International Journal of Sport Nutrition and Exercise Metabolism, 2014, 24, S1-S10

INTERNATIONAL JOURNAL OF
SPORT NUTRITION AND
EXERCISE METABOLISM
www.IJSNEM-Journal.com
SPECIAL ISSUE

Abstracts From the December 2013 International Sports and Exercise Nutrition Conference in Newcastle upon Tyne

Vitamin D status of young elite German athletes

Braun, H; de Marées, M; Mester, J; Thevis, M; Schaenzer, W.

German Research Centre of Elite Sports, German Sport University Cologne, Germany.

Vitamin D has many physiological functions and a vitamin D deficiency could influence health and performance of athletes negatively. Whereas dietary Vitamin D intake is generally low, the endogenous synthesis via ultraviolet-B radiation is able to provide sufficient amounts. However, vitamin D is not synthesized at latitudes > 35-37° in the winter months. In this context it should be noted that the geographic latitude of Germany is between 47.5° and 54.5°. So far, data on vitamin D status of German athletes, especially young athletes are rare. Therefore, the aim of the present study was to analyze vitamin D status of young German athletes with special focus on the time of the year. Between March 2007 and August 2010, 308 young German athletes between 13 and 18 years ($m = 148$, $f = 160$; 15.4 ± 1.5 y, 64.1 ± 13.5 kg, 173.3 ± 11.0 cm, training time per day 102 ± 53 min) reported their diet using a validated 7-d food and activity record (Koehler et al., 2010). The morning after the recording period, fasting blood samples were obtained from the athletes (frozen at –80°C and analyzed retrospectively). Mean dietary vitamin D intake was 1.9 ± 1.5 µg for males and 1.9 ± 2.2 µg for females. Mean 25(OH)D concentration was 24.5 ± 12.3 ng/ml and higher for males than females (26.6 ± 14.8 ng/ml vs. 22.6 ± 9.0 ng/ml; $p = .003$). Serum 25(OH)D concentration < 32ng/ml was found in 82% ($m = 78\%$; $f = 87\%$) of the athletes and < 20ng/ml for 43 % ($m = 39\%$; $f = 47\%$). With respect to the time of the year mean 25(OH)D concentration was highest in Aug & Sep (34.9 ± 11.0 & 40.4 ± 19.7 ng/ml) and below 21ng/ml from Nov to May. 25(OH)D concentration was < 20ng/ml for 11% of the athletes in Aug–Sep and 58% in Nov–May. In conclusion, we observed a high prevalence of athletes with an insufficient (82%) and even deficient (43%) 25(OH)D concentration. While during Aug–Sep vitamin D deficiency was observed only for a few athletes, vitamin D deficiency was significant in the period Nov–May. Based on these findings, and with the limitations that we don't know the potential impact of lifestyle and environmental factors on status, a strategy on regularly assessment of vitamin D status for young German athletes including potential supplementation should be established.

Nutritional status and body mass changes of a 66-year-old ultra-endurance athlete during a 3,000-miles challenge over 100 consecutive days: A case study

Lindsay, CL[1]; Welford D[2;] Etxeberria A[4]; Ammann K[4]; Ferguson R[3]; Sparks A[1]; and Costa R[5]

[1]Edge Hill University, Department of Sports and Physical Activity, St Helens Road, Ormskirk, L39 4PQ. [2]Bishop Burton College York Road, Bishop Burton, Beverly, HU17 8QG. [3]PND consulting, Scotland. [4]Coventry University. [5]Monsah University, Department of Nutrition and Dietetics, 264 Ferntree Gully Road, Notting Hill, Victoris, 3168, Australia.

Multiple day ultra-endurance challenges are increasing in popularity for recreational runners, but there is a paucity of evidence on which to base nutritional recommendations. This case study presents the nutritional status and body mass (BM) changes of a 66 year old, male experienced runner, during a 100-day, 3000 mile challenge (~30 mile·d^{-1}). Daily energy expenditure and intake were estimated for a 24-hr period including a 30 mile run, using a Sensewear accelerometer and a food diary. These results were used by a registered dietitian to design a nutrition plan to provide energy and substrate availability for the run and to promote recovery for the following day. During the challenge, BM was recorded after the first void each day and nutritional intake was estimated using a 24-hr weighed food record, at the end of each week. At the start of the challenge BM was 81.0 kg: this fell to 73.0 kg by day 31, but remained stable until the completion of the challenge. Percentage body fat estimated using Bodpod fell from 20.9% to 16.0%, in contrast fat free mass (FFM) increased from 62.5 kg to 64.3 kg. This was despite a mean energy intake below the estimated expenditure, at 5427±1214 kcal (3426-6789 kcal). Mean daily carbohydrate and protein intake was 841±178 g and 172±47 g respectively. This equated to relative carbohydrate and protein intake of 11.2±2.6 g.kg.d^{-1} (6.2-14.2 g.kg.d^{-1}) and 2.3±0.7 g.kg.d^{-1} (1.3-3.4 g.kg.d^{-1}) respectively. Mean carbohydrate intake was within the carbohydrate recommendations for activity >4.5 h (Burke, et al, 2001, *Sports Med*, 31(4), 267-299). In contrast mean protein intake was considerably higher than that recommended for endurance activities (Genton 2011, *e-SPEN*, 6, e77-e84). The observed increase in FFM likely reflects the positive energy balance achieved in weeks 6 to 13, since high protein intakes were apparent throughout and a negative energy balance was present only in the early weeks of the challenge.

Body fluid retention and electrolyte balance by a formulated drink based on the electrolyte composition of milk

Ishihara, K

Dept. of Human Nutrition, Sugiyama Jogakuen University, Japan.

Milk is an effective-post exercise rehydration drink that maintains the net positive fluid balance. Recent studies revealed that milk protein exerted its effect on body fluid retention. On the other hand, the electrolyte composition of milk differs substantially from that of common sports drink and milk contains much higher level of potassium. We assessed the effect of a formulated drink based on the electrolyte composition of milk (MES) on body fluid retention, gastric emptying and electrolyte balance. MES and water were administered to male Wistar rats at a dose of 10 ml/kg body weight after 24 h of dehydration. Total body fluid retention was assessed by urine volume 2 h after administration of hydration liquids. The rate of gastric emptying was evaluated by the fluid volume in the stomach. Plasma osmolality, Na and K levels, and urinary Na and K were measured by osmometry and ion sensor, respectively. The volume of gastric solution was 1.05 mL (35% of administered drink) in MES and was not different from that of water. Plasma osmolality in MES tended to be lower than that in water group ($P = 0.10$). Urine volumes differed among groups from 60 to 90 min after an administration ($P < 0.05$) with 0.03 and 0.60 mL from MES and water group, respectively. Cumulative sodium and potassium excretion during 2 h of rehydration period were not different between groups. Therefore cumulative sodium and potassium balance were positive in MES group and were negative in water group ($P < 0.05$). No diuretic effect was seen in MES though it contained a higher level of potassium. In conclusion, MES may be an effective rehydration drink because of its rapid gastric emptying rate, positive body fluid retention and positive electrolyte balance.

Nutritional intervention program in elite athletes: single-case design research with one professional basketball player

Bonfanti, N.; Lorenzo Calvo, A.

Sports Department, Faculty of Physical Activity and Sports Science, Polytechnic, University of Madrid, Spain.

