*Journal of Physical Education and Sport* ® (JPES), 14(2), Art 24, pp.151-157., 2014
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

**Original Article**

# Thirst for drink knowledge- how coaches and physical education teachers in Singapore measure up in an exercise hydration knowledge quiz

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*Published online: June 25, 2014*
*(Accepted for publication April 25, 2014)*

**DOI:10.7752/jpes.2014.02024;**

**Abstract:**
Safe regimens are a pre-requisite for children and youths who exercise and train in the hot and humid weather anywhere in the world. Coaches and physical education (PE) teachers have an important role in providing young people with up-to-date exercise hydration knowledge before, during and after exercise. However it is not known if such professionals who practise their craft in Singapore have the requisite exercise hydration knowledge and this provided the main rationale for the study. 193 coaches and 164 PE teachers (mean±SD age: 30.4±8.8 yrs, male=265 and female=92) participated in the study. Participants completed a 31-item exercise hydration knowledge quiz, in the main, reflecting the position statements of youths exercising in the heat from three international organisations. The quiz had established construct and content validity and also very good reliability (Cronbach's Alpha=0.78).Average competence scores of 64.0%±11.6 (range: 16.1-96.8%) and a low passing rate of 7.8 % (correct answers>80% score) were observed. At the 90$^{th}$ percentile, both coaches and PE teachers, had quiz scores of 77.4%, below the minimum passing score of 80%. Participants were most unsure about whether electrolytes helped to retain fluids better within the body and also that over-drinking contributed to exercise hyponatremia and what the signs and symptoms of the condition are. Overall, teaching and coaching professionals dealing with youths do not yet have the minimum competence in terms of exercise hydration knowledge and educational efforts at ameliorating these deficiencies are recommended.
**Key Words:** Exercise hydration knowledge; youth athletes, tropical natives; coaches' education

## Introduction

Weather conditions for Singapore, over the year are a minimum 23 to 26°C to a maximum 31 to 34°C and relative humidity ranges from 90% in early morning to 60% in the mid-afternoon, and is 100% after it rains, according to data provided by the National Environment Agency (NEA) Moreover, Singapore is getting hotter with an increase in temperature of 0.25 degree Celsius per decade based on data from 1948-2008 (National Environment Agency [NEA], 2009). Physical Education is a compulsory subject for about 510,714 school-going youths aged 7 to 17 and PE is conducted outdoors only before 1030 hrs or after 1530 hrs. PE sessions average 120-150 minutes per week, according to guidelines issued by the Ministry of Education of Singapore. Participation and training for sport, 2-3 times a week for up to 3 hours per session after school curriculum hours is also common (Ministry of Education Singapore [MOE], 2011; MOE, n.d.). Both PE and sport sessions are often conducted outdoor and this exposes children and adolescents to heat stress, which is exacerbated by physical exertion since metabolic heat is generated by muscular contraction.

Research into exercise hydration issues has come to the forefront in recent years, especially in the Western world but is still at its infancy, ironically, in the Tropics. A Singapore-based study on 40 male adolescent field hockey players aged 12-13 showed that 97.5% arrived at a 4-hour hockey tournament already dehydrated ($Urine_{SG}$ > 1.020), increasing to 100% at the end of the competition. Mean decrease in pre-to-post competition body mass amounted to 3.26% despite chilled drinks being freely available for player consumption throughout the tournament (Chia & Swarup, 2012). The significance of the loss of fluids equivalent to more than 2% of body mass is that performance is negatively affected (Swaka et al, 2007).The results demonstrated that Singaporean youths do not adequately hydrate before competition and the dehydration is exacerbated, immediately after competition. This was in spite of three types of chilled drinks made available for player consumption at the venue. It is also important to note that on a typical day in Singapore (Air temperature: 30-34 ºC, WBGT: 24-29 ºC; Relative humidity: 60-80%) the wet bulb globe temperature index (Epstein & Moran, 2006; Parsons, 2006) is usually 26-30ºC. This means that Singaporean youth are exposed to a high heat stress index, when exercising outdoors and this increases their vulnerability to heat illnesses (Armstrong et al., 2007). Furthermore, dehydration in such climatic conditions delays the onset of skin vasodilation and sweating (Sawka & Coyle, 1999) which may negate the physiological advantages of heat acclimatization (Buskirk, Iampietro &


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Bass, 1958; Sawka, Hubbard, Francesconi & Horstman, 1983). Therefore, youths exercising outdoors in Singapore, during the daylight hours are at a high risk of suffering from heat disorders and other associated injuries which are preventable in the first instance.

