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D1

The effects of high intensity interval training (HIIT) versus moderate intensity continuous exercise (MICE) on lipid profile in adults with Metabolic Syndrome – a systematic review and meta-analyses

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Background: Dyslipidaemia contributes towards CVD and MetS risk[1]. MICE has shown to improve lipid profile[2]. Despite health benefits, the main barrier to exercise is time. HIIT is potentially a time-efficient strategy for improving lipid profile. No systematic review exists exclusively on the effects of HIIT versus MICE on lipid biomarkers. We aimed to assess the effects of HIIT versus MICE on lipid-related CVD-risk factors of MetS in adults.

Methods: Medline and Embase were searched alongside hand-searches. Inclusion criteria were: (1) HIIT versus MICE, (2) Adults, (3) Body Mass Index >25 kg/m², (4) lipid-related outcomes, (5) ACSM defined workload measures[3], (6) supervised interventions >2 weeks, (7) HIIT protocols performed >3 times/week, where >3 sets, >1 minute high intensity, >1 minute active recovery. MICE protocols >30 minutes per session, (8) No dietary/pharmacological interventions, (9) Randomised Controlled Trials (RCTs), (10) from 1997–2015. The search strategy included 111 terms surrounding MICE, HIIT, MetS, Dyslipidaemia, Insulin Resistance and Blood Pressure. 58 studies were found after removing duplicates and screening abstracts. 47 trials were then rejected because exercise protocols did not meet criteria, used dietary interventions, had “healthy/active” participants, were not full papers/RCTs and were not in English. 5 studies met the inclusion criteria but did not report lipid-related outcomes. The PEDro scale was used to assess quality – high risk of bias trials were not excluded. We found lower and higher levels of publication bias for TG and HDLc respectively.

Results: 6 RCTs were used in this review. No significant effects of HIIT or MICE were found on lipid biomarkers. Trials found significant increases in HDLc more frequently after HIIT than MICE. One study found HIIT improved lipid profile in ~73% less time than MICE per week.

Meta-analyses showed HIIT favoured beneficial reductions in TG and LDLc, whereas MICE favoured beneficial changes in HDLc and TC (all $P > 0.05$).

Discussion: A previous systematic review (which included trials used in this paper) conclude HIIT benefits cardiometabolic health and improves HDLc levels more than MICE[4,5]. HIIT may be a time-efficient strategy favouring reductions in TG and LDLc levels in adults at risk of MetS. More high quality RCTs are required to conclude this.

Summary of meta-analyses (where <0 = favours HIIT, >0 favours MICE)

Outcome	Relative effect size (95% CI) and P_{effect}
TG (mmol/L)	−0.03 [−0.10, 0.04] P_{effect} = 0.40
HDLc (mmol/L)	0.04 [−0.00, 0.08]. P_{effect} = 0.08
LDLc (mmol/L)	−0.26 [−0.56, 0.04]. P_{effect} = 0.09
TC (mmol/L)	0.18 [−0.01,0.36]. P_{effect} = 0.06

Conclusion: We found limited evidence to conclude if HIIT results in greater beneficial effects on lipid biomarkers compared to MICE.

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D2

A structured nutritional strategy and monitoring programme given to a GB heavyweight female junior rower as they transitioned to compete as a lightweight

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Background: Adolescent athletes that compete in weight category sports create unique nutritional requirements thus careful attention must be given to their diet in order to enhance training and promote optimal performance. A case study approach has been used to outline effective nutritional support strategies for achieving body composition goals in senior heavyweight male rowers transitioning to the lightweight category[1]. However, there have been no case studies that have provided nutritional and monitoring support for heavyweight female junior rowers looking to transition into the lightweight category. Therefore, the aim of the present case study was to support a GB heavyweight female junior rower as they looked to decrease their body mass/fat to qualify as a lightweight rower.

