Original Article

Knowledge, attitudes and behaviours regarding hydration and hydration status of Malaysian national weight category sports athletes

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Abstract:

Problem statement: Dehydration not only may decrease sports performance, it may also put athletes at risk of heat illness and injury. Heat illnesses such as heat cramp and heat stroke are life threatening. Weight category sports athletes are frequently in a state of dehydration as they restrict fluid intake to ensure their body weight within the weight division. Purpose: A cross-sectional study was conducted to ascertain the knowledge, attitudes, and behaviours regarding hydration and hydration status of Malaysian national weight category sports athletes. Approach: A total of 60 weight category sports athletes from the National Sports Institute of Malaysia, aged between 16 and 35 years, participated in this study. Results: This study demonstrated that the mean percentage score for knowledge, attitudes, and behaviours were $68.04 \pm 13.97\%$, $75.06 \pm 8.17\%$, and $75.78 \pm 13.79\%$, respectively. The mean value of urine specific gravity was 1.027 ± 0.01 g/ml, which indicated significant dehydration. Gender was significantly associated with percentage of body weight changes ($p=0.035$), with all females in the hydrated category. The knowledge score was significantly correlated with the attitude score ($r=0.459$, $p<0.001$) and percentage of body weight changes ($r=0.306$, $p=0.018$). The knowledge score was significantly different between athletes from different types of sports ($F=5.202$, $p=0.001$), age groups ($F=3.793$, $p=0.015$), and education levels ($F=3.319$, $p=0.043$). Furthermore, the behaviours score was significantly different among athletes from different age groups ($F=3.382$, $p=0.024$). The mean percentage of body weight changes was significantly higher among males compared to females ($t=3.187$, $p=0.002$), and significantly different between athletes from different types of sports ($F=12.096$, $p<0.001$). Conclusions: The findings of this study identify the need for new learning strategies for athletes to improve their knowledge, attitudes, and behaviours with regards to hydration.

Key words: knowledge, attitudes, behaviours, hydration, athletes.

Introduction

The need for water surpasses the need for food sources to survive. A deficiency in food nutrients may take weeks, months, or even years to develop, whereas people may only survive up to a few days without water (Whitney & Rolfes, 2008). Thus, water balance and the maintenance of hydration in the body are crucial.

During physical activity, evaporation is the principal mechanism of heat dissipation, as the body loses water via breathing and perspiration. The evaporation of sweat from the skin's surface facilitates the body in regulating core temperature. If there is insufficient evaporation of sweat from the skin's surface, the core temperature will increase abruptly (Casa et al., 2000). Hence, dehydration or heat illness becomes a threat for athletes.

Fluid balance maintenance and being well hydrated are vital to athletes' performance and thermoregulation (Decher et al., 2008). Since dehydration intensifies the risk of potentially life-threatening heat illness, athletes should practice euhydration before, during, and after exercise. "Making weight" may lead an athlete to dehydration, as making weight is considered an advantage for a specific sport or event. It is a practice where the athletes swiftly decrease their body weight by decreasing their calorie intake, practicing self-induced dehydration, or taking laxatives (American Dietetic Association, 2009). It is usually observed in weight category sports such as boxing, wrestling, and power lifting, where athletes intentionally dehydrate themselves in order to compete in lower weight classes, and they perceive it as an advantage (American College of Sports Medicine, 2007).

There is paucity of studies on athletes' knowledge, attitudes, and behaviours regarding hydration and the hydration status of weight category sports athletes. Hence, understanding the knowledge, attitudes, and

behaviours of athletes regarding hydration plays a crucial role in the management of dehydration. This study was undertaken to evaluate the hydration status of weight category sports athletes at the National Sports Institute of Malaysia and to explore their knowledge, attitudes, and behaviours regarding hydration.

Method

Participants and study design

This study was conducted among weight category sports athletes aged between 16 and 35 years in the National Sports Institute of Malaysia. A total of 60 respondents who fulfilled the inclusion and exclusion criteria were recruited. There were 16 sports registered under six categories: team sports (e.g., hockey); cycling or endurance (e.g., athletic); power and strength (e.g., weight lifting); skills (e.g., bowling); racquet (e.g., badminton), and combat sports (e.g., silat). Combat sports, power, and strength categories (taekwondo, silat, boxing or tinju, karate, and weightlifting) were selected, as athletes were competing based on their weight class. Athletes in weight category sports were classified based on their body mass and if they competed in their weight category. Hence, it was well recognized that athletes were prone to practicing making weight in order to achieve an advantage in one-on-one combat.

