HYDRATION KNOWLEDGE, ATTITUDE, PHYSICAL ACTIVITY LEVEL AND FLUID CONSUMPTION PATTERN AMONG UNDERGRADUATE STUDENTS IN SCHOOL OF HEALTH SCIENCES, UNIVERSITI SAINS MALAYSIA (USM) HEALTH CAMPUS

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UNIVERSITI SAINS MALAYSIA

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HYDRATION KNOWLEDGE, ATTITUDE, PHYSICAL ACTIVITY LEVEL AND FLUID CONSUMPTION PATTERN AMONG UNDERGRADUATE STUDENTS IN SCHOOL OF HEALTH SCIENCES, UNIVERSITI SAINS MALAYSIA (USM) HEALTH CAMPUS

by

JOJO TING SING JOE

Dissertation submitted in partial fulfilment

of the requirements for the degree

of Bachelor in Nutrition with Honours

February 2025

CERTIFICATE

This is to certify that the dissertation entitled "Hydration knowledge, attitude, physical activity level and fluid consumption pattern among undergraduate students in School of Health Sciences, Universiti Sains Malaysia (USM) Health Campus" is the bona fide record of research work done by Ms. Jojo Ting Sing Joe during the period of March 2024 to January 2025 under my supervision. I have read this dissertation and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation to be submitted in partial fulfillment for the degree of Bachelor in Nutrition with Honours.

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DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at Universiti Sains Malysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for teaching, research and promotional purposes.

…………………….

Jojo Ting Sing Joe

Date: 25 February 2025

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

MDG   Malaysian Dietary Guidelines

WHO   World Health Organization

NHMS   National Health Morbidity Survey

PPSK   Pusat Pengajian Sains Kesihatan

BMI   Body Mass Index

PAL   Physical Activity Level

IPAQ   International Physical Activity Questionnaire

SSBs   Sugar-sweetened Beverages

HyKS   Hydration Knowledge Scale

BEVQ   Beverage Intake Questionnaire

LIST OF APPENDICES

PENGETAHUAN PENGHIDRATAN, SIKAP, TAHAP AKTIVITI FIZIKAL DAN CORAK PENGAMBILAN CECAIR DALAM KALANGAN PELAJAR PRASISWAZAH DI PUSAT PENGAJIAN SEKOLAH SAINS KESIHATAN, KAMPUS KESIHATAN, UNIVERSITI SAINS MALAYSIA (USM)

ABSTRAK

Pengambilan cecair yang mencukupi adalah penting untuk mengekalkan fungsi tubuh dan mempromosikan kesihatan yang baik. Namun, faktor-faktor yang mempengaruhi pengambilan air kosong dalam kalangan pelajar universiti di Malaysia masih kurang dikaji. Oleh itu, kajian keratan rentas ini bertujuan untuk menilai faktor-faktor seperti sosiodemografi, tahap aktiviti fizikal (PAL), indeks jisim badan (BMI), pengetahuan dan sikap mengenai hidrasi serta hubungannya dengan corak pengambilan cecair, khususnya air kosong, dalam kalangan pelajar sarjana muda di Kampus Kesihatan Universiti Sains Malaysia (USM). Kaedah persampelan kelompok digunakan untuk memilih 3 program pengajian secara rawak bagi setiap tahun. Seramai 243 pelajar prasiswazah PPSK (190 perempuan, 53 lelaki), berumur antara 18 hingga 33 tahun telah direkrut. Satu set soal selidik yang mengandungi lima bahagian telah diedarkan. Analisis dilakukan menggunakan SPSS versi 27.0. Keputusan menunjukkan purata pengambilan air kosong ialah 1474.28 ± 530.19 mL/hari, di mana pelajar lelaki mengambil sedikit lebih banyak (1551.89 ± 526.60 mL/hari) berbanding pelajar perempuan (1452.63 ± 530.54 mL/hari). Dapatan juga menunjukkan bahawa 46.9% peserta tidak mencapai saranan Garis Panduan Diet Malaysia (MDG) 2020 untuk air kosong. Terdapat hubungan yang signifikan antara BMI dan pengambilan air kosong (p = 0.004), di mana pelajar yang mempunyai berat badan berlebihan dan obes mengambil lebih banyak air kosong berbanding rakan sebaya mereka. "Halangan kekurangan usaha" merupakan satu-satunya peramal kepada pengambilan air kosong, yang secara negatif mempengaruhi pengambilan seperti yang

ditunjukkan dalam model regresi linear berganda ($\beta = -47.403$, $p = 0.001$, $R^2 = 0.168$). Pemboleh ubah ini menyumbang 14.6% daripada varians dalam pengambilan air kosong harian (Adjusted $R^2 = 0.146$). Hasil kajian ini menekankan hubungan antara halangan hidrasi dan pengambilan air kosong dalam kalangan pelajar. Pendidikan dan intervensi yang komprehensif amat penting untuk meningkatkan pengambilan air kosong dan memperbaiki tabiat hidrasi mereka sebagai sebahagian daripada gaya hidup yang sihat.

