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Knowledge, attitude and practice towards hydration in races among Malaysian runners

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Abstract: The study aimed to determine the knowledge, attitudes, and behaviours (KAB) regarding hydration and fluid replacement among Malaysian competitive runners. Over 450 runners aged 18 and above participated in the survey and answered the KAB questionnaires. This study demonstrated that the mean percentage scores for knowledge, attitudes, and behaviours were 64.4±5.8%, 47.4±3.5% and 57.2 ±5.7%, respectively. Formal nutrition education positively affected hydration knowledge quality (p=0.017) among runners. Training competency did not influence runners' KAB. Knowledge had a significant correlation with attitudes (r=0.190, p<0.05) and behaviours (r=0.660, p<0.05). Attitudes demonstrated a significant relationship with behaviour (r=0.236, p<0.05). This study shows that knowledge can indicate attitudes and behaviours regarding hydration and fluid replacement. The potential impact of these findings on improving hydration practices among runners is significant, highlighting the need for adequate education regarding hydration.

Keywords: *KAB, hydration, fluid, runners.*

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I. INTRODUCTION

Hydration and fluid replacement are vital nutrition and sports performance issues for athletes performing before, during, and after training and competition [1]. Drinking throughout those sessions is critical to prevent dehydration and excessive changes in electrolyte balance to prevent any performance setbacks and injury [2]. When water intake equals water loss, homeostasis is maintained, and so-called euhydration is achieved [3].

Sweat production, the body's thermoregulation, is vital to overcome heat stress. Several factors influence sweat production, such as ambient temperature, humidity, and activity levels. In a hot environment, body water may be lost from 0.3 L/h via perspiration and sweating in sedentary conditions and up to 2.0 L/h in high activity. Water intake requirements can range between 2.5 and 3 L/d in adults under normal conditions and reach 6 L/d with high extremes of heat and activity [4].

Long-distance running, such as half marathons (21 km) and full marathons (42 km), lasting between one and two and a half hours, is an endurance sport and very challenging, especially for beginners. High activity levels and metabolic processes demand greater thermoregulation, which promotes more sweat production and a surge in water loss [1]. Potentially life-threatening conditions such as heat stroke can develop because of dehydration and excessive fluid loss [2]. Therefore, maintaining fluid balance is crucial for runners to sustain themselves during the race. The body's thermoregulation requires athletes' competency and experience in hydration strategies [5]. Poor hydration technique leads to dehydration and the onset of heat illnesses such as cramping, dizziness, and loss of ability to think [6]. On the other hand, rampant hydration plans and strategies can lead to imbalanced

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electrolytes, such as hyponatremia [7]. Athletes require knowledge [8].

Malaysia is a tropical country, so it is hot and humid, but people still need to organize and participate in running events. Hundreds of running events are organized annually in the country. With so many sources of information and studies regarding hydration and fluid replacement strategies, a vital question is whether runners use this information to learn them and practice them accordingly.

II. METHODOLOGY

A total of 460 male and female runners aged above 18 were purposively but randomly selected from the registration list of an international marathon event for this study. All selected runners participated in at least one running event yearly and met the inclusion criteria. The sample size was calculated using [9] formula. All runners confirmed their voluntary participation through a consent form. The survey was approved by the university's ethical committee (reference no: REC/139/18).

Self-administered questionnaires of knowledge, attitudes, and behaviour (KAB) regarding hydration and fluid replacement, adopted from Esa et al. (2015), were distributed to participants using Google Forms. The questionnaire consisted of two parts. Part I was a questionnaire about the socio-demographics, namely age, gender, nutrition education, training distance, and the number of years of training, whereas part II probed the knowledge, attitudes, and behaviours regarding hydration. Part II is divided into three sections, with 17 questions for each knowledge, attitudes, and behaviour section. Section A (knowledge section) comprised 17 true/false statements, where 1 point was provided for every correct answer and 0 points for the wrong answer. Section B (attitude section) determined respondents' beliefs in the same 17 statements and responded to each statement on a five-point Likert scale (strongly agree to strongly disagree). For positive statements, five 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 given 5 marks, 4 marks, 3 marks, 2 marks, and 1 mark, respectively. Section C (behaviour section) determined respondents' practice on the same 17 statements by responding yes or no. Proper answers were scored 1, and poor behaviours scored 0. Each participant was given 1 week to complete the questionnaires.