Purposive sampling was employed in selecting the sports category, explicitly weight category sports. All athletes in weight category sports were invited to participate in the study (fig. 1).

Fig. 1. Weight category sports

A minimum sample size of 44 was needed based on the sample size calculated using the formula by Cole (1997). A significant correlation value between behaviour and knowledge scores of 0.4 was applied (Nichols et al., 2005). A total of 60 respondents were recruited to cater to the possibility of non-responses. Malaysian national weight category sports athletes who attend training during data collection from January to March 2014 were included. Injured athletes were excluded.

Measurement

The respondents were requested to answer the research questionnaires, and their hydration status was based on urine specific gravity and percentage of body weight changes. The questionnaire was adapted from a study conducted by Nichols and colleagues (2005), with permission obtained through email on October 26, 2013. The questionnaire consisted of three parts that were translated into the Malay Language and pre-tested. Part I was mainly about the socio-demographic background, whereas part II probed the knowledge, attitudes, and behaviours regarding hydration. Furthermore, it also comprised the questions regarding patterns of weight control behaviours ("making weight"). In addition, part III was meant to assess the hydration status of the respondents.

Part I: Socio-demographic Background

- To obtain data on demographic information such as respondents' age, gender, education level, and household income of the weight category sports athletes.

Part II: Knowledge, attitudes, and behaviours questionnaire and pattern of weight control behaviours ("making weight") questionnaire among weight category sports athletes

- Section A (knowledge section) comprised 17 true/false statements, where 1 point was provided for every correct answer and 0 points for wrong answers.

- Section B (attitude section) comprised 17 questions on a five-point Likert scale (strongly agree to strongly disagree). For positive statements, 5 marks were provided to those who answered "strongly agree," 4 marks for "agree," 3 marks for "neutral," 2 marks for "disagree," and 1 mark for "strongly disagree." On the other hand, for negative statements, those who answered "strongly disagree," "disagree," "neutral," "agree," and "strongly agree" were provided 5 marks, 4 marks, 3 marks, 2 marks, and 1 mark, respectively.

- Section C (behaviour section) also comprised 17 true/false statements. The scoring was similar to that of Section A.

Part III: Hydration status assessment

- Two methods were employed to ascertain the athletes' hydration status, urine specific gravity and percentage of body weight changes. Urine specific gravity was assessed by placing one drop of urine on the "Pocket" urine S.G. refractometer PAL-10S.

- The percentage of body weight changes (weigh-in and weigh-out) was assessed by weighing athletes' weight before and after exercise by using a Seca 880 scale. Athletes may determine how dehydrated they are based on the percentage of body mass lost. To determine an athlete's euhydrated (or hydrated) body mass before exercise, an average of the athlete's body weight over several days was measured. Another session of body weight measurement was conducted once the athlete completed their exercise session. Eventually, each athlete's weight before and after exercise was applied into the percentage of body weight changes formula. The classification of hydration status based on urine specific gravity and percentage of body weight changes were as suggested by Casa and colleagues (2000).

Percentage of body weight changes formula:

$$\frac{(\text{Post-exercise body weight} - \text{pre-exercise body weight})}{\text{Pre-exercise body weight}} \times 100$$

Procedures

Ethical approval was obtained from the Ethics Committee for Research Involving Human Subjects (JKEUPM), Universiti Putra Malaysia. Furthermore, permission was granted by the Research Committee of the National Sports Institute. Prior to data collection, signed informed consent was obtained from all respondents.

Statistical analysis

IBM SPSS Statistics version 21 was used. The socio-demographic background of the respondents was presented in percentages for the categorical data, and mean with standard deviation (SD) for the continuous data. The Pearson product-moment correlation and the chi-square test were used to determine the correlation and association between socio-demographic background, knowledge, attitudes, and behaviours regarding hydration with hydration status of weight category sports athletes in the National Sports Institute, respectively. In addition, the differences between socio-demographic background, knowledge, attitudes, and behaviours regarding hydration with hydration status of the athletes were determined with independent sample t-tests and one-way ANOVA. The statistical significance was set at $p < 0.05$.

