



Liste ausgewählter Publikationen – Sportmedizin Nottwil

Originalartikel

- **Flueck JL, Bogdanova A, Mettler S, Perret C. Is beetroot juice more effective than sodium nitrate? The effects of equimolar nitrate dosages of nitrate-rich beetroot juice and sodium nitrate on oxygen consumption during exercise. *Appl Physiol Nutr Metab.* 2016;41(4):421-9.**

Abstract:

Dietary nitrate has been reported to lower oxygen consumption in moderate- and severe-intensity exercise. To date, it is unproven that sodium nitrate (NaNO₃(-); NIT) and nitrate-rich beetroot juice (BR) have the same effects on oxygen consumption, blood pressure, and plasma nitrate and nitrite concentrations or not. The aim of this study was to compare the effects of different dosages of NIT and BR on oxygen consumption in male athletes. Twelve healthy, well-trained men (median [minimum; maximum]; peak oxygen consumption: 59.4 mL·min⁻¹·kg⁻¹ [40.5; 67.0]) performed 7 trials on different days, ingesting different nitrate dosages and placebo (PLC). Dosages were 3, 6, and 12 mmol nitrate as concentrated BR or NIT dissolved in plain water. Plasma nitrate and nitrite concentrations were measured before, 3 h after ingestion, and postexercise. Participants cycled for 5 min at moderate intensity and further 8 min at severe intensity. End-exercise oxygen consumption at moderate intensity was not significantly different between the 7 trials ($p = 0.08$). At severe-intensity exercise, end-exercise oxygen consumption was ~4% lower in the 6-mmol BR trial compared with the 6-mmol NIT ($p = 0.003$) trial as well as compared with PLC ($p = 0.010$). Plasma nitrite and nitrate concentrations were significantly increased after the ingestion of BR and NIT with the highest concentrations in the 12-mmol trials. Plasma nitrite concentration between NIT and BR did not significantly differ in the 6-mmol ($p = 0.27$) and in the 12-mmol ($p = 0.75$) trials. In conclusion, BR might reduce oxygen consumption to a greater extent compared with NIT.

- **Flueck JL, Hartmann K, Strupler M, Perret C. Vitamin D deficiency in Swiss elite wheelchair athletes. *Spinal Cord.* 2016; 54(11): 991-5.**

Abstract:

This is a retrospective analysis of total serum 25-hydroxyvitamin D (25[OH]D) in Swiss elite wheelchair athletes.

The aim was to investigate the occurrence of vitamin D deficiency in Swiss elite wheelchair athletes over the whole year and to detect differences between winter and summer months, and between indoor and outdoor athletes.

This study was conducted in Switzerland.

A total of 164 blood samples from 72 Swiss elite wheelchair athletes (mean±s.d.: age 32±13 years) were analyzed for total serum 25[OH]D. All participants were members of the national team in their discipline. The following disciplines have been included: rugby, athletics, cycling, tennis, ski alpine, curling and basketball. According to general guidelines, insufficient vitamin D status was defined between 50 and 75 nmol l⁻¹, deficiency below 50 nmol l⁻¹ and severe deficiency below 27.5 nmol l⁻¹.

In all, 73.2% of all samples showed an insufficiency/deficiency in vitamin D status. Total serum 25[OH]D was significantly higher during summer compared with winter months (69.5±21.4 nmol l⁻¹ vs 51.5±21.9 nmol l⁻¹; $P < 0.001$). Indoor sports showed a higher amount of vitamin D insufficiency/deficiency (80.9%) than outdoor sports (70.1%), with a significantly higher 25[OH]D concentration in outdoor sports ($P = 0.042$). A high percentage of vitamin D deficiency was found among Swiss elite wheelchair athletes. Conclusively, we recommend supplementation with vitamin D—especially during winter—to prevent a deficiency and an impairment of performance.



