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Day 1–Poster Presentations

Citrulline Malate has No Effect on German Volume Training Protocol

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Citrulline malate (CM) is purported to improve aerobic and anaerobic exercise performance through a variety of mechanisms including: improved ammonia metabolism, lactate buffering, increased vasodilation and increased adenosine triphosphate production. In a double-blind, placebo controlled, crossover trial 15 healthy, resistance trained individuals (11 men, 4 women) consumed either 8 g of CM or a placebo one hour before participating in a German Volume Training (GVT) exercise protocol. The GVT protocol consisted of 10 sets of 10 repetitions of single leg, leg extensions, with one minutes rest between sets using an isokinetic dynamometer. Each set was ended when full range of motion could no longer be achieved; the number of repetitions achieved across the 10 sets was main outcome measure. Blood samples were taken at baseline and post GVT for blood lactate analysis. The effect of the GVT protocol on post-exercise isometric maximal voluntary contraction (MVC) and self-reported muscle soreness up to 72 h after exercise were measured. A repeated measures ANOVA was used to analyse the number of completed repetitions and muscle soreness. The change in lactate and isometric MVC at baseline to post exercise was assessed using a paired samples t-test. Citrulline malate administration had no effect on the total number of repetitions achieved during the GVT protocol (CM: 90.9 ± 13.9 reps, Placebo: 94.0 ± 7.9 reps, $P = 0.34$), or on post-exercise isometric MVC (Baseline: 208.2 ± 70.9 CM: 213.1 ± 80.3 Nm, Placebo: 206.2 ± 55.4 Nm, $P = 0.24$). Blood lactate concentrations increased between baseline and post-exercise ($P = 0.01$), but there was no difference ($P = 0.47$) in the pre- to post-exercise lactate between treatment conditions (pre: CM: 1.7 mM ± 1.1, Placebo: 1.5 ± 0.5 mM; post CM: 4.2 ± 1.3 mM, Placebo: 4.3 ± 1.3 mM). Finally, self-reported mean muscle soreness after exercise was greater ($P = 0.01$) under the CM treatment (combined soreness score 248 ± 90) compared to the Placebo (combined mean VAS score 150 ± 70). The loading and timing of the dose of CM may have consequences for performance outcomes, but results of this research indicate that an 8 gram acute dose of CM does not provide an ergogenic benefit for trained males and females.

Vitamin D Status of the Players of the Japanese National Badminton Team

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As vitamin D is essential for bone growth, density and remodeling, lack of vitamin D may lead to bone loss and/or fracture. While more than 90% of the Japanese population is considered to have vitamin D insufficiency, the prevalence of vitamin D inadequacy in athletes has currently become clear. Among athletes, the type of sport (indoor vs. outdoor) is one of the factors that affects the incidence of vitamin D. Previous studies have shown that indoor sports athletes are more susceptible to vitamin D inadequacy than outdoor sports athletes. Therefore, in this study, we assessed vitamin D levels among the players of the Japanese national badminton team to comprehend their statuses regarding vitamin D and to utilize it for nutritional education and intervention for the players. The survey was conducted from February to March 2017. Fifty-one players (aged 23 ± 3 years) in the 2017 Japanese national badminton team participated in the survey. We assessed vitamin D status (serum 25-hydroxyvitamin D [25 (OH)D]), serum free fatty acids (arachidonic acid [AA], eicosapentaenoic acid [EPA], docosahexaenoic acid [DHA] and EPA/AA ratio), type I collagen cross-linked N-telopeptide (NTX), dietary intake (energy, protein, carbohydrate, calcium, and vitamin D), geographical location of residence and the duration of sun exposure per day. Vitamin D status was classified as follows: 25(OH)D values <20 ng/mL as deficient, values within 20-30 ng/mL as insufficient and values >30 ng/mL as sufficient. The mean level of 25(OH)D was 15.1 ± 4.0 ng/mL (range: 8.2-23.9 ng/mL). None of the players had sufficient vitamin D levels, 8 players (16%) were classified as vitamin D insufficient and 43 players (84%) as vitamin D deficient. The mean vitamin D intake was 5.8 ± 2.7 μg/day. The mean levels of serum free fatty acids were 243 ± 58 μg/mL for AA, 31 ± 17 μg/mL for EPA, and EPA/AA ratio was 0.13 ± 0.06. EPA and EPA/AA ratio had positive correlation with 25(OH)D levels (EPA: $r = 0.331$, $p < 0.05$, EPA/AA ratio: $r = 0.321$, $p < 0.05$, respectively). A high prevalence of vitamin D deficiency was found among the players of the Japanese national badminton team. However, as EPA and EPA/AA ratio were correlated with 25(OH)D, it is presumed that the vitamin D statuses of the players would be improved by increasing their dietary intake of EPA.