Results

A total of 36 (60.0%) males and 24 (40.0%) females participated in this study. Table 1 presents the athletes' responses to individual knowledge, attitudes, and behaviour questions. Total scores in the knowledge section ranged from 0 to 17, with the higher score representing better hydration knowledge than the lower ones.

Table 1: Distribution of respondents by knowledge, attitudes, and behaviours about hydration (n=60)

KNOWLEDGE			
Statement	True n (%)	False n (%)	Don't know n (%)
(7) It is important to bring fluids in bottle during practice (P)	58 (96.7)	2 (3.3)	0 (0.0)
(8) It is important to bring fluids in bottle during competition (P)	56 (93.3)	3 (5.0)	1 (1.7)
(1) Sports drinks prevent dehydration during competition and training (P)	52 (86.7)	3 (5.0)	5 (8.3)
(3) Dehydration decreases athletic performance (P)	51 (85.0)	5 (8.3)	4 (6.7)
(14) Monitoring colour of urine is a way an athlete can judge if he/she is dehydrated (P)	51 (85.0)	1 (1.7)	8 (13.3)
(15) Weighing before and after practice is a good way to determine how much fluid to consume (P)	45 (75.0)	5 (8.3)	10 (16.7)
(16) Excessive sweating, thirst, and cramping are signs of dehydration (P)	42 (70.0)	3 (5.0)	15 (25.0)
(10) Sports drinks are better than water because they contain glucose (P)	38 (63.3)	5 (8.3)	17 (28.3)
(11) An athlete should drink 500 to 600 ml of water or sports drinks 2 to 3 hours before exercise and 200 to 300 ml of water or sports drinks 10 to 20 minutes before competition (P)	30 (50.0)	30 (50.0)	0 (0.0)
(12) To achieve rapid and complete recovery of dehydration, athletes should drink 1.5 L of fluid for each kilogram of body weight lost (P)	29 (48.3)	5 (8.3)	26 (43.3)
(9) Athletes should drink sports drinks within 2 hours after exercise (P)	22 (36.7)	14 (23.3)	24 (40.0)
(13) When exercising more than one hour, an athlete should drink sports drinks rather than water (P)	21 (35.0)	15 (25.0)	24 (40.0)
(17) More than 2 alcoholic drinks the day before competition can lead to dehydration (P)	14 (23.3)	7 (11.7)	39 (65.0)
(4) Athletes should not drink water or fluids during practice (N)	1 (1.7)	59 (98.3)	0 (0.0)
(5) Coaches should not let players drink fluids during practice (N)	1 (1.7)	58 (96.7)	1 (1.7)
(6) Coaches should not let players drink fluids during competition (N)	3 (5.0)	56 (93.3)	1 (1.7)
(2) Thirst is the best indicator of dehydration (N)	41 (68.3)	12 (20.0)	7 (11.7)
N=Negative statement	Mean±S.D		68.04±13.97
P=Positive statement	Min – Max scores		7.0 – 17.0

