Health awareness concerning soft drinks: Implications for nutritional outcomes among adults in Saudi Arabia

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RESEARCH

Abstract

This study aimed to evaluate the level of health awareness related to soft drink (SD) consumption among adults in Al-Ahsa, Saudi Arabia, and to explore its relationship with sociodemographic characteristics, expenditure patterns, and nutritional outcomes measured by body mass index (BMI). A random sample of 370 individuals was selected from Al-Ahsa Governorate to collect primary data through an electronic questionnaire. The data were investigated using descriptive statistics, such as frequencies, percentages, Chi-square test, independent samples *t*-test, ANOVA table, and Pearson's correlation. The findings revealed that only 3.5% of the sample consumes Pepsi 'daily', whereas 27.6% of individuals consumed Coca-Cola 'rarely once a week'. Generally, the weekly consumption of various SDs is very low. Conversely, there is a statistically significant disparity of 10% between individuals who consumed SDs and those who perceived a link between SDs and health risks, such as obesity and diabetes as indicated by Chi-square test (8.94). The results also signify that while most participants are aware of the adverse effects of SD intake on health—particularly SDs' link with obesity, diabetes, and nutrient deficiencies, the nutritional outcome remains influenced by sociodemographic factors, such as age, gender, education, and marital status. Interestingly, the study found no significant association between health awareness and BMI, suggesting that awareness alone may not directly translate into improved nutritional outcomes. However, the findings highlight the potential role of fiscal policies, such as the national excise tax on sugary beverages, in curbing consumption. Participants with greater awareness tended to report lower weekly spending on SDs, reflecting the impact of both financial and educational interventions. Future research should consider longitudinal designs to assess behavioral trends over time, incorporate objective nutritional assessment tools, and examine additional lifestyle factors.

Keywords: Chronic Diseases; Health Awareness; Nutritional Outcomes; Soft Drinks

Introduction

The escalating prevalence of chronic diseases, such as obesity, type 2 diabetes, and cardiovascular conditions, in the Kingdom of Saudi Arabia (KSA) has intensified scrutiny of population-wide dietary behaviors, particularly the high consumption of sugar-sweetened beverages (SSBs), including soft drinks (SDs) (World Health Organization [WHO], 2023a). Numerous studies have documented the widespread and habitual intake of these beverages among Saudi adults. For instance, a national survey reported that 67% of adults consume SDs on weekly basis, and

30% consume energy drinks regularly. Consumption patterns are particularly pronounced among younger adults aged ≤29 years and males, who exhibit significantly higher intake levels (Aljaadi *et al.*, 2023). Despite the introduction of a 50% excise tax on SSBs in 2017—an initiative aligned with the nation's Vision 2030 health objectives, consumption has remained persistently high. Recent data have indicated that 82.9% of adults continue to consume SDs at least one to three times per month (Alzaben *et al.*, 2025). This resilience suggests that fiscal interventions, although impacted sales, have a limited influence on long-standing dietary habits without accompanying behavioral and educational strategies. Globally and locally, SSB consumption has been strongly associated with adverse nutritional and metabolic outcomes (WHO, 2021). These include increased caloric intake, displacement of essential nutrients, impaired glucose regulation, and the overall metabolic dysfunction (Malik *et al.*, 2013). In the Saudi context, such risks are compounded by sedentary lifestyles, rapid urbanization, and limited nutritional literacy among key demographic segments (Alghamdi *et al.*, 2023). Consumption of SDs is frequently embedded in everyday practices—often consumed during meals, social gatherings, and leisure activities—further normalizing their intake and diminishing perceived health risks (Sarhan *et al.*, 2024). The dietary landscape in Saudi Arabia has shifted markedly over the past two decades. Traditional diets rich in whole grains, fruits, and vegetables are increasingly replaced by calorie-dense, ultra-processed foods high in sugar and fat (WHO, 2023a; Elizabeth *et al.*, 2020). This nutritional transition has contributed significantly to the national burden of non-communicable diseases such as hypertension, obesity, and coronary heart diseases (Teng *et al.*, 2019). Several investigations have drawn direct links between SD intake and these outcomes, emphasizing the beverage's role in promoting energy imbalance, increasing visceral fat, and reducing the overall diet quality (Santos *et al.*, 2022).