The American College of Sports Medicine and the International Olympic Committee argue that sports performance is improved with optimal nutrition. However, scientific evidence shows that professional athletes do not perform adequate nutritional intake compared to recommendations. This work pursues two aims: a) describe the nutritional practices of one professional basketball player, b) carry out a long term nutritional intervention to adapt his diet to current recommendations. A single-case design study was conducted with one professional basketball player (centre) of the Spanish ACB League, healthy, English, 24 years, 111.4 Kg weight (W) and 2.11 m height. Dietary intervention (3 months on competitive phase) was employed regarding the individual dietary needs of the athlete as well as a pre and post sports nutrition knowledge survey (Reilly and Maughan 2007). Dietary intake was assessed with a pre and post 7-day food record. Anthropometric measures (ISAK) were taken before and after the intervention. Pre nutritional intervention, the mean total energy intake (TEI) was below the estimated total energy expenditure (TEE) (3980 vs. 4800 Kcal/day) and carbohydrates (CHO) intake was low in comparison with the recommendation for intermittent intensity sports (3.7 g vs.7-12 g/Kg W). Protein (P) intake was satisfactory (1.4 vs. 1.2-1.6 g/Kg W/day) whereas total fat (TF) intake was just at the maximum recommended value (35% vs. 20-35% of TEI) and saturated fatty acids intake (SFA) was above recommendation (11% vs. < 10% of TEI). Alcohol consumption was also excessive (43g vs. 20g ethanol/day). Post dietary intervention, TEI (4259 kcal) and CHO intake (5.1 g/Kg W/day) were improved, did not reach the recommendation. P intake remained unchanged (1.4 g/Kg W/day) and TF and SFA intake decreased to 26% and 8% of TEI respectively achieving the recommended values. Moreover, alcohol intake decreased to 10 g/day post-intervention. Furthermore, there was an improvement in nutrition knowledge but not statistically significant. A long term nutritional intervention is useful to improve nutritional practices of one professional basketball player. In future research, it will be necessary to prolong the intervention and analyze the relationship between the changes of nutritional practices with sports performance.

Comparison of ventilated hood indirect calorimetry and the SenseWear Armband for assessing energy expenditure

Alhussain, M; Taylor, M; and Macdonald, I

School of Life Science, University of Nottingham, UK

Effective estimation of energy expenditure (EE) is necessary when studying the relationships between physical activity, dietary intake and obesity. EE is typically estimated by indirect calorimetry (IC); a method in which an individual breathes under a Perspex ventilated hood. Gas analysers are used to determine the concentrations of inhaled and exhaled gases. From these values, an estimate of EE can be obtained. A non-invasive device called a SenseWear armband (SWA), has been developed to estimate EE which is more convenient and could be used in free-living subjects. The purpose of this study was to compare the EE estimate obtained using the ventilated hood method (EEIC) and a SWA, to determine the armband's accuracy. Data recorded by two SWA devices, one on an arm (EESWA,arm) and another on an ankle (EESWA,ankle), were compared to investigate whether limb movement is important in the estimation of EE. EE was measured during rest and light exercise by IC and SWA in 9 healthy women (age 28.1 (2.3 SD) years, BMI 25.6 (4.7) kg/m2). Two SWA devices (on an upper arm and an ankle) were worn simultaneously. Estimated EE from the SWA devices were compared with EE measured using IC (the criterion measure), both during 30 min of supine rest and then 60 min of intermittent supine, low intensity exercise. The SWA generally overestimated the resting EE (EESWA,ankle 1.09 (0.09), EESWA,arm 1.08 (0.09) vs. EEIC 0.85 (0.08) kcal/min) and underestimated EE during exercise (EESWA,ankle 1.05 (0.07), EESWA,arm 1.04 (0.07), vs. EEIC 1.17 (0.15) kcal/min). SWA and IC are not interchangeable approaches for assessing EE in healthy participants, and the SWA does not appear to be able to register small increases in EE with low level exercise.

Varying levels of energy deficit induce similar weight loss but different hormonal responses in women undertaking a 3-month exercise intervention

Koehler, K; De Souza, MJ; Williams, NI

Department of Kinesiology, The Pennsylvania State University, University Park, PA

Weight loss requires the induction of an energy deficit. However, an energy deficit is also associated with metabolic adaptations, including a reduction in resting energy expenditure (REE) and the suppression of metabolic hormones, which act to conserve energy and to minimize weight loss. The study aim was to quantify the effects of varying levels of energy deficit on body weight and composition, REE, and hormones (leptin, ghrelin, IGF-1, triiodothyronine) in women undertaking a 3-month exercise intervention. Data from 25 young, healthy women participating in a randomized controlled trial was analyzed retrospectively. Supervised exercise was used to increase energy expenditure by 30% from baseline levels, and participants were randomly assigned to 1) a balanced diet (BAL), which included a 30% increase in EI, 2) a moderate energy deficit (MOD), which was attained by maintaining EI at baseline levels, or 3) a severe energy deficit (SEV), which was attained by reducing EI by 30%. Weight, body composition, REE, and fasting hormone concentrations were assessed before, during, and after the study. Mean energy deficits were 850±220 kcal/day (SEV), 418±183 kcal/d (MOD), and -57±113 kcal/day (BAL). Over the 3-month period, body weight decreased in all conditions ($p<0.05$). Weight loss was greater in MOD (2.7±2.1 kg) and SEV (3.6±2.7 kg) than in BAL (1.1±2.7 kg; $p<0.05$), but not different between MOD and SEV ($p=0.22$). Fat loss (SEV: 2.6±2.2 kg, MOD: 2.2±1.7 kg; BAL: 1.1±1.6 kg) was not different between conditions ($p=0.22$). Leptin decreased only in MOD (-4.4±6.0 ng/mL; $p<0.05$ vs. baseline), while total ghrelin (+271±210 pg/mL; $p<0.05$ vs. baseline) and total T3 (-14.1±14.0 ng/dL; $p<0.05$ vs. baseline) were altered in SEV. Fat-free mass, REE, and IGF-1 did not change in any condition. The results indicate that weight loss is not proportional to the size of the energy deficit in young, exercising women, which could be related to differences in the hormonal response to the imposed energy deficit.

The effect on serum osmolality following high intensity intermittent exercise when access to *ad libitum* water intake was permitted, not permitted or delayed

Stephen A Mears, Phillip Watson, Susan M Shirreffs

School of Sport, Exercise and Health Sciences, Loughborough University, Loughborough, LE11 3TU, UK