- **Flueck JL, Perret C. Supplement use in Swiss wheelchair athletes. Swiss Sports Exerc Med. 2017 ;65(1): 22-7.**

Abstract:

Supplement use in able-bodied athletes during major championships was reported to be around 80 to 90%. In contrast, the prevalence of supplement use in Paralympic athletes according to surveys from 2004 and 2012 was lower with around 40 to 58%. This study aimed to investigate the supplement use in Swiss wheelchair athletes. All Swiss wheelchair athletes were asked to complete a retrospective survey on supplement use during training and competition. The 65 Swiss wheelchair athletes (age: 39 ± 12 y, height: 174 ± 9 cm; body mass: 67 ± 11 kg) responding to the survey participated in rugby, basketball, paracycling, athletics, curling, badminton, alpine skiing and e-hockey. In total, 63% of the athletes used supplements during training periods and 43% before competitions. During training periods, they used mainly sports drinks (29%), recovery drinks (17%), vitamin D (15%), multivitamins (14%), magnesium (12%), proteins (11%), iron (9%) and energy gels (8%). Before competitions, 5% used caffeine, 5% creatine, 1.5% beta-alanine and 1.5% beetroot juice. Forty-two percent of all athletes wanted more information about sports nutrition and supplementation. The number of Swiss wheelchair athletes using supplements was comparable to the one observed in Paralympic sports. Based on the athletes' feedback, it is recommended to promote the specific education in sports nutrition and to provide the athletes and coaches with more specific information on supplements and nutritional strategies.

- **Flueck JL, Perret C. Vitamin D deficiency in individuals with a spinal cord injury: a literature review. Spinal Cord. 2017; 55(5): 428-34.**

Abstract:

Literature review of studies investigating vitamin D status in individuals with a spinal cord injury (SCI). Prevalence of vitamin D deficiency seems to be high in the general population. Little is known regarding such a deficiency in individuals with a SCI. This review aimed to examine the literature that investigated vitamin D status in this population.

Switzerland.

A literature review was performed to investigate the prevalence of vitamin D deficiency in individuals with a SCI and to determine the factors leading to deficiency.

Sixteen studies which met all the inclusion criteria were identified. All of these studies assessed total serum 25-hydroxy vitamin D status in individuals with an acute or chronic SCI. Overall, the prevalence of vitamin D deficiency or insufficiency seems to be high (range: 32-93%) in this population compared with that in able-bodied persons. The main factors are immobility, low physical activity and bedrest, and therefore not enough exposure to sunlight. In addition, age, skin pigmentation, lesion level, occurrence of pressure ulcers, body mass index, season and latitude appeared to be further determinants for vitamin D deficiency. In athletes, playing their sport indoors or outdoors may have an additional role in developing vitamin D deficiency.

The available studies suggest that individuals with a SCI are at increased risk for vitamin D insufficiency/deficiency. Nutritional strategies and supplementation recommendations need to be developed to prevent these conditions in SCI.



- **Flueck JL, Schlaepfer MW, Perret C. Effect of 12-week vitamin D supplementation on 25[OH]D status and performance in athletes with a spinal cord injury. *Nutrients*. 2016; 8(10).**

Abstract:

BACKGROUND: studies with able-bodied athletes showed that performance might possibly be influenced by vitamin D status. Vitamin D seems to have a direct impact on neuromuscular function by docking on vitamin D receptors in the muscle tissue. Additionally, a high prevalence of vitamin D deficiency was shown not only in infants and in the elderly but also in healthy adults and spinal cord injured individuals. Therefore, the aim of our study was to investigate whether a vitamin D dose of 6000 IU daily over 12 weeks would be sufficient to increase vitamin D status in indoor wheelchair athletes to a normal or optimal vitamin D level and whether vitamin D deficiency is associated with an impairment in muscle performance in these individuals; (2) METHODS: vitamin D status was assessed in indoor elite wheelchair athletes in order to have a baseline measurement. If vitamin D status was below 75 nmol/L, athletes were supplemented with 6000 IU of vitamin D daily over 12 weeks. A vitamin D status over 75 nmol/L was supplemented with a placebo supplement. Vitamin D status, as well as a Wingate test and an isokinetic dynamometer test, were performed at baseline and after six and 12 weeks; (3) RESULTS: 20 indoor elite wheelchair athletes participated in this double-blind study. All of these athletes showed an insufficient vitamin D status at baseline and were, therefore, supplemented with vitamin D. All athletes increased vitamin D status significantly over 12 weeks and reached an optimal level. Wingate performance was not significantly increased. Isokinetic dynamometer strength was significantly increased but only in the non-dominant arm in isometric and concentric elbow flexion; (4) CONCLUSION: a dose of 6000 IU of vitamin D daily over a duration of 12 weeks seems to be sufficient to increase vitamin D status to an optimal level in indoor wheelchair athletes. It remains unclear, whether upper body performance or muscle strength and vitamin D status are associated with each other.

