

NO. 1

INVITED TALKS

Behringer M¹, Skutschik C¹

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 overlap. For example, muscle swelling can frequently be observed after both, exercise induced muscle damage and metabolically demanding exercises with intracellular 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. 3

INVITED TALKS

Brinkmann C^{1,2}

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 use has been shown to have positive effects on clinical variables. Effectiveness and efficiency, but also feasibility and personal preference should be criteria for selecting a suitable form of training for type 2 diabetic patients.

NO. 2

INVITED TALKS

Bloch W¹

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 histones 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 that 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 gene 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. 4

INVITED TALKS

Büsch D¹, Schumacher K², Granacher U³

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 myometric phase (i.e., concentric 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. Accordingly, 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“.

NO. 5

INVITED TALKS

Carlsohn A¹

Effects of low carbohydrate availability on body composition and performance

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

- ▶ **High carbohydrate availability before**, during and after exercise has been regarded a 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 or trends towards improved time 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 glycogen state over 3 months neither reduced body mass (69.4±10.8 kg vs. 69.8±12.3 kg) nor body fat mass (9.6±5.1 kg vs. 11.1±5.5 kg) compared to controls (N = 8; body mass: 63.7±9.8 kg vs. 63.4±8.8 kg; p (group*time) = 0.372; body fat mass: 11.1 ± 4.1 kg vs. 11.6 ± 3.0 kg, p (group*time) = 0.406). In a 5000 m time trial no difference between intervention (diff. -47s) or control group (diff. -107s) was observed (p (group*time) = 0.181). However, athletes who periodically restricted carbohydrate availability lost significantly more training sessions due to self-reported illness (1.56±1.74) compared to 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 illness) need to be carefully counterbalanced when counselling athletes.

NO. 7

INVITED TALKS

Ferrauti A¹

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 comes along with an acute performance decrease in athletes in different fitness sports. A fast recovery from fatigue therefore is crucial especially for ageing 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 days (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 as 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 squat 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 athlete's age which also includes the paradox between fast fast recovery and maximum adaptation.

NO. 6

INVITED TALKS

Faigenbaum A¹

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 prerequisite 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 dynapenia. 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 activating 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 divergence 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 strength-building activities and challenge current public health recommendations for promoting physical activity. The incontrovertible negative effects of pediatric dynapenia on modern day youth should encourage the development of novel treatment plans and innovative research initiatives to inform public health policy.

NO. 8

INVITED TALKS

Ferwald J, Hoppe M W², Baumgart C¹

Prevention of and rehabilitation after knee joint injuries

1. BERGISCHE UNIVERSITY WUPPERTAL - DEPARTMENT OF MOVEMENT AND TRAININGSSCIENCE - RESEARCH CENTER FOR PERFORMANCE DIAGNOSTICS AND TRAINING ADVICE (FLT)
2. UNIVERSITY LEIPZIG - FACULTY OF SPORT SCIENCE - DEPARTMENT OF MOVEMENT AND TRAININGSSCIENCE

- ▶ **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 5 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, Tegner, KOOS) as well as by objective methods (clinical examinations; 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 anatomical 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.

NO. 9

INVITED TALKS

Gatterer H¹

Altitude training for performance enhancement: does it work?

1. INSTITUTE OF MOUNTAIN EMERGENCY MEDICINE, *Eurac Research, Bolzano, Italy*

- ▶ **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 training concept (LHTL). Athletes performing this type of training live at altitude (2000-2500m) for several weeks (3-4 wks) and train close to sea level. Living at altitude (min 12-14 hr/d) is intended to increase the total hemoglobin mass (tHbmass), while training at sea level keeps training quality high.
- ▶ **This concept** was recently challenged, showing that elite athletes with already high tHbmass 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 (LHTLH). RSH consists of performing multiple sets (3-4, rest 3-5min) of repeated (n=4-7) short (4-15s) maximal sprinting bouts, interspersed with <30s of rest 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 readers and practitioners are encouraged to critically assess the strength 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.