Following a period of high intensity intermittent exercise (HIIE), serum osmolality increases and usually results in sensations of thirst. The resulting desire to drink is often satiated by *ad libitum* water intake during an ensuing recovery period, however during this period the contribution to reduced serum osmolality levels by voluntary water intake or reduced blood lactate concentrations is unclear. The aim was to examine serum osmolality following HIIE when *ad libitum* water intake was permitted, delayed or not permitted. Twelve males (26 ± 4 y, 80.1 ± 9.3 kg, 1.81 ± 0.05 m, O_{2peak} 60.1 ± 8.9 ml.kg^{-1}.min^{-1}) participated in three trials (7–14 days apart). Subjects sat for 30 min then completed an exercise period (20 x 1 min at 100% VO_{2peak} with 2 min rest) followed by 60 min of recovery in which *ad libitum* water intake was permitted (W), permitted for only the final 30 min (W30) or not permitted (NW). Body mass was measured at the start and end of the trial. Blood lactate, serum sodium, vasopressin and aldosterone concentrations, serum osmolality and sensations of thirst and mouth dryness were measured at baseline, post-exercise and during the recovery period. Plasma volume changes were calculated relative to baseline. Body mass loss was different between all trials (W: 0.25 ± 0.45, W30: 0.49 ± 0.37, NW: 1.29 ± 0.37%) ($p<0.05$). Total voluntary water intake was greater in W (0.846 ± 0.417 v 0.630 ± 0.277 l) ($p<0.05$) but was similar during the first 30 min period of allowed drinking (0.618 ± 0.297 v 0.630 ± 0.277 l) ($p>0.05$). Serum osmolality (299 ± 6 v 298 ± 5 v 298 ± 3 mOsmol.kg^{-1}), blood lactate (7.1 ± 1.1 v 7.2 ± 1.1 v 7.1 ± 1.2 mmol.l^{-1}), serum sodium (142 ± 2 v 145 ± 2 v 145 ± 2 mmol.l^{-1}), vasopressin (8.27 ± 2.61 v 7.17 ± 2.25 v 7.13 ± 2.16 pg.ml^{-1}) and aldosterone concentrations (1229 (106-4001) v 652 (91-4503) v 1326 (113-4967) pg.ml^{-1}) peaked post-exercise (W v W30 v NW) ($p<0.05$) but were not different between trials ($p>0.05$). Sensations of thirst and mouth dryness decreased in W and W30 following water ingestion ($p<0.05$). Plasma volume had been restored to baseline by 15 min after exercise in each trial. A combined effect of reduction in blood lactate and serum sodium concentrations, restoration of plasma volume and voluntary water intake contributed to the similar decrease in serum osmolality throughout the recovery period.

The effect of glucose and fructose ingestion on gastric emptying, appetite and blood biochemistry

Gethin H Evans[1], Daniel Watkinson[1], Adora Yau[1], Emma Derbyshire[1], John McLaughlin[2] and William Gilmore[1]

[1] School of Healthcare Science, Manchester Metropolitan University, Manchester M1 5GD. [2] Institute of Inflammation and Repair, University of Manchester, M13 9PT

Fructose solutions empty from the stomach at a faster rate than glucose solutions and result in smaller rises in blood glucose and insulin concentrations as well as a rise in circulating triglyceride concentration. It has been suggested that appetite response to glucose and fructose ingestion may be different and this may partly explain the correlation observed between change in dietary fructose intake and prevalence of obesity. Previous studies have shown little difference in appetite response but have focussed on the ingestion of fructose in liquid form rather than in semi-solid or solid form, with the latter thought to be more satiating. Seven healthy males completed three experimental trials, completed in a random order, that involved the ingestion of 40 g of porridge oats mixed with 300 g semi-skimmed milk (CON), with the addition of 40g of glucose (GLU) or fructose (FRU). Subjective feelings of hunger were assessed at ten minute intervals for 120 minutes after ingestion. Gastric emptying was assessed via C^{13} breath analysis. T_{half} was (mean ± SD) 159 ± 51, 197 ± 46 and 198 ± 67 minutes ($P = 0.117$) and T_{lag} was 78 ± 21, 88 ± 26 and 89 ± 23 minutes ($P = 0.076$) for the CON, GLU and FRU trials respectively. Blood glucose was elevated ($P < 0.05$) 20 minutes after ingestion of both GLU and FRU with the magnitude tending ($P = 0.073$) to be greater on GLU compared to FRU. Blood lactate concentration was greater ($P < 0.05$) on FRU compared to CON at all time points after ingestion and greater than GLU 60 minutes after ingestion. No difference ($P > 0.05$) in circulating triglycerides or subjective feelings of hunger were observed. While not statistically significant, data suggest that the addition of glucose or fructose to a semi-solid meal reduces gastric emptying rate to a similar extent. The addition of fructose does not appear to negatively affect subjective feelings of hunger, however, additional data should be collected to confirm this conclusion.

Carbohydrate and performance: a dose response investigation in the 20 – 64 g.h^{-1} range

M L Newell[1], A M Hunter[1], K D Tipton[1], C Lawrence[2] and S D R Galloway[1]

1 Health and Exercise Sciences Research Group, University of Stirling, Scotland

2 GlaxoSmithKline Nutritional Healthcare, England

Recent studies have examined the dose-response effect of ingesting a carbohydrate (CHO) drink on exercise performance, with optimal performance from single source CHO suggested to occur at doses around 60 g.h^{-1}. However, the evidence for a dose-response in the 20-64 g.h^{-1} range is still unclear. We aimed to investigate the dose-response of CHO in a dose range where the largest improvements in performance have been reported. In an investigator-blind, randomised cross-over design, male cyclists and triathletes (n=20) mean (±SD), age 34 (± 10) y, mass 75.8 (± 9) kg, and peak power output 394 (± 36) W, completed two familiarisation trials then four experimental trials. Participants were unaware of which treatment they received or the CHO content in each treatment. Each trial consisted of a 2 h constant load ride (185W ± 25W) followed by a work-matched time trial task (531 ± 48 kJ). Three commercially available CHO beverages, plus a control (water), were administered during the 2 h ride providing participants with 0, 20, 39 or 64 g CHO/h at a fluid intake rate of 1 L.h^{-1}. Performance was assessed by time to complete the time trial task and mean power output sustained. Pacing was assessed by examining 10% completion segments throughout the performance task. Mean task completion time (min:s ± SD) for 39 g.h^{-1} (34:19.5 ± 03:07.1, p=0.006) and 64 g.h^{-1} (34:11.3 ± 03:08.5 p=0.004) CHO solutions were faster than control (37:01.9 ± 05:55.0). The mean percentage change from control was -6.1% (95% CI: -11.3 to -1.0) and -6.5% (95% CI: -11.7 to -1.4) in the 39 and 64 g.h^{-1} trials, respectively. The 20 g.h^{-1} (35:17.6 ± 04:16.3) treatment did not reach statistical significance (p=0.126) compared to control despite a mean change of -3.7% (95% CI -8.8 to 1.5%). Mean response in power output mirrored that of the performance time response. There was no interaction between CHO dose and pacing strategy, although the greatest differences between trials occurred later in the performance task. The present study observed that 39 and 64 g.h^{-1} of CHO were similarly effective at improving endurance cycling performance compared to a 0 g.h^{-1} control. Future work will provide insight into the metabolic basis for individual differences in performance with increasing doses of CHO. This work was funded by GlaxoSmithKline Nutritional Healthcare.

Effects of creatine and sodium bicarbonate co-ingestion on power output during repeated Wingate tests in trained men

Griffen, C[1].L; Rogerson, D[1]; Ranchordas, M.K[1]

[1]Sheffield Hallam University, Academy of Sport and Physical Activity, Faculty of Health and Wellbeing, A220 Collegiate Hall, Collegiate Crescent, Sheffield, UK, S10 2BP

The purpose of this study was to investigate the effects of creatine and sodium bicarbonate (NaHCO3) co-ingestion on power output during repeated Wingate tests. Ten well-trained men (age = 21.6 ± 0.9 y, stature = 1.82 ± 0.05 m, body mass = 80.1 ± 12.8 kg) participated in a randomised, double-blinded, crossover, counterbalanced study. Participants completed six 10-s repeated Wingate tests following supplementation of placebo (0.5 g.kg-1 maltodextrin), creatine alone (20 g.d-1 creatine + 0.5 g.kg-1 maltodextrin), NaHCO3 alone (0.3 g.kg-1 NaHCO3 + 0.5 g.kg-1 maltodextrin) and combined creatine and NaHCO3 (20 g.d-1 creatine + 0.3 g.kg-1 NaHCO3 + 0.5 g.kg-1 maltodextrin) for 7 d, with a 7 d washout period between each. Peak power (PP), mean power (MP), relative peak power (RPP), relative mean power (RMP) and fatigue index (FI) were measured during each test. A two-way repeated-measures factorial MANOVA reported no significant ($V = 2.070$, $F(100, 96) = 1.029$, $p = 0.444$, $\eta^2 = 0.517$) combined variable interaction between conditions. Univariate ANOVAs also reported no differences in PP ($F(8.821, 99.249) = 0.764$, $p = 0.648$), MP ($F(7.642, 85.974) = 0.898$, $p = 0.519$), RPP ($F(11.163, 125.587) = 0.872$, $p = 0.571$), RMP ($F(9.951, 111.951) = 0.606$, $p = 0.606$) or FI ($F(16.315, 183.542) = 1.071$, $p = 0.386$). In conclusion, co-ingestion of creatine and NaHCO3 failed to improve power output during Wingate tests. Further research must be conducted before the efficacy of combined supplementation can be made.