ATTITUDES						
	Statement	Strongly Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly Agree n (%)
(7)	I believe it is important for athletes to bring fluids in bottle during practice (P)	1 (1.7)	1 (1.7)	6 (10.0)	18 (30.0)	34 (56.7)
(8)	I believe it is important for athletes to bring fluids in bottle during competition (P)	3 (5.0)	1 (1.7)	5 (8.3)	21 (35.0)	30 (50.0)
(16)	I believe excessive sweating, thirst and cramping are signs of dehydration (P)	1 (1.7)	4 (6.7)	16 (26.7)	18 (30.0)	21 (35.0)
(14)	I believe monitoring colour of urine is one of a way an athlete can judge if he/she is dehydrated (P)	3 (5.0)	1 (1.7)	5 (8.3)	32 (53.3)	19 (31.7)
(3)	I believe dehydration decreases athletic performance (P)	5 (8.3)	3 (5.0)	10 (16.7)	26 (43.3)	16 (26.7)
(12)	I believe athletes should drink 1.5 L of fluid for each kilogram of body weight lost in order to achieve rapid and complete recovery of dehydration (P)	0 (0.0)	1 (1.7)	27 (45.0)	17 (28.3)	15 (25.0)
(1)	I believe sports drinks can prevent dehydration during competition and training (P)	1 (1.7)	2 (3.3)	17 (28.3)	26 (43.3)	14 (23.3)
(15)	I believe weighing before and after practice is a good way to determine how much fluid to consume (P)	2 (3.3)	5 (8.3)	16 (26.7)	24 (40.0)	13 (21.7)
(17)	I believe more than 2 alcoholic drinks the day before competition can lead to dehydration (P)	6 (10.0)	7 (11.7)	27 (45.0)	9 (15.0)	11 (18.3)
(9)	I believe athletes should drink sports drinks within 2 hours after exercise (P)	2 (3.3)	3 (5.0)	32 (53.3)	13 (21.7)	10 (16.7)
(11)	I believe an athlete should drink 500 to 600 ml of water or sports drinks 2 to 3 hours before exercise and 200 to 300 ml of water or sports drinks 10 to 20 minutes before competition (P)	0 (0.0)	1 (1.7)	33 (55.0)	17 (28.3)	9 (15.0)
(10)	I believe sports drinks are better than water because they contain glucose (P)	1 (1.7)	4 (6.7)	25 (41.7)	22 (37.7)	8 (13.3)
(13)	I believe when exercising more than one hour, an athlete should drink sports drinks rather than water (P)	2 (3.3)	10 (16.7)	28 (46.7)	13 (21.7)	7 (11.7)
(5)	I believe coaches should not let players drink fluids during	33 (55.0)	21 (35.0)	5 (8.3)	0	1 (1.7)

	practice (N)				(0.0)	
(6)	I believe coaches should not let players drink fluids during competition (N)	33 (55.0)	21 (35.0)	3 (5.0)	1 (1.7)	2 (3.3)
(4)	I believe athletes should not drink water or fluids during practice (N)	32 (53.3)	21 (35.0)	2 (3.3)	3 (5.0)	2 (3.3)
(2)	I believe I can rely on thirst alone as an indicator of dehydration (N)	1 (1.7)	5 (8.3)	12 (20.0)	27 (45.0)	15 (25.0)
N=Negative statement		Mean±S.D				75.06±8.17
P=Positive statement		Min – Max scores				39.00 – 79.00

BEHAVIOURS			
Statement		Yes n (%)	No n (%)
(7)	I bring my own drinks during practice and it is important for me (P)	58 (96.7)	2 (3.3)
(8)	I bring my own drinks during competition and it is important for me (P)	55 (91.7)	5 (8.3)
(3)	If I dehydrated, it will decrease my athletic performance (P)	54 (90.0)	6 (10.0)
(16)	I use excessive sweating, thirst, and cramping as signs of dehydration (P)	51 (85.0)	9 (15.0)
(1)	I drink sports drinks to prevent dehydration during competition and training (P)	49 (81.7)	11 (18.3)
(10)	Sports drinks are better than water because they contain glucose (P)	45 (75.0)	15 (25.0)
(14)	I like to monitor my urine colour and it is a way an athlete can judge if he/she is dehydrated (P)	44 (73.3)	16 (26.7)
(11)	I drink 500 to 600 ml of water or sports drinks 2 to 3 hours before exercise and 200 to 300 ml of water or sports drinks 10 to 20 minutes before competition (P)	43 (71.7)	17 (28.3)
(15)	I like to weigh before and after practice and it is a good way to determine how much fluid should I consume (P)	42 (70.0)	18 (30.0)
(12)	I drink 1.5 L of fluid for each kilogram of body weight lost in order to achieve rapid and complete recovery of dehydration (P)	38 (63.3)	22 (36.7)
(9)	I drink sports drinks within 2 hours after exercise (P)	26 (43.3)	34 (56.7)
(13)	I drink sports drinks rather than water when exercising more than one hour (P)	25 (41.7)	35 (58.3)
(17)	I drink more than 2 alcoholic drinks the day before competition (N)	3 (5.0)	57 (95.0)
(4)	I should not drink water or fluids during practice (N)	5 (8.3)	55 (91.7)
(5)	My coaches should not let players drink fluids during practice (N)	1 (1.7)	59 (98.3)
(6)	My coaches should not let players drink fluids during competition (N)	4 (6.7)	56 (93.3)
(2)	I use thirst alone as a way to tell if I am dehydrated (N)	44 (73.3)	16 (26.7)
N=Negative statement		Mean±S.D	75.78±13.79
P=Positive statement		Min – Max scores	5.00 – 16.00

Table 2 shows that most of the respondents (85.0%) were in the state of “significant dehydration” and “serious dehydration” based on urine specific gravity, whereas a majority of the respondents (88.4%) were in the state of “well hydrated” and “minimal hydration.”