The recorded data were analyzed using the Statistical Package for the Social Sciences version 25.0 (SPSS Inc, Chicago, IL, USA) for Windows. The socio-demographic background of the participants was expressed in percentages for the categorical data and mean with standard deviation (SD) for the continuous data. The frequency of each question was calculated using the percentage of correct versus incorrect answers in the knowledge section, positively versus negatively answered questions in the attitude section, and proper versus improper answers in the behaviour section. The independent sample t-test was carried out to explore the differences in knowledge, attitudes, and behaviour scores between different levels of nutrition education. A one-way ANOVA was performed to explore the differences in knowledge, attitudes, and behaviour scores between different levels of training distance and the number of training years. Since the data was a normal distribution, Pearson correlation analysis was used to determine the correlation between knowledge, attitudes, and behaviour regarding hydration and fluid replacement of Malaysian competitive runners. The level of significance was set at $p < 0.05$ for all analyses.

III. RESULTS

Demographic Background of Runners

Table 1 shows the demographic information of participants. Of the 460 respondents, 51.7% were males, and 48.3% were females. More than 73% of respondents were aged between 26 and 45. Only 10% of respondents had received formal nutrition education. Most runners (98.3%) have been training for not more than 10 years, while 65.7% claimed to be training more than 25 km per week.

TABLE 1
DEMOGRAPHIC CHARACTERISTICS OF STUDY PARTICIPANTS

	Frequencies	Percentage (%)
Gender		
Male	238	51.7
Female	222	48.3
Age		
18-25	87	18.9
26-35	183	39.8
36-45	153	33.3
46-57	37	8
Nutrition Education		
Yes	46	10
No	414	90
Training Years		
1-10 years	452	98.3
11-20 years	5	1.1
21-30 years	2	0.4
31-50 years	1	0.2
Weekly Training Distance		
Less 25km	302	65.7
25 – 32km	91	19.8
More than 32km	67	14.6

KAB Towards Hydration and Fluid Intake of Runners

Table 2 shows the responses to each knowledge statement by respondents. The runners demonstrated poor knowledge of the importance of drinking during training and competition, based on statements 4, 5 and 6. For statement 4, 93.5% of the runners agreed that athletes should not drink water or fluids during practices. Whereas for statements 5 and 6, most (91.3 and 92.8%) were unsure that coaches should allow athletes to drink fluids during practice and competition. For statement 2, 82.2% agreed that thirst was not the best indicator of dehydration.

More than 85% of respondents recognized the importance of hydration and fluid replacement over dehydration, agreeing with statements 3, 7, and 8 with percentages of 97, 97, and 87.6%, respectively. For statement 1, 83.9% responded positively to sports drinks preventing dehydration during training and competition. However, half of the respondents were unsure about the importance of taking sports drinks within 2 hours after exercise and when exercise more than 1 hour (statements 9 and 13). More respondents (68.5%) thought sports drinks are better than water because of their glucose content (statement 10). For statements 11 and 12 regarding fluid intake guidelines before and after exercise, 73.9 and 69.3% of respondents responded positively.

Most respondents responded positively to statements 14 (92.8%) and 16 (90.4%), indicating their good knowledge regarding signs of dehydration. However, the outcome of statement 15 shows that almost half of respondents were unsure about how much fluid should be taken to rehydrate after training. More than one-third (78.5%) of respondents were aware that consuming alcohol can lead to dehydration (statement 17).

In the attitude survey, 72.8% of respondents believed dehydration can decrease athletic performance (statement 3). The percentage of respondents who believed in statements 1, 7, 8, 14, 15, and 16 was around 50 – 66%. This indicates that half of the runners acknowledged the importance of fluid consumption during training and competition. In addition, they also believed that they should be aware of the signs of dehydration.

