institute of Sport Science, Research Group Sport and Training
2. INTERNATIONAL FITNESS & HEALTH INSTITUTE OF APPLIED SCIENCE
3. UNIVERSITY OF POTSDAM, Division of Training and Movement Sciences

Approximately, 95% of sport-related movements are conducted in the stretch-shortening cycle (SSC). During the SSC, the pre-activated muscle is lengthened during the braking or plyometric phase (i.e., eccentric phase) followed by an immediate muscle shortening in the push-off or concentric phase (i.e., eccentric phase). Notably, reactive strength exercises are characterized by muscle actions in the stretch-shortening cycle (SSC) which is why this training type has also been denoted as SSC training.

There is evidence that reactive strength training is an effective training regime to improve muscle strength, power (e.g., jumping and throwing) as well as selected components of physical fitness (e.g., speed, agility) in athletes from different sports. Reactive strength training is not only important from a performance but also from a health-related perspective.

In fact, it can contribute to increase resistance to injuries (e.g., knee and ankle injuries), and it may help to regain pre-injury performance levels. As a consequence, reactive strength training should be implemented during all stages of “long-term fitness development”, irrespective of age, maturational status, and sex. It has to be noted that exercise prescription progresses through the different stages of “long-term fitness development”.

Strength and conditioning specialists are advised to follow the FITT (frequency, intensity, time, type) principle. Particularly during the early but also the later stages of “long-term fitness development”, strength training skill competency should be at the focus of SSC training. First, we will present constraints and adequacy and, second, we will discuss effectiveness and practical relevance of reactive strength training for “long-term fitness development”.

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ABSTRACTS

NO. 5
INVITED TALKS

CarlsbuHa A*

Effects of low carbohydrate availability on body composition and performance

1. UNIVERSITY OF APPLIED SCIENCES HAMBURG, Faculty of Life Sciences, Nutrition and Health Economics

High carbohydrate availability before, during, and after exercise has been regarded as cornerstone of endurance performance since decades. Even though the relationship between dietary carbohydrate intake on the one hand and muscle glycogen content and endurance performance on the other hand are well known and evidence-based, some athletes attempt to chronically or periodically reduce carbohydrate availability.

Indeed, low carbohydrate availability during selected exercise sessions was shown to increase fat oxidation and to result in glycogen sparing effects. However, whether or not these effects result in a reduction in body mass, body fat mass or in improved exercise performance is still under debate. A systematic literature search was conducted and own data included.

As a result, only very few studies were identified that have analysed effects of periodic low carbohydrate availability on body composition and body mass in athletic populations, and results are inconsistent. Regarding performance outcomes, early studies with athletes conducting several sessions under low glycogen state have shown promising effects with significantly increased time-to-exhaustion trends towards improved trial performance. More recent studies failed to prove performance benefits when exercising with low glycogen stores.

In an own study, recreational competitive runners (N = 9) exercising periodically under low gly\cogen state over 3 months neither reduced body mass (69.1±10.8 kg vs. 69.6±12.1 kg) nor body fat mass (9.6±5.1 kg vs. 11.3±5.3 kg) compared to control (N = 8); body mass 63.7±9.8 kg vs. 63.1±8.8 kg; p (group*time) = 0.372; body fat mass 11.1±4.1 kg vs. 11.3±3.0 kg; p (group*time) = 0.006. In a 5000 m time trial no difference between intervention (diet ? control group; diet ? control group: 0.13±0.35, p = 0.040).

As a limitation, effects of restricted carbohydrate availability on health and performance of athletes from other than endurance disciplines are not well investigated. In conclusion, potential benefits (e.g. increase in fat oxidation rate, increase in time-to-exhaustion measures) and disadvantages (e.g. failure to improve exercise performance, increased risk of injury) need to be carefully counterbalanced when counselling athletes.

NO. 6
INVITED TALKS

Faigenbaum A*

Muscle disuse in modern day youth

1. THE COLLEGE OF NEW JERSEY, Department of Health and Exercise Science, New Jersey, USA

There is increasing evidence that modern day youth are weaker than previous generations. Since prorogative levels of muscular fitness are needed to move proficiently, weaker youth are less likely to participate in daily physical activity and more likely to have functional limitations not caused by neurologic or muscular disease. While the term dynapenia has historically been used to describe the loss of muscular strength and power associated with aging, this concept can be expanded to include younger populations.

The term pediatric dynapenia highlights the significance of an identifiable and treatable condition characterized by low levels of muscular strength and power and consequent functional limitations. An interaction of modifiable physical and psychosocial factors can influence the development and progression of pediatric dys Nepenia. The purpose of this lecture is to explore temporal trends in youth muscular fitness. Describe the potential benefits of resistance training as a primary agent for the prevention of pediatric dynapenia, and challenge the traditional approach for treating inactive youth.

Research evidence underscores the importance of developing muscular strength for girls and boys and meta-analytic data highlight the unique health and fitness benefits of youth resistance training. Without interventions that target strength deficits and build strength reserves early in life, the diver\gence in performance between weaker and stronger youth may persist into adulthood because weaker youth may be unable to break through a so-called strength barrier. New insights have highlighted the importance of initiating developmentally appropriate resistance training activities early in life to optimize performance gains in other health and skill-related components of physical fitness.

Since muscular strength is foundational for all types of exercise and sport activities, a new framework is needed to address physical inactivity in modern day youth. Encourage participation in strength-building activities and challenge current pediatric health recommendations for promoting physical activity. The incontrovertible negative effects of pediatric dynapenia in modern day youth should encourage the development of novel treatment plans and innovative research initiatives to inform public health policy.

NO. 7
INVITED TALKS

Ferrauti A*

For three days in the ice bucket? About the evidence of various recovery interventions in fitness sports

1. RUHR UNIVERSITY BOCHUM, Faculty of Sport Science, Department of Training & Exercise Science

High intensive and high volume exercise as well as accumulated eccentric muscular overload stress can result in disturbances of the autonomic nervous system, metabolic disorders, neuromuscular fatigue and muscle damage which come along with an acute performance decrease in athletes in different fitness sports. A fast recovery from fatigue thereafter is crucial especially for aging athletes. Recovery can be related to different periods of time reaching from minutes (e.g. between sets or during interval training) hours (e.g. in case of two trainings units per day), one night (in case of a daily schedule) or even several years (in case of two or three trainings units per week).