Table 2: Distribution of respondents according to urine specific gravity and percentage of body weight changes

Urine specific gravity			Percentage of body weight changes		
Condition	g/ml	n (%)	Mean±S.D	%	n (%)
Well hydrated	<1.010	2 (3.3)		+1 to <-1	25 (41.7)
Minimal hydration	1.010 to 1.020	7 (11.7)		-1 to <-3	28 (46.7)
Significant dehydration	1.021 to 1.030	36 (60.0)		-3 to <-5	7 (11.7)
Serious dehydration	>1.030	15 (25.0)		>-5	0 (0.0)
Total		60 (100)	1.027±0.01		60 (100)
					1.55±1.01

Gender was the only socio-demographic factor that significantly associated with percentage of body weight changes ($p=0.035$), as all females were in the hydrated category (Table 3). There was no significant correlation between age and hydration status for either urine specific gravity ($r=0.048$, $p=0.716$) or percentage of body weight changes ($r=-0.043$, $p=0.743$).

Table 3: Chi square: Socio-demographic factors with hydration status (urine specific gravity and percentage of body weight changes) (n=60)

Variables	Urine specific gravity				Percentage of body weight changes			
	n (%)		χ^2	p-value	n (%)		χ^2	p-value
	Hydrated	Dehydrated			Hydrated	Dehydrated		
Gender								
Male	5 (8.3)	31 (51.7)	0.579	0.749	29(48.33)	7(11.67)	-	0.035*
Female	4 (6.7)	20 (33.3)			24(40.00)	0(0.00)		
Education Level								
School	7 (11.7)	33 (55.0)	2.825	0.244	34(56.67)	6(10.00)	-	0.407
University	2 (3.3)	18 (30.0)			19(31.67)	1(1.67)		
Household income								
<RM1000	9 (15.0)	39 (65.0)	-	0.182	42(70.00)	6(10.00)	-	1.000
>RM1000	0 (0.0)	12 (20.0)			11(18.33)	1(1.67)		

*Correlation is significant at $p < 0.05$; Fisher's Exact Test

Phi: -0.297

As shown in Table 4, there was a weak positive and significant correlation between knowledge and hydration status based on percentage of body weight changes ($r=0.306$, $p=0.018$). However, there was no significant correlation between attitudes and behaviours with hydration status based on percentage of body weight changes ($r=0.243$, $p=0.061$; $r=0.204$, $p=0.117$), respectively. In addition, the knowledge score was significantly correlated with the attitudes score ($r=0.459$, $p<0.001$).

A One-way ANOVA was performed to explore the differences between the types of sports, age groups, education level on hydration status, knowledge, attitudes, and behaviours scores, whereas independent sample t-tests were carried out to explore the differences between gender on hydration status, knowledge, attitudes, and behaviours score (Table 5). Mean percentage of body weight changes was significantly different between athletes from different types of sports ($F=12.096$, $p<0.001$), and significantly higher among males compared to females ($t=3.187$, $p=0.002$). A significant difference was observed for percentage of body weight changes between the sports groups ($F=12.096$, $p<0.001$). Post-hoc comparison using the Tukey HSD test revealed that the mean percentage of body weight changes for silat ($M=0.77$, $S.D=0.41$) was significantly different from taekwondo ($M=1.63$, $S.D=0.85$), karate ($M=2.38$, $S.D=0.96$), and boxing ($M=2.31$, $S.D=0.92$).

