Hydration Knowledge, Attitude, Physical Activity level, BMI and Fluid Intake Pattern Among Undergraduate Students in Kelantan

Soo Kah Leng[1*], Jojo Ting Sing Joe[1]

[1]Nutrition Program, School of Health Sciences, Universiti Sains Malaysia, Kubang Kerian, Malaysia

ABSTRACT

Adequate fluid consumption is essential for maintaining physiological functions and promoting good health. However, factors influencing plain water intake among Malaysian university students remains understudied. Hence, this cross-sectional study examined the associations between sociodemographic factors, physical activity level, body mass index, hydration knowledge and attitudes with plain water consumption among undergraduate students. Cluster sampling method was used to recruit 243 undergraduate students (190 females, 53 males) who aged between 18-33 years. Chi-square test and multiple regression analyses were performed to determine relationship between variables. Results indicated that average plain water intake was 1474.28 ± 530.19 mL/day, with males consuming slightly more (1551.89 ± 526.60 mL/day) than females (1452.63 ± 530.54 mL/day). Notably, as many as 46% of respondents did not consume plain water according to the Malaysian Dietary Guidelines (MDG) 2020 recommendation. A significant association was found between BMI and plain water intake (χ^2=11.192, p=0.004). with overweight and obese respondents consuming more water than their counterparts. "Lack of Effort Barrier" was the only predictive factor of plain water intake ($\beta = -47.403$, $p = 0.001$, $R^2 = 0.168$). The regression model contributed 14.6% of the variance in daily plain water intake (Adjusted R^2= 0.146). These findings suggest that public health interventions should move beyond knowledge-based education and incorporate behavioral and environmental strategies to reduce barriers and promote sustainable hydration practices. Comprehensive interventions are crucial to increase plain water intake and improve undergraduates hydration habits as part of healthy lifestyle.

Keywords: BMI, fluid intake, hydration attitude, plain water, undergraduate

1 INTRODUCTION

Water is an essential element in our human body and is critical for maintenance of life [1]. It plays a crucial role in supporting various bodily functions such as body temperature regulation, blood circulation maintenance, waste removal, digestion, and cognitive performance [2]. Malaysia's tropical climate, characterized by high temperatures and humidity, heightens the risk of dehydration and underscores the importance of adequate hydration. The National Health and Morbidity Survey (NHMS, 2019) reported that only 49.4% of adults met the recommended intake of 6–8 glasses of plain water per day. Sustained inadequate or inappropriate fluid intake may have detrimental effects on health. For instance, it may lead to poor cognitive and physical performance such as unwillingness to work, headache and dizziness as well as affect concentration during study especially among the student population [3, 4].

Fluid in the human body is obtained from all beverages consumed and foods ingested. Approximately 80% of water intake is derived from fluids such as water, juices, milk, soft drinks, tea, coffee, broths, soups, and sports drinks, while the remaining 20% comes from food [5]. It is important to note that the amount of fluid intake required by each individual differs and is determined by several factors including age, gender, body size, metabolic rate, physical activity level, and environmental factors such as humidity and temperature [2]. As such, it is challenging to define an adequate intake of total water from all sources, but the daily average plain water intake is 6 to 8 glasses per day which is estimated to range between 1500 mL to 2000 mL in adults based on Malaysian Dietary Guideline (MDG) 2020 Key Recommendation [6]. It is crucial to consider nutritional content when taking other sources of fluids as they bring significant impact on our overall well-being.

In today's modern lifestyle, many students opt not to consume plain water due to the availability of alternatives such as juices, sweet beverages like boba drink and milk tea that is high in sugar content, as well as the influence of media advertising these products to allure consumers. Despite experiencing thirst intermittently, many individuals overlook the importance of drinking water [7]. Drinking enough water, specifically plain water is crucial for staying hydrated and maintaining proper bodily functions and overall health. However, even the benefits of drinking plain water is well known, the practice is still remains poor among university students as reported by few studies, where the plain water intake

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*Correspondence email: sookl@usm.my

was less than the recommended requirement and they were depended on other fluids rather than plain water [3, 8]. Some of the factors explored include lack of knowledge and awareness regarding proper hydration, cost, availability of water sources, and water quality [9].