NO. 11

INVITED TALKS

Giessing J¹

Health effects of high intensity training (HIT)

1. UNIVERSITY OF KOBLENZ-LANDAU, *Campus Landau, Institute of Sports Science, Department of Sports Medicine and Training Science*

- ▶ **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. Light weights (30-50% of 1RM) are sufficient for this purpose when exercises are performed until momentary muscle failure.
- ▶ **Another characteristic of HIT** is that repetitions are performed slowly and safely, completely avoiding „cheating“ which results in extremely low injury rates and a very favourable cost-benefit ratio, especially from a health point of view. These characteristics make HIT an option for people who were previously advised to not engage in resistance training.
- ▶ **Results of current research projects** are presented showing significant strength gains and improvements in body composition in seniors (60 to >80 years of age) who engaged in regular high intensity resistance training for six months training twice a week for 30 to 45 minutes each. Results show that HIT is suitable for the prevention and therapy of common age-related health problems such as sarcopenia, dyspnea, and osteoporosis. Resistance training at high intensity of effort was well tolerated by the subjects.
- ▶ **Another recent study** studied the effects of HIT with diabetes type II patients also demonstrating positive results. Within the intervention period of six months, there were significant increases in strength for all exercises, an average increase in muscle mass of 1.5 kilograms per patient while significantly decreasing visceral fat and total body fat. In addition, well-being of the training patients increased (WHO-5 Wellbeing Index) and average HbA1c improved from 7.5 to 7.0. In the non-training control group, these improvements did not occur. Despite the high intensity of effort required while performing HIT training was well tolerated by the patients.

NO. 10

INVITED TALKS

Gehlert S^{1,2}, Jacko D², Wackerhage H³, Bloch W²

Mechano-metabolic aspects of acute and chronic resistance exercise

1. UNIVERSITY OF HILDESHEIM, *Institute of Sport Science, Department for Biosciences of Sports*
2. GERMAN SPORT UNIVERSITY COLOGNE, *Institute of Cardiovascular Research and Sports Medicine*
3. TECHNICAL UNIVERSITY OF MUNICH, *Faculty of Sport and Health Sciences*

- ▶ **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 filaminC (FlnC) proteins. FlnC proteins act by crosslinking actin filaments in the sarcomeric z-disc and further as molecular sensors of damage. Its degradation is coordinated via chaperone-assisted selective autophagy (CASA) by the cochaperone BAG3 which also controls increased FlnC expression.
- ▶ **In contrast to low intense RE**, maximal eccentric RE induces a significant reduction of FlnC and BAG3 within 24 h after acute RE. In a chronic RE intervention (13 RE 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 fast reduction of z-disc streaming and myofibrillar damage and attributes CASA-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 metabolic pathways will be activated, we hypothesized that branches of the skeletal muscle metabolome 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 589 metabolites within biopsy samples in which we also found a significant increase in type I and II myofiber diameter. Metabolites of the amino acid and nucleotide metabolism increased significantly after the first unaccustomed RE session while being reduced up to the 13th 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 metabolomic signature and structural integrity of skeletal muscle which is substantially influenced by the magnitude of loading.

NO. 12

INVITED TALKS

Jöllenbeck T^{1,2}

Practice-oriented gait and treadmill analysis

1. CLINIC LINDENPLATZ, *Institute for Biomechanics, Bad Sassendorf*
2. PADERBORN UNIVERSITY, *Department of Exercise & Health, Sport Science, Psychology & Human Movement*

- ▶ **The gait and treadmill analysis** is a reliable instrument for expanding medical diagnostics or running style analysis. Today the effort 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 ensuing 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 not by conformity to a standard. The high complexity of motion contains a multitude of degrees of freedom and allows for a corresponding number of individual solutions. Human movement is not only a subject of principle of economy and efficiency, but is also characterized by high variability and compensation ability. This can be expressed by a lack of exercise, stress or fatigue effects, as well as by a natural range of movement and exploiting the degrees of freedom. As conclusion the assessment of a movement with respect to its individual normality is more important than the accordance with a normative exercise. Symmetric but non-standard movements primarily have to be changed only when pathological misalignments or afflictions are present. Asymmetric movements deserve special attention in any case, even if the individual one still remains within the standard norm.

NO. 13

INVITED TALKS

Klee A¹

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 (sprint) 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 endurance 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 stretched very intensively. During regeneration for DOMS (delayed onset of muscle soreness) 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 shrinkage, mean losses for a weight-training regime being 5.4 mm and for a 6 km run 3.25 mm respectively. Therefore, relaxation programs in regeneration should include gentle stretching and focus on the rehydration of the intervertebral discs. Stretching is no less important than it used to be, it was absorbed by other trends (fascia training).

NO. 15

INVITED TALKS

Koehler K¹

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 diet-only interventions, which typically result in the loss of weight with a mixed composition (fat mass ~75%; lean mass ~25%), exercise shifts weight loss further towards fat mass and away from lean tissues, and 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 attenuation via exercise alone explain why the combination of caloric restriction with exercise is superior for weight loss and long-term weight maintenance 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 to its preserving effect of lean mass, incorporation of exercise also minimizes the likelihood of weight regain and collateral fattening, thereby improving long-term weight control.