Methods: With institutional ethical approval, the aim of nutritional support was to develop a dietary strategy to ensure the athlete achieved the goal of making weight in a gradual, safe manner, whilst meeting the daily energy, macro- and micronutrient requirements for training/ competition. As muscle mass remains a determinant of competitive success, strategies that promoted the loss of fat mass, whilst retaining lean body mass to optimise power to weight ratio, were implemented. Before support the athlete's typical energy intake was 3,150–3,431 kcal (carbohydrate 7.8 g kg^{-1}.bm.day; fat 2.1 g kg^{-1}.bm.day; protein 1.6 g.kg^{-1}.bm.day) consumed as 3 meals per day. The athlete was provided with a number of nutritional consultations and a variety of educational resources (e.g. shopping lists, weekly menus adapted for competition/travel, cook books). During the support programme, daily energy intake was consumed as 6 meals per day (2,147–2,610 kcal, carbohydrate 3.8 g.kg^{-1}.bm.-day, fat 1.5 g.kg^{-1}.bm.day, protein 2.3 g.kg^{-1}.bm.day). Body composition was assessed throughout using 7 site skin-folds measured by an ISAK accredited level II anthropometrist. A structured training programme was provided by her coach.

Results: The change in frequency and composition of energy intake, resulted in a total body mass loss of 5.7 kg which corresponded to a reduction in body fat (skinfolds) from 18.4% (74.6 mm) to 12% (46.3 mm). Fat and lean tissue loss was 4.72 kg and 0.98 kg, respectively. The greatest reduction in body mass (2.8 kg) and loss in lean tissue (1.98 kg) was between March and April 2015. Fat loss at this time was 0.82 kg. The amount of lean tissue loss in the current case study was 17% of the total body mass loss. Despite this, the athlete was still able to improve her 2,000 m time trial performance (3.5%).

Discussion: The possible reasons for the muscle tissue loss could have included the use of body protein as a gluconeogenic precursor, impaired skeletal muscle protein synthesis and reduction in anabolic hormones. The amount of lean tissue loss in relation to total body mass loss was however lower than that shown previously in three male oarsmen[1] where it was 31–84.6% and 50% in six elite lightweight oarswomen[2].

Conclusion: This intervention demonstrated that a structured nutritional strategy and monitoring programme could support a heavyweight female junior rower successfully transition in their first season as a lightweight.

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D3

Longitudinal changes in the nutritional intake of Elite Junior Female Rowers

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Background: Adolescent athletes who participate in demanding endurance training (10 to 14 training sessions per week) have increased nutritional demands (1). Achieving these greater dietary requirements are important to support training, competition and for ongoing growth and development (2). Studies that report the nutritional intake of young female rowers are rare. Furthermore, it is unclear whether adolescent female rowers are generally successful in self-selecting an appropriate energy intake that meets their basic requirements as well as the additional energy cost of sport participation. Therefore, this study investigates changes in the diet and bodyweight of adolescent female rowers during a nine month training period.

Methods: A convenience sample of twelve elite junior female rowers (Mean age: 16.7 ± 0.6 yrs: height: 171 ± 4 cm; body mass (BM) was: 65.0 ± 6.9 kg) volunteered for this observational study. Each rower was given extensive training in completing written food records including presentation with real food models, flash cards and photographs that illustrated portion sizes. Thereafter, all rowers completed food diaries (unweighted) on four consecutive days and repeated on three occasions, each separated by approximately three months (October to June). Dietary records were assessed with Nutritics software and ANOVA (repeated measures) and T-Tests. Ethical approval was granted in accordance with the Oxford Brookes University Ethics Committee requirements.

Results: There was no significant change across time in bodyweight (66.2 ± 6.9 kg) or energy intake (2245 ± 396 kcal/day). However, relative carbohydrate intake decreased from 5.0 ± 1.1 g/kg BM in October to 3.9 ± 0.8 g/kg BM in June ($P = 0.03$). Relative protein intake was similar across time (1.5 ± 0.3 g/kg BM; $P = 0.21$). Calcium intake decreased between Feb (1136 ± 240 mg/d) and June (897 ± 257 mg/d; $P = 0.04$) only.

Discussion: The energy intake values of these junior female rowers was ~9% lower than the EAR for non-athletic 17 year old females. Based on training logs, we estimate that the energy requirements of these rowers was likely 2750 to 3000 kcal/d (data not shown) which suggests an under report of ~ 18 to 23% based on the observed stable bodyweight and assuming no change in body composition. This value is lower than the 34% under report indicated in a study of female lightweight rowers that compared 4-day self-recorded diet records (weighed) against energy expenditure derived via doubly labelled water found (3 – add Hill and Davies 2002), yet energy intakes (2214 kcal/d) and bodyweights were similar (~61 kg). All athletes recorded carbohydrate and calcium intakes that were lower than recommended for adolescent athletes (1), even after consideration for under record. However, protein intake was well within recommended targets, even without adjustment for under record. Subjective analysis of the food preferences in this study suggests that many athletes were selectively avoiding carbohydrate food sources (e.g. bread and potatoes) and dairy produce, especially toward the end of the study. These findings suggest that adolescent female rowers may benefit from education strategies that highlight the importance of achieving adequate energy intake, carbohydrate and calcium rich sources.

