**Project Title:** An investigation of the impact of hydration status on cognitive performance of karateka (athletes who practice karate)

**Supervisors:** Dr Liz Simpson, Professor Jacqueline McCormack  
Contact Details: eea.simpson@ulster.ac.uk; jm.mccormack@ulster.ac.uk

**Level:** PhD

**Background**

Hydration and exercise: Dehydration has a detrimental impact on exercise performance potentially via increasing core body temperature, cardiovascular strain and glycogen utilisation, altering metabolic function and impairing cognitive performance (Sawka et al., 2007; Ganio et al., 2011). It is, therefore, critical that athletes are adequately hydrated when exercising. Owing to variation in sweat rate and composition between athletes (Sawka et al., 2007; Maughan et al., 2007; Osterberg et al., 2009; Baker et al., 2015), it is not possible to provide one fluid recommendation for all. ‘Salty sweaters’ may be particularly susceptible to heat cramping (Eichner, 2007) and, therefore, may have higher needs for sodium replacement. As the fluid requirements of athletes vary depending on individual characteristics and the type/intensity of athletic activity in which they participate, individualized fluid replacement strategies are needed. The American College of Sports Medicine (ACSM) recommend that fluid intake during exercise should be sufficient to limit body weight (BW) loss to <2% from baseline (Sawka et al., 2007). However, this recommendation has been criticised as it may be inappropriate for athletes that commence exercise in a severely dehydrated state.

Dehydration of ≥2% BW has consistently been shown to impair endurance performance, particularly in warm weather conditions (Sawka et al., 2007; Chevront & Kenefick, 2014). Furthermore, exercise-induced dehydration may have an adverse effect on salivary antimicrobial proteins and immunoglobulins associated with mucosal immunity (Fortes et al., 2012), thereby possibly resulting in increased susceptibility to infection. Additionally pre-exercise dehydration of 3% BW impairs anaerobic performance (Kraft et al., 2012, Davis et al., 2015) and even mild dehydration (~1-2% BW loss) has been shown to negatively impact sport-specific cognitive-motor task performance (Smith et al., 2012). Therefore, when providing nutritional advice to athletes, an area in which many athletes appear to be lacking in knowledge (Heaney et al., 2011; Walsh et al., 2011; Torres-McGhee et al., 2012), it is critical that individual fluid requirements are specifically considered. Despite the obvious benefit of starting exercise in a euhydrated state, many athletes begin exercise already dehydrated (Osterberg et al., 2009; Volpe et al., 2009; Gibson et al., 2012; Rivera-Brown & De Felix-Davila, 2012; Arnaoutis et al., 2014; Pettersson & Berg, 2014; Thigpen et al., 2014; Magal et al., 2015). In addition many athletes do not drink sufficiently to replace their fluid losses during exercise, with a high proportion being dehydrated post- training/competition (Osterberg et al., 2009; Gibson et al., 2012; Rivera-Brown & De Felix-Davila, 2012; Arnaoutis et al., 2014;}

A recently published study within NICHE investigated the hydration status of individuals participating in a variety of sports/activities pre- and post-training/competition and to determine their sports nutrition knowledge, with a focus
on fluid knowledge (Magee et al. 2016). Urine specific gravity (USG) was measured immediately before and after exercise and BW loss during exercise was assessed. Nutritional knowledge was assessed using a validated questionnaire. 31.9% of athletes commenced exercise in a dehydrated state (USG >1.020) with 43.6% of participants dehydrated post-training/competition. Dehydration was particularly prevalent (>40% of cohort) among karateka, female netball players, army officer cadets, and golfers. Golfers that commenced a competitive 18 hole round dehydrated took a significantly higher number of strokes to complete the round in comparison to their euhydrated (properly hydrated) counterparts (79.5 ± 2.1 vs. 75.7 ± 3.9 strokes, p = .049). Nutritional knowledge was poor among participants (median total score [IQR]; 52.9% [46.0, 59.8]), albeit athletes who were euhydrated at the start of exercise had a higher overall score in comparison to dehydrated athletes (55.2% vs. 50.6%, p = .001). Findings from the study recently published by researchers in NICHE, therefore, have significant implications for the education of athletes in relation to their individual fluid requirements around exercise. Specifically in relation to karate more than 60% were dehydrated following the training session. Karateka had the highest change in Urine Specific Gravity (a measure of hydration) during training compared to the other athletes and the highest median level of body weight loss during their training session compared to other athletes. In all the types of athletes poorer hydration was associated with poorer nutritional knowledge.