A prior survey of 586 Singaporean youths aged between 9 and 17 years established that 47% of the participants reported that PE teachers and sport coaches were their main knowledge sources for exercise hydration (Chia et al., unpublished). Yet in Singapore there are no data on the exercise hydration knowledge of PE teachers and sport coaches, even though schools are instructed by the Ministry of Education (MOE) to only employ qualified PE teachers and certified coaches to work with youths.

Research findings about the nutrition and hydration knowledge reported elsewhere show mixed results with some showing poor knowledge of fluid replenishment among high school coaches (Geijer, Pitney & Brandenburg, 2009) and others showing different results for knowledge of sport nutrition among athletic trainers (AT), strength and conditioning specialists (SCS) and athletes in the USA (Torres-McGehee et al., 2012). In the latter study, the authors reported that while ATs and SCS had adequate knowledge (equal or >75% score in sport nutrition quiz), only 35.9% of coaches and 9% of athletes attained a score of 75% or more, in 579 participants polled. Some of these differences between studies could be attributed to the use of non-identical questionnaires in assessing knowledge and also sample differences in size and background (e.g. years of coaching experience, context) reported in the studies. Moreover, it appears that such associated research is not yet reported on sport professionals in the Tropics where exposure to heat and humid climate is the norm, and where the daily occurrence of high ambient temperatures and high humidity present an ongoing hydration issue for PE teachers and sport coaches who deal with youths

In the absence of specific exercise hydration guidelines for youths who live in tropical Singapore, existing guidelines for un-acclimatized youth exercising in the heat from the American College of Sports Medicine (ACSM), the National Athletic Training Association (NATA) and the American Academy of Pediatrics (AAP) are useful references for assessing the hydration knowledge of PE teachers and coaches working in Singapore. Knowledge of these guidelines and how PE teachers and sport coaches use this knowledge is important for addressing education and knowledge gaps in exercise hydration that can prevent and ameliorate heat disorders among physically active Singaporean youth who exercise in the heat.

The exercise hydration knowledge of PE teachers and sport coaches in Singapore needs to be addressed so that knowledge gaps could be ameliorated where they are identified. The purpose of the research was to assess the exercise hydration knowledge of this cohort using a cross-sectional research design.

## Material and method

*Participants*

Institutional ethics clearance was sought and granted for the research (IRB 11/04/14). A convenience sampling of 193 coaches who are registered with the Singapore Sports Council and 164 PE teachers attending a course at the National Institute of Education in Singapore participated in the research.

*Administration of the Exercise Hydration Knowledge Quiz*

The hydration knowledge questionnaire and quiz was administered to participants in a quiet classroom by members of the research team. On the average, participants took about 30-40 minutes to complete the 31-item quiz. The hydration questionnaire and quiz comprised four segments- (i) participant information and sources of hydration knowledge; (ii) exercise pre-hydration statements; (iii) during-exercise hydration statements, and (iv) after-exercise hydration statements. In the first segment, participants reported their age, sex, years of coaching youths in sports and coaching or teaching qualifications. Segments 2, 3 and 4 comprised statements that related to pre-exercise, during-exercise and post-exercise hydration. These are summarized in Table 1.

The hydration knowledge quiz was developed based on the position stands on fluid replacement for athletes by ACSM, NATA and AAP (Sawka et al. 2007; Casa et al., 2000; American Academy of Pediatrics, 2011). Pilot tests were conducted in a separate group of 36 PE teachers to check understanding and the questionnaire was further refined based on feedback. Content validity of the questionnaire was established by two internationally certified exercise physiologists, and an internationally-accredited sport nutritionist. The Cronbach Alpha (an estimate for internal consistency) for the quiz taken by level 3 or the highest certified coaches (N=13) of the Singapore Sports Council was 0.78.