- **Osthoff M, Michel F, Strupler M, Miedinger D, Taegtmeyer AB, Leuppi JD, Perret C. Bronchial hyperresponsiveness testing in athletes of the Swiss Paralympic team. *Sports Sci Med Rehabil* 2013; 5: 1-8.**

Abstract:

The aim of this study was to assess airway hyperresponsiveness to eucapnic voluntary hyperventilation and dry powder mannitol challenge in athletes aiming to participate at the Paralympic Games 2008 in Beijing, especially in athletes with spinal cord injury.

Forty-four athletes with a disability (27 with paraplegia (group 1), 3 with tetraplegia (group 2) and 14 with other disabilities such as blindness or single limb amputations (group 3) performed spirometry, skin prick testing, measurement of exhaled nitric oxide, eucapnic voluntary hyperventilation challenge test (EVH) and mannitol challenge test (MCT). A fall in FEV1 of $\geq 10\%$ in either challenge test was deemed positive for exercise-induced bronchoconstriction.

Fourteen (32%) athletes were atopic and 7 (16%) had a history of physician-diagnosed asthma. Absolute lung function values were significantly lower in patients of group 1 and 2 compared to group 3. Nine (20%) athletes were positive to EVH (8 paraplegics, 1 tetraplegic), and 8 (18%) athletes were positive to MCT (7 paraplegics, 1 tetraplegic). Fourteen (22.7%) subjects were positive to at least one challenge; only three athletes were positive to both tests. None of the athletes in group 3 had a positive test. Both challenge tests showed a significant association with physician-diagnosed asthma status ($p = 0.0001$). The positive and negative predictive value to diagnose physician-diagnosed asthma was 89% and 91% for EVH, and 75% and 86% for MCT, respectively.

EVH and MCT can be used to identify, but especially exclude asthma in Paralympic athletes.



- **Perret C, Elite-adapted wheelchair sports performance: a systematic review. Disabil Rehabil. 2017; 39(2): 164-72.**

Abstract:

Elite-adapted sports performance has considerably improved over the last decades and winning or losing races at Paralympic Games is often a matter of a split second. In other words, every single detail counts, which underlines the necessity of optimizing training interventions and equipment for athletes in order to achieve top-class performance. However, to date, studies which include Paralympic elite athletes are scarce.

A comprehensive literature search was performed to identify potential strategies and interventions in order to optimize elite-adapted wheelchair sports performance, whereas the focus lay on respiratory muscle training (RMT), cooling (CI) and nutritional interventions (NI) as well as on individual equipment adaptations (IEA).

The total number of studies identified for the final analysis was six for RMT, two for CI, three for NI and seven for IEA, respectively. Results point predominantly towards performance enhancing benefits for CI and IEA, whereas NI and RMT provided inhomogenous findings.

In comparison to the able-bodied population, research in the field of Paralympic elite sport is scarce. CI and IEA seem to have significant performance enhancing benefits, whereas NI and RMT revealed controversial findings. However, due to the limited number of elite athletes with a spinal cord injury available to participate in scientific studies, general conclusions are difficult to make at this stage and in daily practice recommendations are still given mainly on an individual basis or based on personal experiences of coaches, athletes and scientists. Implications for Rehabilitation Based on the knowledge gained in elite sports, wheelchair equipment could be optimized also for daily use. Elite sports performance could inspire wheelchair users to achieve their personal fitness goals.

- **Perret C, Flueck JL. Supplementation and performance in spinal cord-injured elite athletes: a systematic review. Dtsch Z Sportmed. 2016; 67: 209-13.**

Abstract:

Supplement use has gained increasing interest in the past decade including in Paralympic sports. However, several physiological differences (e.g. prolonged gastrointestinal transition time, reduced resting energy expenditure) exist between able-bodied and athletes with a spinal cord-injury due to the impairment of the autonomic nervous system, which might influence supplement effects. The aim of this review was to investigate the impact of supplement use on exercise performance in spinal cord-injured athletes.