Concern has been raised regarding the drinking water quality (yellowish water) particularly in the state of Kelantan [10]. These issues not only influence individual choices but also shape social norms regarding the fluid consumption among students. Moreover, the consequences of inadequate fluid intake from the plain water extend beyond immediate health effects, impacting academic performance, mental well-being, and overall quality of life [7]. Despite the essentials of drinking plain water, there was a lack of published studies reporting the fluid consumption especially plain water among university students in Malaysia. One local study reported the presence of sugar-sweetened beverages as an alternative to plain water to quench thirst among students [9].

Hence, it is crucial to assess the knowledge of adequate hydration specifically from plain water among young adults, especially university students to identify the gaps that need to be addressed to formulate effective nutritional intervention strategies. This study aimed to investigate factors influencing plain water consumption, including knowledge and attitude regarding hydration, sociodemographic profiles, physical activity level, and body mass index among undergraduate students at a public university in Kelantan.

2 METHODOLOGY

2.1 Study Design and Location

This study was granted ethical approval from the Human Research Ethics Committee of USM (JEPeM Code: USM/JEPeM/KK/24060517). It was applied cross-sectional design and conducted at the School of Health Sciences, Health Campus of Universiti Sains Malaysia (USM) in Kelantan.

2.2 Study Population and Sampling Method

The population of interest are students in the School of Health Sciences, USM. The total number of the students for academic session 2023/2024 was 993. It is noted that previous studies recommend including at least 20% of the population to ensure a representative sample [11]. Hence, the calculated sample size was 199. An additional 20% was added to account for non-response. So, the desired sample size was 239 respondents. Study respondents were grouped into clusters according to their year of study. Cluster sampling was then employed to select respondents from all 4 years. For each year, three classes from any study programme were randomly chosen using a lottery method. All students in the selected classes were invited to participate in the study. The inclusion criteria for this study were undergraduate students aged 18 years and above, while international students were excluded as fluid intake was assessed using MDG 2020, intended for Malaysians. All respondents were required to fill out an online informed consent form before participating in the study.

2.3 Research Tools

A self-administered questionnaire was applied and permission was obtained from the authors to adapt the validated Hydration Knowledge Scale (HyKS), Hydration Facilitators and Barriers (HFAB) [12], as well as Beverage Intake Questionnaire (BEVQ-15) [13]. It consists of five parts which include sociodemographic profile, body mass index (BMI), physical activity level, hydration knowledge and attitude and plain water and beverage intake. Self-reported weight and height were recorded and BMI was calculated by using the formula (weight in kg)/ (height in m)^2. According to World Health Organization (WHO) cut-off points, the BMI has been categorized into underweight (< 18.5 kg/m^2), Normal weight (18.5 – 24.9 kg/m^2), Overweight (25.0 – 29.9 kg/m^2) and Obese (≥ 30.0 kg/m^2). A short form of the International Physical Activity Questionnaire (IPAQ) which consists of 7 questions were used to assess physical activity level and categorized as low, moderate and high by using the IPAQ short form guidelines for data processing and analysis [14].

The participant's knowledge of hydration was measured using the Hydration Knowledge Scale (HyKS) while the attitude towards hydration and drinking fluids was evaluated by Hydration Facilitators and Barriers (HFAB) [12]. The HyKS consists of 16 items on a five-point Likert scale (-2 = Definitely inaccurate, -1 = Probably inaccurate, 0 = Not sure, 1 = Probably accurate, 2 = Definitely accurate). For items that described accurate or true hydration information, a score of 1 was given for an answer of "probably accurate" or "definitely accurate", and 0 for other responses whereas for items that described inaccurate or false hydration information, a score of 1 was given if a person choose "probably inaccurate" or "definitely inaccurate" with a score of 0 for other responses. Then a total number of items correct was calculated for each person. An overall knowledge score was calculated by adding the total score from the full five-point scale (with false items reverse scored), where a perfect score of 32 indicated all items are correct and the person is "definitive" about each item.

