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PURCHASING AND CONSUMPTION PATTERNS OF TABLE SUGAR AND SUGAR-SWEETENED BEVERAGES (SSBs) OF ADULTS IN SOUTHGATE PHOENIX, KWAZULU-NATAL, SOUTH AFRICA

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ABSTRACT

Excessive sugar and sugar-sweetened beverage (SSB) consumption contributes to the rise of non-communicable diseases. In response, the Health Promotion Levy (HPL) was introduced in South Africa to reduce sugar intake; however, its direct impact on obesity prevalence remains unclear due to the multifactorial nature of obesity and limited long-term data. This study investigated the purchasing and consumption patterns of table sugar and SSBs among adults in Southgate Phoenix. A cross-sectional online survey using a self-reported questionnaire was conducted among 399 randomly selected adults aged 18 years and above. Data were summarised by mean, frequency and percentage and the relationship among variables was determined using chi-square and Fisher tests and Spearman correlation at $p<0.05$. Of the 399 participants, 66.2% were females, 53.1% were young or middle-aged adults, and 71.4% were employed persons. The majority of the participants (92.0%) purchased sugar monthly, having more preference for brown sugar (55.1%) than white sugar (44.9%). Sugar was commonly added to tea and coffee, and was consumed in higher quantities by females than males ($p<0.05$). Purchase of packaging size of sugar significantly increased as household income increased ($X^2 = 64.402$, $p = <0.001$). Carbonated soft drinks (77%) were the most frequently consumed SSBs, followed by flavoured water, energy drinks, and sports drinks, while flavoured tea was the least popular. Women were more inclined to consume flavoured tea and water, while higher-income individuals preferred flavoured water. SSBs were mainly consumed at home (53.9%), followed by work/school (49.6%) and restaurants/takeaways. SSB purchase was significantly associated with gender ($X^2 = 20.685$, $p = 0.023$) and household income ($X^2 = 45.979$, $p = 0.031$). Major motivators of purchasing decision were flavour (48%), brand loyalty (45%) and price (37%). Awareness of the HPL was higher among older and higher-income participants. Table sugar and SSB consumption remain high, with purchasing behaviours influenced by income, age, and gender. Targeted public health interventions are needed to promote healthier consumption patterns and reduce excessive sugar intake.

Key words: Sugar tax, Health promotion levy (HPL), sugar-sweetened beverages (SSBs)

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INTRODUCTION

The rise in non-communicable diseases (NCDs) such as type 2 diabetes, cardiovascular diseases, cancer and fatty liver is a global health concern. This prevalence is on the increase in developing countries where excessive consumption of added sugar, especially in the form of table sugar and sugar-sweetened beverages (SSBs), and contributes significantly to overweight and obesity, which are major risk factors of NCDs [1]. According to the World Health Organisation, 41 million NCD-related deaths are reported per annum globally, with low to middle-income countries contributing to 77% of these deaths [2].

On average, a 12 fluid ounce (355 ml) portion of SSBs contains 140–150 calories (586–628 kJ) and 35.0–37.5g of sugar, making it a high dietary source of added sugar [3]. An analysis of SSB consumption among adults in 187 countries showed that middle-income countries consumed SSBs more than both high- and low-income countries [4]. For example, on average South African adults are reported to consume 12 to 24 teaspoons of sugar per day, with four to eight teaspoons of this intake coming from SSBs. The country ranks highest in epidemics of obesity and diabetes in Africa [5, 6], however a number of lifestyle choices contribute to these conditions, including excessive sugar intake [6].

Consequently, this dietary pattern becomes a generational cycle with children and adults preferring to eat sweetened foods daily as a result of accessibility, low cost of purchasing sugar and SSBs and increased sugar consumption by adults, especially at homes where children's diet and eating habits are greatly influenced [7, 8]. However, since adults' dietary lifestyle usually influences children's consumption of sugar and SSBs, it is imperative to target adults' dietary intake in order to break the cycle of NCDs and associated obesity [9].

In addressing this public health problem, the South African government implemented a sugar tax on sugar-sweetened beverages (SSBs), which is known as the Health Promotion Levy (HPL) in 2018, to decrease added sugar consumption. The levy was set at 2.1 cents per gram of sugar content in beverages, which exceeded 4g/100ml [10]. Prior to the introduction of the HPL, findings showed that mean sugar from taxable beverage purchase was 16.25g/capita per day while mean volumes of taxable beverage purchase were 518·99 mL/capita per day [11]. The HPL makes producers and consumers of added sugar in SSBs liable for the payment of an additional amount for producing and consuming SSBs, respectively. As a result, it was anticipated that the purchase of SSBs would decline or that SSBs would be reformulated by the manufacturers to reduce sugar content to conform to the legislation [12].