Apart from nutritional strategies, some of the most frequently used recovery interventions are active recovery (also referred to an active cool down), cold water immersion (CWI), massage and foam rolling as well as compression clothes (CC). This talk will shortly summarize the potential physiological effects and the meta-analytical evidence of single and combined recovery interventions. A selection of group based and individual effects found in multiple cross-over studies from our group with Olympic weight lifters, the national volleyball team and professional tennis players will be presented. A special focus will be given to our recently completed ageing athlete study comparing the time course of recovery after a high intensity squash protocol between three age groups in trained males (20-25 yrs. vs. 35-40 yrs. vs. 50-60 yrs.). In this study we also compared the age depending efficacy of a combined CWI + CC intervention on recovery after 2h, 24h, 48h and 72h.

In conclusion we offer a clear evidence based approach for fitness coaches to identify tailor made recovery intervention protocols depending on exercise mode, time span for recovery and athletes age which also includes the paradox between fast recovery and maximum adaptation.

NO. 8
INVITED TALKS

Freiwald F, Hoppe M W*, Baumgart C

Prevention of and rehabilitation after knee joint injuries

1. BERGISCHE UNIVERSITY WUPPERTAL - DEPARTMENT OF MOVEMENT AND TRAININGSCIENCES - RESEARCH CENTER FOR PERFORMANCE DIAGNOSTICS AND TRAINING ADVICE (FLT)

The high number of knee injuries in sport - especially in game sports - requires measures of structured rehabilitation. Women are particularly more often affected by knee trauma, especially injuries to the anterior cruciate ligament. Due to the high number of re-injuries of the knee at the same or a different site, the prevention of new injuries is increasingly becoming the focus of medical care. Rehabilitation after knee trauma is performed based on medical evidence (EBM) in collaboration with sports scientists and physiotherapists. Postoperative recovery is divided into five phases: clinical phase, return to activity phase, return to sports phase, return to play phase, return to competition phase.

The transition from one phase to the next is not fixed in time; it takes place when the criteria of the respective phase are fulfilled. The fulfillment of the criteria is checked by subjective and semi-objective procedures (such as IKDC, Lysholm, Funder, KOOS) as well as by objective methods (clinical examination: motor test procedures). Only then is the transition to the next phase of rehabilitation made. Outstanding in the (secondary) prevention of knee trauma is the collection of individual intrinsic and extrinsic risk factors, which must also be addressed in rehabilitation. Intrinsic risk factors may include gender, hormonal factors, previous injuries, and individual anatomic and neuromuscular aspects. Extrinsic factors include flooring, sports shoes, and weather conditions. The lecture will show examples of rehabilitative and preventive measures that contribute to optimizing rehabilitation and prevention, reducing the re-injury rate.

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Many athletes adopt high altitude training to improve performance. It is well established that training at altitude improves endurance performance when competing at altitude. However, if it is the goal to improve sea level performance the literature is controversial. The most utilized training modality is the live high train low concept (LHTL). Athletes performing this type of training live at altitude (2000-2500m) for several weeks (3-4 weeks) and train close to sea level. Living at altitude (min 12-13 h/d) is intended to increase the total hemoglobin mass (HbMass), while training at sea level keeps training quality high.

This concept was recently challenged, showing that elite athletes with already high HbMass will not further increase their oxygen carrying capacity and thus will not improve performance. In the literature, these findings led to a scientific debate mainly because LHTL was considered the “gold-standard” for altitude training with no final answer yet. During the last years, additional high altitude training strategies were introduced. With the development of new approaches, the focus shifted from solely considering endurance athletes to including game sport athletes as well. This led to the development of the repeated sprint training in hypoxia (RSH) concept and furthermore to the combination of LHTL with RSH named live high train low and high (LHTHL). RSH consists of performing multiple sets (3-4 sets 3-5 min) of repeated (4-7) short (4-15 s) maximal sprinting bouts, interspersed with 30s rests between intervals. Performing RSH was found to improve the ability to perform repeated sprints, which is considered a crucial ability in many intermittent sports (e.g., soccer, tennis).

The performance improvements were mainly linked to an increased muscle blood flow, especially to the fast twitch fibers and changes in the energy pathway and buffer capacity. However, similar to LHTL, the RSH concept was challenged in recent years, which also led to a scientific debate with no final answer yet. In summary, from a scientific point of view, the effectiveness of high altitude training to improve sea level performance can be neither proved right nor wrong at present. The researchers and practitioners are encouraged to critically assess the strengths and weaknesses of the different studies and to form their own opinion. From a practical viewpoint, coaches and athletes should decide according to their experience and beliefs whether to implement high altitude training concepts in their training routine.

Altitude training for performance enhancement: does it work?

Gatterer H²

Health effects of high intensity training (HIT)

Jöllenbeck T³

Mechano-metabolic aspects of acute and chronic resistance exercise

Geblerl S², Jacko D¹, Wüchner H², Bloch W³

Health effects and physiological benefits of regular resistance training have been studied extensively in recent years. Studies have shown that inducing these health benefits requires less training time than was previously assumed. Recent data shows that when intensity of effort is sufficiently high, as little as one to two training sessions per week can induce significant health benefits. In contrast to what is widely believed, High Intensity Training (HIT) does not require heavy loads. In contrast to what is widely believed, a high intensity threshold is sufficient to induce improvements in muscle strength and mass. Training loads need to be sufficiently high, as little as one to two training sessions per week can induce significant health benefits. In contrast to what is widely believed, High Intensity Training (HIT) does not require heavy loads.

While molecular signal transduction pathways are well described, less is known about selective protein degradation pathways and changes of the human skeletal muscle metabolome in response to resistance exercise (RE). We determined that maximal eccentric RE leads to a significant degree of z-disc streaming and myofibrillar damage associated with a significant degree of unfolding and degradation of Filamin C (FlnC) proteins. FlnC proteins act by crosslinking actin filaments in the sarcosomes. z-disc and further as molecular sensors of damage. Its degradation is coordinated via chaperone-assisted selective autophagy (CSA) by the co-chaperone BAG1 which also controls increased FlnC expression.