Beyond metabolic concerns, the high sugar content in SDs presents additional health risks. Studies have associated excessive SD intake with dental caries, decreased bone mineral density due to impaired calcium absorption, and a heightened risk of osteoporosis, particularly among women (Ahn, & Park., 2021; Tahmassebi and BaniHani, 2020). These broader health impacts underscore the urgency of addressing consumption behavior through both policy and education. In response to the global rise in SSB-related health issues, several nations have adopted regulatory strategies aimed at reducing intake and shifting consumer behavior. The taxation of SSBs has emerged as one of the most widely adopted and evidence-based measures. Countries such as France, Finland, Mexico, the United Kingdom, and Denmark have reported positive outcomes following the implementation of SSB taxes, including reduction in purchase volumes and modest decline in obesity-related health indicators (Dams, 2017; WHO, 2017). Within the Gulf region, the Gulf Cooperation Council (GCC) in 2015 introduced the world's highest SSB tax, raising prices of SDs by 50% and that of energy drinks by 100% (Jalloun and Qurban, 2022). Saudi Arabia became the first GCC country to implement this excise tax, framing it as a cornerstone of its broader public health reforms under the Vision 2030 health objectives (Alsukait *et al.*, 2020). While initial reports showed a decline in sale volumes, long-term consumption trends remain concerning—especially among younger population who are less price-sensitive and more socially habituated to SD intake. Crucially, the effectiveness of these fiscal policies is not solely dependent on economic deterrents but also on the public's understanding of health risks. Awareness of the link between SSBs and chronic diseases has moderated consumption behaviors in some sections of the populations, although evidence from Saudi Arabia remains mixed (Sarhan *et al.*, 2024). As such, assessing the population's knowledge, attitudes, and spending behaviors is essential for evaluating the actual impact of taxation and for forming future public health interventions.

Accordingly, this study aimed to evaluate the awareness of health risks linked to SDs intake among adults in Al-Ahsa by determining the frequency of various types of SD consumption and examining the relationship between health awareness and weekly expenditures on soft drinks. It also aimed to evaluate the influence of health awareness on nutritional outcomes (BMI) among adults in Al-Ahsa by examining the effect of sociodemographic factors on individual nutritional outcomes and the correlation between nutritional outcomes and health awareness regarding the consumption of SDs. This study will contribute to the existing research on dietary attitudes, public health initiatives, and sustainable nutritional interventions. Accordingly, the primary significance of this study is the identification of distinctive consumption behaviors and health awareness levels among the Al-Ahsa people, which may deviate from national averages as a result of local socio-cultural dynamics. Therefore, the research provides guidance to local health authorities on the development of culturally appropriate strategies that are consistent with community customs and that improve health outcomes.

Methods and Materials

Selection of sample size

The research was carried out in the Al-Ahsa governorate, KSA, over a period of 6 weeks from 9 February 2023 to 23 March 2023. The study employed a random sampling

method to collect data from a representative population. The sample size was calculated using the Thompson (2012) equation to guarantee statistical representativeness. The sample size was determined based on the estimated total population of the Al-Ahsa governorate. The Stephen Thompson equation is as follows:

$$n = \frac{N \times p(1-p)}{\left[\left[N-1\times\left(\frac{d^2}{z^2}\right)\right]+p(1-p)\right]}$$

$$n = \frac{1{,}104{,}267 \times 0.50(1-0.50)}{\left[\left(1{,}104{,}267-1\times\left(\frac{(0.05)^2}{(1.96)^2}\right)\right)+0.50(1-0.50)\right]}$$

Where:

N = Community size (community size of Al-Ahsa is estimated at 1,104,267 inhabitants (General Authority for Statistics, 2023).

z = Normative degree corresponding to the level of significance is 0.95 is equal to 1.96 d = error ratio and is equal to 0.05.

p = The ratio of property availability and neutral and equal to 0.50.

Thus, according to the equation, a minimum sample size of 384 participants was required for this study. However, A total of 419 participants were initially recruited through a random sampling method to obtain complete and accurate data. However, 49 individuals were excluded due to incomplete or missing basic data, resulting in a final study sample of 370 participants.

Method of data collection

The study employed a structured survey method using an electronic questionnaire distributed online to ensure broad accessibility. An experimental questionnaire was administered to a random sample of 17 individuals to evaluate the clarity and comprehension of the questionnaire. Participants were solicited to participate in the survey via social media platforms, including Twitter, Telegram, and WhatsApp applications. The modifications were implemented based on the findings of the experimental questionnaire, which revealed the necessity to amend a series of questions and their corresponding options. The questionnaire was ultimately crafted and disseminated to the participants. The inclusion criteria specified that participants must be adults aged 18–45 years and reside in Al-Ahsa Governorate. Exclusion criteria included individuals who did not provide consent, had missing demographic or consumption-related data, and were outside the specified age range. Thus, according to the absence of fundamental data, including incorrect age entries and monthly income details, a lack of response regarding anthropometry was evident. Consequently, the final count of participants was 370, constituting 96.6% of the overall calculated sample.

