KNOWLEDGE, ATTITUDE, AND DETERMINANTS OF SUGAR SWEETENED BEVERAGE CONSUMPTION IN MALAYSIA

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UNIVERSITI SAINS MALAYSIA

2025

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by

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Thesis submitted in fulfilment of the requirements

for the degree of

Master of Public Health

June 2025

ACKNOWLEDGEMENT

بِسْمِ اللهِ الرَّحْمٰنِ الرَّحِيْمِ

First and foremost, I am deeply grateful to Allah SWT for granting me the strength, patience, and perseverance to complete this study, "Knowledge, Attitudes, and Determinants of Sugar-Sweetened Beverage Consumption in Malaysia." HIS endless guidance and blessings have been my foundation throughout this journey.

My heartfelt appreciation goes to my supervisor, Associate Professor Dr. Surianti Binti Sukeri, whose unwavering support, expert guidance, and constructive feedback were instrumental in shaping this research. Her dedication and encouragement have been a constant source of motivation, and I am truly privileged to have been under her mentorship.

I would also like to extend my sincere thanks to the lecturers from the Department of Community Medicine, Universiti Sains Malaysia, for their valuable insights, support, and encouragement especially during the proposal development phase. Their contributions significantly enriched the quality and clarity of this study.

To my beloved families especially my wife Dr. Farah Wadhihah Binti Hasan, thank you for your endless moral support, understanding, and encouragement. Your belief in me has carried me through the most challenging moments of this academic journey.

Finally, I would like to express my deepest gratitude to all participants who voluntarily took part in this study. Without your willingness to contribute your time and input,

this research would not have been possible. It is my hope that the findings from this study will serve to inform, guide, and benefit the broader community and contribute meaningfully to public health efforts in Malaysia.

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d	Margin of error (precision)
n	Sample size
z	Z-score for confidence level
p-value	Probability value
σ	Population standard deviation

LIST OF ABBREVIATIONS

aOR	Adjusted odds ratio
BMI	Body mass index
CI	Confidence interval
CPG	Clinical practice guideline
DOSM	Department of Statistics Malaysia
MANS	Malaysian Adult Nutrition Survey
MLogR	Multiple logistic regression
NCD	Non-communicable disease
NHANES	National Health and Nutrition Examination Survey
OR	Odds ratio
ROC	Receiver operating characteristic
SD	Standard deviation
SLogR	Simple logistic regression
SSB	Sugar-sweetened beverage
USM	Universiti Sains Malaysia
WHO	World Health Organization

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ABSTRAK

Pengambilan minuman bergula secara berlebihan menyumbang secara signifikan kepada beban penyakit tidak berjangkit di peringkat global seperti obesiti dan diabetes. Kajian keratan rentas ini dijalankan bagi menilai hubungan antara tahap pengetahuan, sikap, dan faktor sosiodemografi dengan kekerapan pengambilan minuman bergula dalam kalangan orang dewasa di Malaysia. Persampelan mudah telah digunakan, dan data kajian telah diperolehi melalui dalam talian menggunakan soal selidik pengetahuan, sikap dan amalan tentang pengambilan minuman bergula yang telah disahkan. Seramai 423 orang peserta dari seluruh Malaysia telah mengambil bahagian dalam kajian ini. Skor purata pengetahuan adalah 7.19 (1.43) dan skor purata sikap 4.85 (0.49) menunjukkan tahap kesedaran yang sederhana baik serta sikap yang positif terhadap pengambilan minuman bergula. Purata kekerapan pengambilan minuman bergula ialah 9.18 (6.27) kali seminggu, dengan 44.0% peserta mengambil minuman bergula sebanyak 9 kali atau lebih dalam seminggu. Analisis regresi logistik berganda mendapati bahawa jantina lelaki (OR Terlaras = 2.43; 95% CI: 1.56, 3.77) dan tahap pendidikan tanpa ijazah (OR Terlaras = 1.69; 95% CI: 1.05, 2.71) dikaitkan secara signifikan dengan pengambilan minuman bergula yang lebih tinggi (9 kali atau lebih dalam seminggu), manakala pendapatan isi rumah B40 dikaitkan secara signifikan dengan pengambilan minuman bergula yang lebih tinggi (kurang dari 9 kali dalam seminggu) apabila dibandingkan dengan Kumpulan M40 dan T20 (OR Terlaras antara 0.09 hingga 0.53; $p < 0.05$). Kajian ini menekankan pengaruh

pengetahuan dan faktor sosiodemografi terhadap tingkah laku pemakanan serta menyerlahkan keperluan untuk intervensi yang disasarkan kepada golongan lelaki dan populasi berpendapatan rendah bagi mengurangkan pengambilan minuman bergula dan menggalakkan gaya hidup yang lebih sihat, walaupun dalam kalangan mereka yang sudah mempunyai kesedaran.

