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Research article

RELATIONSHIP BETWEEN HYDRATION STATUS, HYDRATION KNOWLEDGE AND FLUID INTAKE BEHAVIOUR AMONG SCHOOL ATHLETES OF SELECTED PERAK SPORT SCHOOLS

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Abstract

*Journal of Sports Science and Physical Education 2(*1): 11–19, 2014 - Maintaining proper hydration status is crucial for sports performance and general well- being. Available data show that despite good knowledge in hydration, some elite and collegiate athletes did not practice proper fluid intake to maintain hydration, thus they may have risk of dehydration. Therefore, this study aimed to examine the relationship between hydration status, knowledge and fluid habit among school athletes. This study utilized survey questionnaires to assess hydration knowledge and habit and laboratory equipment to measure hydration status. The findings in this study show that there was no significant correlation (P>0.05) observed among hydration status, hydration knowledge and fluid intake behaviour among the participants. Besides, there were no significant differences (P>0.05) in terms of hydration status, knowledge and fluid intake behaviour between males and female participants. In conclusion, this study provides some new insight with respect to hydration status and knowledge among school athletes.

Keywords: hydration status, hydration knowledge, fluid intake behaviour.

Introduction

Mantainance of proper hydration status is very crucial for health and sports performance. When water intake equals water loss, individuals are said to be in a state of euhydration, which is represented by a sinusoidal wave that oscillates around an average (Oppliger and Bartock, 2002). According to Greenleaf (1992), the volume of total body water is regulated daily within ± 0.22 to ± 0.48% of body weight. When the body water decreased or increased above the average level, people are hypohydrated and hyperhydrated, respectively. Further, dehydration refers to the process of water loss from the body through sweat, urine, faeces and respiratory which reduces the total body water below the average level, meanwhile hyperhydration is the process of gaining body water from ingestions of drinks or foods.

Much of the data available on hydration knowledge and habits are from studies conducted on general nutrition knowledge and behaviour, which hydration section only contributes to a very small portion of the studies (Chapman, Toma, Tuveson, & Jacob,

1997; Shifflett, Timm, & Kahanov, 2002; Zawila, Steib, & Hoogenboom, 2003). Hence, these studies do not convey the information that represents the specific knowledge and habit on hydration itself. At present, little information regarding fluid intake habits among young school athletes is documented. Much information about hydration and fluid intake habits has been obtained from collegiate athletes (Nichols, Jonnalagadda, Rosenbloom, & Trinkaus., 2005) and high performance athletes (Soo & Naughton, 2007). These studies suggest that these populations generally exhibit insufficient knowledge and poor hydration habits and therefore are susceptible to risks of dehydration and performance deterioration.

Furthermore, even though physiological thirst is adequate to stimulate drinking to ensure optimum hydration status, in some circumstances such as people who are performing strenuous exercise such as athletes or hard labour with high rates of sweat losses, knowledge on hydration is important to ensure that people drink accordingly to maintain appropriate hydration status. Thus, this descriptive study is proposed to measure hydration status and to gain an insight into hydration knowledge and fluid intake behaviour among young school athletes.

Methodology

Participants

The participants consisted of 45 males and 25 female school athletes ranges from age 13-17 years old whose randomly selected among Sekolah Sukan Negeri in Perak. All participants received both written and verbal details of the study prior to the start of the trials. Once they agreed to proceed with the trial, written informed consent was obtained from them. This study protocol was reviewed and approved by Universiti Pendidikan Sultan Idris Research Committee (2011-0150-107-01).

Procedures

This study utilized survey questionnaires to assess hydration knowledge and habit and laboratory euqipment to measure hydration status. In this study, the participants were asked to complete a set of modified Hydration Knowledge and Hydration Habit Questionnaire (Nichols et al., 2005). Part A of the questionnaire consisted of questions on demographic information. Part B contained 10 closed-ended statements about hydration knowledge. The participants needed to answer TRUE or FALSE for the statements. Any correct answer was awarded 1 point and no mark was given for the wrong answer. The minimum score that could have been obtained was 0 and the maximum was 10. Part C consisted of 10 statements regarding fluid intake behavior in the form of YES or NO. The proper behavior was given a score of one and no score given for the inappropriate behavior toward hydration. Likewise, the minimum score for fluid intake behavior was zero and the highest was 10. Since these questionnaires was conducted on Malaysian school athletes, it was undergone back-to-back translation of Bahasa Malaysia and English and its reliability was determined by conducting a pilot study on 30 school children in Tanjung Malim. The internal reliability for the questionnaires was 0.74 as calculated using Cronbach alpha (SPSS 21.0), suggesting that the questionnaire had high reliability. When the value is closer to 1, the more reliable the instruments are (Cronbach, 1951). Then, the questionnaires were administered to the participants in the selected Sekolah Sukan Negeri in Perak.