The questionnaire consisted of four main sections: the first section collected personal Information, which included demographic, social, and economic data, gender, age, education level, marital status, food expenditure, and income details.

The second section was on the consumption of SDs: Participants were asked about their consumption habits, including the types of SDs consumed, the weekly expenditure on SDs, and the frequency of consumption of SDs. The frequency of consumption of SDs was important to provide an overview of typical drinks intake across a period, but this might not always represent drinks consumed by other populations due to their percentage contribution to the overall drinks' consumption among representatives of the target population (Regassa *et al*, 2021; Yaghi *et al*, 2022).

The third section was on the awareness and knowledge: This section assessed the participants' awareness and knowledge regarding health impacts, and this was measured through health awareness, which participants responded to statements assessing their understanding of the health risks associated with SD consumption, such as: SD consumption is linked to chronic diseases (CDs); SD affects the absorption of vitamins and minerals; and Saudi society is generally characterized by excessive consumption of SDs.

The fourth was the anthropometric measurements section: The participants were asked to provide a self-report on their height and weight, which were used to calculate BMI and assess their nutritional status. Since the questionnaire was used to address individual opinions and attitudes, both 5-point Likert scale and 7-point Likert scale were applied (Robinson, 2024). The 5-point Likert scale (ranging from 'strongly disagree' to 'strongly agree') was used to measure the opinions on health awareness, while the 7-point Likert scale (ranging from 'not consume at all' to 'daily') was used to assess the frequency of SD consumption.

The questionnaire was validated to ensure that the instrument accurately measured its intended constructs and produced reliable, consistent results. It was sent to nutritional specialists to check its elements and ensure

Table 1. Reliability of the questionnaire utilizing Cronbach's alpha.

Dimensions	No. of expressions	Cronbach's α
Consumption of SDs.	9	0.711
Health awareness	3	0.813
Average		0.762

that it included the necessary elements. A pilot survey was conducted on a limited sample reflective of the target community (20 individuals) to assess clarity, timeliness, reliability, and validity, and to modify the questionnaire in accordance with feedback.

The reliability of the questionnaire was assessed using Cronbach's alpha. As shown in Table 1, the results ranged from 0.711 to 0.813. All constructs exceeded the minimum acceptable threshold of 0.7 (Sekaran and Bougie, 2016; DeVellis, 2003), meaning the study instrument (questionnaire) possessed an acceptable level of reliability for the study's objectives.

Ethical approval was obtained from King Faisal University Ethics Committee (KFU-REC-2022-OCT-ETHICS277) and the Declaration of Helsinki guidelines were adhered to. All participants provided informed consent before enrollment in this study.

Data analysis

Statistical analyses were conducted using the SPSS software to examine relationships between demographic characteristics, SD consumption patterns, health awareness, and health-related outcomes (BMI). Descriptive analysis was performed to summarize demographic, social, and economic characteristics as well as consumption of various types of SDs using frequencies and proportions. The frequencies and proportions were applied to describe the weekly consumption of various types of SDs in the study area. The Chi-square test was used to assess relationships between the intake of SDs and health awareness, that is, weekly expenditure on SDs and health awareness, and the incidence of CDs. The independent sample *t*-test was applied to compare mean differences between gender groups regarding BMI. ANOVA table using *F*-test was applied to compare mean differences between age, marital status, and education level regarding BMI. Pearson's correlation coefficient was employed to assess the relationship between health awareness and health outcome (BMI). This methodological approach ensured robust statistical analysis, providing insights into the factors influencing SD consumption and their broader implications for health outcomes.