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However, there is a shortage of data available on sugar and SSB consumption, comparing both pre- and post-implementation of the HPL in South Africa. Thus, this study was designed to assess the purchasing and consumption patterns of table sugar and SSBs of adults in Southgate Phoenix, KwaZulu-Natal, South Africa.

METHODS

Study design and participants

A cross-sectional study was conducted using a self-reported questionnaire among adults aged 18 years and above who were residents of Southgate Phoenix, KwaZulu-Natal, South Africa. Diabetic adults and those following a weight-reducing diet were excluded from the study.

Study location

Southgate is a neighbourhood situated in Phoenix with a population of 176,989 people. Phoenix is in KwaZulu-Natal, north of Durban [13]. This community, which is primarily composed of the Black and Indian population, is a typical middle-class urban community in South Africa [13]. Thirty-five percent of South African households are classified as middle-income [13], defined by an income of R86,001-R1.48 million per annum [13].

Determination of sample size and sampling technique

The sample size for the survey was calculated using [14], which suggested a sample size for a population of more than 100,000, which is 383. This is to ensure a 95% confidence level with a 5% margin of error [14]. The calculation was based on the population of Phoenix, which is 176,989 people [13]. As a result, 399 people were included in the cross-sectional survey. The selection of participants for the survey was done using the convenience sampling method. An online call was advertised to recruit participants using social media such as Facebook and the community ward WhatsApp group. The form allowed participants to answer only the survey questionnaire once, preventing them from duplicating entries. Data was collected between 2022 and 2023, over a period of 10 months.

Data analysis

A computer statistics software was used for the statistical analysis. The existence of a significant association between the variables shown in cross-tabulations was assessed using the chi-square and Fisher tests [15]. A significant percentage of participants choosing one of two viable answers was assessed using a binomial test. Spearman's correlation was used to quantify the relationship between ranked orders or ordinal variables. Each phase of this study was validated using data analysis to ensure accuracy and reliability. Before administration, the household sugar and SSB consumption survey was piloted. The sample size was calculated using the recommended variance to obtain reliable results. The statistician and supervisors

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ensured the reliability and quality of the data collected for this study. Where appropriate, descriptive statistics provide means and standard deviations. Graphs or tables are used to display frequencies and proportions. The accepted threshold for statistical significance was $p<0.05$.

RESULTS AND DISCUSSION

Socio-demographic characteristics of participants

Table 1 presents the socio-demographic information of participants. Most participants (66.2%, n = 264) were females, while 32.3% (n = 192) were males. That females were the majority participants echoes other studies which have reported that women are more likely to participate in research studies than men [16]; women are also more likely to be responsible for household purchases as they were traditionally deemed as homemakers involved in food purchase, household food selection and preparation [17]. Participants within the age group of 26 to 35 years were 36.1% (n = 144), while 27.1% (n = 108) were in the age group of 36-45 years, 17% (n = 68) in 18-25 years, 14.3% (n = 57) in 46-55 years and the least number of participants 5.5% (n = 22), were 56 years and above. Regarding the employment status, 71.4% (n = 285) of the participants were employed, 13% (n = 52) were unemployed, 8.8% (n = 35) were self-employed, and 6.8% (n = 27) were students. Of the participants, 26.3% reported earning more than R20,000 monthly.

Purchasing patterns of table sugar

The frequency of purchasing table sugar by participants' households is presented in Table 2. A significant number (92.0%, n = 367) of participants' households purchased sugar every month, while those who purchased sugar on a weekly and yearly basis were 3.5% (n = 14) and 4.5% (n = 18), respectively. A significant total of 55.1% (n = 220) households purchased brown sugar, while 44.9% (n = 179) purchased white sugar, respectively ($p<0.001$). This finding is similar to the findings of a study conducted in China by Chen *et al*. [18], who reported that in low-income populations, brown granulated sugar was preferred for its intense sweetness and attractive colour [18]. A possible reason for the preference from white to brown sugar in this study could be due to the perception that brown sugar is more natural and healthier than white sugar [19]. Additionally, participants with higher incomes were found to purchase sugar less frequently. This is similar to the findings of Vermeulen, who reported that affluent consumers attributed only 32% of their total expenditure to granulated sugar, whilst marginalised consumers attributed 87% [20].

