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Knowledge, Attitudes and Practices on Hydration and Fluid Replacement among Endurance Sports Athletes in National University of Malaysia (UKM)

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Abstract: The aim of this study was to determine knowledge, attitudes and practices on hydration and fluid replacement among endurance sports athletes in Universiti Kebangsaan Malaysia (UKM). This study was also to identify the relationship among these parameters. A total of 80 UKM endurance sports athletes were involved in this study. Data collection was conducted using anthropometric measurements and questionaires. Anthropometric measurements included height, weight and body composition using bioimpedance method. Socio-demographic information, hydration knowledge, attitudes and practices were collected using questionnaires. The mean age of athletes was 22.0±2.6 years. The mean score for knowledge, attitudes and practices of subjects towards hydration was 74.1±10.1, 60.9±20.3 and 76.1±14.6%, respectively with higher scores indicating positive hydration knowledge, attitudes and practices. Knowledge did not show a significant correlation with practices ($r = 0.126$, $p>0.05$) but significant correlation with attitudes ($r = 0.285$, $p<0.05$). However, attitudes showed a positive significant correlation with practices ($r = 0.421$, $p<0.01$). Most athletes correctly answered the general hydration questions on the survey but under the assumption regarding usage of salt tables to avoid hydration and thirst is the best indication for dehydration. They are also lacked knowledge regarding appropriate use of sports drinks. The mean score of knowledge, attitudes and practices for subjects with previous nutrition education was not significantly different compared to subjects without nutrition education ($p>0.05$). Only the mean score of knowledge was significantly different between male and female ($p<0.05$). Improvement of hydration knowledge, attitudes and practices is the most relevant step to ensure the hydration level of athletes is at its optimum level during training and competition. The results of this study identify specific areas of education for athletes with regard to hydration.

Key words: Athletes, fluid intake, nutrition knowledge

INTRODUCTION

The term endurance sports are sports that use energy and high speed for long periods of time (Coyle, 1999). Available energy will also be oxidized through the process of energy metabolism in the presence of oxygen. Thus, the ability of athletes is required to carry sufficient amounts of oxygen to the muscles to support their physical activities. The main factor of concern for endurance sports is the maximum oxygen consumption (VO_2 max) which plays an important role in maintaining the performance of athletes in endurance sports (Joyner and Coyle, 2008). In addition to that, endurance sports usually takes a long duration of 2 to 3 hours to complete. UKM's athletes, specifically those involved in various types of training and competitions would be exposed to the risk of hydration. In order to perform well during competition without any problems, therefore, knowledge, attitudes and practices of hydration would be made able to prevent athletes from suffering the risk of injury. Hydration is a very important requirement for every athlete in the world of sports. According to Grandjean and Campbell (2004), hydration is very important but it is often becomes an overlooked aspect of nutrition. Thus, contrary to the problem of hydration is dehydration, which is caused by several factors such as age, physical activity level, climate and altitude.

According to Dunford and Doyle (2008), dehydration is very critical to any football team player. To maintain a level of physical activity and prevent dehydration, every athlete requires water intake before, during and after exercise. This is due to high loss amount of water and electrolytes and the lack of energy sources replacement will interfere with the performance level and the regulation of body temperature among athletes (Berning, 2002). Mountain and Coyle (1992) reported a reduction in the amount of water in the body with at least 2% can affect the level of cardiovascular and reaction of temperature regulation and ultimately will reduce the performance level of training. Recommendations are made on proper hydration by organizations such as the

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National Athletic Trainers' Association (NATA) and the American College of Sports Medicine (ACSM) to help protect athletes from heat illness. Both the ACSM and NATA recommend fluid replacement before, during and after exercise (Casa *et al*., 2000; Convertino *et al*., 1996). Despite the prime importance of hydration in human body, there are still few athletes who participate in competitions and training in a state of dehydration. Finn and Wood (2004) reported that 87% of athletes participating in international competitions such as volleyball, basketball and football in a state of dehydration. During athletes' training and competition, the water content in their bodies would be reduced and this needs to be reversed to avoid the occurrence of dehydration. Replacement of fluids in the body is important because the effects of dehydration is very dangerous. Normally, the effects of dehydration can be seen with the occurrence of symptoms such as thirst, muscle cramps, dizziness, nausea, vomiting and difficulty breathing (Binkley *et al*., 2005).