Results and Discussion

Demographic and socioeconomic characteristics of participants

The demographic and socioeconomic characteristics of the sample in the Al-Ahsa Governorate were examined using descriptive statistics, focusing on frequencies and proportions. Table 2 depicts the distribution of the sample in Al-Ahsa Governorate according to demographic and socioeconomic characteristics. Females comprised approximately 65.9% of the total population, exceeding males at 34.1%. Females exhibited a greater interest in healthful diets compared to males. Literature indicates that women possess greater awareness and superior understanding of nutrition compared to men (Kiefer *et al.*, 2005). On the other hand, Bärebring *et al.* (2020) found significant gender inequalities in the perceived healthiness of sugar, gluten, dairy, red meat, white flour, alcohol, and food additives, with women expressing more negative views than men. The descriptive data indicated that 49.7% of respondents were aged between 20 and 30 years, 27.3% were aged <20 years, and merely 6.5% were aged >41 years. The majority of responders were younger and below the productive age, and their nutritional security was affected by SD consumption. In addition, Table 2 displays the education levels of the respondents of Al-Ahsa Governorate. The majority of respondents (70.8%) had a university education, whereas only 9.5% had attained postgraduate degrees. Conversely, merely 1.1% had finished middle school. The educational attainment statistics indicated that the majority of individuals were educated; this could influence their dietary practices and hence nutritional outcomes. A study conducted by Sandri *et al.* (2024) indicated that the educational attainment of young individuals is critically important for health, especially regarding nutritional practices. Table 2 also shows that 61.6% of the participants were married. Approximately 48.6% of the sample possessed a monthly income of >5,000–10,000 Saudi Riyal SR or Saudi Riyal/SR), but 78.1% allocated >1,000–5,000 SAR for food expenditures. The table illustrates the sample distribution for consumption of SDs, revealing that 86.2% of the respondents consumed SDs, while 13.8% did not. Consequently, 16% of individuals who consume SDs expended >7.5–10 SR weekly, 29% expended >10 SR weekly, and 28.0% allocated ≤5 SR weekly.

Although the expenditure on SDs is minimal in comparison to individual monthly income and food expenses, the consumption of SDs influences the health-related outcomes. A study conducted by Scully *et al.* (2017) found that students who regarded SDs as readily available at home, easily purchasable, and cost-effective were more inclined to be high consumers

Table 2. Distribution of the sample according to demographic and socioeconomic characteristics.

Demographic and socioeconomic characteristics	Categories	Frequency (%)
Sex	Female	244 (65.9%)
	Male	126 (34.1%)
Age	<20	101 (27.3%)
	20–30	184 (49.7%)
	31–40	61 (16.5%)
	>41	24 (6.5%)
Education level	Middle school	4 (1.1%)
	High school	69 (18.6%)
	University	262 (70.8%)
	Postgraduate	35 (9.5%)
Marital status	Single	35 (9.5%)
	Married	228 (61.6%)
	Other	130 (35.1%)
Monthly income	≤ 5000 SR	73 (19.7%)
	>5000–10,000 SR	180 (48.6%)
	>10,000–15,000 SR	50 (13.5%)
	>15,000 SR	67 (18.1%)
Food expenditure	≤1000 SR	63 (17.0%)
	>1000–5000 SR	289 (78.1%)
	>5000 SR	18 (4.9%)
Do you drink SDs?	Yes, I drink SDs	319 (86.2%)
	I do not drink SDs	51 (13.8%)
Spending on SDs per week	≤5 SAR	104 (28.0%)
	>5–7.5 SAR	48 (13%)
	>7.5–10 SAR	59 (16%)
	>10 SAR	108 (29.0%)

Source: Electronic questionnaire 2023.

of SDs. This trend also applied to students who typically bought these beverages from school canteens or vending machines.

Frequency consumption of SDs.

Table 3 illustrates the weekly consumption of several types of SDs by individuals in Al-Ahsa. The frequency consumption of SDs was measured on a 7-point Likert scale, which includes the categories: 'not consumed at all', 'rarely once a week', 'one time a week', '2–3 times a week', '4–5 times a week', '6 or more times a week', and 'daily'. The study's findings indicate that approximately 3.5% of the sample consumes Pepsi daily, while 43.2% of the sample did not consume Pepsi at all. Approximately 17.8% of the sample consumed Diet Pepsi 'rarely once a week'. Approximately 6.5% of the sample consumed Diet Pepsi 'one time per week'. Approximately 27.6% of individuals consumed Coca-Cola 'rarely once a week'. Conversely, 3.8% and 2.2% of the sample reported consuming 7up and 7up Diet '2–3 times a week', respectively. On the other hand, 62.7%, 74.9%, and 79.2% of the sample reported that Mirinda, Sprite, and Fanta were 'not consumed at all', respectively.