Additionally, the study by Laraia *et al*. [21], found that low-income households tend to consume a lower amount of nutritious and energy-dense foods . Similarly, in a study conducted in Australia, low-income households were less likely to buy foods high in fibre and low in salt, sugar, and fat [22]. The packaging size that ranked the

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highest in purchase was 5kg (26.3%, n = 105), with the least purchased being 500g (0.8%, n = 3), p<0.001, as presented in Table 2. There was a significant correlation between income, purchasing, frequency and the size of sugar packaging purchased by participants. Those with higher income purchased sugar less frequently (rho = 0.187, p<0.001) and in smaller packaging (rho = -0.145, p = 0.006).

Table 3 presents information on the association between the packaging size of table sugar purchased and participants' gender, age and household income. Female participants reported that they purchased table sugar across all packaging sizes than the male participants. However, the difference in the quantity of table sugar purchased was not significant (X^2 = 11.549, p = 0.316). Participants who were between the age of 18 to 35 years, purchased table sugar with packaging sizes of 1kg (4.6%, n = 18), 2kg (13.3%, n = 53), 5kg (15.3%, n = 61) and 10kg (13.1%, n = 52), X^2 = 24.690, p = 0.214. Furthermore, an increase in household monthly income was found to significantly increase the packaging size of table sugar purchased (X^2 = 64.402, p= <0.001). Households with a monthly income of more than R20,000 were found to purchase all packaging sizes of table sugar more frequently than households with lower monthly incomes.

Consumption of table sugar

Table 4 and fFgure 1 present information on the use of table sugar in the household. The majority of participants (95.7%, n = 382) used table sugar in tea and coffee, while 57.6% (n = 230) added it to cereal, 36.1% (n = 144) used it for baking, and 6.5% (n = 26) used it for cooking (p<0.001). The proportion of participants who used sugar neither in baking nor in cooking were 64% and 93.5%, respectively.

A total of 68.1% of the participants reported having used 2 and 3 teaspoons of sugar in their tea/coffee, χ^2 = 153.619, p<0.001. While, 16.5% (n = 51), 12.8% and 2.5% (n = 10) of participants consumed one teaspoon, four teaspoons, and more than four teaspoons in their tea and coffee, respectively. Further analysis of the Mann-Whitney test showed that females added significantly more sugar in their tea/coffee than males, the score of deviation (Z) = -2.779, p = 0.005. The use of sugar in teas and coffee was reported as significant in this study. Tea is the most consumed beverage in the world [23]. It is important to note that South Africa was previously colonised by the British Empire, which introduced the concept of teatime [24].

Tea from India and coffee from East Africa were the mainstays of the colonial trade, and these beverages, which were the focus of the tea break or coffee break [24] have remained. Younger participants in this study were found to use more sugar. In a 2012 survey on chemosensory traits in human twins, researchers found that younger individuals liked the taste of sucrose (sugar) more than the older participants [25]. However, in our study, older adults were found to consume more

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servings of tea. Similar to our findings, Vieux *et al.* [26] had earlier reported that tea consumption was higher among older adults, and as people age, they drank more coffee and tea, including herbal tea, thus increasing their overall sugar intake.