Knowledge, attitude and practice are closely inter-related as a good level of knowledge would have a deep impact on attitudes and practices of athletes' hydration. Therefore, each athlete must be provided with adequate hydration knowledge to enable it be applied throughout their involvement in the world of sports. Thus, education could increase the athletes' nutrition knowledge and, potentially, improve their practice. Accordingly, the study to assess the knowledge, attitudes and practices toward hydration was conducted to determine the extent to which UKM's athletes involved in various types of endurance sports with different levels of physical activity that puts the interests of adequate water intake during their training. In addition, the relationship between the variables studied, ie knowledge, attitudes and practices of hydration was also identified. The findings of this study were useful to the management of UKM Sports Center to develop and plan a strategic approach that could improve the quality of athletes sports in UKM.

MATERIALS AND METHODS

Sampling and study location: The study subjects comprised 80 male and female athletes aged between 19 to 30 years. In this study, athletes from various endurance sports such as football, rugby, volleyball, cricket, hockey, netball and futsal have been identified to be involved in this study. The selected subjects shall be UKM's endurance sports athletes with excellent health records who often represent UKM competitions. The study was carried out within UKM locations where the athletes undergoing their training. Approval was obtained from the sports director of UKM to carry out research on UKM's endurance sports athletes.

Data collection: The involvement of all parties is required especially managers and team captain for each type of sports involved. Approval by the subjects have been obtained and their participation should be voluntary. Brief description of the study and the necessary information required to be filled-up were provided to facilitate the subjects when answering the questionnaires. Data collection was done through anthropometric and body composition measurements as well as questionnaires. All subjects underwent anthropometric measurements of weight and height as well as body composition, followed by filling-up the questionnaires. The questionnaires include socio-demographic information, knowledge, attitudes and practices of hydration.

Height without shoes was measured to the nearest 0.1 cm using the SECA body meter 208 (SECA, Hamburg, Germany). Body weight was directly measured using the weighing function of a Tanita TBF-300A body fat analyzer (Tanita Corp., Japan) to the nearest 0.1 kg simultaneously with body composition, from which body mass index (BMI) was computed as body weight (kg) divided by height (m) squared. The weight of the clothing was deducted during the measurement. In order to obtain an accurate data set, the subjects were briefed on the experimental protocol, which included fasting for 12-14 h, not conducting any heavy physical activity the previous day and ensuring they were in normal hydration status.

A questionnaire was used to collect data age, faculty, marital status, gender, race, types of sports participated and nutrition education particularly in hydration which had been attended. Questionnaires on knowledge, attitudes and practices on hydration and fluid replacement used were based on Nicholas *et al*. (2005), with minor modifications. One question concerning alcohol consumption was removed from the original survey. The knowledge section is contained true/false statements while the attitude section using a 5-point Likert scale (strongly agree to strongly disagree) and for the practice section contained yes/no statements. There were 17 questions on the knowledge, 17 questions on the attitude and 16 questions on the practice of hydration.

Data analysis: The recorded data was analyzed using the Statistical Package for the Social Sciences version 20.0 (SPSS Inc, Chicago, IL, USA). Descriptive tests include the mean, standard deviation and frequency. Frequency analysis was calculated for each question in individual section of knowledge, attitude and practice using percentages of correct versus incorrect answers in the knowledge section (true/false), positively versus negatively answered questions in the attitude (agree/disagree) and practice sections (yes/no). If an answer in the knowledge section was correct, it was scored as 1. If incorrect, the score was 0. The positive responses in the attitude section were scored as 1 and

negative responses were scored as 0. Proper answers were scored as 1 and poor practices were scored as 0. Mean scores were calculated for knowledge, attitude and practice sections. Pearson correlation test was used to determine the relationship between knowledge, attitude and practice of hydration. The independent t-test was used to determine significant differences in anthropometric characteristics, body composition, mean score of knowledge, attitude and practice of hydration between male and female subjects. The mean score of knowledge, attitude and practice of hydration between subjects who had participated in formal nutrition education and non-formal ones were determined using independent t-test. Significance level was set at $p<0.05$ for all analysis.