The quiz comprised 31 statements- nine statements relate to ‘pre-exercise hydration’, 13 statements about ‘during-exercise’ hydration and nine statements about ‘after-exercise’ hydration. These statements are shown in Table 1. For each hydration statement, participants responded if they strongly disagreed (scored as 1); disagreed (scored as 2); were unsure (scored as 3); agreed (scored as 4) and strongly agreed (scored as 5). If a statement was correct, a strongly agreed or an agreed response tallied as correct, and was given a score of 1. An unsure, disagreed or strongly disagreed response is consequently considered as a wrong answer, and was given a score of zero. All statements were weighted equally. The number of correct responses for the pre-, during- and after- hydration segments was tallied as expressed as a percentage in relation to number of statements for each segment and also to the total number of statements in the quiz.

Adequate exercise hydration knowledge was accepted as a score of at least 80%, which is consistent with knowledge-based tests (Ransone & Dunn-Bennett, 1999) and is in keeping with certification standards set by the Singapore and American Red Cross organisations for pen and paper tests (American Red Cross, 1988).

Group differences in correct responses to the hydration questionnaire and quiz were analysed using independent t- tests. The level of statistical significance was accepted as $p<0.05$.

**Results**

*Participant information*

Participants were 357 sport coaches and PE teachers (male=265; female=92; mean age ± SD: 30.4±8.8 yrs). Preliminary analysis revealed no sex difference in quiz performance, therefore male and female data were pooled for subsequent analyses.

52.9% of the participants (Coaches=102; PE teachers=87) had less than 2 years of coaching experience, 21% of them (Coaches=48; PE teachers=27) had 2-5 years of coaching experience, while 11.2% had 6 years of experience or more (Coaches=32; PE teachers=8). There were 14.8% of the participants (Coaches=11, PE teachers=42) with no coaching experience. Of the 357 participants, 251 (70.3%) were involved in coaching youth athletes. 14.3% had a formal qualification in the form of a sports science or physical education degree or diploma and 35.6% had coaching certification.

While lectures and workshops were stated as the preferred means of continuing education by 59% of the participants, internet and magazines were stated as the source of knowledge by 65% of the coaches. 28.3 % of the participants were involved with team sports while 27% dealt with both individual and team sports.

*Performance in exercise hydration knowledge quiz*

The overall performance in the quiz is shown in Figure 1 and Figure 2 depicts the relative performances of the PE teachers and the sport coaches.

Figure 1 shows that the overall mean exercise hydration knowledge score for the pooled data of the sport professionals is 64.0%. This is well short of the competence benchmark set at 80%. Only 7.8 % of the participants achieved scores of at least 80%. The knowledge score at the 90$^{th}$ percentile was 77.4%.

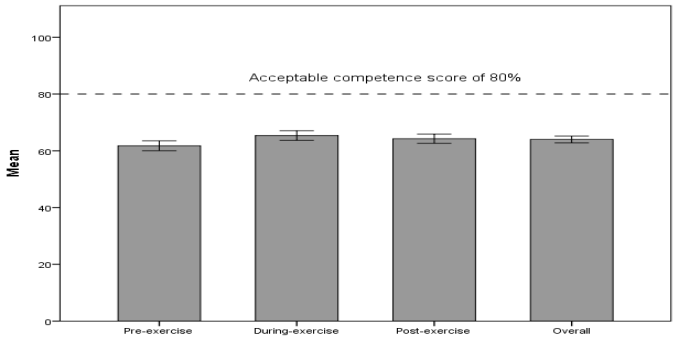


Fig. 1 - Pooled data- performance of coaches and PE teachers in the exercise hydration knowledge quiz.