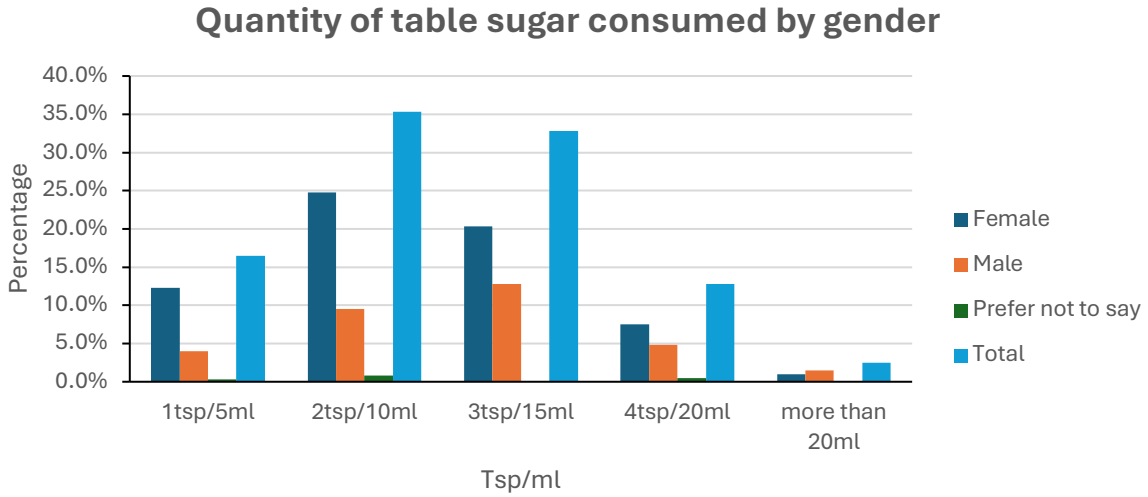

Figure 1: Quantity of table sugar consumed by gender

Purchasing of sugar-sweetened beverages

The type of SSBs purchased are presented in Table 4. A substantial number (77.2%, n = 308) of participants indicated that they frequently consumed carbonated soft drinks. Flavoured water was the second most consumed SSB (32.3%, n = 129), followed by energy drinks (24.1%, n = 96). Consumption of sports drinks was (17.8%, n = 71), with flavoured tea the least consumed (10.8%, n = 43).

Information on the association between SSB purchased and gender, age and household monthly income is presented in Table 6. A significant association was found between gender and SSB purchased (X^2 = 20.685, p = 0.023). Purchase of carbonated soft drinks (37.4%, n = 149), energy drinks (3.1%, n= 12) and flavoured tea (2.3%, n = 9) was higher among individuals between 18 and 35 years. However, there was no significant association between age and packaging sizes of SSB purchased by the participants (X^2= 17.174, p = 0.642). Participants with household income of more than R20,000 purchased all types of SSBs compared to participants with lower household income. A significant association was found between household monthly income and purchase of SSBs (X^2 = 45.979, p = 0.031).

Results from Pearson's chi-square test showed that a significant proportion of those with a monthly income of R1000-R5000, did not consume sweetened flavoured water, while a significant proportion of those who earned >R20,000 consumed sweetened flavoured water, χ^2 = 12.479, p =0.029. A majority (76%; n = 305) of participants reported consuming SSBs at home, p<.001. Results from Pearson's chi-

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square analysis indicated that females significantly consumed flavoured teas, χ^2 = 5.568, p = 0.018 and sweetened flavoured water more than males, χ^2 = 12.983, p<.001. Additionally, the size of SSBs purchased was positively correlated with age (rho =.150, p = 0.003), with older people buying larger sizes of SSBs. A total of 37% of participants purchased 2 litres, 28% purchased 500ml, and 2% purchased 2.25 litres of SSBs.

According to a Nigerian survey, the most common SSBs drank were fruit juice, soft drinks, cocoa-sweetened beverages, and malt drinks [27]. This agrees with a study investigating the SSB consumption behaviours of university students in Australia, where females rather than males, were found to prefer fruit-based drinks [28]. Females tend to make more health-conscious decisions than their male counterparts, placing a higher onus on purchasing healthier food and drink options [29]. According to Renfrew, flavoured water was perceived as a healthier alternative to high-energy SSBs [30]. Young men were also the main purchasers of sports and energy drinks [31]. Sugar-sweetened beverage consumption was associated with meal times [31]; a study conducted in Australia reported that screen-based activities were the most often reported activity while consuming SSBs, and the home was the most common place for consumption, followed by work or university [32].

According to a study conducted in South Africa [11], reporting on household purchasing data from 2014 (pre) to 2019 (post) tax implementation. Researchers reported that there was a notable decline in SSB purchases when HPL was implemented in 2018, when compared to anticipated counterfactual situations in which the tax was not imposed [11]. The study found that the volume of taxable beverage purchases had decreased by 28% [11].

Motivations for SSB purchase among participants

Table 7 illustrates the motivating factors for the purchase of SSB among participants. Participants were prompted to reply with a yes or no answer. Forty-five percent (n = 181) of participants indicated that their purchase decision was influenced by brand loyalty, whilst 55% (n = 218) indicated no influence. Sixty-six percent (n = 264) of participants indicated that taste was a motivating reason for their purchasing decision. A substantial number of participants indicated that their purchasing decision was influenced by flavour (48%, n = 191) and price (37%, n = 148). The SSBs are formulated to be extremely pleasant and thus correlate to a large number of people consuming these primarily for flavour [32] and taste [33]. Children and adolescents cite taste as the most important factor in determining their SSB intake [33]. In a study conducted on adolescence by Wang to investigate what influences teenagers' SSB consumption, participants also indicated that taste is the dominating factor in the consumption of sugary snacks and SSBs [34]. When asked which one

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they would choose between SSB and water, participants chose SSB because it tasted better than water [3].