RESULTS AND DISCUSSION

Profile of subjects: Table 1 shows the demographic characteristics of subjects. A total of 80 subjects from UKM's endurance sports athletes involved in the study and responded to questionnaires that were distributed. The results show that almost all subjects were Malay totaling 79 (98.8%) and only one subject is Chinese (1.3%). Age profile shows that the majority of subjects aged 22 to 25 years (57.5%) with an overall mean age of subjects was 22.0±2.6 years. The majority of subjects involved in this study was from the Faculty of Education, i.e., 50 subjects (62.5%), followed by other faculties with minimal involvement. Currently, Faculty of Education offers Sports and Recreation Program with the most athletes were from this program.

The highest percentage shown by the subjects of futsal (40%) followed by cricket (23.8%), hockey (16.3%), basketball (11.3%) and soccer (8.8%). The number of subjects' involvement in the futsal sport was higher compared to other sports due to the involvement of male and female subjects in this type of sport. The results also showed that 44 (55%) of the 80 subjects had received formal nutrition education. A formal nutrition education was provided to students of Sports and Recreation Program in their 6th semester.

Anthropometric characteristics: Based on Table 2, as expected, the results showed the majority of subjects had normal weight (76.3%) because subjects involved were athletes. Frequency of physical exercises in addition to training for long periods caused the majority of subjects had normal body weight. A total of 7.5% of the subjects were categorized as underweight and overweight (12.5%). However, there were also subjects in the obese category, with a total of 3.8%. This was probably due to factors such as subjects being positioned as goalkeepers or involved in activities that do not involve much movement and running.

Table 3 shows, the mean of height and weight for male and female subjects were 169.9±10.6 cm vs 162.9±9.3 cm and 65.7±10.6 vs 54.4±9.3, respectively. The body fat percentage for male and female subjects was 10.1±4.2% and 17.2±4.3, while lean body mass was 57.7±8.2 and 45.1±8.5 kg, respectively. The overall mean of BMI was recorded at 22.0±3.5 kg/m^2 and according to the WHO classification (2000), these values are categorized as normal. Male subjects had weight, height and BMI which were significantly higher than female subjects ($p<0.05$). However, in terms of body composition, male subjects showed lower body fat ($p<0.05$) and higher lean body mass ($p<0.05$) than female subjects. Thus, this finding clarifies that male subjects have better body composition compared to female subjects.

Knowledge, practice and attitude: Table 4 shows the mean score of knowledge, attitudes and practices on

Table 1: Demographic characteristics of study subjects

Profile	Number (n)	Percentage (%)
Race		
Malay	79	98.8
Chinese	1	1.3
Age		
18-21	30	37.5
22-25	46	57.5
28-32	4	5.0
Gender		
Male	55	68.8
Female	25	31.3
Faculty		
Education	50	62.5
Others	30	37.5
Type of sports		
Soccer	7	8.8
Futsal	32	40.0
Hockey	13	16.3
Cricket	19	23.8
Netball	9	11.3
Previous nutrition education		
Yes	44	55.0
No	36	45.0

Table 2: Distribution of subjects according to BMI category

BMI category	Number (n)	Percentage (%)
Underweight	6	7.5
Normal	61	76.3
Overweight	10	12.5
Obese	3	3.8

Table 3: Anthropometric characteristics and body composition according to gender

	Gender		
	Male (n = 55)	Female (n = 25)	Total (n = 80)
Parameters	Mean±SD	Mean±SD	Mean±SD
Weight (kg)	65.7±10.6	54.4±9.3*	62.2±11.4
Height (cm)	169.9±5.9	162.9±7.7*	167.7±7.3
Body mass index (BMI)	22.8±3.6	20.4±2.3*	22.0±3.4
Body fat (%)	10.1±4.2	17.2±4.3*	7.7±4.1
Lean body mass(kg)	57.7±8.2	45.1±8.5*	53.7±10.1

*Significantly difference at $p<0.05$

Table 4: Subjects' mean score of knowledge, attitude and practice on hydration and previous nutrition education