KNOWLEDGE, ATTITUDE, AND DETERMINANTS OF SUGAR-SWEETENED BEVERAGE CONSUMPTION IN MALAYSIA

ABSTRACT

Excessive intake of sugar-sweetened beverages (SSB) contributes significantly to the global burden of non-communicable diseases such as obesity and diabetes. This cross-sectional study aimed to examine the associations between knowledge, attitude, and sociodemographic factors with SSB consumption frequency among Malaysian adults. Convenience sampling was applied, and data were collected via online survey using a validated Knowledge, Attitude and Practice and Beverage Intake Questionnaire. A total of 423 participants from all over Malaysia participated in the study. The mean knowledge score of 7.19 (1.43), and the mean attitude score of 4.85 (0.49), indicated a generally moderate to good awareness and positive attitudes toward reducing SSB intake. The average frequency of SSB consumption was 9.18 (6.27) times per week, with 44.0% of participants consuming SSB 9 times or more

weekly. The multiple logistic regression analyses revealed that male gender (Adjusted OR = 2.43; 95% CI: 1.56, 3.77) and non-degree education level (Adjusted OR = 1.69; 95% CI: 1.05, 2.71) were significantly associated with higher SSB consumption (9 times or more per week), while B40 household income were significantly associated with higher SSB consumption (9 times or more per week) when compared to M40 and T20 group (Adjusted OR = 0.09 to 0.53; $p < 0.05$). The study underscores the influence of knowledge and sociodemographic factors on dietary behaviour and highlight the need for targeted interventions focused on men and socioeconomically disadvantaged populations to reduce SSB intake and promote healthier lifestyles even among those who are already aware.

CHAPTER 1

INTRODUCTION

1.1 Sugar-Sweetened Beverages

Sugar-sweetened beverages (SSB) are drinks containing added sugars or "free sugars," which are used not only as sweeteners but also as preservatives, fermentation substrates, texture modifiers, flavor enhancers, and coloring agents in various foods and beverages (Bowman, 2017). These beverages have become a major source of added sugar in modern diets, and include soft drinks, energy drinks, sports drinks, fruit juices, and sweetened teas and coffees (Fadupin *et al*., 2014). SSB are widely consumed across all age groups, often driven by their sweet taste, affordability, and high availability in retail outlets, restaurants, convenience stores, and vending machines (Malik & Hu, 2022).

In hot and humid climates such as Malaysia, SSB are particularly appealing as a quick, cold refreshment, often replacing plain water during meals or breaks (Salleh *et al.*, 2021). The consumption is further fuelled by aggressive marketing strategies and attractive packaging, with SSB often promoted as lifestyle products associated with energy, sociability, and youthfulness (Dono *et al.*, 2021). Additionally, the increasing trend of fast-paced lifestyles has made these beverages a convenient choice, especially for those seeking ready-to-drink options during work, travel, or social activities (Teng *et al*., 2019).

Accessibility plays a major role in SSB consumption behavior. These drinks are often placed prominently in retail settings and are readily available in single-serve packaging, making them convenient for impulse purchases. Promotional offers, price discounts, and “bundle deals” further encourage frequent consumption, particularly among price-sensitive groups such as adolescents and low-income individuals (Cheah & Chua, 2023). While prices vary depending on brand and type, many SSB remain relatively affordable and are often perceived as more flavorful and satisfying compared to healthier alternatives like water or plain milk (Foo *et al.*, 2020).

These combined factors of taste, cultural norms, climate, convenience, marketing influence, and easy accessibility have contributed to the widespread habitual consumption of SSB in Malaysia and globally, despite increasing awareness of their health consequences. Understanding these behavioral drivers is essential for designing effective interventions to reduce SSB intake in the population.

1.2 Increasing consumptions of sugar-sweetened beverages

The rising consumption of sugar-sweetened beverages is a critical public health issue worldwide. Global trends indicate a significant increase in SSB consumption, particularly in low- and middle-income countries. According to the World Health Organization (WHO), sales of soft drinks have increased by 21.2% globally over the past 15 years, with especially high growth observed in Asia (WHO,

2023). This upward trend is driven by factors such as aggressive marketing, urbanization, and increased availability of these beverages.