However, most runners believed athletes should not drink water or fluids during training and competition, as shown by statements 4, 5, and 6 outcomes. In addition, more than 50% of respondents were unsure about the benefits of sports drinks and the volume of fluid that needs to be consumed, as confirmed by statements 9, 10, 11, 12, and 13. Only 49% believed the consumption of more than 2 alcoholic drinks the day before the competition can lead to dehydration.

The Table also shows respondents' behaviours regarding hydration and fluid intake. Most runners (96.3%)

claimed to decrease their athletic performance when dehydrated (statement 3). More than 85% of runners practice bringing water during training and competition (statements 7 and 8). A high percentage (>85%) of runners also monitor symptoms of dehydration during exercise (statements 14 and 16).

However, over 85% of runners did not appropriately practice fluid intake during training and competition (statements 4, 5, and 6). The survey outcomes also showed that 86.1% of runners (statement 17) claimed to drink more than 2 alcoholic drinks the day before the competition. The average knowledge of hydration was 64.4±5.8%. The runners' attitudes towards hydration and fluid intake scored 47.4±3.5%. As for the behaviour, the score was 57.2±5.7%.

TABLE 2
SOCIO DEMOGRAPHIC CHARACTERISTICS

Statement	knowledge	Attitude(I believe)		Behavior			
	Score %		Score %			Score %	
	True	False	SD/D	N	A/SA	Yes	No
1. Sports drinks prevent dehydration during competition and training (P)	83.9	16.1	22.2	26.1	51.8	73.7	26.3
2. Thirst is the best indicator of dehydration (N)	17.8	82.2	49.5	18	32.4	46.1	53.9
3.Dehydration decreases athletic performance (P)	97	3	20	7.2	72.8	96.3	3.7
4.Athletes should not drink water or fluids during practice (N)	93.5	6.5	14.8	16.1	69.1	89.6	10.4
5.Coaches should not let players drink fluids during practice (N)	91.3	8.7	15.2	16.5	68.3	88.7	11.3
6.Coaches should not let players drink fluids during competition (N)	92.8	7.2	13.9	17	69.2	88.5	11.5
7. It is important to bring fluids in the bottle during practice (P)	97	3	20.9	13.9	65.2	95	5
8. It is important to bring fluids in the bottle during competition (P)	87.6	12.4	19.4	19.6	61.1	85.7	14.3
9.Athletes should drink sports drinks within 2 hours after exercise (P)	49.6	50.4	25.4	32.4	42.2	54.1	45.9

TABLE 3
CONT...

Statement	knowledge	Attitude(I believe)		Behavior			
	Score %			Score %		Score %	
	True	False	SD/D	N	A/SA	Yes	No
10.Sports drinks are better than water because they contain glucose (P)	68.5	31.5	30.2	24.6	45.3	66.5	33.5
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)	73.9	26.1	19.4	34.3	46.3	70	30
12. To achieve rapid and complete recovery from dehydration, athletes should drink 1.5 L of fluid for each kilogram of body weight lost (P)	69.3	30.7	24.2	36.7	39.1	59.6	40.4
13. When exercising for more than one hour, an athlete should drink sports drinks rather than water (P)	50.4	49.6	33.4	25	41.5	55.4	44.6
14. Monitoring the colour of urine is a way an athlete can judge if he/she is dehydrated (P)	92.8	7.2	19.2	15.2	65.6	86.7	13.3
15. Weighing before and after practice is a good way to determine how much fluid to consume (P)	51.3	48.7	20.7	13.5	65.9	39.6	60.4
16. Excessive sweating, thirst, and cramping are signs of dehydration (P)	90.4	9.6	20.7	13.5	65.9	88.3	11.7
17. More than 2 alcoholic drinks the day before competition can lead to dehydration (P)	78.5	21.5	24.1	27	49	86.1	13.9

Nutrition education was the only socio-demographic factor that significantly influenced the knowledge score (p=0.017), whereas attitude and behaviour were not influenced by formal nutrition education received by participants (Table 3). No significant difference was observed for the knowledge score (F=1.338, $p > 0.05$), attitudes (F=0.683, $p > 0.05$), and behaviours (F=1.642, $p > 0.05$) between the training distance per week performed by participants. There was also no significant difference in knowledge (F=1.634, $p > 0.05$), attitudes score (F=0 .664, $p > 0.05$), and behaviours scores (F=1.622, p >0 .05) across runners' training years.