Weight management with a gene-based diet

H. Kellner1, S.D. Müller2

[1]Romanstr. 9, D-80639 Munich. [2]Center and Surgery for Nourishing Communication, Dietary Advice and Health Journalism, Ostheimer Straße 27d, D-61130 Nidderau.

The evidence of all genetic variations associated with body weight, body mass index (BMI) or body fat was reviewed to see whether it was possible to identify genes that could be used to set up a gene-based weight control program. Five variants in a total of four genes met all the required criteria: 1. Fatty acid binding protein 2 is involved in the absorption of lipids in the small intestine and particular polymorphisms. This is the mechanism whereby variant Ala54Thr is believed to be associated with increased BMI and body fat. 2. Peroxisome proliferator-activated receptor-gamma has a pivotal role in the differentiation of human fat cells and expression of fat cell-specific genes. Variant Ala12 results in a reduction in the transcriptional activity of PPARG-γ. Clinical studies compared carriers of the 12Pro/Pro genotype with the Ala12 type. The former were more affected by the amount of lipid in the diet and had a direct association between higher BMI and the amount of fat intake as opposed to the Ala12 individuals. 3,4. Beta-2 adrenergic receptor gene product is also a component of human fat cells. It affects the hormone-driven mobilization of lipids/fat for energy, which is sensitive to the changing level of catecholamines. Two variants, the Arg16Gly and the Gln27Glu allele, are a matter of scientific interest because they are the most common in Caucasians and possess the most positive associations of all variations of the ADRB2 locus with overweight. Studies showed excessive weight gain when exposed to long-time overfeeding on a high carbohydrate diet. 5. The beta-3 adrenergic receptor protein is expressed in visceral adipose tissue. A variant in this gene has been identified and may be linked to lower lipolytic activity accounting for lipid accumulation in adipose tissue. Arg64 carriers have a higher risk of becoming overweight, but only leading a sedentary lifestyle. The metabolic consequences of these 5 SNPs differ profoundly. Researchers have identified 3 groups with different responsiveness to a certain type of diet: responsiveness to fat restriction or low fat diet; responsiveness to carbohydrate restriction or low carb diet; responsiveness to a balance of fat and carbohydrates in a hypoenergetic diet. They have also identified genetic variants that are particularly responsive to exercise.

Effect of vitamin D supplements on vitamin D status and muscle strength among well trained students

C Helle[1], A Baumann[2], H Wiig[3], O Rønsen[1], L Frost Andersen L[2], T Raastad[3]

[1]The Norwegian Olympic Training Center, Oslo. [2]Department of Nutrition, University of Oslo. [3]The Norwegian School of Sport Sciences, Oslo

Suboptimal vitamin D (25(OH)D) status may decrease muscle function and strength, and athletes are therefore recommended serum 25(OH)D>75 nmol/L. The purpose of this study was: 1) to determine the effect of a daily vitamin D3 supplement of two different doses on 25(OH)D level of well trained students with low-moderate 25(OH)D; and 2) to examine the effect of supplements on the students' muscle strength. Seventy-one students were screened for serum 25(OH)D in December, those with lowest levels were recruited to the study. At start 51 participants were randomly assigned to daily vitamin D3 supplements of 76 µg (LOW), 152 µg (HIGH) or placebo (PLA). Forty-four participants (28±5 years) completed 8 week supplement intervention in January and February, in the group LOW (n=15, 10 women; 5 men), HIGH (n=15, 8 women; 7 men) and PLA (n=14, 11 women; 3 men). Blood samples were analyzed for 25(OH)D, PTH, calcium, phosphate, creatinine, testosterone and SHBG at start, 4 and 8 weeks. Body composition was measured by DEXA scan, and vitamin D intake was calculated from food frequency questionnaire. Muscle strength was measured at start and 8 weeks by the following tests: one repetition maximum in bench and leg press; and maximal isometric strength in knee extension measured at 100 and 300 milliseconds, and the highest force recorded throughout the contraction. At start 25(OH)D levels (mean±SD) were 55±13 nmol/L (LOW), 53±15 (HIGH) and 52±14 (PLA). After 4 and 8 weeks respectively 25(OH)D levels were 91±21 and 91±20 nmol/L (LOW), 130±32 and 126±18 (HIGH) and 53±15 and 42±14 (PLA), (p <.001, ANOVA). There was a tendency to a faster increase in 25(OH)D among women compared to men. The participants' relative dose of vitamin D (dose/bodyweight) correlated strongly with increase in 25(OH)D after 4 weeks (p =.000). There were no changes in muscle strength between the groups after 8 weeks, but there was an increase in bench press (p =.005) and leg press (p =.037) within the LOW group. The lower relative dose of vitamin D among women may explain the tendency towards a faster increase in 25(OH)D among them. We found that a daily supplement of 76 µg vitamin D3 for 4 weeks was adequate to obtain a 25(OH)D level>75 nmol/L. In this study the vitamin D supplements did not affect the muscle strength of well trained students.

The effect of short-term dietary supplementation with fructose on gastric emptying of glucose and fructose and associated gut hormone responses

Adora Yau[1], John McLaughlin[2], Ronald J. Maughan[3], William Gilmore[1] and Gethin H. Evans[1].

[1]School of Healthcare Science, Manchester Metropolitan University, M1 5GD, UK. [2]Institute of Inflammation and Repair, University of Manchester, M13 9PT, UK. [3]School of Sport, Exercise and Health Sciences, Loughborough University, LE11 3TU, UK.