	Gender		Previous nutrition education		
	Male (n = 55) Mean±SD (%)	Female (n = 25) Mean±SD (%)	Yes (n =) Mean±SD (%)	No (n =) Mean±SD (%)	Total (n = 80) Mean±SD (%)
Knowledge	76.0±8.6	69.9±11.8*	73.8±9.9	74.5±10.5	74.1±10.1
Attitude	62.2±21.5	58.1±17.2	59.1±1946	60.3±9.3	60.9±20.3
Practice	77.7±14.0	72.5±15.5	77.9±14.0	73.5±15.2	76.1±14.6

*Significantly difference at p<0.05

Table 5: Athletes responses to knowledge questions regarding hydration and fluid replacement (n = 80)

	Percentage	
Statement	True	False
Using salt tablets keeps athletes from getting dehydrated during training and competition	83.8	16.3
Thirst is the best indicator of dehydration	90	10
Dehydration decreases athletic performance	82.5	17.5
An athletes should not drink water or fluids during practice	7.5	92.5
Coaches should not let players drink fluids during practice	6.2	93.8
Coaches should not let players drink fluids during competition	8.8	91.3
It is important for fluids to be readily available to athletes during practice	100	0.0
It is important for fluids to be readily available to athletes during competition	100	0.0
Athletes should drink a sports drinks within 2 hours after exercise	71.3	28.7
Sports drinks are better than water because they restore glycogen in muscles	83.7	16.3
An athlete should drink 17-20 fluid ounces. of water or sports drink a couple of hours before exercise	81.3	18.7
An athlete should drink 7-10 fluid ounces 10-20 min before competition	77.5	22.5
When exercising more than one hour, an athlete should drink sports drinks rather than water	66.3	33.8
By monitoring color of urine, an athlete can judge if he/she is dehydrated	73.8	26.3
A good way for an athlete to determine how much water or sports drink to consume after practice is to weigh before and after practice	70.0	30.0
Excessive sweating, thirst and cramping are signs of dehydration	87.5	12.5
More than 2 drinks of alcohol the day before practice and/or competition can lead to dehydration	62.5	37.5

Table 6: Athletes responses to attitude questions regarding hydration and fluid replacement (n = 80)

	Percentage (%)		
Statement	A/SA*	UD*	DA/SDA*
I believe using salt tablets will keep me from getting dehydrated during training and competition	75	21.3	3.7
I believe I can rely on thirst alone as an indicator of dehydration	38.8	32.5	28.8
I believe dehydration decreases my athletic performance	73.8	15.0	11.3
I believe no water of fluids should be consumed during practice	15.0	7.5	77.5
I believe my coach should not let our players drink any fluids during practice	18.8	15.0	66.3
I believe my coach should not let our players drink any fluids during competition	22.5	12.5	65.0
I believe fluid should be readily available to me during practice	71.3	15.0	13.8
I believe fluids should be readily available to me during competition	78.0	15.0	6.3
I believe I should drink a sports drink within 2 hours after exercise	62.5	27.5	10.0
I think sports drinks are better than water because they restore glycogen in muscles	67.5	27.5	5.0
I think I should drink 17 to 20 fluid ounces of water or sports drink a couple of hours before competition	73.8	22.5	3.8
I believe I should drink 7 to 10 fluid ounces of water or sports drink 10-20 min before competition	65.0	21.2	13.8
I believe when exercising for more than an hour, I should drink a sports drink rather than water	68.8	26.3	5.0
I believe by monitoring the color of my urine, I can judge if I am dehydrated	58.8	31.2	10.0
I believe weighing myself before and after practice is a good way to determine how much fluid I lost	55.0	30.0	15.0
I believe excessive sweating, thirst and cramping are signs of dehydration	72.4	23.8	3.8
I believe drinking more than 2 drinks of alcohol the day before competing can lead to dehydration	46.3	41.3	12.4