TABLE 4
DIFFERENCE OF KAB BETWEEN RUNNERS WITH AND WITHOUT FORMAL NUTRITION EDUCATION.

	Knowledge		Attitudes		Behaviors	
	Mean±S.D	*p*-value	Mean±S.D	*p*-value	Mean±S.D	*p*-value
Nutrition Education€						
YES	13.6±1.6	0.017*	60.2±15.3	0.71	13.2±2.0	0.1
NO	12.8±2.2		59.3±12.4		12.6±2.4	
Training Distance£						
Less than 25km	12.7±2.1	0.263	59.7±12.2	0.506	12.5±2.4	0.195
25 – 32km	13.0±2.3		59.6±13.0		13.0±2.3	
More 35km	13.2±2.2		57.8±14.5		12.9±2.2	
Training Years£						
10-Jan	12.9±2.2	0.181	59.4±12.8	0.574	12.7±2.3	0.184
20-Nov	10.8±1.8		55.6±6.8		11.0±1.4	
21-30	13.5±2.1		67.0±11.3		13.5±0.7	
31-40	14		71		16	

*Mean difference is significant at $p<0.05$. €Analysis using independent samples t-test. £Analysis using one-way ANOVA.

Relationship Between Knowledge, Attitude, and Behaviour towards Hydration and Fluid Intake of Runners

Knowledge, attitude and behaviour were all significantly correlated with each other. Knowledge was positively correlated with both attitude (r=0.190, $p<0.05$) and behaviour (r=0.660, $p<0.05$). The attitude was also positively correlated with behaviour (r=0.236, $p<0.05$) (Table 4).

TABLE 5
RELATIONSHIP BETWEEN KNOWLEDGE, ATTITUDE, AND BEHAVIOUR TOWARDS HYDRATION AND FLUID INTAKE OF RUNNERS (N=460)

Variables	Knowledge		Attitudes		Behaviors	
	r - value	*p* – value	*r* - value	*p* – value	*r* - value	*p* – value
Knowledge	1	-	0.19	0.000*	0.66	0.000*
Attitudes	0.19	0.000*	1	-	0.236	0.000*
Behaviours	0.66	0.000*	0.236	0.000*	1	-

Pearson correlation *significant value at $P<0.05$

Respondents who participated in this study were marathon runners contacted during their participation in a national marathon race organized annually. This survey found that the runners demonstrated poor knowledge of specific hydration and fluid intake aspects for their training and competition. The runners did not acknowledge fluid intake during practice and competition as necessary, contrasting with what has been recommended in the fluid intake guidelines for athletes [10]. The respondents' answers to those statements in the attitude section showed a similar trend, showing that their assumption regarding fluid intake during training was based on their knowledge [11].

The knowledge and attitude towards the importance of fluid intake during training and competition were also translated into the runners' behaviour or practice in which they did not drink fluid during exercise. It shows that the runners' knowledge and attitude influence their behaviour against fluid consumption during exercise, consistent with a previous report [12]. This result implies that most runners in this survey need to understand the significance of water or fluid consumption when exercising. However,

statements 7 and 8 contradict the initial KAB regarding fluid intake during exercise, in which the runners understand the importance of bringing their drink for rehydrating during training and competition. One may interpret that bringing water does not mean drinking it during exercise, and it can be for pre-exercise drinking or rehydrating after a workout. A report claims that voluntary drinking behaviour during exercise produced better performance than dictated drinking conditions [13], explaining why the runners did not believe and practice taking fluid during exercise.