Table 4: Pearson's correlation coefficient: Knowledge, attitudes and behaviours with hydration status (Urine specific gravity and percentage of body weight changes) (n=60)

Variables	Urine specific gravity		Percentage of body weight changes		Knowledge		Attitudes		Behaviours	
	r-value	p-value	r-value	p-value	r-value	p-value	r-value	p-value	r-value	p-value
Knowledge	0.156	0.233	0.306	0.018*	1.000	-	0.459	<0.001*	0.164	0.210
Attitudes	0.007	0.958	0.243	0.061	0.459	<0.001*	1.000	-	0.208	0.111
Behaviours	-0.068	0.608	0.204	0.117	0.164	0.210	0.208	0.111	1.000	-

*Correlation is significant at $p < 0.05$

Table 5: Differences in hydration status, knowledge, attitudes, and behaviours score between sports categories, age groups, education levels, and gender

Variables	n (%)	Urine specific gravity		Percentage of body weight changes		Knowledge		Attitudes		Behaviours	
		Mean±S.D	p-value	Mean±S.D	p-value	Mean±S.D	p-value	Mean±S.D	p-value	Mean±S.D	p-value
Sports											
	17 (28.3)	1.03±0.01		1.63±0.85		10.82±1.81		62.94±4.01		12.00±1.97	
Taekwondo											
Karate	12 (20.0)	1.03±0.002		2.38±0.96	<0.001*	13.92±1.68		68.25±8.90		13.08±3.15	
Boxing	9 (15.0)	1.03±0.003		2.31±0.92		11.22±2.82	0.001*	63.11±6.72	0.178	14.78±1.39	0.067
Silat	15 (25.0)	1.03±0.01		0.77±0.41		11.40±2.06		62.27±7.80		12.67±1.95	
Weight lifting	7 (11.7)	1.03±0.01	0.497	0.66±0.46		10.14±2.41		62.43±5.86		12.71±2.50	
Age											
	Mean±S.D: 22.20±4.05										
16 to 20	22 (36.7)	1.03±0.01		1.47±0.85		10.77±2.05		62.00±4.40		12.09±2.41	

21 to 25	25 (41.7)	1.03±0.01		1.67±1.19		12.28±2.53		66.16±6.88		13.88±1.62	
26 to 30	11 (18.3)	1.03±0.01	0.832	1.36±0.73	0.657	12.18±1.83	0.015*	62.73±10.26	0.155	12.00±2.86	0.024*
31 to 35	2 (3.3)	1.03±0.01		2.22±2.15		8.00±1.41		60.00±1.41		14.00±2.83	
Education level[‡]											
Secondary school	40 (66.7)	1.03±0.01		1.60±1.08		11.10±2.17		62.23±6.21		12.88±2.16	
Pre-university	6 (10.0)	1.02±0.01	0.550	1.00±0.71	0.380	11.50±2.43	0.043*	61.00±7.43	0.167	12.50±2.95	0.886
University	14 (23.3)	1.03±0.004		1.64±0.91		12.93±2.56		66.64±8.29		13.07±2.73	
Gender[#]											
Male	36 (60.0)	1.03±0.01	0.721	1.87±1.06	0.002*	11.53±2.41	0.878	63.78±7.62	0.976	13.14±2.27	0.305
Female	24 (40.0)	1.03±0.01		1.08±0.72		11.63±2.37		63.83±5.96		12.50±2.45	

Note: *Mean difference is significant at $p < 0.05$

[‡] Analysis using one-way ANOVA

[#] Analysis using independent samples t-test

Discussion

This study observed that athletes not only lacked knowledge, but also had poor attitudes and behaviours on sports drinks consumption (Table 1). Only 35.0% of athletes correctly answered the statement in the knowledge section that sports drinks should be consumed when exercising for more than an hour. Athletes' answer to this same statement in the attitude section demonstrated that only 33.4% agreed or strongly agreed, whereas in the behaviour section, 41.7% stated they consuming sports drinks when exercising for more than an hour. This result implies that athletes have little understanding of the positive outcomes of sports drinks in sustaining electrolytes and fluid balance (Sawka et al., 2007). Hence, exposure to the effects of carbohydrates and electrolytes in sports drinks on sustaining athletic performance is warranted.