Meanwhile HFAB consists of 18 items, including both factors that serve as barriers to hydration (lack of effort, physical barriers such as wanting to avoid frequent bathroom visits, and lack of regular access to a cup or bottle to drink from regularly) as well as factors that help facilitate

hydration (social pressures and effort to monitor hydration levels). Response options include "Not at all like me = 1", "Not much like me = 2", "Somewhat like me = 3", "Mostly like me = 4" and "Very much like me = 5". In the scoring process, certain items were reverse scored, specifically items 1, 8, and 12. Subsequently, averages were calculated for each subscale using designated items. The "Lack of Effort Barrier" subscale comprises items 1 (reverse scored), 7, 8 (reverse scored), and 13. The "Physical Barrier" subscale includes items 4, 10, and 15. For the "Lack of Container Barrier" subscale, items 5, 12 (reverse scored), and 16 were utilized. The "Social Facilitator" subscale incorporates items 2, 6, 11, and 17, while the "Monitoring Facilitator" subscale involves items 3, 9, 14, and 18.

Plain water and other beverage intakes have been assessed using the updated version of Beverage Intake Questionnaire (BEVQ-15) [13]. This questionnaire provided responses estimating mean daily intakes of plain water and other beverages. A total of 10 categories of beverages were listed including plain water, 100% fruit juice, sweetened fruit beverage, etc. Respondents had to specify on "how often" they drink the specific type of beverage in the past month, by indicating either "yes" or "no" and if they respond with "yes", they further specify the drinking frequency (number of times per week) and the amount consumed each time. The amount of beverage consumption for each time was based on household measurement (1 glass = 250mL, 1 can = 325mL and 1 bottle = 500mL). Plain water intake was assessed daily while other beverages was assessed weekly. Plain water intake was then compared with the MDG 2020 of 6 to 8 glasses/day which equivalent to 1500 to 2000 mL [6]. Meanwhile daily mean intake of other beverages was analysed to understand their beverage consumption patterns.

2.4 Data Collection

All respondents from the 12 selected classes were invited to participate in this study. The respondents were selected based on the study's inclusion and exclusion criteria. The researcher reached the representative of each class and requested the course representative to distribute the online questionnaire among their course mates through online platform. A complete research questionnaire was given to all respondents. The entire process of answering questionnaire via Google Form was taken approximately 15 to 20 minutes.

2.5 Data Analysis

Once the respondents submitted their completed online questionnaire, the data was collected and analysed using the IBM Statistical Package for Social Science (SPSS) version 27.0. Numerical variables (age, BMI, physical activity level, hydration knowledge, attitudes, and beverage intake) were summarized as means ± SD, while categorical data were expressed as frequencies and percentages. For inferential statistics, Pearson's Chi square test was used for categorical data. Simple linear regression and multiple linear regression were applied to determine the factors associated with plain water consumption pattern. The categorical variables were recoded into dummy variables before entering into the regression model to predict plain water intake based on the given predictors. All variables with $p < 0.25$ in the simple linear regression model were included in the multiple linear regression model [15]. The significance level was set at $p < 0.05$.

3 RESULTS

A total of 243 undergraduate students from health sciences programmes participated, comprising 190 females and 53 males, with a mean age of 21.26 ± 1.65 years (range: 18–33). This constituted a response rate of 86%. Most respondents were of Malay ethnicity (75.7%) (Table 1). About 61.3% of the respondents had normal BMI range, while 16.9% were underweight, 12.3% were overweight, and 9.5% were obese (Table 2). Self-reported physical activity showed 59.3% of respondents were classified as "moderately active", 21.8% as "highly active", and 18.9% as "low active or sedentary".

Regarding hydration knowledge, the average number of items correct was 8.79 ± 3.00 (maximum score of 16), while the average knowledge score was 7.94 ± 7.00. For hydration attitude, the mean score for "Physical Barrier", "Lack of Effort Barrier" and "Lack of Container Barrier" were 10.15 ± 3.00 (maximum score of 15), 8.66 ± 3.04 (maximum score of 20) and 6.56 ± 3.18 (maximum score of 15), respectively. The average score for the "Monitoring Facilitator" was 14.92 ± 3.25 (maximum score of 20) while "Social Facilitator" had a mean score of 13.80 ± 3.08 (maximum score of 20).