In Malaysia, where sugary drinks are widely consumed across age groups, the public health impacts are particularly significant. Data shows that children and adolescents consume substantial levels of added sugars, at 9.0% and 28.4%, respectively, of their daily intake (Teng *et al.*, 2019). In other regions, like the United States, the patterns and impacts of SSB consumption further demonstrate the scope of this issue. Sugar-sweetened beverages remain the leading source of added sugars in American diets, with the highest consumption rates among young adults (ages 20-39), non-Hispanic Black individuals, and those with lower incomes (Matthews & Kurnat-Thoma, 2024). Importantly, data from the National Health and Nutrition Examination Survey (NHANES) spanning 2003 to 2016 shows that even adults with diabetes continue to consume these high-sugar beverages regularly, indicating both an ongoing preference for these drinks and a gap in effective dietary guidance (Matthews & Kurnat-Thoma, 2024).

Closer to home, the Malaysian Adults Nutrition Survey 2014 revealed that 55.9% of adults consume sugar daily, primarily through added sugars in beverages like tea, coffee, and chocolate-based drinks, with an average daily intake of four teaspoons (Institute for Public Health, Ministry of Health Malaysia, 2014). This finding is particularly relevant, as SSB consumption is often influenced by cultural norms and the widespread availability of sweetened drinks. A study among adolescents in Selangor, Malaysia, found that despite a general awareness of the health risks associated with SSB consumption, socio-economic and environmental factors led to

continued high intake of these beverages (Teng *et al.*, 2020). These findings reflect the reality that for many Malaysians, sweetened beverages are not just a dietary habit but a familiar part of daily life shared at social gatherings, offered in hospitality, and often seen as affordable comforts in a busy environment.

1.3 Consequences of high sugar-sweetened beverages consumption

The high intake of sugar-sweetened beverages has been linked to various health concerns, particularly due to the empty calories they add to diets without providing essential nutrients. As a result, they contribute to a growing burden of health conditions such as obesity, type 2 diabetes, cardiovascular diseases, and other non-communicable diseases (Alothmani & Almoraie, 2023). Early exposure to high sugar intake has also been shown to establish lifelong preferences for sweetness, increasing the risk of chronic diseases in adulthood.

The National Health and Morbidity Survey (2019) illustrated the broader health implications in Malaysia, revealing that approximately 30.3% of adults have hypertension, 19.7% are diabetic, and a staggering 60% are classified as overweight or obese. These figures highlight the significant long-term health burden associated with high SSB consumption and underscore the urgent need for targeted interventions to address dietary habits, particularly among younger populations to reduce the onset of NCD.

Beyond the direct health effects, the increasing prevalence of NCD related to SSB intake has far-reaching consequences for individuals, families, and the nation. At the individual level, chronic conditions like diabetes and heart disease often lead to diminished quality of life, reduced work productivity, and increased medical expenses. For families, the financial and emotional toll of managing long-term illnesses can be profound, often requiring caregiving support, lifestyle adjustments, and ongoing healthcare costs that strain household resources (Drolet-Labelle *et al.*, 2025).

On a national scale, the cumulative impact of high SSB consumption contributes significantly to the country's economic burden. Healthcare systems face increased strain due to the rising demand for treatment and management of NCD, including the need for long-term medications, hospitalizations, and specialized care. Public health expenditures rise, while economic productivity may decline due to absenteeism, disability, and premature mortality among working-age adults (Cheah & Chua, 2023). According to Kristal *et al*., (2015), populations with higher SSB intake often reflect a broader pattern of health inequity, further amplifying systemic challenges in delivering equitable healthcare services.

In essence, unmonitored high SSB consumption not only endangers individual health but also weakens the social and economic fabric of the nation. Preventing the widespread rise of NCD through reduction in SSB consumption is not only a health priority but a national imperative that requires coordinated efforts in education, policy, and community engagement to ensure a healthier, more resilient Malaysia.

1.4 Problem Statement

The rising prevalence of non-communicable diseases such as obesity, diabetes, and cardiovascular conditions continues to pose a major public health challenge in Malaysia. Data from the National Health and Morbidity Survey 2019 indicated that 60% of adults were either overweight or obese, 30.3% were hypertensive, and 19.7% were living with diabetes. A significant contributing factor to these conditions is the excessive intake of sugar-sweetened beverages, which remain widely consumed despite existing awareness campaigns and public health policies.