HYDRATION KNOWLEDGE, ATTITUDE, PHYSICAL ACTIVITY LEVEL AND FLUID CONSUMPTION PATTERN AMONG UNDERGRADUATE STUDENTS IN SCHOOL OF HEALTH SCIENCES, UNIVERSITI SAINS MALAYSIA (USM) HEALTH CAMPUS

ABSTRACT

Adequate fluid consumption is essential for maintaining bodily functions and promoting good health. However, factors influencing plain water intake among Malaysian university students remains understudied. Hence, this cross-sectional study aimed to access factors such as sociodemographic, physical activity level (PAL), body mass index (BMI), hydration knowledge and attitude as well as its relationship with the fluid consumption pattern specifically plain water among undergraduate students in Universiti Sains Malaysia (USM) Health Campus. Cluster sampling method was used to randomly select 3 study programmes for each year. A total of 243 undergraduate PPSK students (190 females, 53 males), aged between 18-33 years were recruited. A set of questionnaires with five sections were distributed. Analyses were performed using SPSS version 27.0. Results indicated that average plain water intake was 1474.28 ± 530.19 mL/day, with male consuming slightly more (1551.89 ± 526.60 mL/day) than female (1452.63 ± 530.54 mL/day). Notably, 46.9% of participants did not meet the Malaysia Dietary Guidelines (MDG) 2020 recommendation for plain water. A significant association was found between BMI and plain water intake (p = 0.004), with overweight and obese students consuming more water than their counterparts. "Lack of effort barrier" was the only predictor of plain water intake, which negatively predicting the consumption as shown in multiple linear regression model (β = −47.403, p = 0.001, R^2 = 0.168). This variable contributed 14.6% of the variance in daily plain water intake (Adjusted R^2= 0.146). The results highlight the relationship between hydration barrier and plain water intake among

students. Comprehensive education and interventions are crucial to increase its intake and improve their hydration habits as part of healthy lifestyle.

CHAPTER 1

INTRODUCTION

1.1   Study background

Water is an essential element in our human body and is critical for maintenance of life (Sims *et al*., 2022). It plays a crucial role in supporting various bodily functions such as body temperature regulation, blood circulation maintenance, waste removal, digestion, and cognitive performance (Ahmeda *et al.*, 2021). The tropical climate, with its elevated temperatures and humidity levels particularly in Malaysia, increases the risk of dehydration and emphasizes the necessity of maintaining adequate hydration levels. According to the National Health Morbidity Survey (NHMS) 2019, not more than half of the adults (49.4%) reach the recommended plain water intake (6 to 8 glasses per day). It is important to maintain proper hydration as insufficient and inappropriate daily fluid intake in a long period of time may possess adverse effects on human's 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 (Alsaeti *et al*., 2021; Djannah & Matahari, 2020).

Fluid in the human body comes from all the beverages that we drink and the food that we eat. According to Anggun Putri *et al*. (2022), about 80% of the sources of water intake come from fluid and 20% come from food. Examples of the fluids are water, fruit and vegetable juices, milk, soft drinks, tea and coffee, broth and soups and sports drinks. 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 (Ahmeda *et al*., 2021). 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 1 (NCCFN, 2021). In addition, the required amount of water by the body can be supplied by other beverages such as juice, tea, coffee, milk, sport drinks and soft drinks (Alsaeti *et al.*, 2021). However, it is crucial to consider their nutritional content and their impact on overall well-being and health status. Therefore, adopting a healthy pattern of drinking water is essential for maintaining proper hydration.

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 (Popkin, D'Anci & Rosenberg, 2020). 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, practice can still remain poor among university students as reported by few studies, where the plain water intake of all the participants was less than the recommended requirement and they were depended on other fluids rather than plain water (Alsaeti *et al.*, 2021; Alanazi, 2018). Some of the factors explored include lack of knowledge and awareness regarding proper hydration, cost, availability of water sources, and water quality (Mohd Fahmi Teng, Nordin & Muhammad Shah, 2019; Azlan *et al*., 2012).