NO. 14

INVITED TALKS

Knicker A¹, Abdulhafiz H², Alt T³

Muscular balance - myth or physiological nonsense? Observations from functional arthromuscular 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 WESTPHALIA, *Dortmund*

- › **In many studies**, muscular dysbalance 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 agonists 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 traits for the estimation of muscle balance around the knee joint neglecting the evidence of its unfunctional contemplation of the muscular situation and disregarding current insights into intermuscular coordination and the intramuscular work conditions. The latter warrant insight into injury mechanisms and constitute valuable, functional and meaningful indexes of agonist - antagonist interactions.
- › **Besides to the muscular agonist - antagonist ratios** we reiteratively find diagnostic indications of lateral dysbalances in the field of competitive sports. Differences between dominant and not 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 abductors or shoulder stabilising muscles. The indicators of muscular balance around the knee joint provide some orientation. Derived from this, it can be seen that the expression of the muscular abilities of the antagonists under eccentric contraction conditions at high speeds of movement is highly predictive of a dysbalance around a joint. They also a strong relation 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 K¹, Radovanovic G^{1,2}

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 commonly occurring clinical problem in both recreational as well as elite sports. Although etiology and progression of this disorder are 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 tendinopathy. However, current evidence suggests, that the intensity and the duration of loading are more important than the muscle 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 simple sling-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 triceps surae strength gains.
- › **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 tendinopathy symptoms, solely the training according to the Berlin Method led to an increase in Achilles tendon stiffness and cross-sectional area. Those 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 physiotherapeutic treatment, making IL-6 a potential target for therapeutic interventions in this subgroup.

NO. 17

INVITED TALKS

Sandau P

Olympic weightlifting, more than just sport

1. INSTITUTE FOR APPLIED TRAINING SCIENCE, *Research Group Weightlifting*

- ▶ **It is commonly believed** that Olympic weightlifters are obese sportsmen 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 on the entire life span, from child to senior. First of all, it should be noted that there is a huge body of scientific evidence that demonstrates that OL is a very safe sport (3.3 injuries/1000h) and will not impair the knees or the back, independent of age. In the past, it was reported that children underwent a loss in muscular strength that led to a weak posture, ending up in postural deformities.
- ▶ **However**, it has subsequently been shown that supervised OL training for children is most beneficial in order to develop muscular strength and movement competency in general without any detrimental or irreversible effects on passive tissue or bone growth, even in the prepubescent child.
- ▶ **Therefore**, OL has a high potential to prevent pediatric dynapenia and reduced physical fitness. Rather than impeding, OL facilitates the early biological development in children. In adults, OL is of growing interest in strength training for fitness enthusiasts. Besides the higher efficiency in developing muscular strength in comparison to traditional machine-based training, OL covers all positive benefits of strength training (fat loss, pain reduction, improved functional fitness and daily living etc.). In addition, OL is highly time-effective because many muscles can be trained with a single exercise. For older adults, OL can provide health benefits too. One of the typical age-related diseases – especially in women – is osteoporosis. Like muscle growth, bone growth also depends on mechanical loading. Scientific investigations have revealed that exercises from OL and training with heavy weights in general are effective in the prevention of osteoporosis in the elderly.
- ▶ **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.

NO. 19

INVITED TALKS

Sperlich B¹

From LIIT to HIIT - Current research & gaps applying low and high-intensity interval training

1. UNIVERSITY OF WÜRZBURG, *Integrative and Experimental Exercise Science and Training*

- ▶ **To enhance** or maintain organ functions various forms of interval training are employed in many sports and therapeutic measures. The predefined or stochastic change of intensity (during the interval and during interval recovery), interval and recovery duration as well as number and series result in countless (sub) maximum stimulus combinations inducing different biological responses.
- ▶ **In the past 15 years**, (High) Intensity Interval Training (HIIT) has received enormous research interest. Compared to continuous submaximal endurance training, HIIT induces similar or greater biological and functional adaptation but in a shorter training time and allows the exploration of physical exertion with less training monotony.
- ▶ **Our own study** results with various HIIT constellations in different settings and populations show that there are considerable interpersonal differences with regard to compliance, motivation or quality of life. Depending on the number of training sessions, indication, population and initial fitness, HIIT induces on average improvements in maximum oxygen uptake of approx. +1.1%/week (with 2-5 training units per week). The applicability and benefits of HIIT in everyday "micro sessions" remains exciting, for example as "fitness snacks" or "nuggets" or in combination with functional strength training as "functional HIIT". Although HIIT has conquered the top three fitness trends podium worldwide, studies on compliance and drop-out analysis are lacking because, among other things, increased sensation of pain is documented in the course of HIIT.
- ▶ **Despite the** obvious advantages and disadvantages, it's surprising that especially low-intensity interval training (LIIT) is less investigated compared to HIIT. Depending on basic fitness, motivation and organ function, LIIT methods are safer, easier to control and allow a higher internal differentiation.
- ▶ **The aim of this overview** is to highlight current trends as well as research results and gaps in LIIT and HIIT in order to ultimately demonstrate a methodical framework concept for endurance training in various fields of application.