To measure hydration status, the subjects were asked to give urine samples in the morning before breakfast and before dinner daily for two consecutive days. Body mass was also measured at the same time the subjects gave their urine samples by using Digital Body weight scale (Omron HN-288, Germany). The urine

samples were assessed using a Handheld Digital Refractometer (Atago, Japan) for urine specific gravity.

Data analysis

All data sets was tested for normal distribution using a Kolomogorov-Smirnov test. Data sets was analysed using descriptive and inferential statistics. The significant difference was set at $P<0.05$. Data analysis was conducted using the Statistical Program for Social Sciences (SPSS) version 21.0.

Results

Characteristics of the participants

Table 1 shows the demographic data of the participants. Forty five males and 25 females voluntarily participated in this study. They had a mean age of 14 ± 1 year. In terms of types of sports they involved in, football tops the list (35.7%), followed by athletics (24.3%), sepak takraw (20.0%), hockey (17.1%) and the least were rugby and netball which were 1.4%.

With regards to level of participation, most of the participants had experience at national level (41.4%), followed by state (22.9%) and district level (17.1%). Only 8.6% had international experience as of this date. About 10.0% of the participants did not provide the information about their playing experience.

When asked about their source of nutrition information, most of the participants gave combinations of answer. As shown in Table 1, Coach (88.6%) seems to be the most popular source for nutrition information, followed by Physical Education class with 71.4% responses while the least popular source was popular magazine (21.4%).

Table 1: Demographic Data of Study Participants (N=70).

Variable	Mean ± SD	Frequency (N)	Percentage (%)
Age (y)	14 ± 1		
Gender			
Male		45	64.3
Female		25	35.7
Types of sport			
Football		25	35.7
Athletics		17	24.3
Sepak takraw		14	20.0
Hockey		12	17.1
Rugby		1	1.4
Netball		1	14
Level of participation			
International		6	8.6
National		29	41.4
State		16	22.9
District		12	17.1
Not stated		7	10.0
Source of nutrition information			
Popular magazine		15	21.4
Coach		62	88.6
PE class		50	71.4

Nutritionist	36	51.4
Medical/Health officers	25	35.7
Newspaper	18	25.7
Parents	39	55.7
Others	0	0

Hydration status, hydration knowledge and fluid intake behavior of the participants

Table 2 shows the mean difference between gender for USG value, hydration knowledge and fluid intake habit. No significant difference (P>0.05) were found for all tested variables between males and females.

Table 2: Urine Specific Gravity, Hydration Knowledge and Behavior between Male and Female Participants (N=70). Values are Mean ± SD.

Parameter	Male (N=45)	Female (N=25)	P value
Urine specific gravity	1.020 ± 0.006	1.023 ± 0.009	0.148
Hydration knowledge (no of correct answer)	7.18 ± 1.17	7.36 ± 0.63	0.403
Hydration habit (no of desired habit)	7.71 ± 0.84	7.48 ± 0.96	0.320

***** significant at P<0.05.

In terms of knowledge towards hydration, a statement about signs of dehydration was answered correctly by all the participants (100.0%). Statements about salt tablet and thirst indicator as well as sports drink were most incorrectly answered. For instance, only 27.1% participants gave the correct answer for the statement that salt tablets did not prevent dehydration during competition training (Table 3).