Other than that, with the emergence of modern facilities and amenities, including vending machines and cafeterias, university students have access to a wide range of sugary

beverages, including sugary carbonated drinks, energy drinks, sugar-sweetened juices and flavoured milk drinks (Faris *et al.,* 2021). Since college life serves as a transitionary period into adulthood where students begin making independent dietary choices, this age group is more vulnerable for unhealthy drink choice. Therefore, the type of beverage consumed by students should have received more attention (Anggun Putri *et al.,* 2022; Alsaeti *et al*., 2021).

Understanding the factors influencing fluid consumption patterns among university students is crucial for designing targeted interventions to promote healthier hydration habits. Little has been reported on fluid consumption, specifically plain water intake among the students population. By exploring their hydration knowledge, attitude, sociodemographic factors, physical activity level and BMI towards the fluid (plain water) consumption pattern, we can develop effective strategies to encourage students to make healthier beverage choices and improve their overall well-being. Hence, this study aimed to investigate fluid consumption specifically from plain water and beverages among undergraduate students in USMKK, shedding light on the various factors influencing their beverage choices and hydration habits.

1.2   Problem statement

Adequate body fluid is beneficial for maintaining physiology, cognitive function, and concentration, which are important for students (Sutanto *et al*., 2023). Despite the known importance of adequate fluid intake, there exists a concerning trend of inadequate hydration among students due to modern lifestyle and the existence of alternatives to plain water (Alsaeti *et al*., 2021). This presents a multifaceted problem that requires deeper exploration and understanding. Several factors contribute to this issue which includes environmental influences, lifestyle habits, individual preferences, socio-cultural factors and medical problem.

Today, the continue rise in temperature due to the climate change in Malaysia as well as the impact of emerging trends such as increased availability of vending machines in university campus which offer sugary drinks, caffeinated beverages, energy drinks and other beverages that exacerbate the issue of inadequate plain water consumption. Another concern has been raised regarding the drinking water quality (yellowish water) particularly in the state of Kelantan. These issues will 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 (Popkin, D'Anci & Rosenberg, 2020).

However, there was a lack of published studies reporting the fluid consumption especially among university students in Malaysia. In addition, little has been reported on plain water consumption and factors influencing the fluid intake behaviour. One of the study's findings reflect the presence of sugar-sweetened beverages as an alternative to plain water in order to quench their thirst and this trend has affected the fluid consumption practice,

specifically the intake of plain water among students (Mohd Fahmi Teng, Nordin & Muhammad Shah, 2019). 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 the factors influencing fluid consumption, including knowledge and attitude regarding hydration, sociodemographic profiles, physical activity level, and body mass index among undergraduate students in USM Health Campus. In addition, this study has also determined any relationship between these factors with fluid consumption patterns of participants.

1.3   Research questions

1. What is the hydration knowledge and attitude level among PPSK undergraduate students in USM Health Campus?

2. What is the physical activity level among PPSK undergraduate students in USM Health Campus?

3. What is the body mass index status among PPSK undergraduate students in USM Health Campus?

4. What is the pattern of water and beverage consumption among PPSK undergraduate students in USM Health Campus?

5. Is there any significant relationship between hydration knowledge, attitude, sociodemographic factors, physical activity level, BMI, and plain water consumption among PPSK undergraduate students in USM Health Campus?

1.4   Objective

1.4.1   General objective

To investigate factors associated with plain water consumption patterns among undergraduate students in School of Health Sciences (PPSK), Universiti Sains Malaysia (USM) Health Campus.

1.4.2   Specific objectives

1. To determine the hydration knowledge and attitude among PPSK undergraduate students in USM Health Campus.

2. To determine physical activity level (PAL) among PPSK undergraduate students in USM Health Campus.

3. To determine body mass index (BMI) among PPSK undergraduate students in USM Health Campus.

6

4. To determine the fluid (plain water and beverage) consumption pattern among PPSK undergraduate students in USM Health Campus.

5. To determine the relationship between hydration knowledge and attitude, sociodemographic factors, physical activity level, BMI and plain water consumption among PPSK undergraduate students in USM Health Campus.

1.5   Study hypotheses

Hypothesis 1

Null hypothesis (H$_0$)

There is no relationship between hydration knowledge and plain water consumption among PPSK undergraduate students in USM Health Campus.

Alternative hypothesis (H$_1$)

There is a significant relationship between hydration knowledge and plain water consumption among PPSK undergraduate students in USM Health Campus.