According to these findings, the weekly consumption of various SDs was very low. The decline in the intake of SDs was likely attributable to heightened awareness and comprehension of their detrimental impact on human health. A study conducted in Sri Lanka including preschool children indicated that most of these youngsters consumed SDs with varying regularity, with the appealing sweetness of SDs being a significant factor influencing their consumption (Silva and Premathilaka, 2016). Aljaadi *et al.* (2023) discovered that 67% of Saudi people consumed SDs at least monthly, with a higher prevalence among males, compared to females. Consumption of SDs varied based on age, monthly income, level of physical activity, and weight.

Table 3. Consumption frequency of several types of soft drinks in Al-Ahsa region.

SDs	Frequency of consumption						
	Never consumed SD	Rarely once a week	Once a week	2–3 times a week	4–5 times a week	6 or more times a week	Consumed daily
Pepsi	160 (43.2%)	100 (27.0%)	62 (16.8%)	24 (6.5%)	11 (3.0%)	0 (0.0%)	13 (3.5%)
Diet Pepsi	262 (70.8%)	66 (17.8%)	24 (6.5%)	11 (3.0%)	3 (0.8%)	0 (0.0%)	4 (1.1%)
Coca-Cola	201 (54.3%)	102 (27.6%)	39 (10.5%)	13 (3.5%)	7 (1.9%)	3 (0.8%)	5 (1.4%)
Diet Coca-Cola	279 (75.4%)	52 (14.1%)	18 (4.9%)	10 (2.7%)	5 (1.4%)	0 (0.0%)	6 (1.6%)
7up	165 (44.6%)	132 (35.7%)	52 (14.1%)	14 (3.8%)	3 (0.8%)	1 (0.3%)	3 (0.8%)
7up Diet	288 (77.8%)	57 (15.4%)	11 (3.0%)	8 (2.2%)	3 (0.8%)	0 (0.0%)	3 (0.8%)
Miranda	232 (62.7%)	88 (23.8%)	32 (8.6%)	9 (2.4%)	3 (0.8%)	2 (0.5%)	4 (1.1%)
Sprite	277 (74.9%)	63 (17.0%)	22 (5.9%)	5 (1.4%)	1 (0.3%)	0 (0.0%)	2 (0.5%)
Fanta	293 (79.2%)	59 (15.9%)	10 (2.7%)	4 (1.1%)	2 (0.5%)	0 (0.0%)	2 (0.5%)

Source: Electronic Survey, 2023.

Almatari *et al.* (2024) conducted a study on substance disorders among people in the western region of Saudi Arabia. It was determined that 13.6% of participants had never consumed SDs, 52% consumed SDs infrequently, 22.2% consumed once daily, and 12.3% consumed SDs two or more times daily. Conversely, 7.5% of individuals aged 20–60 years in Saudi Arabia reported daily consumption of SSBs, with 51.8% consuming less than one can per day and 41.2% ingesting one can per day (Alabdulkader *et al.*, 2024). This discovery contradicts the conclusion of the study conducted by AlTamimi *et al.* (2023), which indicated that the weekly prevalence of SSB consumption was 93.6% in Riyadh, Saudi Arabia. This finding contrasts with the study conducted by Al Otaibi (2017) at King Faisal University in Al-Ahsa, Saudi Arabia, reporting a high prevalence of SSB consumption. The study found that almost 40% of students consumed SSBs daily, nearly one-third (27.5%) consumed two or more servings per day, and the majority (69.6%) consumed sugar-free drinks (SD) weekly. Nevertheless, just 32.9% of students infrequently or never consumed SSBs. The reduced SD consumption could be to a price rise resulting from tax implementation, or it could be due to heightened awareness of the risks associated with SDs. The initial study, conducted in 2017, assessed the framework of selective taxes in Arab Gulf nations and revealed a substantial decline in the sales volume of taxable beverages following tax implementation. This decline was particularly pronounced in KSA, reaching 33%, compared to non-taxable beverages (Alsukait *et al.*, 2020). Megally and Al-Jawaldeh (2020) discovered that excise taxes significantly adversely affected the sales volume of SDs over time. Between 2010 and 2017, the implementation of excise taxes on energy and SDs resulted in a 57.64% decline in soft drink sales. In this study, we could not compare consumption before and after implementation of excise tax because of insufficient data.