As shown in Table 3, the average amount of plain water intake among respondents was 1474.28 ± 530.19 mL/day. When comparing daily plain water intake with the Malaysian Dietary Guideline (MDG, 2020), only 52.1% of female respondents and 56.6% of male respondents met the suggested recommendation for plain water intake which was 1500 to 2000mL per day. In other words, 46.9% of total respondents did not meet the MDG (2020). Among respondents who consumed beverages, the most frequently consumed type was sweetened coffee or tea (consumed by 69.5% of respondents). On average, these consumers reported an intake of 893.49 ± 1021.95 mL per week, followed by sweetened fruit beverages (61.3%) and carbonated soft drink (61.3%). Almost 40% of respondents consumed full cream and low-fat in a

Table 1: Sociodemographic characteristics of participants (n=243)

Characteristics	n (%)	Mean ± SD
Age (years)		
18-22	212 (87.3)	21.26 ± 1.647
23-33	31 (12.7)	
Gender		
Female	190 (78.2)	
Male	53 (21.8)	
Ethnicity		
Malay	184 (75.7)	
Chinese	32 (13.2)	
Indian	14 (5.8)	
Others	13 (5.3)	

Table 2: Body Mass Index (BMI) of participants (n=243)

Body mass index (BMI)	n (%)	Mean ± SD (kg/m^2)
Underweight	41 (16.9)	22.49 ± 5.49
Normal Weight	149 (61.3)	
Overweight	30 (12.3)	
Obese	23 (9.5)	

BMI cut-offs point according to WHO (underweight <18.5 kg/m^2; normal=18.5-24.9 kg/m^2; overweight=25.0-29.9 kg/m^2; obese≥30.0kg/m^2)

week. Only 57 out of 243 respondents consumed energy or sport drink on a weekly basis, with an average amount of 661.40 ± 757.14 mL/week. Alcoholic beverage was the least consumed beverage (1267.50 ± 1185.25 mL/week), as it is reported by only five respondents.

Bivariate analysis results are summarized in Table 4. The analysis revealed that BMI was significantly associated with plain water intake (χ^2=11.192, p=0.004). However, age, gender and physical activity level were not significantly associated with plain water consumption. Multiple linear regression revealed that "Lack of Effort Barrier" was the only barrier factor for hydration attitude that significantly related to plain water intake among university students. This barrier factor negatively predicts the plain water intake (β = -47.403, 95% CI: -72.27, -22.54, p= 0.001). The multiple regression model in Table 5 explained 14.6% of the variances in plain water intake (adjusted R^2=0.146). This indicates that while the model accounts for a modest proportion of the variance, other unmeasured factors are likely to also influence plain water intake.

4 DISCUSSION

Among the factors examined, hydration knowledge was not associated with plain water intake, while the 'lack of effort' barrier was the only significant predictor. This study revealed that almost half of the respondents did not meet the MDG (2020) recommendation of 6 to 8 glasses (or approximately 1500-2000 mL) of plain water daily. This proportion was notably higher than the findings from the National Health and Morbidity Survey 2023, which reported that 22.2% of Malaysian adults did not meet the adequate plain water intake. Insufficient hydration has been linked to various cognitive impairments, including decreased alertness, memory issues, slower reaction times, impaired perception, and compromised decision-making abilities, which are all crucial for students [16]. The brain is composed of about 75% water, and even mild dehydration (1–2% body weight loss) can impair its function, whereas adequate hydration supports blood flow, oxygen delivery, and nutrient transport [17]. Therefore, educating students who are at risk of low water intake is vital for improving their hydration habits.

Plain water was the primary source of fluid as shown in the pattern of beverage consumption observed in this study, which was supported by the previous studies [9, 18, 19]. Sweetened coffee and tea were the most consumed beverages among the respondents. This is in line with a local study that reported a high consumption of coffee and tea among Malaysians university students [9]. Similarly, a study included over 1200 of college undergraduate students across five universities found that coffee, tea, and soda were as the most prevalent sources of caffeine intake [20].

Malaysian university students preferred consuming tea or coffee because the caffeine helps to improve concentration and prevent sleepiness particularly during early classes, while working on assignments or when preparing for exams at night [21]. There was a concerning trend in the rising prevalence of consuming caffeinated energy drinks (ED) and alcohol-mixed energy drinks (AmED) among youth and young adults, notably college students [22]. However, this is in contrast with our study as energy drink and alcohol were the least consumed beverages among university students. The low intake of alcoholic beverages may be attributed to religious reasons as majority of the respondents in this study were Muslims, who are prohibited from consuming alcohol.