NO. 18

INVITED TALKS

Schönfelder M¹

Muscle mass and strength: How important are our genes?

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

- ▶ **Skeletal muscle mass**, muscle fibre numbers per muscle, muscle fibre size, strength and the trainability of these factors all vary greatly in the general population. Twin studies suggest that probably more than 50% of this variation is explained by genetics. Genome-wide association studies in humans and gene manipulation experiments in mice have identified gene variants that affect muscle mass or function. In mice, the gain or loss-of-function of at least 47 genes significantly increase muscle mass by in-between 5 and 345%. In humans, a genome-wide association study has identified 16 loci (regions in the genome) that are associated with grip strength. Together this suggests that the large variation of muscle mass and function depends on probably hundreds of DNA variants or more. It also explains why baseline levels of muscle mass and function and their trainability vary widely in-between humans.

NO. 20

INVITED TALKS

Stein N^{1,2}

Modern systems for resistance workout in high performance sport, physical prevention and rehabilitation

1. GERMAN SPORT UNIVERSITY COLOGNE, *Institute of Professional Sport Education and Sport Qualifications*
2. PH SCHWÄBISCH GEMÜND, *Institute for Health Sciences, Department for Sport and Movement*

- ▶ **In addition to** the ability to develop the highest possible running speed, the conditional requirement profile in many individual and team sports is characterized by outstanding acceleration capability and agility in narrowest space. Since a long time various types of resistance training have been used across all sports as an expected effective training tool.
- ▶ **Modern approaches** to device-based training are using innovative systems to realize the high requirements in relation to the technology-related load management. This opens up new perspectives on specific movements, as in addition to usually familiar linear locomotion now also lateral movement alignments, rotations and jumps against external resistance are made possible. Resistance training against tensile loads is often used to improve inter- and intramuscular coordination and as a supplement to traditional strength training. In technology-related utilization training and in case of application of contrasting load methods, systems with variably adjustable resistances meanwhile play an important role.
- ▶ **Contrary to** the manifest dissemination of resistance loads in the training process of many sports, there is a comparatively low, and above all evidence-based, factual situation regarding the specific efficiency and effectiveness of corresponding physical stress regimes. In addition to the sport-related or disciplinary comparison of loaded and unloaded sprinting or jumping movements, above all the focus of research interest is the consideration of biomechanical characteristics and / or metabolic effects under the influence of defined additional burdens.
- ▶ **Application-related questions** deal, i.a. with the appropriate integration of such forms of physical stress in the short-, medium- and long-term training periodization. After all, it is also the empirical values resulting from many years of practical application that provide valuable information on the effectiveness of draw resistance systems for the inclusion in the targeted training process.

NO. 21

INVITED TALKS

Wackerhage H¹

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 growth and/or 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 anabolic pathways such as nucleotide-RNA/DNA and amino acid-protein synthesis. As a consequence of the increased muscular glucose uptake, less glucose is available for lipid synthesis, resulting in organismal 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. 23

INVITED TALKS

Zimmer C¹

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 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. One 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 (approx. 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-responding is lower compared to a polarized TID or even a training with a high amount of high intensities (ie. HIIT). Even threshold training which has been shown is not a good TID for elite athletes, might be suitable to improve general fitness in recreational athletes.

NO. 22

INVITED TALKS

Zimmer P¹

Exercise immunology

1. LEIPNIZ UNIVERSITY HANNOVER, *Institute of Exercise Science, Dpt. 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 mobilization and redistribution of several immune cell subsets.

› **Additionally**, immune cells may indicate changes of their functionality. Finally, acute exercise induces microtraumata and provokes a short-term pro-inflammatory environment. On the opposite, training and regular physical activity increase the bodies anti-inflammatory capacity and contribute to long-term adaptations of the cellular immune system. Some beneficial long-term effects in view of disease prevention, may rather be based on the sum of acute effects of exercise on the immune system which do not lead to 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. 24

POSTER & PRESENTATIONS, YOUNG INVESTIGATOR AWARD

Aussieker T¹, Fuchs C¹, Snijders T¹, Verdijk L¹, van Loon LJC¹

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

1. DEPARTMENT OF HUMAN BIOLOGY, *School of Nutrition and Translational Research in Metabolism, Maastricht University*

› **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 (eg. 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 leg lean mass (DXA-scan), quadriceps CSA (CT-scan) and muscle strength (IRM) 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 content, myonuclear domain size and MSC content were assessed by immunohistochemistry. Quadriceps CSA decreased by 6.1 ± 3.9% (P < 0.05) and leg lean mass decreased by 5.3 ± 1.7% (P < 0.05) over time. Knee extension and leg press IRM decreased by 8.7 ± 12.4% (P < 0.05) and 6.1 ± 8.2% (P < 0.05), respectively, in response to 2 weeks bed rest. Type I and type II muscle fibre size tended (P=0.06) to decline following 2 weeks of bed rest.