2.2. In contrast to low intense RE, maximal eccentric RE induces a significant reduction of FlnC and BAG1 in 24h after acute RE. In a chronic RE intervention (11RE units, 3 times per week) a progressive but not constant training intensity was associated with a significant increase in FlnC levels over five weeks of RE. This was accompanied by a reduction of z-disc streaming and myofibrillar damage and attributes CSA mediated FlnC incorporation into z-discs a potential role in mediating the “Repeated bout effect”. As it can be assumed that during frequent RE and in a growing muscle various molecular pathways will be activated, we hypothesized that branches of the skeletal muscle metabolism will change acutely and also after several weeks of RE.

In a combined approach using liquid chromatography followed by detection through mass spectrometry we detected 359 metabolites within biopsy samples in which we also found a significant increase in type 1 and II myofiber diameter. Metabolites of the amino acid and nucleotide metabolism increased significantly after the first accustomed RE session while being reduced up to the 33rd RE session. In contrast, metabolites of the lipid metabolism were significantly reduced up to the last training session indicating a reduction in skeletal muscle lipid content induced by RE.

We conclude that RE exerts the acute and chronic adaptation of the mechanobiologic signature and structural integrity of skeletal muscle which is substantially influenced by the magnitude of loading.

Practice-oriented gait and treadmill analysis

Jöllenbeck T³

The gait and treadmill analysis is a reliable instrument for expanding medical diagnostics or running-style analysis. Today the effect is manageable and the results are available promptly. Technical details as well as abnormalities in the dynamics of movement can be recognized that remain hidden to the human eye. Early preventative measures can preclude possible damage to the musculoskeletal system. For that purpose the understanding of movement and the detection of primary deficits of movement is the key component of successful and sustainable diagnosis and treatment. Kinetic force-time curves show problematic movement phases. Pedography helps to assess the rolling performance and dynamic foot loading. Videos, kinematic 3D motion analysis and electromyography support the search for the reasons of aberration and help with the choice of the treatment approach.

However, in addition to the opportunities, especially the limits of the methods must be observed. For example kinematics can describe the motion of the body exactly in space and time, but does not provide any information about the crossing forces or muscle activities. Normal values and standard curves are a great aid in understanding complex interrelationships and the classification of current results. In this sense any deviation from the norm requires special attention. The desire for fast, automated results and simple causal relationships is tempting to use normative data as representative for the evaluation based on motion analysis.

Human individuality is expressed mainly in the way of deviation and thus by conformity to a standard. The high complexity of motion contains a multitude of degrees of freedom and allows for a correspon-
ABSTRACTS

NO. 13  INVITED TALKS
Koehler K

Flexibility training for sports and regeneration

1. UNIVERSITY OF WUPPERTAL, Sports science

- For the effects of stretching, a distinction must be made between long-term and short-term effects. There are different effects with the resting tension; short-term stretching reduces the resting tension up to 20% over 4 repetitions. Long-term stretching does not; it may even cause the opposite, that is, an increase in resting tension possibly due to hypertrophy. Before the year 2000, too many effects were assumed, after which too many were questioned. e.g. the injury prophylaxis.

- However, such studies mainly researched injuries of the passive movement apparatus and chronic and overuse injuries. If one focuses on the prevention of acute muscle strains, fiber tears and tendon injuries, a significant reduction (25% to 50%) can be shown (5-9 years to prevent one injury). It is not possible to say whether the reduction in the injury rate is a consequence of the short-term effects or the consequence of the long-term effects. In the case of speed-strength (sports) sprinters and sports with large range of motion (hurdles) a higher effect of stretching is to be expected in the case of injury prevention than in endurative sports.

- For most effects, there is a large number of studies with contradictory results; so that one can prove both statements (confirmation of effect, refutation of effect). There are studies that determined performance degradation and investigations that found improvement. The effect depends on the types of stretching, the timeframe and the intensity. Stretching training, during warm-up only reduces performance when used intensively and statically. Dynamic stretching can even increase the performance. There are meta analyses in each research field that can provide an overview.

- Nevertheless, you have to look at the summarized studies closely because sometimes artificial treatments are tested. For example, the examinations that found a reduction in performance often started very intensively. During regeneration for DOMS (delayed onset of muscle weakness) no effect is detected from stretching, very intense stretching could even increase DOMS. This does not mean that long-term stretching cannot prevent DOMS; the opposite is likely, perhaps due to possible muscle hypertrophy and connective tissue growth. Sport results in spinal shrinking, mean losses for a weight training regime being 3.4 mm and for a 6 km run 3.25 mm respectively. Therefore, re- laxation programs in regeneration should include gentle stretching and focus on the rehydration of the intervertebral discs. Stretching is no less important than used to be. It was absorbed by other trends (fascia training).

NO. 15  INVITED TALKS
Koehler K

Why we don’t lose weight through exercise - but why exercise is still great for weight loss

1. TECHNICAL UNIVERSITY OF MUNICH, Department of Sport and Health Sciences, Professorship in Exercise, Nutrition and Health

- Although the beneficial effects of exercise are well established for many health outcomes, including diabetes mellitus, cardiovascular disease, certain cancers, emotional well-being, depression and anxiety, the capacity of exercise to induce meaningful weight loss is rather low when compared to dietary interventions. Reasons for the discrepancy between expected and actual weight loss are diverse but include the composition of weight lost and compensatory changes in food intake.

- In contrast to dietary interventions, which typically result in the loss of weight with a mixed composition (fat mass ~75%, lean mass ~25%), exercise induces weight loss with further gains in muscle mass and fat loss. In severe cases lean mass may even be gained despite weight loss. Given the different energetic storage capacity of fat and lean tissues, the energy deficit required to produce the same weight loss exclusively from fat mass is meaningfully higher when compared to weight loss of mixed composition. Further, engagement in exercise alters post-exercise food intake.

- Although this compensatory response is highly variable among individuals, literature evidence suggests that on average individuals increase their food intake such that approximately 50% of the energy cost of exercise is compensated for. Notably, these mechanisms responsible for weight loss attenuations via exercise alone explain why the combination of caloric restriction with exercise is superior to weight loss interventions when compared to caloric restriction alone.