In contrast to a previous study which identified age as a predictor of plain water intake [23], our results showed no significant relationship between age and plain water intake. The average amount of plain water consumed by males and females in this study was almost similar, with males consumed slightly more water than females. These results differ from previous finding that reported females consume more water than males [19]. Additionally, this study found fewer male respondents than female respondents failed to meet

Table 3: Average amount of plain water and beverages consumed among participants (n=243)

Type of beverages	n (%)	Mean ± SD (mL/day)	Mean ± SD (mL/week)
Plain water	243 (100)	1474.28 ± 530.19	
Sweetened coffee/tea (with cream/sugar/milk)	169 (69.5)		893.49 ± 1021.95
Sweetened fruit beverages	149 (61.3)		724.00 ± 729.92
Carbonated soft drink	102 (42.0)		610.17 ± 468.32
Full-cream milk	94 (38.7)		710.11 ± 1091.30
Low-fat milk	91(37.4)		717.03 ± 691.42
100% fruit juice	71 (29.2)		612.68 ± 580.62
Tea/coffee black (no cream/ sugar/ milk)	70 (28.8)		892.86 ± 705.27
Energy/sport drink	57 (23.5)		661.40 ± 757.14
Alcoholic beverages	5 (2.06)		1267.50 ± 1185.25

Table 4: Association between age, gender, physical activity level, BMI and plain water intake among participants (n=243)

Variables	Plain Water Intake, n (%)		χ^2 (df)	P value
	Below Recommendation	In Recommendation		
Age				
18-22	99 (46.7)	113 (53.3)	0.031 (1)	0.860
23-33	15 (48.4)	16 (51.6)		
Gender				
Female	91 (47.9)	99 (52.1)	0.337 (1)	0.562
Male	23 (43.4)	30 (56.6)		
Physical Activity Level				
Low	26 (56.5)	20 (44.5)	2.114 (2)	0.347
Moderate	64 (44.4)	80 (55.6)		
High	24 (45.3)	29 (54.7)		
BMI				
Underweight	28 (68.3)	13 (31.7)	11.192 (2)	0.004*
Normal weight	68 (45.6)	81 (54.4)		
Overweight and Obese	18 (34.0)	35 (66.0)		

*Tested using Pearson's Chi-square with $p < 0.05$

Table 5: Factors associated with plain water intake among participants (n=243)

Factors	beta	t statistic	p-value	95% CI	
				Lower bound	Lower bound
BMI	11.303	1.954	0.052	-0.09	22.70
Hydration Attitude					
Lack of Effort Barrier	-47.403	-3.756	0.001*	-72.27	-22.54
Physical Barrier	-18.589	-1.499	0.135	-43.01	5.84
Lack of Container Barrier	-6.457	-0.513	0.608	-31.25	18.34
Social Facilitator	-14.322	-1.149	0.252	-38.88	10.24
Monitoring Facilitator	20.587	1.788	0.075	-2.10	43.28

Multiple linear regression model summary: $R = 0.409$, $R^2 = 0.168$, Adjusted $R^2 = 0.146$, $F = 7.919$, $p = 0.001$.
*Multiple linear regression was performed with $p < 0.05$.

the recommended plain water intake. It indicates slightly better compliance among males which is also supported by previous researches [3, 24]. Furthermore, this study found no significant association between gender and plain water intake. This finding was agreed by previous researcher who also reported that water intake was not significantly influenced by gender differences [23]. However, these results contradict the findings among college students which showed significant association between gender and water intake [8].

There is a significant association between BMI and plain water intake among university students. This is consistent with earlier study which reported that overweight individuals were found to be high water consumers compared to normal or underweight people [9]. Another study also discovered that individuals' incidence of consuming insufficient fluids was significant lower when their BMI increased [25]. Obese individuals might try to reduce their energy intake by substituting sugar-sweetened beverages (SSBs) with plain water as it may have an important role in decreasing energy intake and possibly preventing incidence of obesity as proved by few studies [7, 26, 27, 28]. Other than that, a significant number of respondents in this study, particularly those who were underweight, failed to meet the recommended intake of plain water. A previous study found drinking more than 4 cups (equivalent to 1 litre) of plain water per day was associated with a reduced risk of new-onset overweight among normal weight individuals [29]. It is crucial to recognize that regardless of having a normal or underweight BMI, it is imperative to maintain a healthy hydration habits for our health.