Hypothesis 2

Null hypothesis (H$_0$)

There is no relationship between attitude and plain water consumption among PPSK undergraduate students in USM Health Campus.

Alternative hypothesis (H$_1$)

There is a significant relationship between attitude and plain water consumption among PPSK undergraduate students in USM Health Campus.

Hypothesis 3

Null hypothesis (H$_0$)

There is no relationship between physical activity level and plain water consumption among PPSK undergraduate students in USM Health Campus.

Alternative hypothesis (H1)

There is a significant relationship between physical activity level and plain water consumption among PPSK undergraduate students in USM Health Campus.

1.6   Significance of study

As we know, adequate fluid consumption is beneficial for maintaining physiology, cognitive function, and concentration which are important for students. This study is crucial to determine the factors associated with fluid consumption patterns, especially plain water intake among health sciences undergraduate students in USM Health Campus. Health sciences students are the future healthcare providers. Understanding their fluid consumption patterns provides insights into their own health behaviours, which can influence their future practice. By developing healthy habits during their education, health sciences students are more likely to promote similar behaviours to their patients, contributing to overall public health. In addition, knowing the fluid consumption patterns among university students and the factors associated with the consumption will serve as a reference point and additional knowledge and ideas that will be tackled in future research. The association between factors and plain water consumption pattern among undergraduate students in USM Health Campus will then be understood better. By identifying the fluid consumption pattern and its associated factors, the study findings will guide health providers in planning appropriate strategies such as awareness programs to increase the water intake and promoting healthier hydration habits.