Data presented are mean± standard error of the mean (95% CI) for pre-exercise, during-exercise, post-exercise and overall percentage scores obtained in the exercise hydration knowledge quiz. No significant differences ($p>0.05$) existed between the exercise hydration knowledge segments.

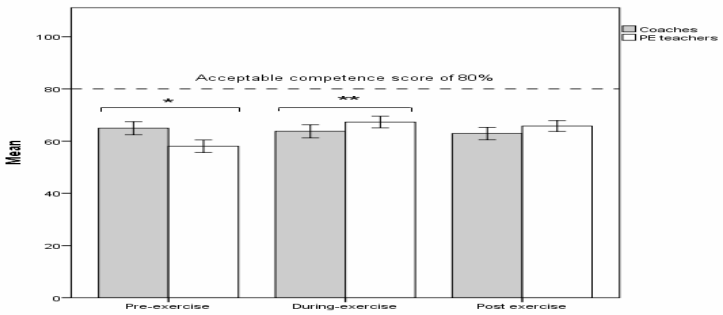


Fig. 2 - Performance of coaches and PE teachers in the exercise hydration knowledge quiz.

Data presented a comparison of mean± standard error of the mean (95% CI) for pre-exercise, during-exercise, post-exercise and overall percentage scores obtained in the exercise hydration knowledge quiz by coaches and PE teachers. *Coaches scored higher (64.9%±14.9 vs. 58.1%±13.3, $p<0.05$). **PE teachers scored higher (67.3%±10.7 vs. 63.8%±14.4, $p<0.05$).

Though, mean overall exercise hydration knowledge scores were not significantly different ($p>0.05$) between sport coaches and PE teachers, Figure 2 shows that coaches scored significantly higher in pre-exercise hydration knowledge (Coaches: 64.9%±14.9 vs. PE teachers: 58.1%±13.3, $p<0.05$) whilst PE teachers scored significantly higher for during-exercise hydration knowledge (Coaches: 63.8%±14.4 vs. PE teachers: 67.3%±10.7, $p<0.05$). No significant differences in scores was found between both groups in the post-exercise hydration section of the quiz (Coaches: 63.0%±14.6 vs. PE teachers: 65.8%±12.1, $p>0.05$).

Table 1 describes the performances of the PE teachers and sport coaches for the 31-item exercise hydration quiz. Among the quiz questions, the ones that participants did not attempt were if fluids should be consumed slowly, whether drinks containing electrolytes helps body retain fluids better and whether diet drinks are ideal choice for fluid, energy replenishment and to prevent electrolyte imbalance during training/competition. The questions which participants were unsure of were related to occurrence and symptoms of exercise associated hyponatraemia and about the percentage of fluid lost to be consumed within the next 24 hours.

Table 1 - Summary of performance of coaches and PE teachers in the exercise hydration knowledge quiz.