**Hydration and karate:** The practice of karate involves three aspects: Kihon (basic movements such as punches, kicks and blocks); Kata (karateka must memorise, learn and be to perform a large number of Kata which each are a very highly specific series of attacks and blocks which are carried out in sequence) and Kumite (sparring with a partner). During regular training sessions karateka usually train intensively for 90 minutes to 2 hours, traditionally with no break for hydration. In addition asking to go to the toilet is disapproved, therefore, many karateka do not hydrate in the hour or two before training. Whilst allowance is of course made for anyone with medical issues, this may be a particular concern for any karateka with continence issues (such as women who have difficulties related to pregnancy and childbirth) and given that Kumite in particular is doing in a loose, bouncing stance. In addition senior karateka also wear heavy cotton outfits (Gi’s) which may increase sweating and may absorb sweat. Compared to many other athletic activities, karate is quite unique in that, as well as requiring flexibility, strength and endurance, it also necessitates memory, spatial awareness and speed of reaction but is often undertaken in a dehydrated status and with no opportunities to hydrate – which may adversely affect the cognitive performance of the karateka. It is important also to note that for the first time karate will be included in the Olympics in 2020 so this is critical time for the UK national team in beginning their focused preparation towards this event. The team are working closely with the Karate Union of Great Britain on this project.

**PhD proposal:**
This sports nutrition and psychology project aims to:

- Determine the impact of hydration status of (senior grade) karateka on performance and cognitive function in a UK wide study.
- Determine the nutritional and hydration knowledge of karateka across the UK.
Investigate the impact of the implementation of a nutrition and hydration intervention programme on the performance and cognitive function of the UK national karate squad.

Determine the views of karateka across the UK towards traditional hydration practices, at both training and competition sessions.

Methods

Pilot work is currently underway with the Northern Ireland Shotokan Karate squad to determine the most appropriate cognitive tests in the CANTAB system for the assessment of cognitive performance in karate. These will include assessment of memory, spatial awareness and speed of reaction.

Part 1

The first part of the project will be a UK wide study involving assessment of the impact of hydration status on cognitive performance of senior grade adult karateka and will take place at the UK national Easter and summer training schools. Hydration status will be assessed by measuring urine specific gravity and urine colour pre- and post- exercise. Karateka will be asked to provide a urine sample immediately before training. Height will be measured using a stadiometer and weights will be recorded before and after training. Kareteka will also be asked to complete a validated questionnaire in order to assess their knowledge of sports nutrition and hydration. Following an intensive 90 minute training session hydration status and weight will be reassessed and karateka will undertake a series of cognitive function tests via the CANTAB system. The PhD student, assisted by a placement student, and will test approximately 5 karateka per session with three sessions per day for a week at each of the training schools.

Part 2

The PhD student will also undertake a more focused intervention with the UK National Squad (who are now focusing on their preparations for Olympics 2020, as well as the other European and World competitions that they participate in regularly). For the squad members, baseline assessment of their usual hydration status and cognitive function following an intensive training session will be undertaken. In addition their nutrition and hydration knowledge at baseline will be assessed. Detailed dietary assessment of each competitor will be undertaken using the diet history method and employing the Nutritics software to enable an estimation of the levels of individual nutrient intakes as well calorie intake and hydration. The competitors will be given focused and individual dietary and hydration advice to follow for a period of 6 months. Then their hydration status, cognitive performance and nutrition/hydration knowledge will be reassessed. In addition individual interviews will be
conducted with competitors and their coaches to assess the perceived impact on their performance and well-being.

Part 3

Quantitative and qualitative research will be undertaken to determine the attitudes of UK karateka towards hydration practices in karate. This work will take place via focus groups, questionnaires and individual interviews.

Part 4

Starting towards the beginning of their project, the student will also undertake a systematic review analysing the impact of hydration status on cognitive function and performance in athletes.

Resources

The student will have access to the School of Psychology Psychology Test library where we hold measures of health and lifestyle, cognitive function and psychological well-being. They will have access to CANTAB a computerised cognitive test battery, and training on how to select, administer and interpret tests. They will also have access to the Human Intervention Studies Unit in NICHE and training on how to take diet histories and analysis reported intakes using the Nutritics software undertake urine specific gravity and anthropometric measures. They will also be given training in how to undertake a systematic review.

Skills required of applicant:

Ability to perform scientific literature searches. Good communication skills. Good report writing skills. Ability to work independently and as part of a team. Experience of databases and SPSS.

Experience of carrying out research projects. Preferably some experience of memory testing but not essential as training will be given for CANTAB testing. Undertaking the project will necessitate travelling to various locations around the UK and Ireland (with overnight stays) in order to undertake testing, therefore, the applicant would need to be able and willing to travel.

As significant numbers of karateka under the age of 18 will also be present at the training sessions (although not taking part in the study) the Karate Union of Great Britain will likely expect that the applicant will undertake a criminal record check.

References