Health awareness of SD consumption

Table 4 illustrates the participants' health awareness regarding the consumption of SDs, utilizing a 5-point Likert scale. The assessment of health awareness was conducted through three dimensions: the link between (SDs) and CDs, the impact of SD consumption on the absorption of vitamins and minerals, and the general characteristics of Saudi society, noted for its heightened consumption of SDs. The findings indicated that the participants possessed a comprehensive understanding of the health concerns linked to the intake of SDs. Approximately 39.4% of the sample indicated that they 'strongly agree' that the consumption of (SDs) is associated with CDs, such as obesity and diabetes. The Chi-square result was 8.94, signifying a statistically significant disparity between individuals who consumed SDs and

Table 4. The relationship between SD intake and health awareness among the residents of Al-Ahsa Governorate.

Variables	Categories	Drink SDs		Chi-square	*p* value
		Yes	No		
SDs is linked to chronic diseases (CDs)	Strongly disagree	6 (1.6%)	2 (0.5%)	8.94*	0.06
	Disagree	10 (2.7%)	0 (0.0%)		
	Neutral	40 (10.8%)	3 (0.8%)		
	Agree	117 (31.6%)	13 (3.5%)		
	Strongly agree	146 (39.4%)	33 (8.9%)		
Average	**Strongly agree**	**4.25±0.92**			
SDs affects the absorption of vitamins and minerals	Strongly disagree	1 (0.3%)	1 (0.3%)	10.32**	0.03
	Disagree	7 (1.9%)	0 (0.0%)		
	Neutral	56 (15.1%)	6 (1.6%)		
	Agree	153 (41.3%)	18 (4.9%)		
	Strongly agree	102 (27.6%)	26 (7.0%)		
Average	**Agree**	**4.12±0.79**			
Saudi society is generally characterized by excessive consumption of SDs	Strongly disagree	2 (0.5%)	0 (0.0%)	3.10	0.54
	Disagree	19 (5.1%)	2 (0.5%)		
	Neutral	78 (21.1%)	13 (3.5%)		
	Agree	129 (34.9%)	26 (7.0%)		
	Strongly agree	91 (24.6%)	10 (2.7%)		
Average	**Agree**	**3.90±0.89**			
Axis weighted average	**Agree**	**4.09±0.62**			

Source: Electronic Survey, 2023.
Notes: Sample size: 370.
*Statistically significant relationship at 10% significance level; **statistically significant relationship at 5% significance level.

those who perceived a link between SDs and health risks, such as obesity and diabetes at a level of 10%. Accepting the substantial threshold of 10% indicates that the findings necessitate subsequent validation through more stringent methodologies. The overall trend indicated that all participants unanimously agreed regarding the link between the consumption of SDs and CDs, with a mean score of 4.25. Conversely, around 27.6% of individuals who consumed SDs reported that they 'strongly agree' that the intake of SDs influenced the absorption of vitamins and minerals in the human body. The Chi-square result was 10.32 (at a level of 5%), indicating significant variability regarding the impact of SD consumption on vitamin and mineral absorption in the human body. Their opinion generally indicated agreement, with an average score of 4.12. Additionally, between 34.9% and 24.6% of individuals who consumed SDs indicated that they 'agree' or 'strongly agree' that Saudi society, in general, consumed SDs at a higher frequency. The Chi-square test indicated no significant relationship between the consumption of SDs and health awareness, with Saudi society exhibiting a higher consumption of SDs. In comparison to the outcomes of other studies, it was evident that over 90% believed that excessive consumption of SDs elevates the risk of CDs, hyperglycaemia, obesity, and dental caries (Dams, 2017).

A study was undertaken in Seattle, Washington to assess the impact of beverage tax on perceptions of health concerns related to the overall consumption of SSBs. The survey revealed notable increases in the proportion of low-income respondents who concurred that the consumption of SSBs elevates the chance of getting diabetes and other severe health issues. Nonetheless, there was no significant variation in high-income individuals' beliefs on the harmful effects of SSBs on health (Sawyer *et al.*, 2022).

A study conducted by Rivard *et al.* (2012) revealed that the majority of participants perceived that regular consumption of SDs increases the risk of obesity by 91% and diabetes by 90%. Scully *et al.* (2017) found that high SD consumption correlates with other detrimental lifestyle behaviors among Australian secondary school students, prompting the need for measures to reduce SD availability, such as implementing taxes or banning their sale in schools. Nevertheless, the results of our study demonstrated that the Saudi population exhibited a considerable

degree of health knowledge and awareness concerning the intake of SDs and their effects on personal health. This primarily manifested in the reduced consumption of SDs among individuals. A possible factor could be the tax imposed on SDs since 2017.