| | Coaches n (%) | PE teachers n (%) |
|---|---|---|
| **Pre-exercise hydration statement** | | |
| (Maximum score is 9) | | |
| 1. Athletes are encouraged to begin training/competition well hydrated | 187 (96.9) | 71 (43.3) |
| 2. Athletes are encouraged to drink as much as they can until they feel full in order to fully hydrate | 46 (23.8) | 24 (14.6) |
| 3. Drinking just before exercise is a good strategy to restore the hydration status of a dehydrated athlete | 124 (64.2) | 93 (56.7) |
| 4. Effective rehydration during exercise can be enhanced by filling the stomach with a gulp of fluid before exercise | 94 (48.7) | 64 (39.0) |
| 5. Drinking slowly helps the body to retain fluids better | 130 (67.4) | 70 (42.7) |
| 6. Drinks containing electrolytes e.g. sodium can help body to retain fluid better | 136 (70.5) | 110 (67.1) |
| 7. Monitoring urine colour is the most effective method to determine the hydration status of an athlete | 139 (72.0) | 113 (68.9) |
| 8. Always aim to have a dark urine colour | 167 (86.5) | 159 (97.0) |
| 9. Athletes should weigh themselves before and after training sessions of different durations and intensities and in different weather conditions to estimate their sweat losses | 132 (68.4) | 96 (58.5) |
| (A) Sub-total: mean score±SD | 5.8 ±1.6 | 5.2 ±1.4 |
| Sub-total: % mean score±SD | 64.9 ±17.4 | 58.1 ±15.5 |
| Confidence scores for correct answers (95% CI) | 5.6 – 6.1 | 5.0 – 5.4 |
| **During-exercise hydration statement** | | |
| (Maximum score for this segment is 13) | | |
| 1. Exercising in a dehydrated condition increases the risk of thermal injury and may reduce performance | 178 (92.2) | 158 (96.3) |
| 2. Sports drinks should contain carbohydrates and electrolytes for optimal hydration during training and competition | 164 (85.0) | 145 (88.4) |
| 3. Water is a good hydration fluid for sports events lasting more than 60 minutes | 39 (20.2) | 61 (37.2) |
| 4. Overconsumption of fluids before, during and after exercise causes Exercise Associated Hyponaetremia or water intoxication. | 116 (60.1) | 96 (58.5) |
| 5. Water intoxication is rare but can happen most likely during extreme exercise, e.g. marathons, when a person replenishes fluids with water instead of electrolyte-containing sports drinks | 82 (42.5) | 66 (40.2) |
| 6. Water intoxication is rare but can happen most likely during extreme exercise, e.g. marathons, when a person replenishes fluids with water instead of electrolyte-containing sports drinks | 97 (50.3) | 70 (42.7) |
| 7. Replacement of fluids lost by sweating should be based on the fluid intake plan that has been practiced in training | 131 (67.9) | 102 (62.2) |
| 8. Diet drinks are an ideal fluid choice to replenish energy, fluid loss and prevent electrolyte imbalance during training and competition | 82 (42.5) | 104 (63.4) |
| 9. Fluid replacement in the body works better if the liquid drunk is cooler as this will help to reduce core body temperature and encourage drinking | 94 (48.7) | 89 (54.3) |
| 10. Carbonated soft drinks are good hydration choice during exercise due to its high sugar content | 136 (70.5) | 139 (84.8) |
| 11. Athletes training and competing in air-conditioned environment perspire less and will not need to drink fluids | 164 (85.0) | 151 (92.1) |
| 12. In aquatic sports like swimming and water polo, athletes do not need to drink during training or competition | 167 (86.5) | 156 (95.1) |
| 13. Athletes should only consume drinks that they are familiar with and avoid trying anything new competition | 150 (77.7) | 98 (59.8) |
| (B) Sub-total: mean score±SD | 8.3 ±2.3 | 8.8 ±1.9 |
| Sub-total: % mean score±SD | 63.8 ±17.5 | 67.3 ±14.5 |
| Confidence scores for correct answers (95% CI) | 8.0 – 8.6 | 8.5 – 9.0 |
| **Post-exercise hydration statement** | | |
| (Maximum score for this segment is 9) | | |
| 1. Weight loss after exercise should generally exceed 2% of body mass | 32 (16.6) | 41 (25.0) |
| 2. Incomplete rehydration will have a negative effect on the subsequent exercise | 141 (73.1) | 129 (78.7) |
| 3. Athletes should not rely on thirst or opportunity to drink for rehydration | 175 (90.7) | 147 (89.6) |
| 4. A volume of equal to 50% of the fluid lost during exercise should be consumed in the next 24 hours for full rehydration | 12 (6.2) | 22 (13.4) |
| 5. A combination of carbohydrate and protein rich food/ fluid e.g. raisin buns and low fat milk can help achieve both energy and fluid replacement after exercise | 131 (67.9) | 109 (66.5) |
| 6. It is important to have a fluid replacement plan especially when fluid losses during exercise are high | 172 (89.1) | 156 (95.1) |
| 7. Consuming salt-containing food and drinking water slowly could help to restore both fluid and electrolytes | 105 (54.4) | 86 (52.4) |
| 8. Beer is a good replacement fluid as it has carbohydrates and 'cools' the body | 160 (82.9) | 137 (83.5) |