1.7   Conceptual Framework

```
┌─────────────────────────────┐
│ Sociodemographic factors:   │
│      • Age                  │
│      • Gender               │
└─────────────────────────────┘


┌─────────────────────────────┐
│ Body mass index (BMI)       │          ┌───────────────────────────┐
└─────────────────────────────┘          │ Plain   water  consumption│
                                         │ pattern                   │
┌─────────────────────────────┐          └───────────────────────────┘
│ Physical activity level (PAL)│
└─────────────────────────────┘


┌─────────────────────────────┐
│ Hydration  knowledge  and   │
│ attitude                    │
└─────────────────────────────┘
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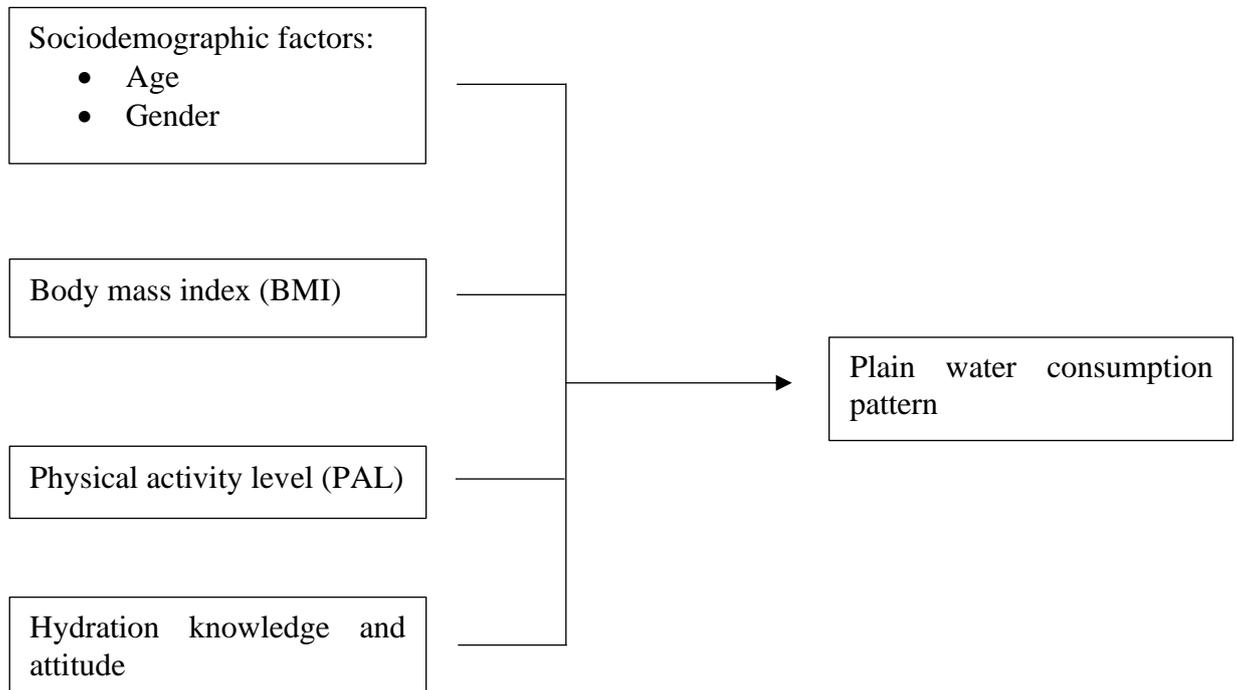
Figure 1: Conceptual framework for hydration knowledge, attitude, physical activity

level and fluid consumption pattern among undergraduate students in School of Health

Sciences, Universiti Sains Malaysia (USM) Health Campus

As shown in Figure 1 above, sociodemographic factors, BMI, physical activity level, hydration knowledge, attitude are the independent variables of this study while the dependent variable is plain water consumption pattern. Sociodemographic factors include age which is one of the predictors of water intake based on study conducted by Albasheer *et al.* (2021) and gender that is associated with the fluid intake as shown by previous studies (Adams *et al.*, 2022; Alsaeti *et al.,* 2021).

CHAPTER 2

LITERATURE REVIEW

2.1 Overview of plain water and beverages consumption pattern

Water is an essential nutrient for humans with several vital roles including maintaining body functions, temperature and preventing dehydration. The importance of water has gained an increasing attention as that there is a notably significant shift in fluid consumption preference towards high energy drinks and other beverages (Merve *et al.,* 2023). As we know, plain water offers substantial benefits compared to other beverages, especially sugar-sweetened beverages, as it is necessary for metabolism, proper physiologic functions and provides essential minerals such as calcium, magnesium, and fluoride (NCCFN, 2021). Sugar-sweetened beverages (SSB) are any type of drinks that contain added sugar such as raw sugar, brown sugar, sucrose, fructose, lactose, glucose, dextrose, corn syrup, malt syrup, and molasses (CDC, 2018). Examples of SSB include carbonated drinks, energy drinks, fruit drinks, sweetened coffee, teas, flavoured milk, and others drinks that are being sweetened.

While water plays a crucial role in active tissue within the human body in general, conversely, sugar-sweetened beverages may contribute to a variety of adverse health effects, including type 2 diabetes, obesity, and increased risk for cardiovascular disease (Alothmani & Almoraie, 2023). Despite the fact that most people understand the importance of drinking water every day, many groups in the population still do not consume sufficient water to meet their bodies' needs (IPH, 2020). To understand the importance of proper water intake for maintaining health and healthy functioning of the body, many factors need to be examined in this context. These factors include identifying the hydration knowledge and attitude, sociodemographic factors, BMI, and physical

activity level that may influence the fluid, specifically plain water, and beverages consumption.

2.2   Plain water and beverages consumption pattern among young adults in Malaysia

A recent study on sugar-sweetened beverages (SSB) consumption among university students in Malaysia was conducted by Cheah & Chua (2023) indicated that students consumed plain water the most (98.9%), followed by sugar-sweetened coffee or tea (39.8%), and low-fat milk (15.9%) at least once daily. Other beverages such as regular soft drinks (52.3%) were the most consumed beverage by students on a weekly basis (≤ 6 times per week), followed by 100% fruit juice (46%) and tea or coffee with sugar (45.5%). The least frequently consumed drinks of the participants consuming them either once a week or none were alcoholic drinks and energy or sports drinks with 84.1% and 83.5% respectively.

The findings of the study on consumption of SSB among Malaysian university students during the Covid-19 showed that the most consumed beverage in a week was milk (59%), followed by tea or coffee with cream and/ or sugar (56%) and soft drink (44%). Interestingly, approximately one-tenth of the students reported drinking tea or coffee with cream and/or sugar on a daily basis. Energy drinks were the least consumed beverage, with the vast majority of students (99%) not consuming them at all within a week (Cheng & Lau, 2022). In addition, according to a cross-sectional study focusing on young adults in Malaysia during pandemic lockdown, it revealed that about 60.2% of 1045 participants had higher plain water intake during the pandemic as opposed to pre-pandemic (Tan *et al.*, 2022).

Furthermore, Aida *et al.* (2020) found that university students in Terengganu, Malaysia preferred sweetened tea the most. Based on the beverage's consumption pattern, almost half of the students (49.4%) consumed moderate amounts which are 2 cups (500ml) of