Large quantities of fructose in the diet and over-consumption of sugary foods and beverages is suggested to contribute to the development of the metabolic syndrome and obesity epidemic. Previous work in our laboratory has shown a monosaccharide specific acceleration of gastric emptying rate of fructose solutions following 3 days dietary supplementation with fructose. This study examined the associated gut hormone responses to this. Ten healthy males completed four experimental trials in a randomised crossover design; fructose with supplementation (FS), fructose with water control (FC), glucose with supplementation (GS) and glucose with water control (GC). Supplementation involved the consumption of four 500mL solutions each containing 30g fructose per day for 3 days prior to the experimental trial. Gastric emptying of the test solutions was assessed over 60 min using the [^{13}C]acetate breath method. Blood was collected at regular intervals and the serum concentration of acylated ghrelin (GHR), active glucagon-like peptide-1 (GLP-1), glucose dependent insulinotropic hormone (GIP), insulin, and leptin determined. Gastric emptying rate of fructose was accelerated with fructose supplementation (mean±SD; T½ FC 59±13 vs FS 51±10 min, P<0.01; Tlag FC 37±10 vs FS 32±7 min, P<0.05). Gastric emptying of glucose was not different (T½ GC 75±18 vs GS 68±16 min, P=0.245; Tlag GC 38±7 vs GS 40±7 min, P=0.679). No differences in mean GHR, GLP-1, insulin or leptin area under curve (AUC) were found for either fructose or glucose ingestion and their respective supplement trials. However, a trend for greater GIP AUC was observed for GS compared to GC (2267±983 vs 2044±984 pg/ml 1h, P=0.072). GIP was higher at 60 min for GS compared to GC (35±17 vs 29±14 pg/ml, P<0.05). In addition, a trend of greater GHR concentration was observed at baseline for FS compared to FC (175±82 vs 157±77 pg/ml, P=0.089) and GHR concentration for GS was greater than GC at 10 min (177±63 vs 155±59 pg/ml, P<0.05). This data suggests accelerated emptying rate of fructose following increased fructose in the diet may be due in part to elevated baseline ghrelin concentration which is not counteracted by an increase in GIP as seen with glucose ingestion. Further work on the subsequent effects on food intake should be investigated.

The influence of hydration status during prolonged endurance exercise on salivary antimicrobial proteins

Sophie C Killer, Ida S Svendsen and Michael Gleeson

Several antimicrobial proteins (AMPs) in saliva including secretory immunoglobulin A (SIgA), lysozyme (SLys) and lactoferrin (SLac) are important in host defence against oral and respiratory infections. The aim of this study was to investigate the effects of hydration status on saliva AMP responses to prolonged endurance exercise. Using a randomized design, 10 healthy male participants (age 23±4 y, body mass 73.8±7.4 kg, VO_2max 56.8±6.5 ml/kg/min) completed 2 h cycling at 60% VO_2max in states of euhydration (EH) or dehydration (DH) induced by 24 h fluid restriction. Timed unstimulated saliva samples were collected before, during and immediately post-exercise and each hour for 3 h recovery. Baseline body mass was determined over 3 consecutive days prior to the first trial. Fluid restriction resulted in a 1.5±0.5% loss of body mass from baseline and a 4.3±0.7% loss immediately post-exercise. Pre-exercise urine osmolality was elevated in DH compared to EH (958±134 vs 721±237 mOsm/kg; $p = .025$). Heart rate and perceived exertion were higher throughout exercise in DH compared to EH. Saliva flow rate was reduced in DH compared to EH. Baseline SIgA secretion rates were not different between conditions, but exercise induced an increase in SIgA concentration in DH (161 ± 134 to 309 ± 271 mg/L; $p < .05$) but not EH and remained elevated throughout 3 h recovery. There was an increase in SLac secretion rate from pre- to post-exercise in both conditions (1.2 ± 1.2 to 3.2 ± 3.0 µg/mL and 1.7 ± 1.7 to 4.2 ± 1.8 µg/mL for DH and EH, respectively) which remained elevated in DH but returned to baseline by 1 h post-exercise in EH. Overall, SLac concentrations were higher in DH than EH ($p = .021$). Pre-exercise SLys concentration was lower in DH compared to EH (1.2 ± 1.6 vs 5.5 ± 6.7 ng/mL; $p < .05$). Exercise elicited an increase in SLys secretion rate in both conditions. Post-exercise SLys concentrations remained elevated from baseline in DH whereas concentrations in EH returned to baseline by 1 h post-exercise. Exercise in DH caused a reduction in saliva flow rate yet induced greater secretion rates of SLac and higher concentrations of SIgA and SLys. Thus, DH does not impair saliva AMP responses to endurance exercise.

Surgeon General's armed forces feeding project: changes in vitamin D during a summer operational deployment (pilot study)

J.L. Fallowfield[1], S.K. Delves[1], S.A. Lanham New[2], R. Cobley[1], V.R. Nevola[3], N.G. Verral[3], F. Gunner[1], A.J. Allsopp[1]

[1]Institute of Naval Medicine, Alverstoke, Gosport, Hants., PO12 2DL, UK, [2]Nutritional Sciences Department, University of Surrey, Guildford, GU2 7XH, UK. [3]DSTL, Porton Down, Salisbury, UK.

Understanding the nutritional demands of soldiers is critical to inform physical training and food provision. British soldiers during a 6-month deployment to Afghanistan face austere living and arduous working environments. This pilot study investigated changes in body composition, physical fitness, energy intake (EI), energy expenditure (EE), micronutrient and vitamin D status in ($n = 88$) male soldiers assessed Pre-, Mid- and Post-Deployment. Body size and composition were estimated from body mass, height, girth and skinfold measurements. Physical strength (dynamometry) and aerobic fitness (MSFT) were measured. EI was assessed from bespoke food diaries, and EE estimated using accelerometers and Task Analysis Questionnaires. A blood sample was drawn to assess serum micronutrient and vitamin D status. Mean (SD) body mass decreased between Pre vs. Mid (80.7 (13.2) vs. 74.7 (11.6) kg; $P < .05$), mainly due to fat loss. Body mass partially recovered (+2.4 (2.0) kg) between Mid and Post. Lean mass decreased initially before increasing between Mid and Post ($P < .05$). Daily EI during deployment (~2100 kcal) was lower than EE ($P < .05$), where the estimated EE of frontline soldiers could exceed 4000 kcal.day^{-1}. However, despite body mass loss, aerobic fitness (Pre vs. Post VO_{2max} 45.6 vs. 43.6 ml.kg^{-1}.min^{-1}) and strength were well-maintained. Micronutrient (Mg, Cu, Se, Zn) status changed during the first half of the deployment (Zn increased 15% (12.7 vs. 14.7 mmol.l^{-1}), Se decreased 12% (1.01 vs. 0.91 µmol.l^{-1}); $P < .05$); concentrations remained stable thereafter. Serum 25-hydroxyvitamin D (as a marker of vitamin D) increased 3-fold in (n=37) matched volunteers Pre to Mid (March–June: 51 (20) vs. 212 (85) nmol.l^{-1}; $P < .05$), decreased during leave ($P < .05$), and decreased further between Mid to Post (October: 152 (50) nmol.l^{-1}; $P < .05$). At Pre, 100% of volunteers were suboptimal in vitamin D for bone health (<50 nmol.l^{-1}), with 78% being deficient (<25 nmol.l^{-1}). By Mid 16% were suboptimal, increasing to 30% at Post. In conclusion, current nutritional provision for deployed UK soldiers appeared sufficient to maintain physical capability and nutritional status. However, the marked fluctuations in vitamin D before and during an operational deployment warrant further investigation.

Can beetroot juice supplementation reduce muscle soreness and enhance recovery?

A Mcneilly, L Kleiner

Sport and Exercise Sciences Research Institute, Ulster Sports Academy, University of Ulster, Belfast, Northern Ireland.