*A/SA: Agree/Strongly agree, UD: Undecided, DA/SDA: Disagree/Strongly disagree

hydration according to gender and nutrition education courses attended. Subjects managed to get 12.6±1.7 nutrition knowledge score of the total score of 17 marks and is equivalent to a score of 74.1±10.1%. For the attitude of subjects on hydration, the score obtained is 10.4±3.4 of the total score of 17 marks with a relatively low percentage score of 60.9±20.3%. As for the practice of hydration, subjects managed to score 12.2±2.3 of the number of full marks ie 16 marks where the percentage score obtained is higher than the level of knowledge and attitude of 76.1±14.6%. The mean score of knowledge, attitude and practice of subjects obtained by Nicholas *et al.* (2005) is 81.8, 57.6 and 72.9%, respectively. When compared to the finding by Nicholas *et al.* (2005), the mean score of subjects' knowledge for this study was lower, but the mean score of attitude and practice was higher. Comparison by gender shows a significant difference in mean score or knowledge between male and female subjects but not for the mean score of attitude and practice. It is important to note that only a minimal research on knowledge, attitude and practice regarding hydration and fluid replacement of athletes being conducted so far. Thus, comparing results with other studies is difficult and inappropriate due to the fact

Table 7: Athletes responses to behaviour questions regarding hydration and fluid replacement (n = 80)

	--------Percentage(%)--------	
Statement	True	False
I use salt tablets to keep from being dehydrated when training and competing	60	40
I use thirst alone as a way to tell if I am dehydrated	46.3	53.8
I drink plenty of fluids so my athletic performance will not decrease due to dehydration	90	10
I do not drink water or some type of fluid during practice	13.8	86.3
My coach does not allow me to drink fluids during practice	10	90
My coach does not allow me to drink fluids during competition	5.0	95.0
Fluids are readily available to me during practice	91.3	8.8
Fluids are readily available to me during competition	90.0	10.0
Within 2 hours after exercise, I drink a sports drink	67.5	32.5
I drink sports drinks rather than water to restore glycogen in my muscles	77.5	22.5
I drink approximately 17 to 20 fluid ounces of water or sports drinks a couple of hours before competition	77.5	22.5
I drink at least 7 to 10 fluid ounces of water or sports drink 10-20 min before the game	78.8	21.3
I drink sports drinks rather than water when competing for more than 1 h	68.8	31.3
I use the color of my urine to determine if I am dehydrated	70	30.0
I weigh myself before and after practice to see how much weight I have lost from sweating and use this to determine how much water or sports drink to consume	53.8	46.3
I use excessive sweating, thirst and cramping to warn me if I am getting dehydrated	86.3	13.8

Table 8: Correlation coefficients between knowledge attitude and practice scores

	Knowledge score	Attitude score	Practice score
Knowledge score	1	0.285*	0.126
Attitude score		1	0.421**
Practice score			1

**Significantly correlated at p<0.01, *Significantly correlated at p<0.05

that this study focuses more on hydration and fluid replacement in addition to the broad area of general nutrition covered in previous studies.

T-test results had found no significant difference in the mean score of knowledge, attitude and practice of hydration between subjects who received formal nutrition education and non-formal ones. Regardless, the formal nutrition education attended by some subjects are still not able to influence their level of knowledge on hydration. According to Chapman and Amstrong (1997), education can improve the nutrition knowledge of the subjects and thus able to improve their practice. Furthermore, Cupisti *et al.* (2002) suggests that adequate nutrition knowledge can improve poor forms of dietary behaviors. Although nutrition education is used to increase knowledge of an athlete, nutrition knowledge does not always translate into behavior change.

Knowledge: Table 5 presents the responses to individual knowledge questions by subjects. None of the subjects were able to answer all questions correctly on nutrition knowledge. A total of 27 subjects (34%) had a score of more than 14 out of 17, equivalent to 82%. Questions 7 and 8 were answered by all subjects correctly. The question is concerned with general knowledge on the importance of water during training sessions and competition. This indicates subjects of this study recognize the importance of water during training sessions and competition.

One specific area of hydration and fluid replacement in which many of the subjects demonstrated poor knowledge were in questions 1 and 2. For question 1, a total of 83.8% of the subjects were under the assumption that salt tablets keeps them from getting dehydrated during training and competition and whereas for question 2, most of the subjects (90%) did not know that thirst is not the best indicator of dehydration. In addition, there are several aspects of knowledge regarding hydration were answered correctly by more than 90% of subjects. For example, on questions 4, 5 and 6, the percentage of those who answered correctly was high, i.e., 92.5, 93.8 and 91.3%, respectively. From these results, it was seen that subjects' knowledge and awareness on the importance of drinking during training was at a high level.