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

The findings show that households and individuals have a preference towards table sugar and SSBs. Targeted public awareness campaigns should be developed and implemented to educate adults throughout South Africa about the health risks associated with excessive SSB and household sugar consumption. Revenue generated from the HPL should be directed towards sugar tax awareness campaigns, nutrition education programmes, and the promotion of healthy eating. This can be achieved by targeting mainstream media channels and using social media. To determine emerging patterns, more longitudinal research studies need to be conducted into the sugar tax and its effectiveness nationally throughout the provinces and communities, including rural areas, townships and other lower LSM communities in South Africa. A monitoring and evaluation system should be established to track SSB and sugar consumption patterns over time. The development of a tool aimed at helping South Africans monitor their daily sugar intake, serving sizes and portions of food items and drinks would be beneficial if users could input their data and the tool would calculate total sugar consumption and provide customised tips on how to reduce sugar intake. More research needs to be conducted into the increased use and long-term impact of consuming non-nutritive sweeteners (NNSs) and their effect on public health.

Limitations of the study

The study's conclusions may not accurately reflect the overall South African population; instead, it indicates the middle-class living standards measure (LSM) households. Participation was limited to adults. The study was conducted over a specific period. However, consumption patterns can vary seasonally or due to external factors. A short study duration may thus not have captured long-term trends accurately. There may have been some bias toward self-selection because participation in this study was voluntary. The study did not include the category of juices, and the survey data was self-reported and not supported by till point receipts. No results are available to compare pre-tax household sugar consumption with the results of this study.

Ethical considerations

Participants were given an informational letter during the recruitment phase, and informed consent was obtained. Ethical clearance was obtained from the Institution Research Ethics Committee (IREC) at the Durban University of Technology, which provided ethical permission-Ethics Clearance Number: 152/21.

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Conflict of interest

None

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Table 1: **Socio-demographic information of participants**

Category	Description	n (%)
Gender	Male	192 (32.3)
	Female	264 (66.2)
	Prefer not to say	6 (1.5)
Age (years)	18-25	68 (17.0)
	26-35	144 (36.1)
	36-45	108 (27.1)
	46-55	57 (14.3)
	56+	22 (5.5)
Employment status	Employed	285 (71.4)
	Unemployed	52 (13.0)
	Self-employed	35 (8.8)
	Student	27 (6.8)
Income	<R1,000	29 (7.3)
	R1,000- R5,000	75 (18.8)
	R6,000-R10,000	40 (10)
	R11,000-R15,000	57 (14.3)
	R16,000-R20,000	46 (11.5)
	>R20,000	105 (26.3)
	Prefer not to say	47 (11.8)

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Table 2: Frequency of purchasing table sugar by participants' households (n=399)

Items	Variables	Frequency (%)	X^2	p-value
How often do you purchase sugar for the household?	Weekly	14(3.5)	617.609	<.001*
	Monthly	367(92.0)		
	Yearly	18(4.5)		
Which type of sugar do you purchase?	Brown	220(55.1)	4.213	<.001*
	White	179(44.9)		
What packaging size of sugar do you purchase regularly?	500g	3(0.8)	142.218	<.001*
	1kg	30(7.5)		
	2kg	102(25.6)		
	3kg	57(14.3)		
	5kg	105(26.3)		
	10kg	102(25.6)		

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Table 3: Packaging size of table sugar as purchased by participant gender, age and household income

Variable		Packaging size of table sugar purchased per household N(%)						X^2	p
		500g	1kg	2kg	3kg	5kg	10kg		
Gender	Male	1(0.3)	13(3.3)	35(8.8)	14(3.5)	36(9.0)	30(7.5)	11.549	0.316
	Female	2(0.5)	15(3.8)	66(16.5)	43(10.8)	68(17.0)	70(17.5)		
	Prefer not to say	0(0.0)	2(0.5)	1(0.3)	0(0.0)	1(0.3)	2(0.5)		
Age (years)	18-25	1(0.3)	3(0.8)	19(4.8)	6(1.5)	18(4.5)	21(5.3)	24.690	0.214
	26-35	0(0.0)	**15(3.8)**	**34(8.5)**	21(5.3)	**43(10.8)**	**31(7.8)**		
	36-45	2(0.5)	7(1.8)	23(5.8)	**22(5.5)**	31(7.8)	23(5.8)		
	46-55	0(0.0)	4(1.0)	18(4.5)	6(1.5)	11(2.8)	18(4.5)		
	≥56	0(0.0)	1(0.3)	8(2.0)	2(0.5)	2(0.5)	9(2.3)		
Household income per month (R)	<1,000	0(0.0)	3(0.8)	3(0.8)	4(1.0)	4(1.0)	15(3.8)	64.402	<0.001
	1,000-5,000	0(0.0)	7(1.8)	22(5.5)	5(1.3)	17(4.3)	24(6.0)		
	6,000-10,000	0(0.0)	3(0.8)	9(2.3)	3(0.8)	9(2.3)	16(4.0)		
	11,000-15,000	0(0.0)	4(1.0)	11(2.8)	15(3.8)	12(3.0)	24(6.0)		
	16,000-20,000	1(0.3)	3(0.8)	14(3.5)	2(0.5)	18(4.5)	8(2.0)		
	>20,000	0(0.0)	9(2.3)	31(7.8)	18(4.5)	27(6.8)	19(4.8)		