The effectiveness of the recovery process after high intensity exercise is reflected in subsequent athletic performance. Insufficient recovery can exacerbate the symptoms of overreaching such as; reduced performance capacity, altered mood status and increased ratings of perceived exertion especially reflected during periods of intensified training. The aim of this pilot study was to examine whether beetroot juice could reduce muscle soreness post exercise. 7 well trained distance runners were recruited to take part in the study. After 1 week washout all participants received 14 days Beet it sports shots (James White Drinks, UK) providing a dietary nitrate intake of 13 – 14.4 mmol/day. Blood pressure and blood lactate concentration were measured prior to and following training sessions for 3 consecutive weeks. Muscle soreness questionnaires were completed 48 hours after training. A significant reduction in muscles soreness was observed after beetroot juice supplementation, ($F(2,10) = 12.647$, $p < .002$) over the 3 weeks, between week 1 and week 2 ($p < .025$) and between week 1 and week 3 ($p < .003$). A significant reduction in diastolic blood pressure was also observed at 15 minutes after training ($F(2,10) = 4.169$, $p < .048$) particularly between weeks 2 and 3 ($p < .062$). Beetroot juice was found to have no significant effect on systolic blood pressure, lactate, mean arterial pressure or heart rate at any time-point. Results indicate in this population, that consumption of concentrated beetroot juice may be effective in reducing muscle soreness following intense exercise, without having an effect on other markers of recovery such as lactate and vascular health.

Effect of a carbohydrate-electrolyte beverage on blood lactate level of Indonesian elite canoeing athletes

Muhamad Hisbullah Amrie[1], Zainal Abidin[2]

[1]Department of Nutrition and Public Health, Faculty of Public Health, Universitas Indonesia, Indonesia. [2]Chief of Sport Science and Technology, Indonesia National Committee of Sport, Indonesia

A high level of blood lactate is believed to be one cause of fatigue among athlete in Indonesia. It triggers the sensation of fatigue from nervous system and it is also known that lactic acid can cause muscular pain that leads to discontinuation of activity. This research investigated the effect of carbohydrate-electrolyte beverage on the blood lactate level of Indonesian elite canoeing athletes. This study recruited 28 male Indonesian elite canoeing athletes (*M* ± *SD* age 22 ± 2 y; body mass index 24 ± 2 kg/m^2) in a pretest-posttest control group design, divided to experiment group (EG) and control group (CG) by random assignment. EG consumed 1 liter of electrolyte-carbohydrate beverage consisting 6% of glucose: meanwhile CG consume electrolyte-carbohydrate beverage consisting 3% of glucose in the same quantity. Both beverage contained electrolytes (Na^+, K^+, Ca^{2+}, Mg^{2+}, and Cl^{-}) at concentrations similar to those in sweat. Blood lactate measurement was conducted before 10 km water paddle training, after water paddle training but before experiment, and 30 minutes after consuming 1 liter of beverage. The difference of blood lactate level and blood lactate decrease in both groups was analyzed by independent T-test. No difference of blood lactate level before and after training on both groups was observed, but there was a difference of blood lactate level after consuming beverage (EG 6.0 ± 0.9 mmol/L; CG 7.1 ± 1.6 mmol/L) and a difference of blood lactate decrease in both groups (EG 3.2 ± 0.3 mmol/L; CG 1.9 ± 0.3 mmol/L). Carbohydrate-electrolyte beverage has a positive effect to decrease acute blood lactate level at the end stage of training from the Cori Cycle by promoting gluconeogenesis in liver cell to transform lactate into glycogen.

Nutrient density in athletes: adjusting nutrient intake to energy intake

N. R. Hoerner[1,2], H. Braun[1,2], W. Schaenzer[1], K. Koehler[3]

[1]Institute of Biochemistry, German Sport University, Cologne, Germany. [2]German Research Centre of Elite Sports, German Sport University, Cologne, Germany. [3]Department of Kinesiology, Women's Health and Exercise Laboratory, The Pennsylvania State University, University Park, PA, USA

It is well known that athletes require more energy than sedentary individuals. It is generally believed that athletes also have an increased micronutrient (MN) demand, but to date there are no MN recommendations available for athletes. One way to account for the typically greater food intake in athletes is to express MN intake relative to energy intake (EI). The purpose of this study was to correlate MN intake in athletes with and to assess differences in MN density between male and female athletes and between sport categories. Dietary data was collected in 102 young athletes (female: 56; male: 46; 15.7 ± 2.9 years) competing on national or international level. Athletes documented their nutrition using a standardized 7-day food record, and nutrient intake was analyzed by standard software (Ebispro 7.0; University of Hohenheim, 2007) and statistical analysis was performed using SPSS (version 21, 2013). Correlation analysis showed that only few MN were significantly correlated with EI. Correlation coefficients (r) varied between 0.38 (vitamin C) and 0.89 (iron). No significant correlation between MN intake and EI was found for biotin, vitamins B12 and C, potassium, and calcium. MN density was higher ($p < .05$) in female than in male athletes for vitamins A (609 ± 392 vs. 415 ± 208 µg/1000 kcal), D (1.1 ± 1.1 vs. 0.6 ± 0.4 µg/1000 kcal), E (6.5 ± 1.7 vs. 5.6 ± 1.5 mg/1000 kcal), and C (77 ± 45 vs. 56 ± 27 mg/1000 kcal), and for calcium (569 ± 245 vs. 477 ± 187 mg/1000 kcal). There were no differences in the nutrient densities between female and male athletes for vitamins K, B1, B2, B6, B12, niacin, folic acid, and sodium, potassium, phosphate, magnesium, iron, and zinc. Two-way ANOVA revealed no differences in MN density between sport categories (game sports, endurance sports, weight-class sports, and other sports) for any nutrient. These results demonstrate that the intake of most MN is only moderately related to EI, indicating that MN intake is not automatically increased in athletes with high EI. Based on the lower nutrient densities observed in male athletes, future recommendations in athletes should not only address increased energy and macronutrient requirements but also MN intake.

The effect of fish oil (FO) and exercise on heart rate (HR)-a meta analysis of randomised controlled trials

Wakeman M;

The Orchards, Fenny Bentley DE6 1LB

FO reduces HR by reducing membrane electrical excitability of the cardiac monocyte by lowering its resting membrane potential and the duration of the refractory period through inhibition of ion channels. Research shows FO improves cardiovascular efficiency through enhanced stroke volume and cardiac output responses. This may be due to attenuation of sympathetically induced vasoconstriction and/or augmentation of vasodilatation in skeletal muscle during exercise, enhancing oxygen delivery and improving functional capacity. A search of randomised controlled trials identified over 200 articles evaluating the effect of FO on HR, of which 7 specifically addressed the issue of response to exercise and 5 were deemed suitable for inclusion in this meta-analysis. In the overall pooled estimate FO plus exercise decreased HR by 2.5 beats per minute (BPM) (95% CI 2.14 to 2.8; $P < .05$) compared to heart rate measurements at the commencement of each trial. This compares with a meta-analysis of the effect of FO alone on HR which demonstrated a decreased HR of 1.6 BPM compared with placebo. Trials included in this meta-analysis show FO supplementation produced HR reductions in well trained male cyclists both at rest and at peak work load. Similarly FO reduced HR during exercise in a in a group of Australian rules players. Investigations examining the effects of FO and exercise demonstrated a dose dependent decrease in HR as FO supplementation increased from 2g/day to 6g/day. FO does not appear to alter HR or heart rate variability response to exercise onset, but provokes a more rapid decline in HR (faster recovery) following termination of exercise. Further, FO acts within the healthy heart and skeletal muscle to reduce both whole-body and myocardial oxygen demand during exercise without a decrement in performance.

The role of dietary intake on incidence of illness in elite rugby union players during preseason.

Charlesson B[1], Trainor J[2], McQuaid S[2], Mahony L[1], McNeily A[2]

[1]Performance Science, Sports Institute Northern Ireland. [2]Ulster sports Academy University of Ulster.