- The protective capacity of exercise: for lean mass likely minimizes adaptive reductions in resting metabolic rate, which in turn maintains the initial energy deficit to prevent weight loss attenuations. Adaptive reductions in other components of energy expenditure, especially in non-exercise activity thermogenesis, may also be prevented through incorporation of exercise in weight loss programs, possibly via protective effects on mood and perceived fitness. Due its preserving effect of lean mass, incorporation of exercise also minimizes the likelihood of weight regain and collateral fattening, thereby impeding long-term weight control.

NO. 14  INVITED TALKS
Knicker K, Abdulhaji H, Ali T

Muscular balance - myth or physiological nonsense? Observations from functional anarthromuscular diagnostics

1. GERMAN SPORT UNIVERSITY COLOGNE, Institute of Movement and Neuroscience
2. GERMAN SPORT UNIVERSITY COLOGNE, German Research Centre for Elite Sports, Momentum
3. OLYMPIC TRAINING AND TESTING CENTRE WESTPHALA, Dortmund

- In many studies, muscular imbalance is considered to be the cause of sports injuries and overuse symptoms. Conversely, therefore, muscular balance should be able to counteract injuries and overuse symptoms. But there is little practical information about what muscular balance really means and how it can be identified. For the ratio of the strength capabilities of agonist to antagonists, values are sometimes prevalent that have been consistent and confirmed in many studies, but which lack both functional significance and physiological relevance. The hamstring to quadriceps ratio is one of these persistently utilized ratios for the estimation of muscle balance around the knee joint neglecting the evidence of its uninformative contemplation of the muscular situation and disregarding current insights into intramuscular coordination and the intramuscular work conditions. The latter warrants into injury mechanisms and constitute valuable, functional and meaningful indexes of agonist-antagonist interactions.

- Besides to the muscular agonist-antagonist ratios we retroactively find diagnostic indications of lateral dysbalances in the field of competitive sports. Differences between dominant and non-dominant limb sides of over 30% are frequently reported even in sports where both body sides are equally contributing to the underlying performance. Here the question consistently arises to what extent these imbalances take shape as tolerable sport-specific or injury relevant. This is made even more difficult by the fact that there are no comparative values for some very relevant muscle groups such as hip adductors or shoulder stabilizing muscles. The indicators of muscle balance around the knee joint provide some orientation. Derived from this, it can be seen that the expression of the muscular abilities of the agonists under eccentric contraction conditions at high speeds of movement is highly predictive of a dysbalance around a joint. They also strongly relate to sports injuries such as cruciate ligament and muscle fiber ruptures and overuse symptoms such as shoulder impingement syndrome or pubic bone irritation.

- Still the underlying algorithms need to be validated with reference to their predictive power and prospective potential.

NO. 16  INVITED TALKS
Legerlotz K, Radavovanic G

Prevention and rehabilitation of tendon pathologies with high intensity strength training

1. HUMBOLDT UNIVERSITY OF BERLIN, Institute of Sport Sciences
2. MEDICAL SCHOOL HAMBURG, Department of Performance, Neuroscience, Therapy and Health

- Tendinopathies, characterized by chronic tendon pain and impaired functionality, are a common occurring clinical problem in both recreational as well as elite sports. Although etiology and progression of this disorder is still poorly understood, which makes it difficult to develop effective treatment options, we know that exercise plays a fundamental role in tendon rehabilitation. Thus, eccentric training is a widely used treatment approach in chronic Achilles tendonopathy. However, current evidence suggests, that the intensity and the duration of loading are more important than the eccentric contraction mode. Previous studies with healthy participants have shown, that the optimal stimulus for tendon adaptation is characterized by high intensity strain of several seconds duration being repetitively applied. Thus, we hypothesized that this stimulus, consisting of five series of four isometric plantar flexions (4x/week) with 90% of the MVC held for 3 seconds with 3 seconds rest between repetitions, would provide a superior therapeutic effect for pathological tendons as well.

- To transfer this approach, termed ‘Berlin Method’, into practice we developed a single-dose based training device to facilitate execution of maximum plantar flexions, leading to high tendon strains, in a home-based setting.

- First, we tested our tendon training approach, with healthy participants, showing good applicability and significant increase of peak strength.

- Second, we conducted a randomized controlled trial with Achilles tendinopathy patients to compare the effects of the Berlin Method on mechanical and morphological Achilles tendon properties, functionality and pain to other treatment approaches such as eccentric training and passive physiotherapy. While all treatment approaches similarly reduced tendonopathy symptoms, solely the treatment according to the Berlin Method led to an increase in Achilles tendon stiffness and cross-sectional area. These strength training induced adaptations may have a preventive effect, protecting the tendon from future injuries.

- Third, we investigated the role of inflammation in the context of tendinopathies. A subgroup of patients represented with elevated interleukin 6 (IL-6) levels at baseline, that dropped with physio- therapeutic treatment, making IL-6 a potential target for therapeutic interventions in this subgroup.
Olympic weightlifting, more than just sport

1. INSTITUTE FOR APPLIED TRAINING SCIENCE, Research Group Weightlifting

It is commonly believed that Olympic weightlifters are obese спортmen who will ruin their backs and knees because of the heavy weights they lift in training and competitions. This old viewpoint is still in people’s minds when thinking about Olympic Weightlifting (OL). As a result, OL still has a bad image.

The intention of this abstract is to briefly summarize the overlooked health benefits of OL, not only in the context of applications but also in non-applications such as aerobic training, rehabilitation, and surgical patients. In particular, OL may be applied in the context of injury prevention and rehabilitation, as OL is an excellent tool to improve performance in movement coordination and balance. 

In addition, OL may be applied in the context of injury prevention and rehabilitation, as OL is an excellent tool to improve performance in movement coordination and balance. 

Furthermore, OL has a high potential to support the everyday activities of elderly people through improved movement competency and the prevention of falls. The latter is of great interest for the healthcare system because of the high financial costs that arise from therapy for injuries associated with falls (e.g., femoral neck fractures). All in all, OL is more than a sport with a bad reputation. OL is a hidden "secret weapon" to fight for health at any age which should have more attention devoted to it by public and private sectors.
ABSTRACTS

NO. 21

Wackerhage H

What explains the association between muscularity and leanness?