Urine specific gravity was used in this study to determine whether an individual is euhydrated or dehydrated (Popowski et al., 2001). On the other hand, percentage of body weight changes will determine how much fluid athletes need to consume based on a hydration status check at weigh-in and weigh-out (Casa et al., 2000). Most of the athletes fell into the category of "significant dehydration" (60.0%) and "serious dehydration" (25.0%) based on the urine specific gravity, whereas a majority of the respondents fell into the category of "well hydrated" (41.7%) and "minimal hydration" (46.7%) according to the percentage of body weight changes. However, Casa and colleagues (2000) reported that dehydration with body weight loss of 1% to 2% ("minimal hydration") will start to compromise physiologic function, and eventually athletic performance. Rivera-Brown and Félix-Dávila (2012) noted that dehydration experienced during training (average body weight changes of 1.7%), together with the fluid deficit before training, may result in a level of dehydration greater than 3% after training. This may further disturb physiological function and put an athlete at risk of developing heat illnesses, such as heat cramps, heat exhaustion, or heat stroke.

The use of both the urine specific gravity and percentage of body weight changes should allow adequate sensitivity (low false negative) to detect dehydration among respondents. However, there were differences in the hydration status category based on the urine specific gravity and percentage of body weight changes. The discrepancies may be due to the percentage of body weight changes, which are easily influenced by many factors. The various ranges of percentage of body weight changes may be affected by the intensity and duration of exercise, environmental condition, and type of outfit (Oppliger & Bartok, 2002). Furthermore, individual characteristics, such as genetic predisposition and body weight, will affect sweat rates for a given activity, which will indirectly affect the percentage of body weight changes (Sawka et al., 2007). The environmental condition during data collection in this study was typically in temperate and cool environments. According to Cheuvront and colleagues (2004), the cooler environment or environment with air motion (wind) will facilitate greater dry heat loss and minimize sweating rates. Eventually, it will affect the percentage of body weight changes.

Taken together, both urine specific gravity and percentage of body weight changes may be employed to assess athletes' hydration status. Urine specific gravity is a good marker to determine athletes' hydration status for the entire day of the previous day, as the urine will be collected right after the athletes wake up. On the other hand, percentage of body weight changes may be employed to assess how much an athlete should drink before the next training or competition session (Lopez et al., 2006).

The findings of this study demonstrate that, even though athletes could have sufficient hydration knowledge, their knowledge did not necessarily correspond to their behaviours ($r=0.164$, $p=0.210$). The findings emphasize the significance of regular monitoring of athletes' fluid consumption behaviours to prevent practices that may have a negative effect on their performance and health. Appropriate hydration behaviours should be highlighted, while athletes should be warned about negative hydration behaviours and the outcomes of these behaviours.

Karate athletes had the highest mean percentage body weight changes, while silat athletes had the lowest values. This is in tandem with the researcher's observation that karate athletes had the longest practice duration. Athletes who have higher intensity and longer duration training may lose at least 5% of their weight during a strenuous exercise session (Oppliger & Bartok, 2002).

There are several limitations to this study. First of all, this study was a cross-sectional study and, hence, cause-and-effect relationships or associations between the socio-demographic factors, knowledge, attitudes, and behaviours regarding hydration and hydration status could not be portrayed. Secondly, over-reporting or under-reporting may exist, as the respondents may tend to try to please the researcher.

Despite these limitations, the findings of this study emphasize the importance of ongoing education regarding hydration among athletes. Athletic coaches, trainers, and sports nutritionists not only have to counsel athletes about proper fluid replacement, but also to create an environment that will encourage positive attitudes and behaviours in order for athletes to put their knowledge into practice.

Conclusion

In conclusion, most of the athletes fell in the category of “significant dehydration” (60.0%) and “serious dehydration” (25.0%) based on the urine specific gravity, whereas a majority of the respondents fell in the category of “well hydrated” (41.7%) and “minimal hydration” (46.7%) according to the percentage of body weight changes. There was a significant association between hydration status based on percentage of body weight changes with gender. On the other hand, the knowledge score was significantly correlated with the attitudes score and the percentage of body weight changes. The knowledge score was significantly different between athletes from different type of sports, age groups, and education levels. Furthermore, the behaviours score was significantly different among athletes from different age groups. The mean percentage of body weight changes was significantly higher among males compared to females, and significantly different between athletes from different type of sports. The findings of this study identify the need for new learning strategies for athletes to improve their knowledge, attitudes, and practices with regards to hydration.

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