› **No change in type I and type II** myonuclear content, myonuclear domain size or MSC content was found in response to the 2 week bed rest intervention. Two weeks of bed rest resulted in a loss of muscle mass and strength in healthy young men, which was not accompanied by a change in type I or type II myonuclear and MSC content.

NO. 25 POSTER & PRESENTATIONS, YOUNG INVESTIGATOR AWARD

Budig M¹, Hölthke V¹, Keiner M¹**Accuracy of optical heart rate / distance measurement of fitness tracker and their use in sports**1. GERMAN UNIVERSITY OF HEALTH & SPORT, *Faculty of Sports Science*

- ▶ **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:** In total, 30 moderate endurance-trained adults (15 males/ 15 females) completed a running test- battery, 3 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/ 1000 m, biking for 4.3/ 36.7 km, stadium-running and walking for 3 km and running for 1.6 km interval and off-road- running for 3/7.1 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 ($p < 0.049$) during seven phases and at rest HR (RestHR, $p < 0.021$). The false discovery rate (FDR) calculation showed similar results ($p < 0.047$; $p < 0.026$; effect sizes interval- running $d > 0.67$; RestHR $d > 1.12$). The t-test analysis distance showed significant differences in biking ($p = 0.000$) 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 $< 4.50\%$ for swimming.
- ▶ **Conclusion:** This study showed significant inaccuracies in optical HR measurements during rapidly 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.

NO. 27 POSTER & PRESENTATIONS, YOUNG INVESTIGATOR AWARD

Düking P¹, Giessing L², Frenkel MO², Sperlich B¹**Validity of the Polar Vantage V to assess heart rate variability during an orthostatic test**1. INTEGRATIVE AND EXPERIMENTAL EXERCISE SCIENCE, *Department of Sport Science, University of Würzburg*
2. DEPARTMENT OF SPORT PSYCHOLOGY, *Institute for Sport and Sport Sciences, Heidelberg University*

- ▶ **Validly assessed and correctly interpreted heart rate variability (HRV)** data monitored by Wearable Sensor Technologies (Wearables) may be used to guide training of endurance athletes across different performance levels. However, provided data by commercially 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, which is pre-defined in 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 (sTEE), the Coefficient of Variance (CV%) as well as Pearson's Correlation Coefficient (r) were 0.35 ("moderate" sTEE) and 0.85 ("large" sTEE), 12.6% and 20.5%, and 0.94 ("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 standing 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.

NO. 26 POSTER & PRESENTATIONS, YOUNG INVESTIGATOR AWARD

Dohm A¹, Heine O², Alfuth M^{1,3}**Diagnostic value of fasting glucose levels – A pilot study**1. GERMAN SPORT UNIVERSITY COLOGNE, *Department of further education, (M.Sc.) Sport Physiotherapy*
2. OLYMPIC TRAINING CENTER RHINELAND, *Cologne*
3. NIEDERRHEIN UNIVERSITY OF APPLIED SCIENCES, *Faculty of Health care, Therapeutic Sciences, Krefeld*

- ▶ **The change** in the filling status of the glycogen stores 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 filling state of the glycogen stores 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 training from an average of 4.55 (± 0.29) 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 fasting 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 studies 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.

NO. 28 POSTER & PRESENTATIONS, YOUNG INVESTIGATOR AWARD

Hanke L¹, Diel P¹**The acute impact of different load intensities of a strength training on thyroid function in women**1. GERMAN SPORT UNIVERSITY COLOGNE, *Institute for Cardiovascular Research and Sports Medicine, Department of Molecular and Cellular Sports Medicine*