Although prior research has explored knowledge, attitudes, and practices related to SSB, these studies have predominantly targeted adolescents, university students, or parents of young children (Teng *et al.*, 2020; Abu Bakar *et al.*, 2024). As such, adult populations who are key drinkers of SSB remain underrepresented in current literature. This represents a critical gap, especially considering that adults often exhibit unique consumption behaviors influenced by work routines, social norms, cultural habits, and accessibility.

Furthermore, while existing studies report relatively high awareness of the health risks associated with SSB, many individuals continue to consume these beverages frequently (Qi, 2021; Cheah & Chua, 2023). Such findings suggests that knowledge alone does not necessarily translate into healthier choices, and the mechanisms driving this gap remain insufficiently explored. Moreover, recent consumption trends involving modern, franchise-based, and café-style beverages —

often high in added sugars — have not been adequately accounted for in previous assessments of SSB intake, especially among working adults.

Given these limitations, there is a pressing need to investigate the current patterns of SSB consumption among Malaysian adults, while examining how sociodemographic characteristics, knowledge, and attitudes influence their behavior. Addressing these gaps is essential for informing future public health strategies that are more targeted, relevant, and effective in curbing SSB consumption and reducing the burden of diet-related NCD in Malaysia.

1.5 Study Rationale

Overall, the increasing consumption of SSB is an urgent public health issue with multifaceted challenges. While awareness of the risks associated with SSB has improved, effective strategies to reduce intake have proven challenging due to a combination of individual habits, social norms, and economic factors. This study seeks to further explore the intake frequency of SSB consumption, with a focus on understanding the factors that drive consumption among adults in Malaysia. By identifying these factors, this study aims to provide insights that could inform targeted public health interventions, ultimately reducing the burden of NCD associated with high sugar intake and improving population health outcomes.

1.6 Research Questions

i. What are the mean scores of knowledge and attitude on SSB among adults in Malaysia?

ii. What is the mean weekly consumption of sugar-sweetened beverages among adults in Malaysia?

iii. What is the association between age, gender, body mass index (BMI), ethnicity, locality, health status, education, occupation, work shift, income, region of residence, knowledge and attitude, and SSB consumption among adults in Malaysia?

1.7 Objectives of the study

1.7.1 General Objective

To study the knowledge, attitude and determinants of sugar-sweetened beverage consumption among adults in Malaysia.

1.7.2 Specific Objective

1. To determine the mean scores of knowledge and attitude toward SSB among adults in Malaysia.

2. To determine the mean weekly consumption of sugar-sweetened beverages among adults in Malaysia.

3. To determine the associated factors of SSB weekly consumption among adults in Malaysia.

1.8 Research Hypothesis

There are significant associations between age, gender, body mass index, ethnicity, locality, health status, education level, occupation, work shift, income, region of residence, knowledge, and attitude with the frequency of sugar-sweetened beverage consumption among adults in Malaysia.

CHAPTER 2

LITERATURE REVIEW

The literature review was conducted using university-subscribed databases and multiple search engines available on the web, such as PubMed, Scopus, and Ebscohost. The literature search was filtered to only published materials between 2014 to 2024. Numerous searching strategies were applied, such as combining terms with Boolean operators (AND, OR, NOT). The keywords used during the search were 'sugar-sweetened beverages', 'SSB', 'associated factors', 'knowledge', 'attitude', 'consumption', 'sweet drinks', 'adults' and 'Malaysia'.

2.1 Consumption of sugar-sweetened beverage

Research on sugar-sweetened beverage consumption highlights its widespread appeal and concerning prevalence across both developed and developing nations. In the United States, Chevinsky *et al*., (2021) reported that 63% of adults consumed SSB daily, a pattern mirrored in many parts of the world. In Malaysia, the situation is similarly worrying. According to the Malaysian Adult Nutrition Survey 2014, 55.9% of adults consumed added sugar daily mostly from beverages like tea, coffee, and chocolate drinks with an average intake of four teaspoons per day (Institute for Public Health, Ministry of Health Malaysia, 2014). Cheah & Chua, (2023) observed that 83.6% of university students in Klang Valley reported daily SSB intake, with common preferences including flavored milk, instant coffee, and sachet beverages. Despite

90.6% of participants expressing positive attitudes toward reducing intake, knowledge levels were low (51.7%), and practice remained poor (80.7%), revealing a significant knowledge-behavior gap.