1. TECHNICAL UNIVERSITY OF MUNICH, Department of Sport and Health Sciences, Exercise Biology Group

- Being muscular and lean is a fitness and health goal for many people. Interestingly, muscularity and leanness seem associated. For example, highly muscular, transgenic mice (e.g., Mstn and Akt1 mutants) typically have less body fat than wildtype mice. Similarly, young adults and bodybuilders with more muscle mass and lean mass are on average leaner than elderly individuals or hypogonadal men. What can explain this association between muscularity and leanness? Here, we propose that a hypertrophying skeletal muscle undergoes a cancer-like metabolic reprogramming which is similar to the Warburg effect. As a consequence, hypertrophying muscles take up more glucose and channel some of this glucose into anaerobic pathways such as nucleotide- RNA, DNA and amino acids protein synthesis. As a consequence of the increased muscular glucose uptake, less glucose is available for lipid synthesis, resulting in organisational leanness. Here, we will discuss data of 14C glucose tracer and enzyme manipulation experiments that support the idea that hypertrophying muscles indeed increase their glucose uptake to support anabolism.

NO. 22

Zimmer P

Exercise immunology

1. LEIPZIG UNIVERSITY HANNOVER, Institute of Exercise Science, Dept. Exercise and Health

- Acute bouts of exercise as well as training and regular physical activity are associated with distinct alterations in immune function. Acute effects of exercise are frequently associated with an increased risk of infections (“open window”). However, evidence for this relation is still sparse. In contrast, overwhelming evidence suggests that training and regular physical activity reduce the risk for several chronic diseases. Acute bouts of exercise provoke a specific endocrine response, leading to a mobilisation and redistribution of several immune cell subsets. Additionally, immune cells may indicate changes of their functionality. Finally, acute exercise induces microinflammation and provokes a short-term pro-inflammatory environment. On the opposite, training and regular physical activity increase the body’s anti-inflammatory capacity and contributes to long-term adaptations of the cellular immune system. Some beneficial long-term effects in terms of prevention, may rather be based on the sum of acute effects of exercise on the immune system which do not lead chronic adaptations. This talk will give an overview on current knowledge in ‘exercise immunology’ connecting bench research results and implications for healthy subjects (athletes) and clinical populations.

NO. 23

Zinner C

Periodization of endurance training for recreational athletes

1. UNIVERSITY OF APPLIED SCIENCES FOR POLICE AND ADMINISTRATION OF HESSE, Department of Sport, Wiesbaden

- Periodization is the process of planning a training over a certain time and thereby considering all factors that influence the overall performance of an individual. After publication of the linear periodization concept (from high volume with low intensity to low volume with high intensity) in 1981 several different periodization models have been proposed (e.g., nonlinear, block, fractal, and conjugate).

- Independently of the chosen model, periodization implies the organization of different elements related to endurance training (e.g., volume, intensity distribution, frequency, etc.) to achieve an improvement in performance. In the last years the concept of periodization has been questioned by researchers by several reasons. One main argument is that planning training on the long term needs to consider the long-term needs forecastable reactions of an athlete to a certain training. The reality of biological complexity makes adaptations to training highly individual and nearly impossible to predict.

- In contrast to elite athletes, far less is known about the physiological responses of sub-elite and recreational athletes executing different periodization models for endurance training. Nevertheless, knowing that variation of the stimulus after a certain time is a critical aspect of effective endurance training, periodization might help recreational athletes to vary their training to maintain a high stimulus. Even though the variation of individual responses to training is large, results of different studies help to set up a basic structure of endurance training for recreational athletes on the long term.

- Especially the training intensity distribution (TID) has been investigated extensively in the last years. For elite endurance athletes of different sports two main TIDs have been proposed. The model employed is the pyramidal TID with a high amount of training with low intensities (~70%), some amount of threshold training and only a minor portion of high intensities. The other TID is the polarized model with a high amount of low intensities (~80%), nearly no threshold training and approx. 20% high intensity training. For recreational athletes it seems that with a pyramidal TID the relative risk of not-responder is lower compared to a polarized TID or even a training with a high amount of high intensities (~80%). Even though training which has been shown is not a good TID for elite athletes, might be suitable to improve general fitness in recreational athletes.

NO. 24

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The impact of two weeks bed rest on muscle stem cell content in healthy young men

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- On the muscle fibre level, the loss of skeletal muscle mass with age (i.e. sarcopenia) is characterized by a decline in type II muscle fibre size and muscle stem cell (MSC) content. MSC are critical in muscle fibre growth, repair and regeneration. Whether MSC cells are also lost during short-term period of physical inactivity (e.g. bed rest) induced muscle fibre atrophy remains ambiguous. Twelve healthy young men (24.4±3.5 yrs) were subjected to two weeks of bed rest. Before and immediately after bed rest, muscle biopsy samples were collected from the vastus lateralis of the participants. Muscle and tissue strength (1RM) were determined.

- In addition, muscle biopsies from the vastus lateralis were obtained before and after the 2 week bed rest intervention. Type I and II muscle fibre distribution, fibre cross-sectional area, myonuclear domain size and MSC content were assessed by immunohistochemistry. Quadriceps CSA (CT-scan) and muscle strength (1RM) were determined.

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Background: The possibilities of continuously monitoring everyday training have become more varied and precise. Fitness trackers are common devices used for collecting training data. The aim of this study was to validate the optical heart rate (HR) and GPS distance measurements under real conditions.

Methods: To total, 30 moderate endurance trained adults (15 males / 15 females) completed a running test: battery, 3.5 km of walking and running, and 1.6 km of interval- running with optical HR measurement. The distance measurement test: battery consisted of swimming for 500 ± 100 m, biking for 3.3 ± 3.7 km, stadium running and walking for 3 km and running for 1.6 km interval and off-road running for 3.7 ± 1.1 km. The criterion measurements consisted of HR- measurement via chest strap and distance measurement via map: 400 m stadium / 50 m pool.