Conclusion: It is unclear why carbohydrate intake decreased during the training period when daily energy intake and body weight remained stable. Further research is needed to elucidate why some female adolescent rowers may be selectively decreasing their carbohydrate intake during training despite the well-established importance of this macronutrient for endurance sports.

Macronutrient Intake	October	February	June	Main Effect (time)
Carbohydrate g/day	321	293	260	$P < 0.05$
kcal/day	1284	1172	1040	
% energy	51	50	48	
Protein g/day	105	95	97	$P > 0.05$
kcal/day	420	380	388	
% energy	18	17	20	
Fat g/day	85	83	80	$P > 0.05$
kcal/day	765	747	720	
% energy	32	33	36	

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D4

The effects of high intensity interval training (HIIT) compared with moderate intensity continuous training (MICT) on glycaemic and insulinaemic biomarkers: a systematic review and meta-analysis

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Background: Physical inactivity, obesity and type 2 diabetes (T2DM) are significant contributors of metabolic syndrome (MetS). Current public health messages support management of T2DM and obesity targeting a reduction in weight and body mass index. However, weight loss does not provide optimal public health messages for T2DM and obesity management. Moderate intensity continuous training (MICT) has been shown to improve health outcomes for all populations. However, time constraints can be a challenge in implementing MICT, therefore high intensity interval training (HIIT) has been proposed as a more time efficient approach [1].

The aim of this systematic review and meta-analysis is to compare the efficacy of HIIT compared to MICT in improving specific glycaemic and insulinaemic parameters.

Methods: Two electronic databases (Medline, Embase) were searched from 1997 onwards on studies that compared HIIT versus MICT on glycaemic and insulinaemic biomarkers. Randomised control studies were systematically reviewed for eligibility against inclusion/exclusion criteria and appraised against GRADE and PEDRO from a panel of three researchers. Studies that assessed pre/post intervention results, minimum 2-week intervention and participants with at-least one metabolic risk factor were included into final meta-analysis. Revman software (v 5.3) was used for meta-analysis using mean difference 95% confidence intervals. Random effects model and confidence intervals were used to account for between-studies variability to define heterogeneity.

Results: From 559 studies, 183 duplicates and 369 low quality/dietary manipulated/incorrect intervention studies were excluded. A final seven studies were reviewed. Total duration of timed exercise bouts for HIIT was mean 14 minutes, range 8–16 minutes compared to mean 56 minutes, range 30–70 minutes for MICT. Both interventions improved glycaemic and insulinaemic outcomes independently. HIIT significantly reduced insulin resistance (HOMA) and improved VO2max against MICT, with no statistical differences between other biomarkers when compared to MICT. However, the overall quality of evidence was graded low.

Summary Statistics on glycaemic and insulinaemic biomarkers comparing HIIT versus MICT protocol

Biomarkers	N study used & N subject in studies	Total mean difference, overall effect estimate	Favour of	Significance	Heterogeneity
Fasting glucose (mmol/l)	5 (76HIIT: 75MICT)	−0.09 [−0.41 to 0.22] (95%, CI)	HIIT	Non-significant	(P = 0.01) I^2 = 92%
HOMA-IR	2 (23HIIT: 23MICT)	−0.07 [−0.11, 0.03] (95%, CI)	HIIT	Significant	(P = 0.68) I^2 = 0%
HbA1c (%)	2 (27HIIT: 26MICT)	0.00 [−0.20, 0.20] (95%, CI)	HIIT	Non-significant	(P = 0.22) I^2 = 33%
BMI (kg/m²)	3 (37HIIT: 38MICT)	0.2 [−027, 0.68] (95%, CI)	MICT	Non-significant	(P = 0.98) I^2 = 0%
Waist Circumference (cm)	2 (20HIIT: 22MICT)	1.07 (−2.95, 5.08] (95%, CI)	MICT	Non-significant	(P = 0.91) I^2 = 0%
VO_{2max} (ml/kg/min^{-1})	3 (26HIIT: 30MICT)	1.38 (0.08, 2.67] (95%, CI)	HIIT	Significant	(P = 0.98) I^2 = 0%