Table 3: Number of Correct Responses to Hydration Knowledge Items among Participants (N=70)

Statement	Correct answer	Frequency	Percentage (%)
Tablet garam mineral mengelakkan dehidrasi semasa latihan dan pertandingan/ *Salt tablets prevent dehydration during competition training.*	Salah/*False*	19	27.1
Rasa dahaga merupakan indikator terbaik bagi kekurangan air dalam badan (dehidrasi)/*Thirst is the best indicator of dehydration.*	Salah/*False*	20	28.6
Dehidrasi mampu melemahkan prestasi atlet/*Dehidration decreases athletic performance.*	Betul/*True*	61	87.1

Atlet tidak sepatutnya mengambil minuman semasa sesi latihan/*Athletes should not drink fluids during training.*	Salah/*False*	69	98.6
Jurulatih tidak sepatutnya membenarkan athlet mengambil minuman semasa latihan/*Coaches should not let the players to drink fluids during training.*	Salah/*False*	69	98.6
Jurulatih tidak sepatutnya membenarkan atlet mengambil minuman semasa pertandingan./*Coaches should not let the players to drink fluids during competition.*	Salah/*False*	66	94.3
Atlet sepatutnya mengambil minuman sukan dalam masa 2 jam selepas latihan/*Athletes should drink sports drink within 2 hours after exercise.*	Betul/*True*	26	37.1
Minuman sukan adalah lebih baik berbanding air biasa kerana ia membekalkan tenaga kepada tubuh/*Sports drink are better than water because they restore glycogen in muscles.*	Betul/*True*	53	75.7
Warna urin boleh digunakan sebagai indikator bahawa seseorang atlet itu mengalami dehidrasi/*Monitoring colour of urine is a way an athlete can judge whether she/he is dehydrated.*	Betul/*True*	51	72.9
Berpeluh berlebihan, rasa dahaga dan kekejangan otot adalah tanda-tanda dehidrasi/*Excessive sweating, thirst and cramping are signs of dehydration.*	Betul/*True*	70	100

Similarly, Table 4 demonstrates that for fluid intake habit, most participants had appropriate behavior towards most aspects of hydration except for salt tablets (27.1%), thirst indicator (28.6%) and timing of sports drink consumption (37.1%).

Table 4: Percentage of Proper Fluid Intake Behavior Regarding Hydration Practices among the Participants (N=70).

Statement	Proper habit	Frequency	Percentage (%)
Tablet garam mineral mengelakkan dehidrasi semasa latihan dan pertandingan/ *Salt tablets prevent dehydration during competition training.*	Tidak/*No*	21	30.0
Rasa dahaga merupakan indikator terbaik bagi kekurangan air dalam badan (dehidrasi)/*Thirst is the best indicator of dehydration.*	Ya/*Yes*	45	64.3
Dehidrasi mampu melemahkan prestasi atlet/*Dehidration decreases athletic performance.*	Ya/*Yes*	59	84.3
Atlet tidak sepatutnya mengambil minuman semasa sesi latihan/*Athletes should not drink fluids during training.*	Tidak/*No*	67	95.7
Jurulatih tidak sepatutnya membenarkan athlet mengambil minuman semasa latihan/*Coaches should not let the players to drink fluids during training.*	Tidak/*No*	67	95.7

Jurulatih tidak sepatutnya membenarkan atlet mengambil minuman semasa pertandingan./*Coaches should not let the players to drink fluids during competition.*	Tidak/*No*	66	94.3
Atlet sepatutnya mengambil minuman sukan dalam masa 2 jam selepas latihan/*Athletes should drink sports drink within 2 hours after exercise.*	Tidak/*No*	25	35.7
Minuman sukan adalah lebih baik berbanding air biasa kerana ia membekalkan tenaga kepada tubuh/*Sports drink are better than water because they restore glycogen in muscles.*	Ya/*Yes*	54	77.1
Warna urin boleh digunakan sebagai indikator bahawa seseorang atlet itu mengalami dehidrasi/*Monitoring colour of urine is a way an athlete can judge whether she/he is dehydrated.*	Ya/*Yes*	51	72.9
Berpeluh berlebihan, rasa dahaga dan kekejangan otot adalah tanda-tanda dehidrasi/*Excessive sweating, thirst and cramping are signs of dehydration.*	Ya/*Yes*	62	88.6

There were no correlations observed among USG, hydration knowledge and habits as shown in Table 4.5.

Table 5: Correlations between Urine Specific Gravity, Hydration Knowledge and Hydration Habits of the Participants (N=70)

	USG	Hydration Knowledge	Hydration Habit
USG	1.0	0.10	0.07
Hydration Knowledge	0.10	1.0	0.10
Hydration Habit	0.07	0.10	1.0

*significant at P<0.05

Discussions

The main findings of the present study suggest that the participants across gender had minimal dehydration despite showing good knowledge and practiced proper behavior towards hydration.