SSB on average per day while 21.7% of them consumed at least 3 cups per day. Researchers reported that this may be due to the vast availability on campus as well as its cheap price. The results also showed that female students drink more plain water than male students per day.

Other than that, the study conducted by Ahmad and his colleagues (2019) found that the prevalence of SSB consumption was high among undergraduate students in Malaysia. In this study, an intake of three or more SSB in a day was considered as high SSB intake. The results showed that the prevalence of students who consumed SSB at least once daily and a high SSB intake were 89.3% and 53.3% respectively. Majority of the students consumed sweetened coffee or tea (68.1%), followed by flavoured milk and fruit juice (57.9%), three-in-one sachet drinks (57.6%) and sport drinks (23.4%) in a day.

The study of plain water and beverage consumption patterns among university students by Mohd Fahmi Teng, Nordin & Muhammad Shah (2019) also showed that the most commonly consumed was plain water (92.3%) with a majority of students drinking more than 2 cups each time. It was then followed by sweetened coffee or tea (18.4%) and full cream milk (9.6%) which consumed only less than equal 1 cup each time. The least frequent intake of beverage was alcoholic drinks, with 97.1% of participants consuming such beverages either once or not at all in a week. Based on the results, soft drinks and milk were also less favoured among the participants.

2.3 Factors influencing plain water and beverages consumption pattern

2.3.1 Sociodemographic factors

Age

A recent study conducted by Nur *et al.* (2024) revealed that there was no significant association between age and sugar-sweetened beverages consumption pattern among Malaysian young adults (X^2 (1, n = 408) = 0.485, p = 0.486). This claim was also supported by another study conducted by Alanazi (2018), demonstrating that there was no corelation between consuming plain water and age (r = 0.03, p = 0.082). However, research among Malaysian university students during Covid-19 pandemic found that with the exception for age (p < 0.05), there was no significant difference between sociodemographic variables and sugar intake from sugar-sweetened beverages (SSBs). It showed that students in the 21-24 age range consumed more SSBs than in the 18-20 age range (Cheng & Lau, 2022).

Apart from that, the research done by Albasheer *et al.* (2021) proved that age was one of the predictors of water intake. From the study, it showed that an increase in age was associated with higher intake of water with a p-value of 0.006. On the contrary, findings from Shaheen and his colleagues (2018) predicted that participants consumed less water when there is an increase in the age of 10 years (p = 0.012). On the other hand, the results gained by Hasan *et al.* (2019) also showed that age was not associated with the energy drinks consumption among university students (p = 0.078).

Gender

Few studies have shown that gender is one of the factors that have been associated with the fluid (plain water and beverages) consumption pattern.

According to the study conducted by Alsaeti *et al.* (2021), there was a positive correlation between plain water intake and total water intake among male and female medical college students ($r = 0.92$, $p < 0.001$), showed that the intake of plain water in male was higher than female's plain water intake. The results of the total water intake based on gender indicate that male consume more fluids from plain water and beverages than females. This study expected that males have slightly better compliance to the total water recommendation compared to females. In this study, it was found that the relationship between tea consumption and gender as well as between coffee consumption and gender are highly significant with a p-value less than 0.001. Male students consumed more tea and coffee as compared to female students. Similar results have been reported in a study conducted among college students, in which the result of t-test showed that both plain water intake ($t (79) = 2.83$, $p = 0.006$) and total water intake ($t (79) = 2.96$, $p = 0.004$) possessed a significant association with gender (Alanazi, 2018). However, the results are not consistent with Albasheer *et al.* (2021) findings which reported that more water intake was not significantly affected by gender differences.

Additionally, a study conducted among university students during the Covid-19 pandemic had reported that females consumed significantly lower daily fluid intake compared to males ($p < 0.001$). This study also found that females consumed a lesser amount of beer, hard liquor, coffee, energy drinks, milk, sweetened juice beverages, and soft drinks but more nut milk than male ($p < 0.05$). The reduced fluid intake in females compared to male

could be attributed to the difference of the body composition and fluids requirement between both genders (Adams *et al.*, 2022).

Apart from that, Hasan *et al.* (2019) found that gender was significantly associated with the energy drink consumption among university students ($p < 0.001$). The multivariate analysis showed that male students consumed energy drinks 3.82 times higher as compared to female students ($p < 0.001$). The participants showed an intention to consume energy drinks 1.2 times more for each increase in their university study duration ($p = 0.010$). This could be due to the fact that with longer study duration, the desire for socializing, exploring new taste for beverages and the stress level in higher classes increased, and these may lead them to consume more energy drinks as a way to alleviate stress and relax (Hasan e*t al.*, 2019). Similarly, male students were also found to significantly consume more energy drinks than female students ($p = 0.004$) as reported in the study conducted by Ghozayel *et al.* (2022).