Illness and infections can be significant in some illness prone athletes. This often leads to the disruption of the training schedule and may prevent the athletes from achieving their full training potential during that phase. In Rugby Union this disruption is often seen during the initial preseason training phase. The importance of dietary intake during intense training is well documented to ensure athletes have adequate energy to train, adapt and recover. There is also some evidence linking nutrient intake to incidence of injury and illness rates and it is suggested that an inadequate macro or micronutrient intake may blunt the immune system. The purpose of this study was to investigate the relationship between the dietary intake and incidence of illness during preseason in elite rugby union players. 93 professional rugby union players participated in the study, age: 24 ± 7years; height: 184 ± 6cm; weight: 98.5 ± 25kg. The study monitored dietary intake using a 3 day food diary and illness incidence rates were collected using a validated questionnaire (Cunniffe et al., 2010). Data were collected over a 4 week preseason training block during 2 pre seasons. Participants were divided into three groups according to duration and severity of illness; Group 1 no illness, Group 2 mild illness, Group 3 severe illness. The average incidence of illness was 24% with 35 participants reporting at least one illness incidence over the 4 week period. Of those 35, 18 reported symptoms lasting for 2 or more weeks. 6 participants reported illness for ≥3 weeks. Results showed no differences in the food intakes between groups. There was, however, a trend towards lower vitamin C intakes in those reporting illness (154.8, 129.7 and 138.9mg/day respectively). Total carbohydrate and energy intake appeared low in all 3 groups (2.6, 2.6, 2.7 g/kg body mass; 25.5,25.8,26.2kcal/kg respectively) and suggests under reporting was an issue in this study. In conclusion, the reported illness incidence is comparable to other studies in the area. No relationships were evident between nutrient intake and illness incidence but it is likely that errors in dietary intake reporting may have contributed to this. Further research is required to provide clarity on the role of diet in optimal health in elite athletes.

Novel encapsulation technology for oral delivery of creatine monohydrate

Doherty S.B and Kickham, J.

Future Nutrition Ltd. Railways Stores, Templeshannon, Enniscorthy, Co. Wexford, Ireland.

Creatine is a naturally occurring amino acid-like compound generated in the liver, kidneys and pancreas from the essential amino acids arginine, glycine and methionine. In humans, over 95% of the total Creatine content is located in skeletal muscle. For example, a 70 kg male possess approximately 120 g of total creatine with a daily turnover estimated to be around 2 g. Part of this turnover can be replaced through exogenous sources of Creatine in foods, including meat, fish and poultry. In its phosphorylated intracellular form as Creatine phosphate, it provides the high energy phosphate for adenosine triphosphate, commonly known as ATP. However, uptake of Creatine from the intestine and transport into the target muscles is limited due to Creatine solubility in beverage formulations and stability in aqueous solution and subsequent uptake from the intestine and transport into the target muscle tissue. For this purpose, encapsulation and stabilization of Creatine monohydrate was the object of the present study for targeted oral delivery of bioavailable Creatine to the human muscle. In this way, encapsulation technology could potentially prevent the breakdown of Creatine to Creatinine and improve Creatine uptake from the intestine to the muscle.

A 7-day randomised control trial was preformed involving adminstration of Encapsulated Creatine supplementation (0.3g/kg body weight) to a large group of physicially active men (20-36 subjects) aged between 18-30 years (weight 83.2 ± 8.2kg). Full body composition (iDEXA), dietary and exercise analysis, muscle biopsies and blood kinetics were performed to evaluate blood and muscle Creatine concentrations, excretion and possible conversion to Creatinine. In the Creatine-supplemented group, serum Creatine, total muscle Creatine / PhosphoCreatine and body mass were increased after 7-day loading period. No difference was observed for urinary Creatine, Creatinine, after 7-day loading period. Relative to placebo, ingestion of Encapsulated Creatine provided a mean peak concentration at 30-60 minutes of 123 ± 3 umol/L. Furthermore, muscle Creatine increased by 105 mmol/kg (Dry Mass) after 7-day loading compared to the placebo. The results generated by this study suggest that encapsulation technology can improve stability and bioavailability of oral Creatine supplementation in well-trained athletes.

Identifying sub-optimal diets among athletes - a pilot study for validation

Parsonage, SR

Department of Human and Health Sciences, University of Westminster, 115 New Cavendish Street, London W1W 6UW, UK:

The ability to identify athletes most in need of nutritional support is important, but time and cost often preclude all team or club members having access to a full dietary analysis based on a detailed food intake record. Making a "global" assessment of an athletes' status, i.e. physical, mental, and nutritional, demanded the creation of a rapid method of assessing current nutritional intake. Anthropometric measures such as BMI or body composition indicate past, rather than present, nutritional status so a food frequency questionnaire format, combined with a 20 point "test" in which subjects simply had to indicate how many times a week, on average, each group of foods was consumed offered a chance for early identification of sub-optimal diets. In this way the underlying inaccuracy of under-reporting was avoided, and the focus remained on the quality of the diet consumed, as expressed by a ratio of low energy/high nutrient density "good foods", versus high energy/low nutrient density "bad foods" consumed. In the initial study 331 students completed the assessment, and of these 34 (mean age 17 years) had full dietary analyses based on checked 3-day food diaries. Statistical analyses of these showed that there was a good correlation (R = 0.73, P <0.003) between overall diet quality and calcium intake. To further validate this method, and to see if the same relationship held good for athletes in different age ranges and sports, a group of 23 recreational runners were asked to complete the Diet Quality assessment and keep a detailed 3-day food diary for analysis. Their diet quality scores were, on average, "good", but this group only showed a weak correlation and non-significant with measured calcium intakes (R = 0.238, *P* = .275), the best relationship being a relatively weak correlation with % protein kcals (R = 0.454, *P* = .029). The conclusions are that (a) older athletes are appear to be more aware of their diet with nearly 40% scoring "excellent" and only 12% "sub-optimal, (b) the "good" and "bad" foods listed in the test may be more applicable to younger student-aged athletes, and (c) although a few showed dietary traits not ideal for endurance performance, most actually had a habitual diet good enough to support an active and healthy lifestyle.

Effect of aerobic fitness and physical activity on bone mineral density in lactating postpartum women

E M Kyle[1], B M Alexander[2], D E Larson-Meyer[1]

[1]Dept of Family and Consumer Science, University of Wyoming, United States. [2]Dept of Animal Science, University of Wyoming, United States

Bone mineral density (BMD) of the maternal skeleton is expected to decrease during lactation due to a high demand for calcium, and rebound following weaning. How postpartum physical activity influences changes in BMD as well as body weight/composition is not fully understood. The purpose of this study was to evaluate body composition and BMD in lactating postpartum women compared to age- and body mass index (BMI) matched, never-pregnant controls. Fifteen lactating women (26.2±5.3 y; 70.5 ±9.7 kg; BMI 25.3±3.4 kg/m^2; 38.9±6 % body fat) and 15 never-pregnant controls (26.1±5.7 y; 68.63 ±8.4 kg; BMI 24.4±3.2 kg/m^2; 35.3±5.7 % body fat) were followed for one year. Bone density and body composition were measured (DXA scan) at baseline (1 month postpartum), and at 6 and 12 months. Physical activity was estimated by Baecky questionnaire at these same time points. Maximal oxygen uptake ($V0_{2\ Max}$) was measured while walking/running on a treadmill at 12 months, and records of lactation status were kept throughout. At baseline, body weight, body composition and BMD were similar (*p*> .05) among lactating and never-pregnant controls. Similarly, $V0_{2\ Max}$ at 12 months averaged 37.6 ± 7.0 ml/kg/min and did not differ (*p* > .05) among groups. In lactating women, body mass, fat mass and body fat percentage decreased from baseline to 12 months postpartum (time effect, *p* ≤.03) but fat free mass did not change (*p* > .05). The change in percent body fat in lactating women was influenced by aerobic fitness (time × $V0_{2\ Max}$, *p*= .04) such that women with increased fitness at 12 months lost more body fat overall. BMD in the lumbar spine decreased over time (time effect, *p* = .03) with no signs of rebound at 12 months. Lactation did not influence BMD in the hip or total body (*p*> .05). The change in BMD in the lumbar spine was not influenced by $V0_{2\ Max}$ or reported physical activity, however, bone loss was influenced by a longer duration/greater frequency of lactation (time x lactation, *p*=0.007). Reported physical activity correlated (*p*< .05) with $V0_{2\ Max}$ at 6 (*r*=0.59) and 12 months (*r*=0.65) but not at baseline (*r*=-0.16), such that increased exercise during the 12 month period resulted in a higher $V0_{2\ Max}$, and greater body fat loss. In conclusion, fitness in the postpartum period promotes a more favorable body composition, but does not appear to influence BMD.