A comprehensive review was performed using Pubmed as search engine to detect studies investigating supplement use in spinal cord-injured athletes.

Only five studies were identified. These studies dealt with the use of carbohydrates, creatine, caffeine, sodium citrate or the combination of the latter two supplements. One study using an 11% carbohydrate solution found an endurance performance enhancing effect. Caffeine seemed to have ergogenic effects on sprint and short-term but not on endurance performance in athletes with a para- or tetraplegia. Sodium citrate and creatine showed no performance enhancing effects.

The results showed that results from studies performed with able-bodied individuals cannot be transferred into a wheelchair sport context. Evidence-based recommendations on supplement use are not feasible due to the lack of data from spinal cord-injured athletes.

This means that individually tailored solutions for each wheelchair athlete are necessary for supplement use at present and further studies are needed to gain more evidence-based information.



- **Perret C, Flueck JL. The taste of salt in the athlete's soup: a short update with practical recommendations. Swiss Sports Exerc Med. 2017; 65(1):12-5.**

Abstract:

The general recommendation for daily sodium consumption is about 6 g/d, as a higher intake was associated with an increased risk for cardiovascular mortality in individuals already suffering from hypertension. However, this recommendation is not necessarily valid for athletes as they often experience high sweat and sodium losses during exercise. While it is well-known that a balanced hydration status and fluid replacement are important factors to maintain an adequate exercise performance, the importance of salt losses during exercise seems to be often underestimated. This short update will focus on the role and impact of salt or sodium ingestion before, during and after exercise and its implication on performance. Pre-exercise ingestion of highly concentrated sodium solutions (164 mmol/l) induces a plasma volume expansion leading to a performance enhancing effect. Sodium intake during exercise of more than 60 min helps to prevent from or compensate dehydration. Sports drinks ingested during exercise commonly contain a sodium concentration of 30-50 mmol/l, whereas a higher concentration might be advantageous for so called salty sweaters or athletes prone to heat cramps. For a fast rehydration after exercise, drinks with a sodium concentration of around 100 mmol/l were found to be most effective. In any case, taste preference and gastrointestinal discomfort have to be considered individually and the amount of salt or sodium to be ingested in the different exercise settings depends highly on the desired goal. Finally, the timing of salt or sodium intake as well as the right dosage are of high importance to successfully influence exercise performance.

- **Tweedy SM, Beckman EM, Geraghty TJ, Theisen D, Perret C, Harvey LA, Vanlandewijck YC. Exercise and sports science Australia (ESSA) position statement on exercise and spinal cord injury. J Sci Med Sport. 2017; 20(2): 108-15..**

Abstract:

Osteoporotic fractures are associated with substantial morbidity and mortality. Although exercise has long been recommended for the prevention and management of osteoporosis, existing guidelines are often non-specific and do not account for individual differences in bone health, fracture risk and functional capacity. The aim of the current position statement is to provide health practitioners with specific, evidence-based guidelines for safe and effective exercise prescription for the prevention or management of osteoporosis, accommodating a range of potential comorbidities. Position statement. Interpretation and application of research reports describing the effects of exercise interventions for the prevention and management of low bone mass, osteoporosis and osteoporotic fracture. Evidence from animal and human trials indicates that bone responds positively to impact activities and high intensity progressive resistance training. Furthermore, the optimisation of muscle strength, balance and mobility minimises the risk of falls (and thereby fracture), which is particularly relevant for individuals with limited functional capacity and/or a very high risk of osteoporotic fracture. It is important that all exercise programs be accompanied by sufficient calcium and vitamin D, and address issues of comorbidity and safety. For example, loaded spine flexion is not recommended, and impact activities may require modification in the presence of osteoarthritis or frailty. Specific guidelines for safe and effective exercise for bone health are presented. Individual exercise prescription must take into account existing bone health status, comorbidities, and functional or clinical risk factors for falls and fracture.



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