| | | |
|---|---|---|
| 9. Caffeinated drinks are good fluid replacement drinks | 165 (85.5) | 144 (87.8) |
| (C) Sub-total: mean score±SD | 5.7 ±1.5 | 5.9 ±1.2 |
| Sub-total: % mean score±SD | 62.9 ±16.7 | 65.8 ±13.6 |
| Confidence scores for correct answers (95% CI) | 5.5 – 5.9 | 5.7 – 6.1 |
| **A+B+C Grand total: Mean Score ±SD** | **19.8 ±4.0** | **19.9 ±3.2** |
| **A+B+C Grand total: % Mean Score ±SD** | **63.9 ±12.7** | **64.2 ±10.2** |
| **95%CI (correct response)** | **19.2 – 20.4** | **19.4 – 20.4** |

**Discussion**

The importance of Singaporean youths possessing adequate exercise hydration knowledge cannot be over-emphasized since during the 10 years of compulsory schooling from age 7-16 years, children and adolescents are exposed to exercising in the hot and humid climate of Singapore during compulsory physical education lessons and also sports practice throughout the year. Although fatalities because of heat stroke among young people in Singapore are rare, many non-fatal heat disorders are not reported. Moreover, many experts believe that appropriate knowledge of exercise hydration among youths can prevent these heat ailments from occurring in the first instance (Casa et al., 2000). A pilot study on male adolescent hockey players engaged in a mini-tournament showed that nearly all players arrived at the competition venue already demonstrating signs of dehydration [4]. Unpublished data suggest that nearly 47% of Singaporean youth polled reported that they relied on their teachers and coaches for exercise hydration knowledge. It was therefore important to investigate the exercise hydration knowledge of coaches and PE teachers who are the main sources of hydration knowledge for youths.

The aim of the present study was to elucidate the exercise hydration knowledge of a large sample of sport coaches and PE teachers in Singapore. Of significance is that the validated exercise hydration questionnaire was developed based upon the position statements of three internationally recognized organizations- ACSM, NATA and APP.

The present exercise hydration knowledge quiz involved nine statements that relate to pre-exercise hydration, 13 statements that relate to during-exercise hydration and nine statements that relate to post-exercise hydration. Other existing knowledge questionnaires are more general and juxtapose knowledge, attitudes and behaviours into a single survey. Results of such surveys are limited in that targeted interventions to ameliorate knowledge gaps will tend to be more general rather than specific and may not address the roots of the knowledge gaps. Moreover, the present study reports the internal consistency of the hydration knowledge questionnaire (Cronbach's $\alpha = 0.78$) as an index of reliability. Previous studies on hydration or nutrition knowledge do not present reliability measures of the instrument used. While using a knowledge questionnaire with Likert-type response, the items in the scale need to have internal consistency and all the items should measure the same construct so that the items are correlated with each other. Cronbach's alpha is a useful coefficient as it is associated with the variation accounted for by the true score of the underlying construct. For comparing groups an $\alpha$ of 0.7-0.8 is considered satisfactory (Bland & Altman, 1997). Therefore, the $\alpha$ value of 0.78 in the present study reflects a high degree of internal consistency of the construct in the hydration knowledge questionnaire.

Geijer et al. (2009) reported on the hydration and fluid replacement knowledge of 22 high school coaches in Illinois in the USA. The authors reported that only 54.5% achieved a passing score of at least 80%. The participants had about 11 years of coaching experience and were members of the high school coaching association. The coaches reported that their main sources of hydration and fluid replacement knowledge were derived from magazines, conferences and from medical staff. A key limitation of the cited study was the very poor response rate 0.4% (22 out of 500 polled).

Over concerns that professionals lacking sports nutrition might disseminate incorrect information that are based on heresay or unsupported by research, Torres-McGeheee et al. (2012) embarked on an investigation that examined the sports nutrition knowledge among 185 athletes, 131 coaches, 192 athletic trainers (AT) and 71 strength conditioning specialists (SCS). Adequate sports nutrition knowledge was accepted as having an overall score of at least 75%. Results showed that 83.1% of SCSs, 71.4% of ATs, 35.9% of coaches and only 9% of athletes attained quiz results of at least 75%.