- ▶ **Hypothyroidism**, especially its subclinical form, is one of the most commonly occurring endocrinopathies. The incidence is 7-10 times higher in women than in men and its rate increases with age. Standard therapy involves hormone replacement with levothyroxine or a combination of levothyroxine and liothyronine. However, despite euthyroid metabolism, patients report existing symptoms such as reduced quality of life, an increased somnolence, weight problems or reduced physical performance. There is only limited information regarding effects of strength training on thyroid function. Therefore, this pilot study aims to analyze the effects of different intensities of a strength training on thyroid hormone levels in healthy, premenopausal women.
- ▶ **5 participants** (24.2 \pm 2.8 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 circadian changes in thyroid hormone concentrations (fT3, fT4 and TSH). In a second pretest the 1 repetition maximum (1RM) of the participants is recorded for all exercises to identify the training intensities. Subsequently a total of 3 testing days take place, on which the participants carry out a submaximal (5 repetitions, 85 % 1RM), a hypertrophy (10 repetitions, 75 % 1RM) and a strength endurance training (20 repetitions, 65 % 1RM). The order of testing days is randomized for each subject. On each day of training the thyroid hormones are determined at 9 am and 10 am. All subjects complete the second pretest as well as all strength trainings in the second half of their individual menstrual cycle.
- ▶ **As a result TSH serum concentrations** increased after strength endurance training from 1.45 \pm 0.26 to 1.71 \pm 0.69 μ U/ml and after submaximal training from 1.59 \pm 0.28 to 1.63 \pm 0.43 μ U/ml. Serum fT3 concentrations decreased after hypertrophy training from 3.1 \pm 0.54 to 2.9 \pm 0.34 pg/ml and after strength endurance training from 2.88 \pm 0.46 to 2.72 \pm 0.36 pg/ml. Further serum fT4 concentrations decreased after submaximal training from 1.04 \pm 0.15 to 1.00 \pm 0.16 ng/dl and after hypertrophy training from 1.08 \pm 0.20 to 1.06 \pm 0.18 ng/dl. There were no changes observed in fT3 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.

NO. 29 POSTER & PRESENTATIONS, YOUNG INVESTIGATOR AWARD

Holzer R¹, Bloch W², Brinkmann C^{1,2}

H2020 ELSAH project: Innovative technology for monitoring biomarkers at rest and during exercise

1. GERMAN SPORT UNIVERSITY COLOGNE
2. IST UNIVERSITY OF APPLIED SCIENCES DÜSSELDORF

- › **The ELSAH** (electronic smart patch system for wireless monitoring of molecular biomarkers for healthcare and well-being) project is funded by the European Union. A wearable microneedle-based sensor system that measures several biomarkers, e.g. glucose and lactate, in the interstitial fluid in real-time by electrochemical detection is developed within the project. The ELSAH patch transfers the data to the user's mobile phone. In the context of sports and exercise, continuous monitoring of glucose and lactate can help better control the training process.
- › **Initial results of a survey** with potential end users (n=316) show a high acceptance of the ELSAH system. The end users see a high personal and general need for the ELSAH system. However, different variants of the ELSAH system for different use cases (distinguished by measurement frequency and lifetime of the patch) should be considered.

NO. 31 POSTER & PRESENTATIONS, YOUNG INVESTIGATOR AWARD

Kirmse M¹, Oertzen-Hagemann V¹, de Marées M¹, Bloch W², Platen P¹

Resistance exercise training in combination with collagen peptide supplementation

1. RUHR-UNIVERSITY BOCHUM, Department of Sports Medicine and Sports Nutrition
2. GERMAN SPORT UNIVERSITY COLOGNE, Department of Molecular and Cellular Sports Medicine

- › **Protein supplementation** while resistance training (RT) can augment hypertrophic effects and further increase strength enhancements. However, specific collagen peptide (CP) intake strategies are barely considered within RT regimes due to its low amount of essential amino. Recent studies in elderly have demonstrated a positive impact of a CP supplementation on body composition and strength. Little is known about effects of CP intake in young recreational athletes. Therefore, the purpose of this study was to determine the effects of a specific CP intake in combination with RT on body composition, strength, and muscle cell size in younger men.
- › **57 young men** (24 ± 3 yr, 1.84 ± 0.06 m, 78.8 ± 7.4 kg) completed the pre and post testing procedure with MVC and 1RM strength testing, body composition analysis, muscle biopsies, and food record protocols. Participants were double blinded and randomly divided in either a placebo control group (PLA) or a CP treatment group (COL, 15g/d of CP). Both groups performed an identical barbell RT 3 times a week for 12 weeks.
- › **No differences** were found at baseline in any parameter as well as in training loads and dietary food intake during the intervention between the groups. A significant increase in FFM was found in COL compared to PLA (COL: Δ2.0 ± 1.9 kg, PLA: Δ0.6 ± 1.3 kg; p<0.05) while an increase in FM was significantly higher in PLA after the intervention (COL: Δ-0.1 ± 1.5 kg, PLA: Δ0.8 ± 1.9 kg; p<0.05). The increase in CSA was significant for both fiber types without group differences. Most 1RM and the MVC testing showed significant higher values after the intervention without group differences. Only squat 1RM showed a trend for a higher strength enhancement in COL (COL: Δ20.6 ± 11.7 kg, PLA: Δ14.8 ± 9.4 kg; p=0.054).
- › **We showed** that an additional CP intake affected the adaptation of the FFM. However, this was not reflected in differences of the increase in muscle fiber CSA between the groups. Our explanations for the higher increase in FFM after supplementation of CP include an enhanced adaptation of the passive tissue components which has a significant impact on the function and biochemical structure of skeletal muscle. This might be an explanatory approach for small difference in the increase in strength that was found between groups which tend to be higher in the group with a daily CP intake.