Among adolescents, the Adolescent Nutrition Survey 2017 conducted in Malaysia reported that 98.2% had consumed SSB within the past month, with a daily average of 1.4 cups (Institute for Public Health, Ministry of Health Malaysia, 2017). Similarly, Teng *et al*., (2020) found that one-third of school-going adolescents in Selangor exceeded WHO-recommended sugar intake limits, and most of this sugar was consumed via beverages. Ahmad *et al*., (2019) further identified that 83% of undergraduates in a Malaysian public university consumed at least one SSB daily, and 38.5% exceeded two servings. These habits were often influenced by taste, affordability, and peer behavior. Aliah *et al*., (2020) echoed this trend in Terengganu, where a high intake of SSB was also observed among university students. Among preschoolers, Foo *et al*., (2020) reported that sugar-sweetened drinks were major contributors to daily energy intake, suggesting early exposure and preference for sweetness begins in childhood.

International comparisons reveal similarly high prevalence rates in other developing countries. For instance, in Colombia, Kim *et al*., (2017) reported that males had significantly higher odds of daily SSB intake compared to females (AdjOR = 1.63; $p < 0.001$), and in Mexico, Colchero *et al*., (2016) found that lower-income individuals had higher odds of consuming SSB daily. In South Africa, Wrottesley *et al*., (2021) documented persistent SSB intake even after sugar tax implementation, with some

demographic groups maintaining high consumption due to affordability and limited access to healthier alternatives.

2.2 Knowledge on sugar-sweetened beverages

Knowledge regarding the health risks of sugar-sweetened beverages has been identified as a significant determinant of consumption behavior. Numerous studies have demonstrated that individuals with higher levels of SSB-related health knowledge are less likely to consume such beverages frequently. In the United States, Smith *et al*., (2020) found that individuals with high awareness of the negative health impacts of SSB had significantly lower consumption rates, with an adjusted odds ratio (aOR) of 0.67 (95% CI: 0.54, 0.84; $p < 0.01$). This suggests that knowledge-based interventions may serve as an effective behavioral deterrent.

Similarly, Ezendam *et al*., (2010) reported that adolescents who understood the health implications of SSB were 25% less likely to increase their consumption over time (aOR = 0.75; 95% CI: 0.65, 0.87). In Malaysia, Abu Bakar *et al*., (2024) found that participants with higher knowledge scores were significantly less likely to consume SSB excessively (aOR = 0.58; 95% CI: 0.37, 0.91), reinforcing the role of awareness in shaping healthier beverage choices. A study by Salleh *et al*., (2021) involving Malaysian

adolescents also reported that those with good knowledge were less likely to consume SSB daily, and more likely to limit their intake to less than one cup per day (aOR = 0.73; 95% CI: 0.56, 0.95).

Internationally, Kim *et al*., (2017) conducted a multi-state survey in the United States and found that adults who disagreed that SSB contribute to weight gain had significantly higher odds of consuming sugary beverages at least twice per day (aOR = 1.61; 95% CI: 1.15, 2.25). A similar pattern was observed in Inner Mongolia, where subjective dietary knowledge was inversely associated with daily SSB consumption, indicating that even small increases in perceived nutritional knowledge could reduce SSB intake (Liu *et al*., 2021). These findings coherent with conclusions by Dono *et al.*, (2021), who highlighted that perceived health risks—particularly the belief that SSB lead to obesity or diabetes—are associated with stronger intentions to reduce consumption (aOR = 0.62; 95% CI: 0.45, 0.86).

Collectively, these studies underscore the importance of targeted educational interventions in reducing SSB consumption. These findings suggest that improving public knowledge particularly about the link between SSB and chronic health conditions can significantly lower the odds of excessive intake.

2.3 Attitudes towards sugar-sweetened beverages

Attitudes toward sugar-sweetened beverage consumption significantly influence individuals' likelihood to consume or reduce their intake. In Australia, Dono *et al*., (2021) found that individuals who perceived their future health to be at risk were more likely to consider reducing their SSB consumption. Specifically, the odds of intending to reduce intake were significantly higher among those with perceived susceptibility to health risks: aOR = 8.07 (95% CI: 1.76, 36.95) for those “somewhat likely” and aOR = 4.06 (95% CI: 1.84, 8.95) for those “very likely” to reduce SSB intake. Conversely, a U.S. study conducted by the CDC (2024) reported a positive association between favorable attitudes toward SSB and increased consumption, with an odds ratio of 2.34 (p = 0.03), suggesting that perceived benefits or enjoyment from sugary drinks can reinforce habitual intake.