Table 5 illustrates the relationship between health awareness on SD consumption and weekly SD expenditures among the individuals of Al-Ahsa Governorate. About 16.3% of the sample allocated less than 5 SAR weekly on SDs, and their disposition indicated a 'strongly agree' stance regarding the detrimental effects of SDs. Conversely, 7.5% and 15% allocated >7.5–10 SR and >10 SR weekly on SDs, reflecting 'agree' and 'strongly agree' with the detrimental effects of SDs, respectively. This outcome demonstrated that, despite expenditures on SDs, the participants in Al-Ahsa possessed substantial information of the detrimental health impacts of SDs, signifying heightened health awareness. This could be due to taxes levied to deter the intake of substances because of their health outcomes. Consequently, individuals were increasingly aware of the adverse impacts of SD consumption. The Chi-square test (19.11) identified significant differences at the 10% level between spending on SDs and health awareness. Thus, accepting the significant level of 10% signifies that the results require further validation via more rigorous approaches.

A research conducted by Alsukait *et al.* (2020) in Saudi Arabia indicated that the volume of SD sales decreased by 35% because of the SD tax. Within 1 year of the implementation of the Philadelphia sweetened beverage tax, which covered artificially sweetened beverages, net sales of taxable beverages declined by 38% (Roberto *et al.*, 2019). Teng *et al.* (2019) conducted a meta-analysis of 17 studies on SSB taxes, revealing that levies of up to 10% decreased SSB purchases by 10%. The researchers determined that tariffs on SSBs significantly reduced both sales and dietary intake of SSB.

The implication of health awareness on nutritional outcomes

Table 6 illustrates the relationship between specific sociodemographic characteristics and BMI. The findings indicated that the cohort aged <20 years and those aged between 20 and 30 years had a normal weight, with a BMI of 22.23 and 24.26, respectively. The *F*-test statistic (20.21) signifies a substantial disparity between age and mean BMI at the 1% significance level. Females also possess a typical weight, averaging 23.89, compared to 26.37 for males. The independent *t*-test result of approximately 3.57 indicates a significant relationship between gender and average BMI at the 1% significance level. Unmarried participants had a normal BMI, while married individuals were overweight. The *F*-test result (15.50) indicated a significant difference between marital status and average BMI at the 1% level.

Individuals possessing higher education (university and post graduation) maintain normal weight, suggesting that those with advanced degrees exhibit greater health consciousness, compared to their less educated counterparts (middle and high school educated). The average BMI of individuals with a middle school education was approximately 30.42, indicating obesity. The *F*-test statistic (2.73) indicated a substantial disparity between educational attainment and average BMI at a 5% significance level.

Campos-Ramírez *et al.* (2020) identified gender variations in the quantity of SD consumption, with these statistical disparities attributed to male individuals exhibiting a larger total body fat percentage (TBF%). Conversely, Al Otaibi (2017) discovered that 26.3% of university students at King Faisal University in Al-Ahsa were overweight because of consuming SDs. This ratio was congruent with that identified in the study conducted by Islam *et al.* (2020). It was reported that 32.5%

Table 5. The relationship between health awareness about consumption of soft drinks (SDs) and weekly spending on SDs.

Spending on SDs	Health Awareness					Chi-square	*p* value
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree		
≤5 SR	0 (0.0%)	2 (0.6%)	10 (3.1%)	40 (12.5%)	52 (16.3%)	19.11*	0.08
>5–7.5 SR	1 (0.3%)	0 (0.0%)	5 (1.6%)	16 (5.0%)	26 (8.1%)		
>7.5–10 SR	0 (0.0%)	0 (0.0%)	10 (3.1%)	24 (7.5%)	25 (7.8%)		
>10 SR	0 (0.0%)	0 (0.0%)	25 (7.8%)	35 (10.9%)	48 (15%)		

Note: SR: Saudi Riyal.

Table 6. Impact of sociodemographic characteristics on BMI.