Discussion: Engaging in either intervention significantly improved glycaemic and insulinaemic outcomes measures [2]. HIIT is a safe and time saving exercise in improving insulin resistance and cardiorespiratory fitness against MICT. The consensus favours participants with factors of metabolic risk to partake in HIIT to improve metabolic outcomes. However, the reported improvement in glycaemic and insulinaemic outcomes warrants further research to quantify if HIIT offers any advantages over MICT. Limitations in studies such as small sample sizes, no comparison to control population and limited blinding diminished the overall quality of evidence, and therefore graded as low. The results suggest clinically, there are no significant difference between either intervention improving metabolic risk outcomes.

Conclusions: HIIT offers an alternative method to increase exercise and improving metabolic outcomes, which may be more time efficient. However, with limited studies of low graded quality in this research area, overall there are no significant difference between either intervention in improving metabolic risk outcomes.

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D5

Developing an expert consensus in rugby nutrition: a Delphi study

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Background: Limited empirical evidence exists which has direct translation for nutrition practitioners working with team sport athletes. Furthermore, given the lack of rugby specific nutrition recommendations, it is important to provide a framework on the requirements of players in order to enhance the standard of nutritional practice in rugby. The primary aim of this research was to develop an expert consensus on optimum nutritional practices of rugby players.

Methods: To obtain expert opinion, a Delphi Poll was implemented; this survey technique allows a consensus to be established where information is currently contradictory or insufficient(1). Following ethics approval, seven expert nutrition practitioners from across the United Kingdom (UK) and Ireland were recruited for the study. Practitioners were required to have at least two years continuous experience in professional rugby clubs. All recruited practitioners had at least three years elite experience and were working with international rugby teams at the time of data collection. During the initial stage of the research, three of the UK national nutrition leads were invited to participate in standardised open-ended interviews. A total of 359 statements, divided into 20 topic areas were generated from these interviews and were included in the first round of voting in the Delphi poll. Using a 5-point likert scale, all practitioners selected their level of agreement with the statements from *strongly disagree* to *strongly agree*. For a statement to be agreed upon as good practice, 75% of the practitioners were required to vote in agreement. Statements which were not agreed upon were recirculated for the second round of voting. During the first round of voting, all practitioners were invited to provide additional statements for inclusion in the final round.

Results: Following the two rounds of voting a total of 201 statements were agreed upon, an indicative sample is provided below:

Practitioners encouraged estimating energy needs from lean body mass measures but recommended that caution should be exerted when using predictive equations with rugby players. Recording dietary intakes should be done so with caution with additional supporting quality control measures adopted. High protein intakes (>2 g·kg·BM^{-1}) are deemed acceptable by practitioners provided other nutrient consumption is not compromised. There appears to be varied practices in carbohydrate consumption across playing positions, and often players may sacrifice carbohydrate intake for body composition goals. Body composition is a primary driver for the rugby player, however influencing factors of vanity and body image play a large role which may compromise them as a rugby player. Social media has increased interest in food and can be used as an educational tool, however sometimes players receive inappropriate information. A trackable system of supplement use should be in place and any supplementation protocols implemented should have an evidence basis. Practitioners should always have an alternative food strategy to any supplements used. All supplement strategies should be assessed throughout the season for psychological and physiological variation and it is important to be aware of the large influence senior players have over young players regarding supplement use. Finally, a key message was that even in a team sport setting it is important to acknowledge that responses to nutrition and training are highly individual and variable. Despite obtaining much agreement in appropriate practices, a relatively high level of disparity in opinion occurred in the areas of fat intake, recovery and nutrition for supporting illness.

Discussion: While current research in rugby nutrition is developing, this Delphi Poll study presents a unique approach to conducting research in the field of applied sport and exercise nutrition. These statements will facilitate expert practitioners in moving towards a consensus regarding optimum nutritional strategies for the rugby player. This research can be utilised by new or developing practitioners, while an empirical evidence base is being established.

Conclusion: As well as providing a consensus, the present study highlights areas where practitioners should exercise caution regarding recommendations, as more research is required to help inform their practice.

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