People, including athletes, are often unaware of the optimal amount of fluid to consume when exercising. Increasing knowledge about hydration may be necessary for people with inaccurate information about hydration, but attitudes about hydration are likely to impact fluid intake behaviours significantly [14]. A study reports that a group of weight-categorized athletes with significant dehydration showed low KAB about hydration during exercise [15]. The latter study is similar to previous reports stating that high KAB scores improved hydration behaviours during training and competition among endurance [16] and school athletes [17].

The knowledge regarding dehydration of the runners based on urine colour (statement 14) and dehydration signs (statement 16) was high. Even though their attitude towards monitoring dehydration using urine colour and symptoms was moderate, the runners still used both methods to monitor dehydration levels. The outcomes were consistent with reports by [15] and [16], showing that most athletes used urine colour, sweating rate, thirst, and cramping to monitor dehydration. Urine colour is associated with urine osmolality, providing an objective perspective on hydration status [18]. Some of the most common symptoms of dehydration include but are not limited to fatigue, thirst, dry skin and lips, dark urine or decreased urine output, headaches, muscle cramps, dizziness, syncope, orthostatic hypotension, and palpitations. (Taylor et al., 2024).

Urine-specific gravity, based on urine colour, and measuring body weight changes in monitoring hydration status are user-friendly and easy to apply [19]. However, the technique of self-weighing before and after exercise was unfamiliar to many runners when their knowledge and behaviour regarding the technique were moderate (statement 15). [12] reported the same when less than 66% of athletes understand the concept of fluid loss based on body weight changes before and after training. [16] and [20] also reported that less than 55% of athletes need more knowledge and practice regarding monitoring fluid replacement based on weight change.

This study found that runners with formal nutrition education have higher knowledge but similar attitudes and behaviours regarding hydration compared to those without formal nutrition education. The outcomes were similar to a previous study showing runners with a complete nutrition course in college demonstrated more excellent nutritional knowledge than those who learned nutrition informally from various sources [21]. In another study, athletes with a previous college-level nutrition course had significantly higher sports nutrition and hydration knowledge than those without [22]. Athletes who do not have a formal nutritional education background require intervention programs to improve their knowledge [23]. A study by [24] also reported that nutrition education intervention on trained athletes improved sports nutrition and hydration knowledge.

Our study showed that the runners' training years and distance did not influence KAB towards hydration. The result shows that experienced runners with greater training distance had the same level of hydration KAB as new runners. However, our findings differed from those of an [6] study, in which experience played a significant factor in hydration knowledge but not behaviours. A high dehydration rate may be attributable to the increased distances, frequencies and intensity of runs. Since runners were common in increasing the incident rate of dehydration, most of the runners in the latter study had a high knowledge of hydration during exercise. [22] found that the knowledge of sports nutrition and hydration of well-trained athletes was low before education intervention, which shows that experience did not influence knowledge.

The present findings demonstrated that knowledge is significantly related to attitudes and behaviours. It was found that attitudes also have a significant relationship with behaviours. It shows that the higher the knowledge, the better the attitude and behaviour towards hydration and fluid replacement. Good attitudes influence behaviours towards good hydration. Our findings support a report by [12] and [25], who also showed a significant relationship between knowledge, attitudes, and behaviours among athletes. However, according to [15], knowledge failed to correspond to athletes' hydration behaviour, and the athletes required fluid consumption monitoring to prevent performance drawbacks. While hydration knowledge may positively affect attitude towards fluid replacement in athletes, it is still insufficient to improve their behaviours towards good hydration [16].

In conclusion, most runners demonstrated good hydration knowledge regarding fluid consumption before and after exercise and the signs and symptoms of dehydration. However, they must be more concerned about fluid intake

during training or competitions. Nutrition education was found to be a way to improve hydration knowledge. A positive relationship existed between knowledge, attitude, and behaviour regarding hydration and fluid replacement. Thus, the present study suggests adequate knowledge will improve participants' attitudes and provide favourable hydration and fluid replacement behaviour. Ongoing education regarding hydration among runners is important to encourage positive attitudes and behaviours so that runners can put their knowledge into practice.

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