Aerobic Fitness Relates to Resting Metabolic Rate in Women

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Resting metabolic rate (RMR) accounts for the largest portion (60-70%) of a human's total energy requirements (TEE), the remainder being accounted for by diet-induced thermogenesis (~10%) and physical activity (typically ~20-30% or more, depending upon physical activity level (PAL = TEE/ RMR)). RMR varies with age, gender, and fat-free mass (FFM). It remains uncertain whether aerobic capacity (VO_{2max}) *per se* relates to RMR. We analyzed the relationship between VO_{2max} and RMR in 29 female endurance athletes (ATH) (age: 30 ± 6 years, body mass index: 20.4 ± 1.6 kg/m^2) and 28 healthy controls (CON) (27.3 ± 4.8 years, 21.9 ± 1.6 kg/m^2). RMR (indirect calorimetry, fasted state), VO_{2max} (graded treadmill exercise test with spirometry), body composition (dual x-ray absorptiometry), and PAL (combined heart rate and movement sensor) was determined. Group differences were tested by independent *t*-tests and Mann-Whitney-U-tests ($\alpha = 0.05$). Correlation coefficients (r) between RMR and VO_{2max} were

assessed by Spearman correlation and analyzed by groups; the significance of difference between r was assessed by Fisher z-transformation. A multiple linear regression analysis with RMR as dependent variable and age, FFM, body fat, and VO_{2max} as factors was performed. PAL was higher in ATH than in CON (2.1 ± 0.3 vs. 1.9 ± 0.2, $p = 0.01$). ATH had significantly higher absolute and relative VO_{2max} than CON (3.3 ± 0.4 and 56.2 ± 4.2 vs. 3.0 ± 0.4 L/min and 48.5 ± 4.2 ml/kg min; all $p < 0.01$). For the absolute RMR no group differences were found (ATH: 1474 ± 151 vs. CON: 1507 ± 157 kcal/day, $p = 0.42$). When RMR was normalized to kg body mass ATH had higher values than CON (25.4 ± 2.3 vs. 24.4 ± 1.4 kcal/kg day, $p < 0.01$); when normalized to kg FFM no group differences were detected (ATH: 32.5 ± 3.1 vs. CON: 33.0 ± 2.1 kcal/kg FFM day, $p = 0.52$). There was a positive correlation between absolute RMR and absolute VO_{2max} in the total sample ($r = 0.60$, $p < 0.0001$), and in ATH and CON ($r = 0.60$ and $r = 0.74$; all $p < 0.01$); whereas the difference between r was not significant ($p = 0.38$). Age, FFM, body fat and VO_{2max} explained 60% of the variation of RMR in the total sample ($p < 0.0001$). It follows that VO_{2max} *per se* might relate positively to RMR in women. Therefore, improving VO_{2max} might support weight loss strategies by increasing RMR and thus TEE.

Prior Exercise Alters the Difference Between Arterialised and Venous Glycaemia - Implications for Blood Sampling Procedures