Results: The t-test analysis of HR measurement showed significant differences during the 1.6 km of interval- running (p<0.009) during seven phases and at rest (HR(rest), p<0.021). The t-test analysis of walking showed significant differences during the 1.6 km of interval- running (p<0.012) (RestHR, p=0.012). The t-test analysis distance showed significant differences (p<0.000) and running tests (p<0.002). The effect sizes were: d= 0.47 and d=0.72, respectively. Medium absolute percentage error (MAPE) showed: 2.75% for biking and running and 4.90% for walking.

Conclusion: This study showed significant maeasures in optical HR measurements during spped- changing HRs in real field testing for the first time. GPS measurements also showed significant differences, but the absolute deviation. MAE and MAPEs were negligible. Therefore, the use of these devices for everyday sports can be recommended. When used in ambitious and competitive sports there are some limitations, especially for sports that result in rapidly changing HR. Furthermore, the recording of vital data and their subsequent evaluation on a PC could inspire and motivate people to become more active in sports and daily movement.

In conclusion, the change value of the golden store on the basis of the blood glucose level is discussed as a possible performance diagnostic parameter. The aim of this pilot study was to examine the blood glucose level in the fasting state for its suitability as a practicable performance diagnostic marker for the fasting state of the golden store of the musculature. Ten healthy volunteers: two women and eight men - at an average age of 28.4 ± 12.8 years completed a glycogen depleting running workout over a period of two days. There was a daily 7-day blood glucose level determination, maximum post workout lactate, maximum lactate production rate, and maximum power output through a 10-second sprint test.

The changes in outcome parameters after the run program were checked for statistical significance by analysis of variance (ANOVA) or by Friedman test and Wilcoxon-signed rank tests (p<0.05) with Bonferroni correction. There was a significant drop in blood glucose level on the day after glycogen depleting running from an average of 5.55 ± 2.29 mmol / l to 4.18 ± 0.27 mmol / l (p<0.002). This was followed by a significant recovery of the values from 4.18 ± 0.27 mmol / l to 4.56 ± 0.28 mmol / l (p=0.036). The results of peak lactate, maximal rate of lactate production and maximal power output remained unchanged (p>0.05).

The present results support the suggestion that there is a decline in blood glucose levels as a result of a glycogen depleting training program. However, the results are likely to be influenced by a number of factors that could not be controlled in this pilot study. The available data lead to the conclusion that the fasting glucose level seems to be of limited suitability as a performance diagnostic marker. For example, in the following study it is necessary to control a number of possible influencing factors in order to be able to make a corresponding statement from the measurement results.

Validity of the Polar Vantage V to assess heart rate variability during an orthostatic test

Validity of the Polar Vantage V to assess heart rate variability during an orthostatic test

Validity assessed and correctly interpreted heart rate variability (HRV) data monitored by Wearable Sensor Technologies (Wearables) may be used for guidance training of endurance athletes across different performance levels. However, provided data by commercial available Wearables is seldom investigated for its validity. Our aim was to investigate the validity of the Polar Vantage V (Polar Electro Oy, Kempele, Finland, Firmware 3.1.7) to assess HRV in recreational runners.

24 individuals performed an orthostatic test, who pre-defined the software of the Polar Vantage V an one channel electrocardiogram (eMotion Faros 180°, Mega Electronics, Kuopio, Finland) was used as criterion measure. Data was log-transformed, analysed according to existing recommendations and interpreted as previously performed.

For the sitting and standing position, the standardized typical error (STE) (Equation of Variance (CV)%) as well as Pearson’s Correlation Coefficient (r) were 0.3% “poor” (STE) and 0.85 (“large” STE) 12.6% and 20.5% (“good” r) and 0.76 (“poor” r), respectively.

Our results show that HRV data is more valid during the sitting than the standing position. HRV data during the sitting position needs to be interpreted with caution. Our results indicate that the Polar Vantage V may be used to guide training based on HRV measurements which are obtained during the sitting position with moderate error rates.

Diagnostic value of fasting glucose levels – A pilot study

Diagnostic value of fasting glucose levels – A pilot study

The acute impact of different load intensities of a strength training on thyroid function in women

The acute impact of different load intensities of a strength training on thyroid function in women

Hypothyroidism, especially in subclinical form, is one of the most commonly occurring endocrinopathies. The incidence is 7-10 times higher in women than in men and it increases with age. Standard therapy involves hormone replacement with levothyroxine or a combination of levothyroxine and liothyronine. However, despite thorough metabolic work, patients report existing symptoms such as reduced quality of life, increased somnolence, weight problems or reduced physical performance. There is only limited information regarding effects of strength training on thyroid hormone levels in healthy, premenopausal women.

5 participants (21.2 ± 4.9 years) complete a total of 4 familiarization training sessions. For baseline blood samples are taken at 9 am and 10 am without training to determine circulation changes in thyroid hormone concentrations (T3, T4 and TSH). In a second pretest the 1 repetition maximum (IRM) of the participants is recorded for all exercises to identify the training intensities. Subsequently a total of 13 testing days take place, on which the participants carry out a submaximal (5 repetitions, 95 % IRM), a hypertrophy (10 repetitions, 75 % IRM) and a strength endurance training (20 repetitions, 65 % IRM). The order of testing days is randomized for each subject. On each day of training thyroid hormones are determined at 9 am and 3 pm. All subjects complete the second pretest as well as all strength training in the second half of their individual menstrual cycle.

As a result TSH serum concentrations increased after strength endurance training from 1.45 ± 0.26 to 1.71 ± 0.09 µIU/ml and after submaximal training from 1.59 ± 0.28 to 1.63 ± 0.54 µIU/ml. Serum T3 concentrations decreased after hypertrophy training from 3.4 ± 0.54 to 2.9 ± 0.34 pg/ml and after strength endurance training from 2.88 ± 0.46 to 2.72 ± 0.36 pg/ml. Further serum T4 concentrations decreased after submaximal training from 1.84 ± 0.15 to 1.00 ± 0.16 µIU/ml and after hypertrophy training from 1.08 ± 0.20 to 1.06 ± 0.18 ng/dl. There were no changes observed in T3 concentrations after strength endurance training.