Adequate exercise hydration knowledge was accepted as a score of 80% is in keeping with certification standards set by the American and Singapore Red Cross organizations for pen and paper tests. This compares with other associated studies where adequate knowledge was set as a score of 75% and above. For instance, Torres-McGehee (2012) established a criterion score of 75% as adequate nutrition knowledge among athletes, coaches and trainers.

A main finding of the present study was that both coaches and PE teachers did not possess adequate exercise hydration knowledge. Pooled data showed that only 7.8 % of the 357 sport professionals polled attained at least 80% of correct answers in the quiz. One reason could be that the majority of professionals who were involved in coaching youths had less than five years of coaching experience. Moreover, many coaching and PE certification programmes equip participants only with general nutrition knowledge, including exercise hydration but the content of these nutrition courses may not include important and specific information that emanate from

consensus position statements of ACSM, NATA and APP. This knowledge gap can be addressed by having deliberate hydration education coverage in PE and sport coach certification programmes.

A noteworthy result was that PE teachers had greater during-exercise hydration knowledge while coaches were significantly more knowledgeable in pre-exercise hydration. Importantly, current coach and PE certification programmes did not sufficiently equip these sport professionals in terms of specific exercise hydration information. It is important that these domains of exercise hydration knowledge be addressed as a priority since local sport-active youths and school-going children are exposed to high heat stress index in Singapore all-year round. Moreover, unpublished results among 586 children and adolescents surveyed showed that nearly 47% reported that PE teachers and sport coaches were their main sources of exercise hydration knowledge. Given the evidence of low hydration knowledge levels amongst coaches in this study, it is likely that the coaches might not be providing the youth athletes with accurate and adequate information on hydration and fluid replacement strategies.

A more detailed examination of the data showed that to statements that were mostly unanswered included (i) whether drinking slowly helped to retain fluids better; (ii) whether drinks containing electrolytes (e.g. sodium) help the body to retain fluids better; and (iii) whether diet drinks are ideal choice for fluid, energy replenishment and to prevent electrolyte imbalance during training/competition. Additionally, the sports professionals were mainly unsure about (a) overconsumption of water over prolonged periods could lead to exercise-associated hyponatremia (water intoxication); (b) the symptoms of water intoxication- confusion, nausea, fatigue and seizures and (c) the percentage of water loss that should be consumed within the next 24 hours. The research team interpreted incorrect responses, being unsure or not answering each item on the questionnaire as a 'knowledge gap'. The authors recommend that these specific knowledge gaps should be ameliorated through a specific education or training programme for PE teachers and sport coaches, and that the education and training should be focused on exercise hydration for active youths exercising in the heat.

The current research has several unique strengths and weaknesses. In terms of strengths, coaches and PE teachers were quizzed on specific exercise hydration knowledge that was grounded on statements that emanate from 3 international organizations that published hydration guidelines for un-acclimatized youths exercising in the heat. The research revealed significant knowledge gaps, since both coaches and PE teachers did not achieve the acceptable knowledge competence of at least 80%. This lack of exercise hydration knowledge should be ameliorated through a comprehensive and targeted exercise hydration education programme for youths.

Several limitations of the current research are noteworthy- the knowledge addressed relates specifically only to exercise hydration. Other important knowledge of sports nutrition such as macronutrients and micronutrients were not assessed. Another area of plausible concern is the use of nutritional ergogenic aids such as energy drinks and other forms of dietary regimens to boost training, recovery and sport performance among Singaporean youth.

**Conclusions**

The research investigated the exercise hydration knowledge of a large sample of PE teachers and coaches who are involved in training of Singaporean youths who exercise in the heat. Results showed that there were significant knowledge gaps in terms of exercise hydration among PE teachers and coaches and these should be specifically addressed through PE and coach education programmes so as to minimize risk exposure among sporting Singaporean youth.

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