Further supporting the importance of attitude, a study conducted in Northern Manhattan examined parental beliefs and their influence on infants' SSB consumption. Woo Baidal ., (2018) found that each point increase in negative parental attitude toward SSB was associated with a 16% decrease in the odds of the child consuming SSB (aOR = 0.84; 95% CI: 0.71, 0.99), emphasizing the role of family-based beliefs and early dietary modeling.

In the Malaysian context, Teng *et al*., (2020) found that adolescents with a more cautious attitude toward SSB were less likely to consume them frequently. Positive attitudes toward limiting SSB intake were significantly associated with better dietary behavior, underscoring the importance of targeting attitudes in health promotion

strategies among youth. These findings correspond with earlier evidence that showed adolescents' perceived importance of health risks influences beverage choices.

Expanding this perspective globally, the International Food Policy Study conducted by Drolet-Labelle *et al*., (2025) compared attitudes and perceptions about sugary beverages across five countries. The study found that individuals who viewed sugary drinks as unhealthy had lower odds of daily consumption. In Mexico, for instance, the odds of perceiving 100% juice as unhealthy increased over time (aOR = 1.71; 99% CI: 1.10, 2.64), which was associated with decreased intake of sugary beverages.

Collectively, these studies demonstrate that attitudes—whether influenced by personal health beliefs, cultural norms, or family dynamics—play a pivotal role in shaping SSB consumption. While increasing knowledge is essential, reshaping public attitudes through targeted health communication and community-level interventions may offer more sustainable reductions in intake.

2.4 Factors associated with sugar-sweetened beverage consumption

2.4.1 Age and Gender

Age and gender are influential factors in sugar-sweetened beverage consumption patterns, with younger adults consistently showing higher intake levels compared to older individuals. According to data from the Global Dietary Database, adults aged 18-24 have an adjusted odds ratio (AdjOR) of 7.84 for daily SSB consumption, significantly higher than those aged 55 and older. This trend shows a progressive decline with age, as those aged 25-34 have an OR of 5.13, and adults aged 45-54 have an OR of 1.82, indicating that younger adults are significantly more likely to consume SSB ($p < 0.05$). Similarly, in the United States, Lundeen *et al.*, (2018) reported that individuals aged 18 to 54 have significantly higher odds of consuming SSB daily compared to those 55 and older, with a similar finding in New York, where Lundeen *et al*., (2018) showed that patients aged 18 to 29 were 1.55 times more likely to consume daily SSB compared to those aged 70 and above.

Gender differences also impact SSB consumption, with males generally reporting higher intake than females. In Taiwan, Kristal *et al*., (2015) found that the adjusted odds ratio for SSB consumption in males was higher (AdjOR = 0.82) than in females (95% CI = 0.74, 0.91). Similarly, Lundeen *et al*., (2018) noted that men in the United States had significantly higher odds of drinking SSB daily (AOR = 1.66, p-value <0.05) compared to women. In Colombia, Kim *et al*., (2017) further supported this trend, observing that male participants had an adjusted odds ratio of 1.63 for daily SSB intake compared to females, with a p-value of <0.001. These findings consistently demonstrate that both age and gender play critical roles in shaping SSB consumption behaviours across different regions and cultures.

2.4.2 Body mass index (BMI)

Body mass index (BMI) is closely linked to sugar-sweetened beverage consumption, with several studies indicating that higher SSB intake is associated with increased BMI and obesity. In Asia, Neelakantan *et al*., (2022) found that individuals with the highest levels of SSB consumption had a significantly higher BMI, with an adjusted odds ratio of 1.51 (95% CI: 1.15, 1.98, P < 0.001) when compared to those with the lowest levels of consumption. In the United States, Lundeen *et al*., (2018) similarly reported that SSB consumption was higher among individuals with obesity, with an adjusted odds ratio of 1.40 compared to those with a normal or underweight BMI (p-values < 0.05). Supporting these findings, Kim *et al*., (2017) observed in Colombia that adults who consumed SSB daily had an adjusted OR of 1.58 (95% CI: 1.41, 1.77) for obesity compared to non-consumers. These studies highlight a consistent association between high SSB intake and elevated BMI, suggesting that SSB consumption may be a contributing factor to obesity across various populations.