In addition, knowledge concerning sports drinks and appropriate amount of water intake showed the percentage is somewhat different. For example, questions 9, 10, 11, 12 and 13, the percentage was around 66 to 84% was recorded for all questions. For questions 11 and 12, a total of 81.3 and 77.7% of subjects, respectively knew the amount of drink that should be taken before the competition as suggested by NATA and ACSM. Based on question 13, a lower percentage of subjects (66.3%) knew that sports drinks should be taken during training with duration of more than 1 h.

In terms of subjects' knowledge regarding signs of dehydration and a good way to determine how much water or sports drink to be taken after a training, based on questions 14, 15 and 16, the percentage who answered, correctly were 73.8, 70.0 and 87.5%, respectively. This indicates that most of the subjects were able to monitor for signs on their bodies when dehydration occurs. The results also show that most of the subjects knew that excessive sweating, thirst and cramps are signs of dehydration as compared to

only urine color. However, based on question 17, most of the subjects were not so aware of the dangers of consuming alcohol can lead to dehydration. As only the small percentage of subjects (62.5%) who answered correctly.

Attitude: Responses to the attitude statements are reported in Table 6. A high percentage recorded in question 8 (78.8%) indicates the subject emphasizes on the importance of water during competition. However, question 7 obtains a lower score that which 71.3% agreed that water should be readily available during the training. A total of 62.5% of the subjects (question 9) agreed that they should take sports drink after 2 h of training. This hydration process is very important for them to enable to cope with the further training and competition. A slightly higher percentage listed in question 10, namely 67.5% agreed that sports drinks are better than plain water because it restores glycogen in the muscles. This type of drink is important because glucose present in the body have been used during the training and competition. Thus, the energy sources replacement needs to be done to meet the next energy needs.

There is a small percentage of 10.0% of subjects who did not agree on the need to take sports drink 2 h after exercise, while 5.0% of subjects did not agree that sports drinks are better than plain water because it stores glycogen in the muscle. The Sports Center of UKM should emphasize on the advantages gained from taking sports drink among UKM athletes because there were about 27.5% of them who are not sure of the information stated in questions 9 and 10. In addition, to educate athletes about the appropriate use of these sports beverages, coaches, athletic trainers and sports nutritionists would have a responsibility to ensure that athletes engaged in endurance sports consume these beverages.

However, for question 11, almost three-quarter of the subjects (73.8%) agreed that they should take as much as 500 to 600 ml of water or sports drink 2 h before the competition. This coincided with the actual recommendations in which the subject should take water to the amount of 500 ml to 600 ml before a competition. However, a lower percentage obtained for question 12 with a total of 65.1% of subjects agreed that they should drink about 200 ml to 300 ml of water, 10 to 20 min before the game.

Additionally, for questions 16, a total of 72.4% of the subjects believe that excessive sweating, thirst and cramps are signs of dehydration. This attitude is very important for subjects as to how they can detect the causes of dehydration and can avoid those problems. For question 14, a total of 58.8% of subjects believe by looking at the color of their urine, they were able to determine that they are dehydrated or not, while the rest were either unsure (31.3%) and disagree (10.1%). The percentage who agrees on question 14 is slightly lower compared with question 15 where only 55.5% of the subjects agree the best way to assess how much water loss after exercise is to weigh yourself before and after exercise. Based on the results of questions 14 and 15, the subject is still visibily lack of exposure on the signs of dehydration and on how to assess the amount of water loss after training. However, the attitude of subjects on dangers of drinking alcohol is very low because only 46.3% of subjects who agree that taking more than two alcoholic drinks a day before training or competition can lead to dehydration. Although the possibility of many subjects do not take alcohol, but the awareness on its negative side which can cause dehydration should be emphasized to the subjects concerned.