Energy intake, hydration status and body composition profile of elite canoe athletes during competition preparation

R Verch[1], A Carlsohn[1,2], F Mayer[1]

[1]Outpatient Clinic, University of Potsdam, Germany. [2]Institute of Health Sciences, University of Education Schwäbisch Gmünd, Germany

Dietary intake (DI), hydration status (HS) and body composition (BC) may affect an athlete's health and performance, but little is known about DI, HS and BC of elite canoe athletes during different periods of competition preparation. The purpose was to assess DI, HS and changes in BC of elite canoeist during 3 training periods (TP) of competition preparation. 5 female (F, 26±3 y, 173±4 cm; 66.9±3.6 kg) and 10 male (M, 25±4 y, 186±8 cm, 89.1±8.3 kg) canoeists of the German national team completed 6 measurement setups within 3 TPs. Each TP consisted of different training volumes, intensities and exercise tasks. Measurements were conducted at the beginning and at the end of each TP. Energy (E), carbohydrate (CHO), protein (PROT) and fat intake were investigated using a 3d-dietary record. HS was assessed by urine specific gravity (USG, dehydration cut-off ≥1.020) of 3 urine samples per measurement day. To evaluate body fatness, skinfold thickness was measured in the outset of TP1 and at the end of TP2/3. Statistical analysis by descriptive statistic (mean ± SD), Friedman-Test and one-way ANOVA for repeated measurements. Mean E intake was less than recommendations (Table).

	TP	E [kcal]	PROT [g]	FAT [g]	CHO [g]	USG	BF [%]
F	1	3246±361	116±17	113±18	410±54	1.022±0.008	11.4±2.5
	2	3062±317	110±25	111±11	377±65	1.020±0.007	9.3±1.2
	3	3074±126	104±22	112±12	387±65	1.017±0.012	8.7±0.7
M	1	4394±985	197±40	160±43	508±126	1.021±0.008	17.4±2.5
	2	4181±1251	200±74	163±46	446±178	1.020±0.008	14.3±2.4
	3	4169±955	197±62	181±50	446±189	1.021±0.009	14.0±2.3

There was no significant difference in DI for M and F between the TPs. USG differed during TP1 for M ($p < .05$), but not F. Differences of USG between the 3 TPs were not significant for M and F. A decrease of BF was measured for M ($p < .05$) and F ($p < .05$).Many athletes (73%) began the morning training session in a dehydrated state. However, USG changes during the day for M were observed and suggest an adaptation of fluid intake to exercise fluid demands. E intake was lower than recommended for elite endurance athletes, which might be ascribed to effects of under-reporting. In the course of the competition season, body fat slightly decreased, which might be due to higher exercise loads. Nutritional guidance is required to better match DI to exercise demands of these athletes.

The effect of caffeine on perceived exertion and oxygen uptake during submaximal arm cranking exercise in humans.

Alslouli, F.R. [1], Baxendale, R.[2]

School of Life Science, The University, Glasgow, Scotland,

Caffeine's metabolic and performance effects have been widely reported. However, caffeine's effects on affective states during exercise are unknown. Therefore, the aim of this study is to investigate the effects of caffeine on the perception of effort and fatigue during prolonged upper limb exercise. A randomised double blind placebo controlled crossover design was used to compare the effects of caffeine at 7.5 mg/kg and a placebo of starch at the same dose. The caffeine was consumed in gelatine capsules 45 minutes before the start of the exercise test. Fifteen Healthy young males performed 20 min of arm exercise at an intensity equivalent to 90% of individual lactate threshold, determined from a standard ramp-incremental exercise protocol. Physiological as well as rates of perceived exertion using Borg (0-10) RPE scale and Visual Analogue Scales (VAS) were assessed during the last 20 seconds of each 5 minutes of the test and during three stages of post exercise. A 2-way repeated measures ANOVA was used to test the differences between the caffeine and the placebo responses. Caffeine ingestion produced no effect on RPE, (VAS), blood lactate concentration, peak oxygen uptake or peak minute ventilation. However, heart rate (HR) levels (mean +/- SD) were higher after caffeine consumption than after placebo use at 15 min: (143.7) +/-(16.1) b· min^{-}-1 vs (134) +/-(15) b· min-1, at 20 min: (149) +/- (16.4) b·min-1 vs (136.5 +/- 15.4) b·min-1^{-}. Our findings indicated that except for the differences in HR responses, no noticeable variations were found in gas exchange, blood lactate or RPE responses between caffeine and placebo arm exercise trials.

Acute effect of exercise on appetite related hormones, fat metabolism and energy intake.

Ghalia Shamlan, M Denise Robertson & Adam Collins.

Department of Nutritional Science, Faculty of Health and Medical Sciences, University of Surrey, Guildford

Appetite control (i.e. control of energy intake) is important for weight maintenance. Exercise contributes to the most variable component of energy expenditure but its impact is beyond the energy cost of exercise including physiological, behavioural, and appetite effects. Exercise is known to acutely influence effect appetite but evidence as to the independent effect of intensity is lacking). This study investigated the role of exercise intensity on appetite, energy intake (EI), appetite related hormones, fat utilisation and subjective measures of appetite. One hour after a standardised breakfast, 39 healthy normal- weight volunteers subjects undertook either 8 repeated 60 second bouts of cycling at 95% VO2 max (high intensity) or 30 minutes of continuous cycling, at a fixed cadence, equivalent to 50% of the participant's VO2 max (low intensity) in a randomised crossover design. Glucose, insulin, triacylglycerol (TAG), nonsaturated fatty acids (NEFAs) and glucagon-like peptide-1 (GLP-1) were measured fasted, postprandial, and pre and post exercise. Satiety was assessed subjectively throughout the study using visual analogue scales. *Ad libitum* intake of a pasta meal was measured at the end (3 hr post-breakfast). No effect of exercise was observed on the *ad libitum* meal or 24 hour energy intake post-exercise. Hunger scores were decreased following high intensity (HI) only. No differences in glucose, insulin and TAG between both intensities were observed. HI increased fat oxidation compared to low intensity (LI) at 15 minutes post-exercise with a difference in NEFAs level. No differences were observed in energy intake of fat for 2 days post-exercise between two intensities. In conclusion, there are mechanisms and consequences of exercise in short and long-term appetite control; however, these mechanisms warrant further explanation. These results support the need for future research in to the role of in regulation energy balance, especially for obese people.