In conclusion, the results demonstrate possible effects of strength training on thyroid function. This effect has to be further analyzed in bigger cohorts to confirm.
Sarcopenia, i.e. the loss of muscle mass, strength and function is a common burden among cancer patients and survivors. This condition has shown to increase the likelihood of cancer therapy associated toxicities and cancer associated mortality. Resistance Training (RT) might counteract the muscle degeneration as it has been demonstrated in multiple healthy and clinical populations. However, it remains unclear to what extend these findings can be translated to cancer populations. We conducted a systematic review and meta-regression to answer this question. 

 Trials were eligible if they included adult patients diagnosed with cancer, regardless of cancer site and therapy or survivor status if the patient underwent some sort of RT if the patients were randomly assigned to an intervention or control group and if muscle mass or lean body mass were assessed. 36 studies fulfilled the eligibility criteria, of which 32 were included into the primary analysis since they assessed lean body mass (LBM). The analysis was conducted by comparing the post-test measurements from the remaining 4 studies. In the baseline adjusted model a mean superiority of 0.73 kg [95%-CI=0.28, 1.17] was calculated. In a second model, the supervision modalities (SUP) were included as dummy coded predictor (0= No Supervision, 1= Supervision). All models were also fitted to a data set, including the measurements from the remaining 4 studies. In the baseline adjusted model the intercept of the model dropped to 0.23 kg [95%-CI=0.30, 1.42] with SUP excluded as predictor. In this case, the mean superiority of 0.73 kg [95%-CI=0.28, 1.17] was maintained. 

 We found that resistance training increases the lean body mass of cancer patients: A meta-regression
Comparison of pro-regenerative nutritive actions given by foodstuff or shake after strength exercise

1. GERMANY SPO Sports University, Institute for Cardiovascular Research and Sports Medicine, Department of Molecular and Cellular Sports Medicine
2. IST University of Applied Sciences Düsseldorf, Department of Fitness and Health

Various studies suggest that ingestion of combined carbohydrates and proteins after exercise result in a decrease of inflammatory processes and consequently in an increase of regeneration and physical performance. Usually these nutritive actions are ingested by shakes containing isolated forms of carbohydrates (glucose-based ingredients) and proteins (whey/protein). Recent studies compared the pro-regenerative effects of these shakes with the intake of foodstuffs on the skeletal muscle after acute endurance exercise.

This project aimed to transfer this design on a strength-based training. Therefore, twelve subjects run through a placebo controlled, double-blind crossover study with three groups. After a standardized training protocol the participants ingested after the placebo shake (placebo-group), a protein-glucose shake (shake-group) or a meal consisting white bread and sour milk cheese (food-group). All data were collected under standardised conditions. To evaluate the muscle damage effects, serum creatine kinase as an physiological parameter and ISRM-squat as a functional marker were measured at two times (t0, t24).

In all groups, the serum creatine kinase increased significantly from t0 to t24. In comparison of the groups, no statistical difference could be determined. In regard to the effect size, a medium effect between the placebo- and food-group (cohans d = 0.33) and a medium-strong effect between the placebo- and shake-group (cohans d = 0.62) was found. In contrast, no clear difference could be detected within the functional parameter (ISRM-squat).

On the contrary to the shake and food group, the placebo-group had a statistically significant exercise induced drop in physical performance (p = 0.021 ≤ 0.05). This data underlines the importance of pro-regenerative nutritive actions after exercise. However, the form in which this action is taken does not seem to be a major factor.

Endurance training for pupils with intellectual disability

1. UNIVERSITY OF EDUCATION LUDWIGSBURG, Faculty of Special Needs Education

Athletes with intellectual disabilities (ID) are, first and foremost, athletes, no different to athletes without disabilities. For example, the basis of running do not differ compared to any other athlete. Nonetheless, there are some very important aspects to keep in mind. First, the general motor ability is at a lower level compared to people without ID. Coaches have to recognize and understand these abilities. A hard task especially for coaches from the mainstream sport. Second, due to the ID, the understanding of tasks, the instinctive and cognitive learning speed and competence is somewhat different. Coaches may have to spend more time clearly explaining and demonstrating a task and possibly doing this repeatedly. A coach must also realize that the likelihood of injury is bigger than in mainstream sport.

In the present project the possibility of endurance training for people with ID was highlighted, tested and analysed. 23 students from special needs education schools participated on a 3 months regularly track and field training program, focusing on endurance aspects. The training program was adapted for pupils with ID and was based on the Special Olympics (SO), the biggest organization dealing with sports for people with ID worldwide and has an outstanding expertise in ID and sport related aspects. Two aspects were central. First, the overall possibility of such training for this group. Consideration was given to understanding, manageability and compliance using structured interviews with the coaches and the pupils. Second, the effect of the training was monitored by contrasting the performance between the beginning and the end of the training program with the group and between the group and a control group of 18 pupils with ID which were not participating in the training. The interviews showed, the possibility of an adapted endurance training is achievable although the effort required is higher and the danger of drop-outs and emotional stress is also higher than in regular groups. The pupils gave very positive feedback, mostly highlighting the incentive of participating in competition. The comparison within the group showed a significant improvement in the 6-minute run (t = 18.39, p = .05) from t1 to t2 in the experimental group and an even larger improvement between the groups at t2 (t = 18.34, p = .05).

Caloric restriction induces anabolic resistance to resistance exercise

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- Calorie-restricted weight loss reduces muscle mass. Thus, clinicians and fitness professionals recommend resistance exercise to preserve muscle mass during caloric restricted weight loss. However, the endocrine response of anabolic hormones such as growth hormone (GH) and insulin-like growth-factor 1 (IGF-1) to resistance exercise during caloric restriction has not been characterized.
- Participants (n = 7) consumed a controlled liquid diet during three 3-day conditions of caloric restriction (15 kcal · kg FFM-1) with post-exercise carbohydrate (CRC), caloric restriction (15 kcal · kg FFM-1) with post-exercise carbohydrate (CRC), caloric restriction (15 kcal · kg FFM-1) with post-exercise protein (CRP) and an energy balance control (40 kcal · kg FFM-1) with post-exercise carbohydrate (CON). Serial blood draws were taken following 3 sets of 5 repetitions of the barbell back squat exercise on Day 3 of each condition. In CRC and CRP, respectively, GH peaked at 2.6 ± 0.4 and 2.5 ± 0.9 times the peak concentrations observed during CON. Despite this, IGF-1 concentrations declined 18.3 ± 3.4% in CRC and 27.2 ± 5.8% in CRP, which was greater than the 7.9 ± 3.6% decline in CON, over the subsequent 24 hours.
- There is considerable anabolic resistance to the endocrine response to a single bout of resistance exercise which persists in the presence of post-exercise whey protein supplementation. Alternative strategies to restore the sensitivity of IGF-1 to GH stimulation during caloric restriction need to be explored. These strategies will empower clinicians and fitness professionals to make specific recommendations which minimize the deleterious effects of weight loss.