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Oral glucose tolerance and insulin sensitivity are common measures, but are determined using various blood sampling methods, employed under many different experimental conditions. This study established whether measures of oral glucose tolerance and oral glucose-derived insulin sensitivity (ISI) differ, when calculated from venous versus arterialised blood. Critically, we also established whether any differences between sampling methods are consistent across distinct metabolic conditions (after rest versus after exercise). Ten healthy men completed two trials in a randomised order, each consisting of a 120-minute oral glucose tolerance test (OGTT), either at rest or post-exercise. Blood was sampled simultaneously from a heated hand (arterialised) and an antecubital vein of the contralateral arm (venous). Under both conditions, glucose time-averaged area under the curve was greater with arterialised compared to venous plasma but importantly, this difference was larger after rest than after exercise (0.99 ± 0.46 vs 0.56 ± 0.24 mmol.L^{-1} respectively; $p < 0.01$). OGTT-derived ISIMatsuda and ISICederholm were lower when calculated from arterialised relative to venous plasma, and the arterialised-venous difference was greater after rest versus after exercise (ISIMatsuda: 1.97 ± 0.81 vs 1.35 ± 0.57 au, respectively; ISICederholm: 14.76 ± 7.83 vs 8.70 ± 3.95 au, respectively; both $p < 0.01$). Venous blood provides lower postprandial glucose concentrations and higher estimates of insulin sensitivity compared to arterialised blood. Most importantly, these differences between blood sampling methods are not consistent at rest versus post-exercise, preventing standardised venous-to-arterialised corrections from being readily applied.

Acute Chronic Workload Ratio and Concussion Risk in Elite Rugby Players

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The acute chronic workload ratio (ACWR) is a value derived from a combination of external and internal workloads. Calculation of the ACWR is currently widely utilised for intermittent field based sports, such as rugby, where it can help to monitor workloads and subsequent identification of injury risk. The objective of the present study was to assess if there was any relationship between increases in the ACWR and exposure to serious injury risk, specifically concussion, amongst elite rugby players. For the purposes of this study, acute workload was defined as the players' state of fatigue, and the chronic workload was defined as the players' state of fitness. The acute workload was calculated on a 7 day basis, and the chronic workload was calculated on a rolling 28 day basis. Data for eleven elite rugby players were retrospectively analyzed for the 2016-2017 season to quantify and compare ACWRs between two groups of players; Group A: players who had experienced a concussion ($n = 5$) during the previous season and Group B: players who did not experience a concussion ($n = 6$) in the previous season. The control group (Group B) were comparable positionally with Group A. All data were accumulated on athlete performance software (Kitman Labs, Dublin). The ACWR for the concussed group (Group A) was ($P < 0.05$) higher when compared to the mean of the non-concussed group (Group B). The mean ($\pm$SD) ACWR for the concussed cohort of players was 1.05 (± 0.07), and the mean for the non-concussed group of players was 0.65 (± 0.09). Cohen's d (1.953) indicated a large effect size between the concussed ($n = 5$) and non-concussed ($n = 6$) group of players. There was a moderately strong correlation ($R^2 = 0.71$) between ACWR and injury risk in the current cohort. The present retrospective analysis has demonstrated that the players in the concussed group had a higher ACWR than those in the non-concussed cohort of players. Therefore this study highlights that higher ACWR in elite rugby players may increase risk of injury. Considering the implications of concussion on overall player welfare and, for the management of injury prevention programmes, regular monitoring of ACWR and optimization of cut off points prior to field play is recommended. However, caution of over-interpretation must be exercised based on the number of participants who took part in this study ($n = 11$).

Difference in Muscle Glycogen Recovery in the Carbohydrate Intake Within One Hour Post-Exercise

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Carbohydrate (CHO) intake is recommended as soon as possible after exercise. In previous studies, the muscle glycogen synthesis rate was reduced when post-exercise CHO ingestion was delayed two hours compared with CHO ingestion immediately post-exercise. However, the differences in muscle glycogen recovery when CHO intake occurs within one hour of exercise are not clear. The purpose of this study was to clarify the muscle glycogen recovery by intake of CHO within one hour after exercise, assuming a practical scene using common foods. Seven male endurance-trained athletes (age: 20 ± 2 years; height: 170.6 ± 7.2 cm, body mass: 61.7 ± 5.3 kg) consumed CHO (2.0 g/kg body weight) either immediately (P0), 30 minutes (P30), or 60 minutes (P60) after a time trial (TT) on a cycle ergometer at 70% maximum power for approximately 60 min. The glycogen contents of the thigh muscle group of the right leg, the vastus lateralis and vastus intermedius muscles, were measured by carbon magnetic resonance spectroscopy (^{13}C-MRS) before and at 2 and 4 h after exercise. Plasma glucose, insulin concentrations, and a visual analogue scale (VAS) score of the whole body fatigue feeling were also measured at the same time points. The muscle glycogen recovery every 2 h