2.4.3 Income Level

Income level also plays a significant role in influencing SSB consumption, with lower-income individuals generally exhibiting higher SSB intake. In Mexico, Colchero *et al*., (2016) found that as income increased, the likelihood of high SSB consumption decreased, with an adjusted odds ratio of 0.80 (95% CI: 0.75, 0.85) for each unit increase in income (p-value < 0.001). In the United States, Park *et al*., (2014) reported that individuals with an annual household income of less than $25,000 had an adjusted odds ratio of 1.40 (95% CI: 1.18, 1.83) for consuming SSB at least once daily, compared to those with an income of $75,000 or more. Those with incomes between $25,000 and $49,999 had a slightly lower OR of 1.30 (95% CI: 1.11, 1.61) but were still more likely to consume SSB daily than higher-income groups. These findings indicate that lower income is consistently associated with higher SSB consumption, which may be due to factors such as limited access to healthier options or the lower cost of SSB compared to healthier beverages.

2.4.4 Ethnicity

Ethnicity has been shown to influence sugar-sweetened beverage consumption, with certain ethnic groups displaying a higher likelihood of daily intake. In California, Lee *et al*., (2021) found that non-Hispanic Black adults had a significantly higher adjusted odds ratio of 1.55 (95% CI: 1.23, 1.96, p < 0.001) for consuming SSB daily compared to non-Hispanic White adults. Similarly, Lundeen *et al*., (2018) reported higher SSB consumption among Hispanic (AOR = 1.43) and non- Hispanic Black participants (AOR = 1.65) than among non-Hispanic Whites in the United States. In

Malaysia, Salleh *et al*., (2021) observed that Malay individuals had a higher likelihood of consuming SSB, with an OR of 1.35 (95% CI: 1.05, 1.75, p = 0.02) compared to other ethnic groups, underscoring ethnic differences in SSB intake across various countries and cultures.

2.4.5 Education

Education level also plays a significant role in SSB consumption patterns, with lower education levels generally associated with higher intake. In the United States, Lundeen *et al*., (2018) found that individuals who had not completed college were more likely to consume SSB daily, with adjusted odds ratios ranging from 1.67 to 2.71, compared to those who had completed college. In Malaysia, Salleh *et al*., (2021) reported that each additional year of education was associated with a decrease in SSB consumption, with an adjusted OR of 0.86 (95% CI: 0.75, 0.98, p = 0.034). These findings suggest that higher education levels may be linked to greater health awareness and healthier consumption habits, potentially lowering the likelihood of regular SSB intake.

2.4.6 Locality

Locality has been shown to influence sugar-sweetened beverage consumption, with significant differences observed based on geographic and rural-urban contexts. In

the United States, a CDC study by Lundeen *et al*., (2018) found that the likelihood of consuming SSB daily varied widely by state, with Indiana having an adjusted odds ratio of 2.28 (95% CI: 2.02, 2.57) and Mississippi an OR of 2.69 (95% CI: 2.26, 3.20), with all p-values less than .001. Additionally, Kristal *et al*., (2015) reported that rural adults in New York were more likely to consume SSB frequently, with an adjusted OR of 1.44 (95% CI: 1.10, 1.89) compared to urban adults. Supporting this trend, Guzman-Vilca *et al*., (2022) found that in Peru, rural adults had a higher likelihood of high SSB consumption when less healthy eating patterns were present, with an OR of 1.66 (95% CI: 1.50, 1.84). These findings suggest that both state-level and rural-urban factors may play a role in shaping SSB consumption patterns.

2.4.7 Occupation

Occupation also influences SSB intake, with studies indicating that certain job categories and income levels are associated with higher SSB consumption. In the United States, Lundeen *et al*., (2018) found that individuals working in "service occupations" had an OR of 1.56 (95% CI: 1.22, 2.00) for daily SSB consumption compared to those in other job categories, with a p-value less than 0.01, highlighting a statistically significant disparity. Freije *et al*., (2021) further found that low-income workers in the U.S. were more likely to consume SSB at higher rates, with an OR of 1.68 ($p < 0.01$). These findings indicate that occupation and income level may affect access to healthier alternatives and contribute to varying SSB consumption patterns across different job types.

2.4.8 Work shift

Work shift patterns appear to influence sugar-sweetened beverage consumption, with night- shift workers generally exhibiting higher intake levels. In Taiwan, Lin *et al*., (2020) found that night- shift employees had 1.5 times higher odds of consuming SSB compared to their day-shift counterparts (adjusted OR: 1.5, 95% CI: 1.0, 2.1), indicating a trend toward increased intake of empty- calorie foods and beverages among those working irregular hours. However, in Australia, Dono *et al*., (2021) found a non-significant association between shift work and moderate SSB consumption, with an adjusted OR of 1.05 (95% CI: 0.86, 1.3, p = 0.66), suggesting that the impact of shift work on SSB intake may vary by region or study population.