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Table 4: **Uses of table sugar in the household**

Item	Frequency (%)		p-value
	Yes	No	
Baking	144 (36.1)	255 (63.9)	<.001*
Teas and coffee	382 (95.7)	17 (4.3)	<.001*
Add to cereal	230 (57.6)	169 (42.4)	.003*
Cooking	26 (6.5)	373 (93.5)	<.001*

Table 5: **Types of SSBs consumed**

Type of SSB consumed	Response	Frequency (%)	p-value
Carbonated soft drink	Yes	308 (77.2)	.000[a]
	No	91(22.8)	
Energy drink	Yes	96(24.1)	.000[a]
	No	303(75.9)	
Flavoured water	Yes	129(32.3)	.000[a]
	No	270(67.7)	
Sportdrinks	Yes	71(17.8)	.000[a]
	No	328(82.2)	
Flavoured Tea	Yes	43(10.8)	.000[a]
	No	356(89.2)	

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Table 6: Sugar-Sweetened Beverages purchased by gender, age and household income

Variable		Sugar-Sweetened Beverages purchased N(%)						X^2	p
		Carbonated soft drink	Energy drink	Flavoured tea	Flavoured water	Sports drink	Others		
Gender	Male	91(22.8)	8(2.0)	2(0.5)	8(2.0)	11(2.8)	9(2.3)	20.685	0.023
	Female	186(46.6)	16(4.0)	11(2.8)	24(6.0)	4(1.0)	23(5.8)		
	Prefer not to say	3(0.8)	0(0.0)	1(0.3)	1(0.3)	1(0.3)	0(0.0)		
Age (years)	18-25	49(12.3)	3(0.8)	3(0.8)	7(1.8)	3(0.8)	3(0.8)	17.174	0.642
	26-35	**100(25.1)**	**9(2.3)**	**6(1.5)**	8(2.0)	9(2.3)	**12(3.0)**		
	36-45	79(19.8)	7(1.8)	1(0.3)	**10(2.5)**	2(0.8)	8(2.0)		
	46-55	34(8.5)	4(1.0)	3(0.8)	8(2.0)	1(0.3)	7(1.8)		
	≥56	18(4.5)	1(0.3)	1(0.3)	0(0.0)	0(0.0)	2(0.5)		
Household income per month (R)	<1,000	21(5.3)	0(0.0)	0(0.0)	4(1.0)	4(1.0)	0(0.0)	45.979	0.031
	1,000-5,000	48(12.0)	3(0.8)	3(0.8)	5(1.3)	3(0.8)	13(3.3)		
	6,000-10,000	41(10.3)	0(0.0)	1(0.3)	3(0.8)	0(0.0)	3(0.8)		
	11,000-15,000	38(9.5)	6(1.5)	3(0.8)	4(1.0)	4(1.0)	2(0.5)		
	16,000-20,000	31(7.8)	5(1.3)	3(0.8)	4(1.0)	2(0.5)	1(0.3)		
	>20,000	73(18.3)	6(1.5)	4(1.0)	8(2.0)	2(1.9)	11(2.8)		

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Table 7: Motivators for SSB consumption

Factors	Motivation for purchasing decision of SSBs			
	Category	N=399	Percentage (%)	p
Brand loyalty	Yes	181	45	.071[a]
	No	218	55	
Price	Yes	148	37	.000[a]
	No	251	63	
Taste	Yes	264	66	.000[a]
	No	135	34	
Packaging size	Yes	34	9	.000[a]
	No	365	91	
Flavour	Yes	191	48	.423[a]
	No	208	52	

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