Variables	Categories	Average BMI	Value of statistical test	*p* value
Age (years)	>20	22.23 (5.82)	20.21[b***]	0.00
	20–30	24.26 (5.41)		
	31–40	27.92 (7.38)		
	>41	30.77 (6.77)		
Gender	Male	26.37 (7.31)	3.57[a***]	0.00
	Female	23.89 (5.75)		
Marital status	Single	23.40 (5.87)	15.50[b***]	0.00
	Married	26.56 (6.63)		
	Other	30.15 (7.14)		
Educational level	Middle school	30.42 (7.74)	2.73[b**]	0.04
	High school	26.20 (6.93)		
	University	24.36 (6.38)		
	Postgraduate	24.00 (4.94)		

Source: Electronic Survey, 2023.
Notes: Sample size: 370.
Numbers in parentheses represent standard deviation.
***Statistically significant relationship at 1% significance level; **statistically significant relationship at 5% significance level.
[a]Independent *t*-test sample; [b]ANOVA *F*-test.

of students were classified as overweight or obese. A 'Knowledge, Attitude, and Behaviour Survey' evaluating SSB consumption patterns and expected responses to a proposed 20% tax in the United States revealed that higher consumption of SSBs was associated with African-Americans, males, individuals aged 18–24 years, those having a BMI of ≥30.0 kg/m^2, and individuals with lower educational attainment (Rivard *et al.*, 2012). Sandri *et al.* (2024) found that younger persons with higher educational attainment had a lower BMI, an improved healthy nutrition index, and reduced consumption of SSBs.

Table 7 depicts the correlation between health awareness related to SDs consumption and nutritional outcomes (BMI). Pearson's correlation coefficient was 0.031, signifying absence of a significant association between total health awareness and BMI. The absence of a direct correlation does not imply that awareness is insignificant. It suggests that awareness might indirectly affect BMI through food choices, physical activity, socioeconomic factors, and social and psychological factors, all of which may influence BMI outcomes. A study investigating respondents' perceptions of health issues associated with obesity and SD consumption revealed that the majority of participants recognized the detrimental effects of excessive SD consumption (Dams, 2017). Moreover, Megally and Al-Jawaldeh (2020) found positive link between the intake of SSBs and the incidence of obesity and overweight. This demonstrated that a primary rationale for taxing SSBs was their association with obesity and diet-related chronic diseases.

Table 7. Correlation between health awareness about the consumption of SD and nutritional outcome.

	Average health awareness
Pearson's correlation	0.031
p value	0.553

Source: Electronic Survey, 2023.
Note: Sample size: 370.

Conclusions, Recommendations, and Future Research

This study intended to evaluate the awareness of health concerns linked to SD consumption among individuals in Al-Ahsa. The findings indicate that although adults generally recognize the detrimental health effects of SD consumption, their nutritional outcomes are still affected by sociodemographic characteristics, including gender, age, education, and marital status, despite the absence of an association between health awareness about SD intake and nutritional outcomes (BMI). The study underscores the potential influence of taxing policies on reducing SD intake, indicating that financial disincentives, beside health awareness initiatives, could effectively alter consumption patterns regarding SD beverages. Moreover, examining individuals' attitudes and behaviors about SD intake is crucial for developing effective intervention programs and fostering a healthy, disease-free society devoid

of obesity. This research enhances the wider discussion on dietary practices, public health initiatives, and sustainable nutrition method. Future research should prioritize longitudinal studies, longitudinal data, and multivariate regression models to identify predictors of unhealthy consumption. These approaches strengthen the validity and depth of findings, guiding more targeted and effective interventions to reduce unhealthy dietary behaviors to evaluate temporal changes, integrate objective nutritional assessment techniques, and investigate supplementary lifestyle factors affecting eating behavior and health consequences. Additional studies involving people from all regions of Saudi Arabia are necessary to validate our findings.

Limitations of the Study

This study has several limitations that should be acknowledged. The use of self-reported height and weight to calculate BMI may introduce reporting bias, as individuals often overestimate their height and underestimate their weight. This results in a consistent underestimation of BMI, which may skew conclusions regarding obesity prevalence and health risk assessments.

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Author Contributions

Conceptualization: Randah M Alqurashi and Samar M. Abdalla; methodology: Randah M Alqurashi, Kawthar A. Alanezi, and Samar M. Abdalla; validation: Randah M Alqurashi and Samar M. Abdalla; formal analysis: Randah M Alqurashi, Kawthar A. Alanezi, and Samar M. Abdalla; investigation: Randah M Alqurashi and Samar M. Abdalla; data curation: Kawthar A. Alanezi; writing—original draft preparation: Randah M Alqurashi, Kawthar A. Alanezi, and Samar M. Abdalla; writing—review and editing, Randah M Alqurashi and Samar M. Abdalla; and supervision: Randah M Alqurashi and Samar M. Abdalla. All authors had read and agreed to the published version of the manuscript.

Conflict of Interest

The authors had no conflicts of interest regarding the study.

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