Contrary to predictions considering the known relationship between hydration and physical activity level [24, 30], present study did not find significant association between physical activity level and plain water consumption. It is plausible that a physically active individual may compensate for their hydration needs by consuming other beverages such as sport or energy drinks. This is supported by research showing that energy drinks are commonly perceived as beneficial for enhancing sport performance and boosting energy level [31, 32]. Therefore, it highlights the need for targeted education to emphasize the importance of plain water as the optimal source of hydration for physically active people.

Despite having a moderate knowledge level, respondents still held some misconceptions about hydration (e.g. “light urine is an indicator of dehydration”). Nevertheless, knowledge scores were slightly lower than the number of correct items when confidence ratings were taken into consideration. This suggests that while most respondents have basic hydration knowledge, their confidence in that knowledge was not particularly strong. Notably, hydration knowledge has no meaningful relationship with plain water intake, which may be attributed to failure in translating knowledge to good hydration practices. This claim was supported by one finding showing that higher levels of knowledge do not lead to changes in practice [21]. It suggests that knowledge or information alone is insufficient to make behaviour change unless people understand, believe, personalize and act upon the information [30].

In this study, attitudes toward hydration emerged as the only significant factor influencing hydration behavior, whereas hydration knowledge was not associated with intake. This finding highlights that knowledge alone may be insufficient to drive behavior change, supporting previous evidence that attitudes, motivations, and environmental factors play a critical role. The result has important implications for public health interventions, suggesting that strategies should extend beyond knowledge dissemination to include practical, behavioral, and motivational components in order to effectively promote adequate hydration. Regression model revealed a significant negative relationship between water intake and the “Lack of Effort Barrier” factor. With a greater perceived difficulty, lack of motivation or habits to consume water, was associated with a decrease in plain water intake by approximately 47.403 mL/day. Thus, this highlights the importance of motivational factors and habit formation in promoting behaviours associated with increased fluid consumption [12].

4.1 Strengths and Limitation of Study

To the best of our knowledge, this is the first study to investigate factors associated with plain water consumption among Malaysian university students. This study discovered potential misconceptions or barriers that could hinder the behaviour change regarding water consumption. Furthermore, our findings were also strengthened by random selection of study programmes from each year of study which helps to reduce the selection bias. Given the current scarcity of data on the factors associated with plain water consumption among Malaysian university students, this study addresses a gap in the literature and provides valuable insights.

Several limitations of the present study should be considered. One of the limitations was the distribution and recruitment process relied on course representatives rather than being conducted directly by the researchers. This reliance on a third party may have introduced risks of human error or inconsistency in questionnaire distribution. The sample reflected the actual demographic distribution of USM students and the Malaysian population, with a higher proportion of females and Malay respondents. Nevertheless, the gender imbalance may have influenced the findings, and the predominance of Malay respondents could limit the generalizability of the results to minority ethnic

groups. Recall bias could occur as data depended heavily on respondents' memory to complete the questionnaires. This may prone to risk of inaccuracies of data as they had to recall and self-reported detailed amounts of plain water and beverages consumed over the past month. Meanwhile, self-reported body weight and height may also lack of precision that will further contributing to inaccuracies in the study's data. Complement self-reported surveys with objective measures (e.g., hydration biomarkers, water bottle tracking, or 24-hour recall interviews) can be applied to minimize recall bias.

5 CONCLUSION

Nearly half of the respondents did not achieve the recommended daily plain water intake, while sweetened coffee or tea was the most commonly consumed beverage. Plain water intake was significantly associated with BMI, with overweight and obese respondents reporting higher consumption than those with normal or underweight status. There was no significant relationship found between hydration knowledge and plain water intake. However, "lack of effort" barrier was identified as the only significant determinant factor that predicted plain water intake. The practical implication of this finding is that public health interventions should not rely solely on knowledge-based education campaigns (e.g., emphasizing the importance of water intake). Instead, intervention strategies should incorporate behavioral and environmental components that actively reduce barriers such as lack of effort, thereby fostering sustainable improvements in hydration practices. Other variables including age, gender and physical activity level are not significant predictors for plain water consumption. The final model of regression analysis consisted of BMI, hydration facilitators and barriers as independent variables managed to explain 14.6% of the variance in daily plain water intake. It is essential to consider other underlying factors such as students food intake habits, socioeconomic status, medical conditions and cultural practices which could influence their hydration patterns in the future research. Ultimately, these findings emphasize the importance of additional efforts to promote adequate water intake among university students to support overall health and well-being.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

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