Practice: Table 7 showed a high percentage of subjects, above 90% who answered correctly questions on the practice of hydration in questions 3, 5, 6, 7 and 8. For example, for question 3, approximately 90% of subjects are taking water so their performance does not decrease. Questions 5 and 6 concerning the coach does not allow athletes to take a drink during training and competition, respectively, thus helped to raise the subject of hydration practices score as both statements were not agreed to by more than 90% of subjects. For questions 7 and 8, a total of 91.3 and 90% subjects, respectively have reported that drinking water is readily available during training and competition and thus, encourages the practice of water intake by the subjects during training.

For question 2, a total of 46.3% of the subjects use thirst alone as a sign of dehydration. Subjects should not use thirst alone as a sign that they are dehydrated. In addition, on question 10, it was found that almost one-quarter (22.5%) of subjects did not follow the recommendations issued by NATA and ACSM on the use of sports drinks over plain water which seeks to restore glycogen in their muscles. There was 68.8% of the subjects (question 13) reported taking a sports drink when undergoing training for more than 1 h. Felder *et al*. (1998) found that only half (50%) of the subjects take sports drinks, 20% take sports drinks during training and 40% drink alcoholic beverages during the competition. In addition, Nicholas *et al*. (2005) reported a total of 46.3% of the subjects did not use sports drink after they undergo training sessions and competition.

Result for question 11 found that 77.5% of the subjects are practicing the correct drinking pattern of 500-600 ml of water or sports drink 2 h before the competition.

Question 12 found a total of 78.8% drink 200-300 ml of water, 10 to 20 min before the game. The percentage who do not practice proper water intake 20 min before the competition is just about one-fifth of the number of subjects studied. In question 15, approximately half of the subjects (53.8%) consider their body weight before and after exercise to determine how much weight lost by sweating and use it to determine the volume of water or sports drink that should be taken. It is different with question 16 which found that majority of subjects (86.3%) used excessive sweating, thirst and dehydration cramps as signs of dehydration and only 13.8% do not adopt such practices. A study by Nicholas *et al*. (2005) found that a higher percentage of subjects (21.6%) who were not using excessive sweating, thirst and cramps as signs of hydration. While the use of the color of urine as a sign of dehydration is also practiced by some 70% of the subjects in this study to determine their dehydration status.

Relationship between knowledge, attitude and practice: From Table 8, it was found that knowledge has a significant positive relationship and weak with attitudes ($r = 0.285$, $p<0.05$) but no significant relationship with the practices ($r = 0.126$, $p>0.05$). This means that the higher the level of knowledge of subjects, the better their attitude, but knowledge does not influence the subjects on the practice of hydration. The results of this study demonstrate attitudes have significant positive and moderate relationship with practices ($r = 0.421$, $p<0.01$). Attitudes towards good hydration can improve practice among subjects in this study. Nicholas *et al*. (2005) also showed a significant relationship between knowledge with attitudes ($r = 0.38$, $p<0.05$) and practices ($r = 0.46$, $p<0.05$) and between attitudes and practices ($r = 0.22$, $p<0.05$). Improved practices and attitudes should be in line with the increasing knowledge of hydration. Therefore, the low mean score specifically the attitude of subjects on hydration should be taken due attention.

Conclusion: The mean score for knowledge of hydration among subjects was 74.1±10.1% higher than the mean score of 60.9±20.3% for attitude but lower than the mean score of 76.1±14.6% for practice. Knowledge scores did not correlate with scores of practice ($r = 0.126$, $p>0.05$) but significantly correlated with attitude ($r = 0.285$, $p<0.05$). In addition, the attitude score was also significantly correlated to the practice of subjects ($r = 0.458$, $p<0.01$). In general, athletes in this study had adequate knowledge on hydration and fluid replacement but under the assumption that salt tablets prevent dehydration during training and competitions and thirst is the best indicator of dehydration. Besides, they also did not practice the knowledge they reported. Level of hydration knowledge, attitude and practice among UKM's endurance sports athletes need to be further enhanced to produce athletes who are concerned about the high level of hydration and able to withstand a long period of training and competitions. UKM's Sports Centre should play a role in designing and conducting courses relevant to hydration to all UKM athletes regardless of sports fields. In addition, UKM Sports Centre should create an environment that will encourage positive attitudes and practices such as monitoring each venue being used and to make sure the cooling water engine provided at the training ground is functioning properly to ensure athletes practice their existing knowledge wisely.

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