On top of that, the research done by Aida *et al.* (2020) among university students in Malaysia showed a significant difference in the water and beverage consumption pattern between male and female, in which the results showed that female students consumed a significantly greater amount of plain water, low fat milk and fermented drinks than male students with a p-value of 0.019, 0.017 and 0.003 respectively, whereas the intake of regular soft drinks, sweetened coffee, unsweetened coffee or tea and energy or sport drinks in male students were significantly higher than female students ($p < 0.05$).

Another research done by Islam *et al.* (2020) among undergraduate students showed that gender was one of the predictors of carbonated beverages. It was predicted that for every ml of carbonated beverage consumed by students, the intake would increase by 147 ml for male students while holding other independent variables constant ($p < 0.05$). Besides,

Soumya Kanti Mandal *et al.* (2021) also found that male students had about 1.8 times higher odds of high SSB intake as compared to females (p = 0.04).

2.3.2 Body Mass Index (BMI)

A meaningful relationship between BMI and plain water intake was determined by a study conducted by Mohd Fahmi Teng, Nordin & Muhammad Shah (2019) that investigated the plain water and beverage consumption pattern among university students in Malaysia. The study results showed that there is a significant association between the amount of plain water consumption and BMI ($p < 0.05$). Overweight participants consumed a significantly greater amount of plain water with more than 2 cups each time (78.9%) compared to those who were underweight (27.9%), who typically drank less than 1 cup of water each time. In contrast, Alanazi (2018) suggested that there was no relationship between drinking water and BMI ($r = 0.0003$, $p = 0.99$). However, it was found that students who were underweight consumed plain water the most (2090 mL), followed by overweight (1667 mL), normal weight (1523 mL), and obese students (1455 mL). Similar findings have also reported that there was no significant relationship between BMI and water intake in male ($p = 0.845$) and female ($p = 0.447$) (Alsaeti *et al*., 2021).

Besides, a study conducted among undergraduate students had reported that BMI was significantly related to caffeine containing beverages (CCBs) and carbonated beverages (CarBs) consumption ($p < 0.05$). In this study, BMI was a predictor of beverage consumption based on the results from multiple linear regression models. It showed that the intake of sugar sweetened beverages (SSBs) would increase by 70 ml for every unit increase in BMI that is obesity while keeping all other independent variables constant ($p < 0.05$). Similar to the intake of CCBs and CarBs which would increase by 163ml and 312ml respectively for every increase in BMI after adjusting all the variables ($p < 0.05$) (Islam *et al*., 2020).

Another influence of BMI on beverage consumption patterns was demonstrated in a study that examined the predictors of coffee consumption among female university students in Saudi (Alfawaz *et al.*, 2020). The results of multivariate-adjusted odds ratios (ORs) showed that high BMI emerged as an independent predictors of coffee consumption among female students in which the odds of the coffee consumption were 4.42 times higher in obese students compared to those with a normal BMI (95% CI; 1.15-11.7, p = 0.031).

In addition, Azzeh & Hamouh also proved that BMI was positively associated with sugar-sweetened carbonated beverages (SSCBs) consumption (p < 0.001). The results from the multinomial logistic regression showed that obesity was one of the predictors of increased SSCBs consumption among the students. Obesity were positively associated with high intake of SSCBs in the regular SSBCs consumption group (OR: 3.051, 95% CI: 1.9080–4.879; p < 0.001) while other significant odds values for high intake of SSCBs were observed for students who being overweight (OR: 1.501, 95% CI: 1.085–2.076; p < 0.05) and obesity (OR: 2.346, 95% CI: 1.478–3.723; p < 0.001) (Azzeh & Hamouh, 2022).

2.3.3 Physical activity level (PAL)

In the study conducted by Adams *et al.* (2022) among university students during Covid-19 pandemic, it showed that students who increased in exercise participation was found to be associated with greater total fluid intake including water, energy drink, milk ($p < 0.001$) and nut milk ($p < 0.05$) but less intake of soft drink ($p < 0.01$) and sweet tea ($p < 0.05$). On the contrary, Alsaeti *et al*. (2021) found that there was no significant relationship between physical activity level and water intake in both male and female students.