2.4.9 Health status

Health status also plays a role in SSB consumption patterns, with individuals experiencing certain health conditions generally consuming fewer SSB, while other health indicators show a different relationship. Kristal *et al*., (2015) found that adults in New York with type 2 diabetes or hypertension were significantly less likely to drink SSB daily, with an adjusted OR of 0.56 (95% CI: 0.47, 0.65) for those with diabetes and 0.86 (95% CI: 0.76, 0.97) for those with hypertension. Conversely, Freije *et al*., (2021) reported that frequent SSB consumers in the U.S. (≥1 time per day) had a 26% higher prevalence of poor mental health compared to non-consumers, with an adjusted

prevalence ratio of 1.26 (95% CI: 1.11, 1.43). These findings indicate that while some physical health conditions may discourage SSB consumption, frequent intake could be linked to poorer mental health outcomes.

2.4.10 Geographic state or regions

Regional differences in sugar-sweetened beverage consumption across Malaysia reflect disparities in socioeconomic status, infrastructure, cultural practices, and public health exposure. Studies have observed that residents in different Malaysian states exhibit varied consumption patterns due to factors such as accessibility to beverages, local food customs, and urbanization. For example, Salleh *et al*., (2021), using data from the Adolescent Nutrition Survey 2017, found that adolescents in East Malaysia had significantly higher odds of daily SSB consumption compared to those in West Malaysia. The study reported that adolescents in Sabah were nearly twice as likely to consume SSB daily compared to those in Selangor (aOR = 1.93; 95% CI: 1.18, 3.17), highlighting the influence of regional context on dietary behavior. Contributing factors may include limited availability of healthier alternatives in rural and interior areas, differing cultural norms around beverage consumption, and varying exposure to nutrition education.

Similarly, Cheah *et al*., (2023), in a cross-sectional study among university students in Sarawak, observed high SSB consumption linked to socioeconomic factors and local habits such as offering sugary drinks at social events and religious gatherings. This contrasts with findings from more urbanized regions like Klang Valley, where consumption was influenced more by marketing exposure and convenience. Despite the growing recognition of regional disparities, state or location-based differences remain underexplored in many national health studies. Given Malaysia's geographical and cultural diversity, investigating state or regional residence as an independent variable is essential. It provides a more nuanced understanding of consumption patterns and can inform the development of region-specific strategies for reducing SSB intake—especially in underserved or rural populations where behavioral and environmental interventions may need to be tailored to local contexts.

2.5 Research Gaps

Review of the literature revealed that most studies on sugar-sweetened beverage consumption in Malaysia have predominantly focused on adolescents, university students, and parents of school-aged children, leaving adult populations underexplored (Aliah *et al*., 2020; Teng *et al*., 2019; Teng *et al*., 2020; Abu Bakar *et al*., 2024). This age-specific focus presents a significant gap in understanding, as adults remain key contributors to national dietary trends and SSB consumption patterns. Additionally, while previous knowledge, attitude, and practice studies have provided valuable insight into public awareness of SSB-related health risks, they fall short in clarifying the complex relationship between knowledge and actual consumption

behavior. Despite moderate to high levels of awareness, many individuals continue to consume SSB at high frequencies, suggesting that awareness alone may be insufficient to drive behavioral change (Qi, 2021; Cheah & Chua, 2023).

Moreover, current research has yet to account for the evolving beverage landscape, particularly the rise in popularity of modern and trendy beverages such as bubble tea and café-based drinks, which are widely consumed by working adults and urban populations. These products may substantially contribute to added sugar intake but remain underrepresented in traditional SSB assessments. The exclusion of these emerging beverage trends risks underestimating the true extent of SSB consumption and its impact on public health.

Given Malaysia's escalating burden of non-communicable diseases and the persistent high intake of SSB, there is a clear need for studies that focus on adult populations and their specific consumption patterns, including exposure to modern beverage trends. This study aims to fill these critical gaps by examining the knowledge, attitudes, and frequency of SSB consumption among Malaysian adults, thereby supporting the development of more targeted and effective public health interventions.

2.6 Conceptual framework

Based on the literature review, there were several variables that may be associated with sugar-sweetened beverage consumption. The factors can be classified into the following subcategories: