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Day 1 – Orals: Performance Theme

Protein Supplementation Does Not Further Augment Physiological Adaptations to Prolonged Endurance Exercise Training
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We assessed the impact of protein supplementation during prolonged endurance exercise training on whole-body oxidative capacity (VO2max) and endurance exercise performance. Sixty recreationally active males (age: 27±6 y; BMI: 23.8±2.6 kg·m-2; VO2max: 47±6 mL·min-1·kg-1) were subjected to 12 weeks of triweekly endurance exercise training. After each session and each night prior to sleep, participants ingested either a protein supplement (PRO; 29 g casein protein) or an isocaloric carbohydrate placebo (PLA). Before and after the 12 weeks of training, VO2max and endurance exercise performance (~10-km time-trial) were assessed on a cycle ergometer. Muscular endurance (total workload achieved during 30 reciprocal isokinetic contractions) was assessed by isokinetic dynamometry and body composition by DXA. Dietary intake was assessed at baseline and during the intervention period. Repeated measures ANOVA was applied to assess whether training adaptations were different between groups. Protein intake increased in PRO (1.2±0.4 to 1.6±0.3 g·kg-1, time x treatment interaction, P<0.001). Endurance exercise training induced an 11±6% increase in VO2max (time effect, P<0.001), with no differences between groups (PRO: 48±6 to 53±7 mL·min-1·kg-1; PLA: 46±5 to 51±6 mL·min-1·kg-1; time x treatment interaction, P=0.50). Time to complete the 10-km time-trial was reduced by 14±7% (time effect, P<0.001), with no differences between groups (time x treatment interaction, P=0.15). Muscular endurance increased by 6±7% (time effect, P<0.001), with no differences between groups (time x treatment interaction, P=0.84). Whole body lean mass was unchanged over time (P=0.097). However, leg lean mass showed an increase following endurance exercise training (P<0.001), which tended to be greater in PRO (PRO: 0.5±0.7 kg; PLA: 0.2±0.6 kg; time x treatment interaction, P=0.073). Protein supplementation after exercise and before sleep does not further augment the gains in whole-body oxidative capacity and endurance exercise performance following prolonged endurance exercise training in healthy, young males.

Low Energy Availability Assessed by a Sport-Specific Questionnaire and Clinical Interview Indicative of Bone Health, Endocrine Profile and Cycling Performance in Competitive Male Cyclists
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We evaluated the efficacy of a sport-specific energy availability (EA) questionnaire, combined with clinical interview, for identifying male athletes at risk of developing bone health, endocrine and performance consequences of relative energy deficiency in sports (RED-S). Fifty competitive male road cyclists, recruited through links of participants in a pilot study, were assessed by a newly developed sport-specific questionnaire and clinical interview (SEAQ-I), received dual energy X-ray absorptiometry (DXA) bone mineral density (BMD) and body composition scans and blood tests for endocrine markers. Low EA as assessed using the SEAQ-I, was observed in 28% of cyclists. Low lumbar spine BMD (Z-score < −1.0) was found in 44% of cyclists. EA was the most significant determinant of lumbar spine BMD Z-score (p<0.001). Among low EA cyclists, lack of previous load-bearing sport was associated with the lowest BMD (p=0.013). Low EA was associated with reduced total percentage fat (p<0.019). The 10 cyclists with chronic low EA had lower levels of testosterone compared with those having adequate EA (p=0.024). Mean vitamin D concentration was below the level recommended for athletes (90 nmol/l). Training loads were positively associated with power-to-weight ratios, assessed as 60 minute Functional Threshold Power (FTP) per kg (p<0.001). Percentage body fat was not significantly linked to cycling performance. This study demonstrates that a sport-specific questionnaire and clinical interview (SEAQ-I) is effective for identifying male road cyclists with acute intermittent and chronic sustained low EA. Cyclists with low EA, particularly in the long-term, displayed adverse quantifiable measures of bone, endocrinology and performance consequences of RED-S.

The Impact of a 24-h Low FODMAP Diet on Exercise-Associated Gastrointestinal Symptoms and Breath Hydrogen Responses in Endurance Athletes
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Exercise-associated gastrointestinal symptoms (GIS) in endurance athletes are common and can potentially lead to debilitating exercise performances and hampering of post-exercise recovery. This study aimed to determine the impact of pre- and post-exercise dietary fermentable oligo- di- mono-saccharide and polyol (FODMAP) intake on GIS and breath hydrogen (H2) responses (marker of carbohydrate malabsorption) in response to exertional-heat stress. Using a randomised crossover and counterbalanced study design, non-heat acclimatised recreationally competitive endurance runners (n = 18; male = 10 and female = 8) consumed a 24-h high (HFOD) or low (LFOD) FODMAP diet on one occasion, prior to completing 2-h of running at 60% VO2max in hot ambient conditions (35°C, 23% relative humidity). Immediately post-exercise a recovery beverage was consumed matching the 24-h FODMAP diet. GIS and breath H2 samples were collected pre-exercise, every 15 min during exercise, and every 15 min post-exercise for 4-h. Blood samples were collected pre- and post-exercise.
to determine plasma osmolality and plasma cortisol concentrations. Participants then repeated the protocol on the alternating diet after a one-week washout period. The results showed that GIS incidence during exertional-heat stress did not differ between LFOD and HFOD (89%). However, compared with LFOD, the severity of GIS was significantly higher on HFOD pre- and during exercise, and in total across the day (p = 0.027, p = 0.035, and p = 0.042, respectively). A significant rise in breath H2 (>10 ppm) was evident in HFOD post-exercise from 2:15-h onwards but not on LFOD. A significant difference in total breath H2 production over the 4-h period and the area under the curve was observed on HFOD (mean and 95% CI: 2525 (1452-3597 ppm·h-1), peak +17 ppm) compared to LFOD (1505 (1031-1978 ppm·h-1), peak +8 ppm), (p = 0.03). Pre- and post-exercise plasma cortisol did not differ between diets (p > 0.05). Findings suggest that a 24-h HFOD diet prior to exertional-heat stress, and a HFOD recovery beverage immediately post-exercise, results in exacerbating exercise-associated GIS and carbohydrate malabsorption in comparison to a LFOD dietary intervention.

**Individual Muscle Hypertrophy to Different Resistance Training Variations: Biological Responsivity vs Training Modulation**

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To date, it is unknown if such practice augments intra-individual RT-induced muscle hypertrophy. In this retrospective study, we aimed to examine individualised changes in vastus lateralis cross-sectional area (CSA) to distinct RT variables (ie, frequency, repetition duration and intensity) modulations over an 8-10 wk RT period. A study cohort of 34 young (18-30 y) men from 3 separate data sets each completed a single leg RT programme, ie, each participant completed two RT programmes. Data set A consisted of 10 untrained men who performed 3 sets of leg extension exercise (9-12 max reps) 5x/wk (RT5) vs 3x/wk (RT3) for 8 wk. Data set B consisted of 10 untrained men who performed 3 sets of leg extension exercise (70% 1RM) with a fixed repetition duration (FIX, 2:2s) vs. self-selected tempo (SELF) 2x/wk for 8 wk. Data set C consisted of 14 trained men (RT experience: 5 (3y)) who performed ~6 sets of leg press + 6 sets of leg extension + 5 sets of leg flexion per RT session (75% 1RM) until muscle failure (RT-F) vs. volitional interruption of each set (RT-V) 2x/wk for 10 wk. Vastus lateralis CSA was measured pre- and post-RT by ultrasound imaging fitting technique and the change was compared between protocols by paired samples t-tests. Results showed similar (P>0.05) increases in muscle CSA (mean (SD) in cm2) for: A, RT5, 2.0 (1.3) and RT3, 2.4 (1.7); B, FIX, 1.0 (0.6) and SELF, 1.3 (0.8); and C) RT-F, 4.2 (3.3) and RT-V, 4.4 (1.7). Intra-subjects analyses revealed that some subjects responded better to one of the protocols (A, RT3: 1; RT3: 5; B, FIX: 1, SELF: 5; C, RT-F: 4, RT-V: 9 subjects) but others showed no differences between legs (A, 4; B, 4; C, 1 subject). Inter-subject variability in the muscle hypertrophic response was high, with the CV varying from 37-77% intra-protocols. These results demonstrate that regardless of RT frequency, repetition duration, intensity manipulation or training status, the individual biological predisposition determines the muscle hypertrophic response to RT. Individually, subjects might respond better to specific RT modulations.

**Effect of Carbohydrate Intake During Matches on the Cognitive Function of Professional Female Football Players**

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Football involves an intermittent high-intensity movement pattern over a prolonged period of time. Carbohydrates (CHO) are the main fuel for intense training sessions and matches. Previous studies have shown a reduction of fatigue alongside a retention of cognitive performance in football players ingesting CHO during trials conducted in laboratory settings. However, little work has examined female players or whether taking CHO during matches can have similar effects in an applied setting. The current study aimed to determine if a 12% CHO beverage taken before and at half time in a football match could aid retention of cognitive function and reduce fatigue, in female football players. 6 Spanish players played 2 football matches on separate days. The players ingested 250 ml during the warm-up and 250 ml at half-time of either a non-caloric placebo beverage (PLA) or a 12% maltodextrin beverage (CHO). Both beverages were matched for taste, odor and color. Gastric distress and gut fullness (GD, GF), session rate of perceived exertion (S-RPE), fatigue () and mood (MS) were recorded before the match, during half-time, and at the end of the match. Urine color (UC) and body mass were assessed before the warm up and at the end of the match. Ball possession (BP) and sprints were recorded during matches. Players completed the Stroop Color cognitive function test and a mental concentration test at the end of the match. All data were analyzed by Wilcoxon signed-rank test. S-RPE was higher in CHO than in PLA at half-time (p = 0.03) and at the end of the match (p = 0.03). Fatigue increased between the half-time and the end of the match when players took PLA (p = 0.04). Mass loss over the match was significantly higher in CHO trial (p = 0.04). No differences were found for GD, GF, MS, BP, S, or cognitive function and mental concentration. In conclusion, taking 250 ml of a 12% CHO beverage during warm up and at half-time of football matches with similar game analysis aspects did not impact upon gastrointestinal symptoms, cognitive function, or mental concentration in professional female soccer players, which could be related with the different S-RPE of each match that cannot be controlled during an ecological valid setting.

**Estimated Energy Balance of International Female Rugby Sevens Players in Training and Competition Scenarios**

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Rugby sevens is a contact sport comprising of two teams of seven players who compete over two 7-min halves. Rugby sevens players experience accentuated loads during match-play, with mean total distances of ~113-120 m·min-1 covered. Likewise, ~30% of total match distances are covered at speeds ≥5 m·s-1, while 39% more high velocity (≥24 m·s-2) accelerations are performed when players compete in international tournaments. Accordingly, to facilitate optimised performance during match-play and realisation of training-induced adaptations, the energy balance of rugby sevens players needs consideration. However, limited data currently exists regarding the energy intake (EI) and expenditure (EE) of rugby sevens players in both training and competitive scenarios, especially in the case of female players. Therefore, this two-part study aimed to estimate EI and EE in international female rugby sevens players during a) a training camp (n = 11), and b) an international competition (n = 8) held within 14 days of each other. Tri-axial accelerometers (Actigraph wGT3X-BT, USA) and 5-day food diaries (quantifying portion sizes using household measures) facilitated estimation of EE and EI, respectively. Activity-based EE was combined with body mass-derived estimates of resting EE to estimate total daily EE (TDEE). Energy deficits of ~47% (TDEEF Training: 3502±400 kcal·d-1, EITraining: 1859±221 kcal·d-1, p≤0.001, d=5.1) and