Both male and female athletes had mean USG of 1.020 ± 0.006 and 1.023 ± 0.009 respectively which indicated minimal dehydration (Armstrong, 2005). This finding was in agreement with Decher et al. (2008) who found that children (mean age 12 ± 2 years) who attended summer sports camp had high incidence of dehydration across the study period with USG ranging from 1.020 to 1.027. The authors concluded that despite having a generally good knowledge on hydration, it does not necessarily translate into proper hydration status among the children.

In terms of hydration knowledge, there was no significant difference in mean correct answer in both male (7.18 ± 1.17) and female (7.36 ± 0.63) student athletes. Scoring an average of 7 point out 10 can be considered as having good knowledge towards hydration.

Nevertheless, when referred to individual responses to items on hydration knowledge, this study reveals that the participants had misconception on the three following aspects which were on the use of tablet salts to prevent dehydration, inappropriate use of thirst as indicator for

dehydration and the need to consume sports drinks within 2 hours after exercise or training (Table 3). Likewise, Table 4 shows the similar result about the participants' habit toward these three aspects of hydration.

Salt tablet is believed to prevent dehydration by supplementing the body with electrolytes that retains the water in the body. Even though numerous research have been conducted on the use of salt tablets supplement in athletes, but the findings on its effectiveness to prevent dehydration is equivocal. Studies done by Speedy *et al.* (2003) and Hew-Butlet, Sharwood, Collins, Speedy and Noakes (2006) show that Ironman triathlon athletes who consumed salt tablets did not show any difference in serum sodium concentration compared to placebo. They suggest that salt tablet is suitable for use in events that concur heavy sweat loss in prolonged duration that is several hours or more.

On the other hand, Sims, Vliet, Cotter and Rehrer (2007) who conducted the sodium loading in eight endurance trained runners in the heat show that sodium supplementation helps to retain fluid balance, hence prevent dehydration. Similarly, Cosgrove and Black (2013) studied the sodium supplementation in 9 well trained athletes during cycling in the cool suggest that even though sodium supplementation did not improve time-trial performance, but it helps to maintain plasma sodium and osmolality within normal reference point, hence maintain the hydration status.

With regards to thirst as the best indicator for dehydration, there are also disagreement exist among the research findings. Perception of thirst has been used to assess hydration status (McGarvey *et al.*, 2008) but not as extensively as objective markers. Most data available suggest that thirst is a poor indicator of hydration because it lags behind the body mass loss, which only occurs when total body water reaches 1 to 2 % of body mass (Greenleaf & Harrison, 1986; Hubbard *et al.*, 1990).

Available data suggest that thirst is insufficient to promote fluid intake to maintain normal hydration during exercise (Greenleaf, 1992; Passe *et al.*, 2007). However, Noakes (2007) recommends that exercising man should drink as dictated by thirst to avoid gastrointestinal discomfort and medical complications. Since the view remains inconclusive, further work in the area of hydration, thirst and fluid intake are warranted. Indeed, perception of thirst may potentially be used in situations where instrumentations or technical expertises are unavailable (Armstrong, 2005), while at the same time provides the non-invasive alternative to individuals who may not like the invasive methods such as blood samples.

The present study also highlights points for consideration in terms of fluid consumption during exercise. There is a suggestion made by American College of Sports Medicine (Sawka *et al.*, 2007) and National Athletic Trainers' Association (Casa *et al.*, 2000) on sports drinks consumption during exercising for more than 1 hour. If they regularly exercise for more than 1 hour, sports drinks may be a better option for proper hydration during exercise because sodium and carbohydrate contents help to increase physiological drive to drink and to maintain blood glucose level, respectively.

Conclusions

In conclusion, despite having good knowledge and attitude towards hydration, the school children athletes came to the training session with inappropriate hydration status. Therefore, further intervention may be needed to ensure that they translate the knowledge that they have into proper drinking habit.

References

1. Armstrong, L. E. (2005). Hydration assessment techniques. *Nutrition Reviews, 63* (6), S40-S54.

2. Casa, D. J., Armstrong, L. E., Hillman, S. K., Montain, S. J., Reiff, R. V., Rich, B. S. E., et al. (2000). National Athletic Trainers' Association position statement: Fluid replacement for athletes. *Journal of Athletic Training, 25,* 212-224.