NO. 30 POSTER & PRESENTATIONS, YOUNG INVESTIGATOR AWARD

Javanmardi S¹, Brochhagen J¹, Baumgart C¹, Hoppe MW², Freiwald J¹

Impact of a pre-season preparation on intermittent endurance performance in top-level handball

1. UNIVERSITY OF WUPPERTAL, Institute for sports science, Department of Movement and Training Science
2. UNIVERSITY OF LEIPZIG, Institute of Movement and Training Science I

- › **Physical capacities** like intermittent endurance performance are required to compete on a top-level in team handball. Therefore, the training is typically focused on those capacities during pre-season. This study analyzed the effects of a pre-season preparation on intermittent endurance performance in a top-level male handball team. Twelve handball players including goalkeepers (26 ± 5 years) competing in the 1st German Bundesliga participated.
- › **The players** were tested before and after a six-week pre-season preparation. The intermittent endurance performance was examined by an interval shuttle run test. Number of shuttles was analyzed. Additionally, heart rate at the beginning, submaximal efficiency at 14 km/h and maximum heart rate were compared. Furthermore, longitudinal data of three players over three seasons were used to evaluate potential long-term changes. Effect sizes (ES) and Magnitude-based inferences for practical significance were computed.
- › **The players** had a most likely higher number of shuttles as well as a most likely lower heart rate at 14 km/h submaximal efficiency (ES: 1.8 – 3.1) after pre-season preparation. Contrary, heart rate differences at the beginning and maximum were likely trivial (ES: 0.2 – 0.4). Interestingly, the three players showed similar results over three seasons (number of shuttles: 0.01%; maximum heart rate: 0.00%). Even in top-level male handball, a pre-season preparation can have a large impact on the intermittent endurance performance. Perhaps these results are caused by a low initial level of the players after off-season and/or the ability for a fast cardio-pulmonary and muscular adaptation. However, after the initial increase, no meaningful long-term changes in the intermittent endurance performance were found.

NO. 32 POSTER & PRESENTATIONS, YOUNG INVESTIGATOR AWARD

Köppel M^{1,2}, Kathryn H Schmitz², Wiskemann J^{1,2}

Resistance training increases the lean body mass of cancer patients: A meta-regression

1. NATIONAL CENTER FOR TUMOR DISEASES, Heidelberg, Germany, Onkologische Sport und Bewegungstherapie
2. PENNSYLVANIA STATE UNIVERSITY, Hershey, USA, Department of Public Health Sciences

- › **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. Since it remains unclear to what extent these findings can be translated to cancer populations, we conducted a systematic review and meta-regression.
- › **Trials were eligible** if they included adult patients diagnosed with cancer, regardless of cancer site and therapy or survivor status; if the participant 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-means for LBM. In order to adjust baseline inequalities, the pretest difference was included as predictor for the model. 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 a mean superiority of 0.86kg [95%-CI= 0.30, 1.42] in favor of the intervention group was observed.
- › **By including SUP**, the intercept of the model dropped to 0.23kg [95%-CI= 0.30, 1.42] with SUP exhibiting an incremental impact of 1.02 kg [95%-CI= -0.11, 2.16]. In the analysis, which contained all measurements, the baseline adjusted model displayed a mean effect of 0.73kg [95%-CI= 0.28, 1.17] in favor of the intervention group. By including SUP, the intercept dropped to 0.22 [95%-CI= -0.41, 0.85] while the incremental effect of SUP was 1.03kg [95%-CI= 0.12, 1.95]. In conclusion, it seems that resistance training can help cancer patients and survivors fight against sarcopenia. Given the relationship between sarcopenia and treatment toxicity, resistance trainings should be implemented on a regular basis for the treatment of cancer patients. However, this analysis revealed that interventions need to be supervised in order to achieve substantial effects on muscle mass.