Besides, according to the research done by Hasan and his colleagues (2019), they reported that university students who did physical activity more regularly were 1.69 times more likely to consume energy drinks in comparison with students who were inactive or did irregular physical activity (95% CI: 1.04 - 2.75, p-value = 0.033). Similar results have been gained by Gyozayel *et al.* (2022) in which physically active students were 1.89 times more likely to consume energy drinks as compared to inactive students (95% CI: 1.01, 3.51) after adjusting sociodemographic-related factors such as age and gender. The reasons behind were getting energy to study (47%), to work (36%), to play sports (35%) and to reduce sleepiness (20%). In addition, another similar result have been highlighted that students who engage in sports either recreationally or professionally were significantly more likely to consume energy drinks than students who do not play sports (X^2- test; p = 0.024) (Pavlovic *et al*., 2023).

Furthermore, a study conducted among female university students had reported that sugar-sweetened carbonated beverages (SSCBs) were negatively associated with regular exercise ($p < 0.001$). For students who regularly consumed SSCBs, lack of regular physical activity was positively associated with high SSCBs consumption with an odds

ratio of 3.431 (95% CI: 2.18–5.399, $p < 0.001$). Participants who engaged in physical exercise "once a week" or "2 to 4 times a week" were significantly ($p < 0.05$) more likely to have high SSCBs intake (OR: 1.979, 95% CI: 1.239–3.161, and OR: 1.769, 95% CI: 1.113–2.810, respectively) compared to participants who exercised daily. Additionally, significant odds values for high SSCBs intake were observed for non-regular exercise, with an odds ratio of 2.561 (95% CI: 1.728 – 3.793) (Azzeh & Hamouh, 2022).

2.3.4 Hydration Knowledge and Attitude

In recent years, several studies have examined hydration knowledge that influence the fluid intake among specialized samples such as in the context of sports. It is crucial to consider hydration knowledge in this field as hydration is a key factor in sport performances. However, given the importance of hydration in maintaining homeostasis other than sports, a more thorough assessment of general public hydration awareness is necessary. Beyond knowledge, the attitudes that individuals hold towards hydration could either help or hinder their engagement in fluid consumption patterns.

According to the study on fluid intake and hydration status among sport science students at Cenderawasih University, Sinaga *et al.* (2022) found that there was a moderate significant correlation between total fluid intake and hydration knowledge (r = 0.729). The mean total fluid intake, primarily from water consumption was 2708.99 ml ± 416.97, below the recommended total fluid intake as stated in IOM guidelines used in this study. The mean hydration knowledge score among sports students was 15.15 ± 6.85, which indicates a relatively low level compared to the maximum score achievable based on the Hydration Knowledge Scale (HyKS). Besides, the study results also showed a moderate negative relationship between hydration knowledge and hydration status (r = -0.657) which means that most of the students experience dehydration due to poor or inadequate knowledge regarding proper hydration behaviour. The contrast finding was shown in a study conducted by Jusoh & Salim (2018) that hydration knowledge did not significantly correlate with the amount of fluid intake (r = 0.031, p = 0.883).

Moreover, Albasheer *et al.* (2021) also found that although participants reported good knowledge regarding dehydration definition (97.95%), prevention (94.8%) and

recommended minimum water intake (75%), one-third of the participants still did not meet the recommended water intake level.

According to the research on knowledge, attitude and practice (KAP) of sugar-sweetened beverages (SSBs) among university students in Malaysia, Cheah & Chua found that the majority of students had a poor knowledge (51.7%) but positive attitudes towards SSBs consumption (90.6%). Although the most of them had a positive attitude that illustrated willingness to limit the consumption of SSBs, practice still remained poor (80.7%). In terms of the daily beverage intake, the top three beverages preferred by students were plain water (98.9%), followed by sugar-sweetened coffee or tea (39.8%) and low-fat milk (15.9%) (Cheah & Chua, 2023).

Furthermore, a cross-sectional study on KAP related to the consumption of sugar-sweetened beverages among Malaysian young adults showed that while the majority had a high attitude (100%) to reduce SSB intake and moderate knowledge (60%), they still demonstrated a moderate practice (60%) on SSB consumption (Nur *et al*., 2024). A significant correlation was observed between knowledge and practice among participants (rs = 0.138, p = 0.005) but no significant relationship was observed between attitude and practice (rs =0.049, p = 0.321). It predicted that having a positive attitude towards lowering SSB consumption does not necessarily lead to making corresponding changes in actual practices.

Apart from that, in a study conducted by Ahmad *et al.* (2019) among undergraduate students, it was found that there was no correlation between level of knowledge and consumptions of SSBs (X^2 = 1.251, p = 0.535). It means that despite the majority of students having high knowledge regarding SSBs intake, including the effects of SSBs on health, they still consumed a greater amount of SSBs on a daily basis. According to the