Enablers and barriers in the nutrition service for German Olympic athletes. A mixed-methods study

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- Adequate dietary intake can support exercise performance and wellbeing but plays also a pivotal role in preventing illness or injuries in athletes. Due to highly variable inter- and intrasport dietary needs, athletes should seek the advice of qualified sports nutritionists to develop specific nutritional strategies.
- This study aimed to analyse the perspectives of sports’ nutritionists at German Olympic Sports Centers (OCS) in order to identify the enablers that are needed to provide an effective service. Also, the perceived barriers are identified. An exploratory sequential mixed design was used. Four guided interviews were conducted with nutrition experts working at OCS in Germany. The interviews were recorded, transcribed, and coded. This step helped identify enablers and some barriers. From the qualitative content analysis results, a questionnaire was developed with the aim of verifying the already identified barriers and collect new ones. The questionnaire was then sent to nutrition experts working at German OCS and analyzed with descriptive statistics. Results from both the qualitative and quantitative part were merged and analyzed.
- In regards of the individual nutritional counselling, three main factors were identified as crucial for the success of the service: 1) the relevance given to sports nutrition by trainers and decision-makers, 2) the value given by trainers and decision-makers to the service of nutritional counselling for athletes and 3) the communication between the staff at different training fields at the OCS. In order to optimize the support for the German athletes, several barriers have to be overcome: some sports nutrition research has to gain visibility in the German research context, therefore education opportunities in this field have to be intensified. Also, the recognition of the importance of nutrition by other players, such as trainers and decision-makers, is needed to improve the collaboration amongst the OCS staff. Moreover, a well-structured framework should be created to ease and encourage the exchange and interdisciplinary teamwork. Thus, an increased visibility of nutrition and nutrition counselling services alongside an intensified collaboration between the different disciplines at German OCS could improve the service for Olympic athletes. This would provide them with optimized nutrition support that could benefit exercise performance and potentially decrease diet-related health risks.
Effect of acute cannabidiol supplementation on recovery after strenuous strength training

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The medical qualities of cannabidiol (CBD) have been known for a long time. Especially in recent times increasingly more research is being conducted on this subject. Nevertheless, the direct effects of CBD on regeneration after physical activity are still unclear. Even though the anti-inflammatory effect of CBD is undisputed in medicine, the extent to which this quality has a positive effect on secondary muscular damage after resistance training has not yet been researched.

Therefore, in the present randomized pilot study, the effects from supplementing CBD (3ml with 2% of CBD) after strenuous strength training were compared with that of a placebo in a crossover design. For this purpose, neuromuscular (Vertical Jump + Back Squat) and biochemical (Creatine Kinase) parameters were measured in eight strength athletes immediately before and 24 hours after a fatigue protocol was performed. The given protocol consisted of three sets of 12 repetition in the back squat at 70% of the one repetition maximum that was measured right beforehand. In addition, the subjects performed three sets of 15 drop jumps. Following that protocol, subjects consumed a beverage containing either 60mg of CBD or a placebo.

As a result, a significant decrease in the back squat was found only within the CBD group (CBD: -6.56kg ± 6.94, p<.009; PL: -3.75kg ± 5.18, p<.105). While for other parameters within each as well as between both groups, differences failed to satisfy required levels of significance, an almost three times greater average increase in CK values in the placebo group compared to the CBD group gives reason to assume that the anti-inflammatory effect of CBD has a positive effect on secondary damage and can thus promote regeneration. Yet, further research is needed to confirm these findings.

Effect of active recovery used on the next day after a high-intensity exercise session on fatigue

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The purpose of this double cross-over trial was to identify if active recovery (ACT) used on the next day after a high intensity exercise session benefits recovery and to assess whether individual responses are replicable over multiple recoveries. After an initial familiarization and pre-examination, 11 well trained male intermittent sport athletes (age: 23.5 ± 1.8 years) completed 4 intensive exercise sessions, separated by 2 week washout periods. Each was followed by either passive recovery (PAS) or 60 min of moderate biking (ACT) 24 h after the fatiguing activity in the following order: ACT, PAS, ACT, PAS, ACT, PAS. ACT. Maximal voluntary isometric strength (MVIC), countermovement jump (CMJ) height, muscle contractile properties, serum concentration of creatine kinase, perception muscle soreness, and perceived recovery and stress states were determined before and after training, as well as after 24 h and 48 h of recovery.

Values were analysed using a full factorial three-way ANOVA employing three main factors of recovery intervention (RI; two levels: ACT and PAS), sequence (two levels: two times ACT vs. PAS) and time (four levels). Individual random effects of intercept, time, sequence, and individual were tested within intervention to control for unobserved heterogeneity. Significant effects (p < 0.05) were further evaluated with a Tukey’s multiple comparison procedure.

All parameters revealed a significant time effect. Post hoc analyses indicated that training always induced a similar temporary state of fatigue. Effects on RI were never significant, suggesting that ACT did not affect exercise-induced fatigue. Sequence effects were only significant for MVIC and CMJ height, but absolute differences were small, suggesting that athletes responded similarly in both cross-over. The distribution of variance components among the random effects indicated that the variability of data between sequences is similar, further suggesting that athletes’ response is not altered between the first and second cross-over.

Overall, a consistent inability of ACT to limit the severity of fatigue was found. Thus, athletes and their coaches are advised to focus on other recovery modalities rather than ACT. However, since ACT was not detrimental to the recovery process, individual preferences, experiences and beliefs may influence the choice of whether ACT is performed as a recovery method.