3. Chapman, P., Toma, R., Tuveson, R., & Jacob, M. (1997). Nutrition knowledge among adolescent high school female athletes. *Adolescence, 32,* 437-446.

4. Cosgrove, S. D & Black, K. E. (2013). Sodium supplementation has no effect on endurance performance during a cycling time-trial in cool conditions: a randomised cross-over trial. *Journal of International Society of Sports Nutrition,* 10 (30), 1-7.

5. Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16,* 297-334.

6. Decher, N. R., Casa, D. J., Yeargin, S. W., Ganio, M. S., Levreault, M. L., Dann, C. L., et al. (2008). Hydration status, knowledge and behaviour in youths at summer sports camps. *International Journal of Sports Physiology and Performance, 3,* 262-278.

7. Greenleaf, J. E (1992). Problem: thirst, drinking behaviour and involuntary dehydration. *Medicine and Science in Sports and Exercise, 24* (6), 645-656.

8. Hew-Butler, T. D., Sharwood, K., Collins, M., Speedy, D., & Noakes, T. (2006). Sodium supplementation is not required to maintain serum sodium concentrations during an Ironman triathlon. *British Journal of Sports Medicine,* 40(3), 255-259.

9. Hubbard, R.W., Szlyk, P.C., & Armstrong, L. E. (1990). Influence of thirst and fluid palatability on fluid ingestion during exercise. In C. V. Gisolfi, & D. R. Lamb (Eds.), *Perspectives in Exercise Sciences and Sports Medicine. Fluid Homeostasis During Exercise* (pp. 39-95). Indianapolis, IN: Benchmark Press.

10. McGarvey, J., Thompson, J., Hanna, C., Noakes, T. D., Stewart, J., & Speedy, D (2008). Sensitivity and specificity of clinical signs for the assessment of dehydration in endurance athletes. *British Journal of Sports Medicine*. doi: 10.1136/bjsm.2008. 053249.

11. Nichols, P. E., Jonnalagadda, S. S., Rosenbloom, C. A., & Trinkaus, M. (2005). Knowledge, attitude and behaviours regarding hydration and fluid replacement of collegiate athletes. *International Journal of Sport Nutrition and Exercise Metabolism, 15,* 515-527.

12. Noakes, T. D. (2007). Hydration in the marathon: using thirst to gauge safe fluid replacement. *Sports Medicine, 37,* 463-466.

13. Oppliger, R. A., & Bartok, C. (2002). Hydration testing of athletes. *Sports Medicine, 32,* 959-971.

14. Passe, D. H., Horn, M., Stofan, J., Horswill, C., & Murray, R. (2007). Voluntary dehydration in runners despite favourable conditions for fluid intake. *International Journal of Sport Nutrition and Exercise Metabolism, 17,* 244-295.

15. Sawka, M. N., Burke, L. M., Eichner, E. R., Maughan, R. J., Montain, S. J., & Stachenfeld, N. (2007). American College of Sport Medicine Position Stand: Exercise and fluid replacement. *Medicine & Science in Sports & Exercise, 39* (2), 377-390.

16. Shifflett, B., Timm, C., & Kahanov, L. (2002). Understanding of athletes' nutritional needs among athletes, coaches and athletic trainers. *Research Quarterly for Exercise and Sport, 73*, 357-362.

17. Sims, S. T., Vliet, L., Cotter, J. D., & Rehrer, N. J. (2007). Sodium loading aids fluid balance and reduces physiological strain of trained men exercising in the heat. *Medicine & Science in Sports & Exercise*. DOI: 10.1249/01.mss.0000241639.97972.4a

18. Speedy, D. B., Noakes, T. D., Kimber, N. E., Rogers, I. R., Thompson, J. M. D., Boswell, D. R., et al. (2001). Fluid balance during and after an Ironman Triathlon. *Clinical Journal of Sport Medicine, 11*, 44-50.

19. Soo, K., & Naughton, G. (2007). The hydration profile of female cricket players during competition. *International Journal of Sport Nutrition and Exercise Metabolism, 17,* 14-26.

20. Zawila, L., Steib, C., & Hoogenboom, B. (2003). The female collegiate cross-country runner: nutritional knowledge and attitudes. *Journal of Athletic Training, 38,* 67-74.

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