NO. 33 POSTER & PRESENTATIONS, YOUNG INVESTIGATOR AWARD

Michels J¹, Isenmann E^{1, 2}, Diel P¹**Comparison of pro-regenerative nutritive actions given by foodstuff or shake after strength exercise**

1. GERMAN 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 an 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 checked double-blind crossover study with three groups. After a standardized training protocol the participants ingested either a 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 creatin kinase as a physiological parameter and IRM-squat as a functional marker were measured at two times (t0, t24).
- **In all groups**, the serum creatin 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 $d = .334$) and a medium-strong effect between the placebo- and shake-group (cohans $d = .624$) was found. In contrast, a clear difference could be detected within the functional parameter (IRM-squat).
- **On the contrary to the shake and food group**, the placebo-group had a statistically significant exercise induced drop in physical performance ($p=0.021 \leq 0.05$). 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.

NO. 35 POSTER & PRESENTATIONS, YOUNG INVESTIGATOR AWARD

Pochstein F¹**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 basics of running do not differ compared to any other athlete. Nonetheless, there are some very important aspects to keep in mind.
- First, the general motoric 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 elite mainstream sport.
- **Second, due to the ID**, the understanding of tasks, the (motoric 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 realise 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, focussing on endurance aspects. The training program was adapted for pupils with ID and is based on the Special Olympics (SO) Coaches Guide. SO is the biggest organisation 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 within the group and between the group and a control group of 18 pupils with ID which were not participating in the training. The (interview) results show, 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 minutes run ($t=-18.59, p < .05$) from t1 to t2 in the experimental group and an even larger improvement between the groups at t2 ($t=-48.34, p < .05$).

NO. 34 POSTER & PRESENTATIONS, YOUNG INVESTIGATOR AWARD

Murphy C¹, Koehler K¹**Caloric restriction induces anabolic resistance to resistance exercise**1. TECHNICAL UNIVERSITY OF MUNICH, *Department of Sport and Health Sciences, Professorship in Exercise, Nutrition and Health*

- **Calorie-restricted weight loss** reduces muscle mass. Thus, clinicians and fitness professionals recommend resistance exercise to preserve muscle mass during calorie-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 (CR), 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 5 sets of 5 repetitions of the barbell back squat exercise on Day 3 of each condition. In CR 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 $18.3 \pm 3.4\%$ in CR and $27.2 \pm 3.8\%$ in CRP, which was greater than the $7.6 \pm 3.6\%$ decline in CON, over the subsequent 24 hours.
- **There is considerable anabolic resistance** in 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.

NO. 36 POSTER & PRESENTATIONS, YOUNG INVESTIGATOR AWARD

Rossi CD¹, Adam S¹, Carlsohn A¹**Enablers and barriers in the nutrition service for German Olympic athletes. A mixed-methods study**1. UNIVERSITY OF APPLIED SCIENCES HAMBURG, *Faculty of Life Sciences, Dept. Nutrition and Home Economics*

- **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 intraindividual dietary needs, athletes should seek the advice of qualified sports nutritionists to develop specific nutritional strategies.
- **This study aims** to analyze the perspectives of sports' nutritionists at German Olympic Sport Centers (OSCs) 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 OSCs 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 OSCs 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 OSCs. In order to optimize the support for the German athletes, several barriers have to be overcome: 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 OSC 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 OSCs could improve the service for Olympic Athletes. This would provide them with reinforced nutrition support that could benefit exercise performance and potentially decrease diet-related health risks.

NO. 37

POSTER & PRESENTATIONS, YOUNG INVESTIGATOR AWARD

Veit S¹, Isenmann E¹, Diel P¹

Effect of acute cannabidiol supplementation on recovery after strenuous strength training

1. GERMAN SPORT UNIVERSITY COLOGNE, *Institute for Cardiovascular Research and Sports Medicine, Department of Molecular and Cellular Sports Medicine*

- › **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: $-6.56\text{kg} \pm 6.94$, $p < .009$; PL: $-3.75\text{kg} \pm 5.18$, $p < .105$). In contrast, a significant increase in the biochemical parameter CK was found only within the placebo group (CBD: $+87.88\text{U/l} \pm 100.89$, $p < .298$; PL: $265.89\text{U/l} \pm 298.29$, $p < .003$). 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.

NO. 38

POSTER & PRESENTATIONS, YOUNG INVESTIGATOR AWARD

Wiewelhove T¹, Hessel A^{1,2}, Ferrauti A¹

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

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

2. UNIVERSITY OF MÜNSTER, *Institute for Physiology II*

- › **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: 25.5 ± 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 or 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 inter-time, -sequence, and individual were nested 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, and 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.