Perceptions, willingness-to-pay, and associated socio-demographics of sugar-sweetened beverage taxation in an affluent Asian setting

Jingxuan Wang[1†], Yuchen Wei[1,2†], Matteo M. Galizzi[3], Hoi Shan Kwan[4], Benny Chung Ying Zee[1,5], Hong Fung[1], Tony Ka Chun Yung[1], Eliza Lai Yi Wong[1], Qianying Yue[1], Michelle Kit Ling Lee[6], Yushan Wu[1,2], Kailu Wang[1,2], Hongjiang Wu[7], Eng Kiong Yeoh[1,2], Ka Chun Chong[1,2,5*]

Affiliations:

[1] School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong Special Administrative Region, China

[2] Centre for Health Systems and Policy Research, The Chinese University of Hong Kong, Hong Kong Special Administrative Region, China

[3] Department of Psychological and Behavioral Science, London School of Economics and Political Science, London, United Kingdom.

[4] School of Life Sciences, The Chinese University of Hong Kong, Hong Kong Special Administrative Region, China

[5] Shenzhen Research Institute, The Chinese University of Hong Kong, Shenzhen, China

[6] School of Biological Sciences, The University of Hong Kong Hong Kong Special Administrative Region, China

[7] Department of Medicine & Therapeutics, Faculty of Medicine, The Chinese University of Hong Kong, Hong Kong Special Administrative Region, China

[†]These authors contribute equally to this work.

***Address for correspondence**

Ka Chun Chong

RM501, School of Public Health Building, Prince of Wales Hospital, Hong Kong Special Administrative Region, China

Email: marc@cuhk.edu.hk

Abstract

Taxation on sugar-sweetened beverages (SSBs) is proposed as a measure to address the health consequences of excessive sugar intake, yet research on its implementation in Asian contexts is limited. This study examined the perceptions, willingness-to-pay, and associated socio-demographics of SSB taxation in Hong Kong, an affluent Asian setting. A random-sampled telephone survey was conducted with 1,250 Hong Kong adults. We used the maximum willingness to pay (WTP_M), defined as the highest accepted price that a subject willing to consume SSB products, as a measure of willingness to pay. The contingent valuation method was employed to assess the WTP_M for different types of SSBs. A multiple linear regression analysis showed that, about 50% of participants were aware of negative health impacts, and over 60% being confident in reducing their intake. Even with a 30% tax, approximately 70% of individuals remained willing to continue consuming SSBs. Non-diet soft drinks had the highest WTP_Ms (83% of current price), while parents reported higher WTP_M for their children (74%) than for themselves (66%). Full/part-time workers had higher WTP_M, whereas higher income and better self-rated health correlated with lower WTP_M. Full/part-time workers had higher WTP_Ms, while higher income and better self-rated health were associated with lower WTP_Ms. In summary, despite awareness of the potential health risks associated with consuming SSBs, a high tax rate was necessary to reduce SSB consumption, particularly among children and non-diet soft drinkers. Our study highlights how economic measures can influence consumer behavior and informs the implementation of such measures.

Keywords: sugar-sweetened beverage, taxation, perception, health policy

Sugar-sweetened beverages (SSBs) have emerged as a significant public health concern due to their substantial contribution to excessive sugar intake and associated health problems, including but not limited to obesity, diabetes, and dental caries (Tappy & Lê, 2010; Te Morenga et al., 2013; Te Morenga et al., 2014). Frequent SSB consumption was also found to be associated with other unhealthy lifestyles such as smoking, lack of sleep, lack of exercise, fast food consumption, and low fruit intake (Imoisili et al., 2020). Increasing the price of SSB products through taxation has been proposed as a practical and effective method to reduce individual sugar intake through economic mechanisms. Studies conducted in various African (Essman et al., 2021), American (Caro et al., 2018), Australian (Cobiac et al., 2017), and European (Thow et al., 2022) countries demonstrated a decrease in average purchases and sugar consumption following the implementation or increase of taxes on SSBs. However, there is evidence suggesting resistance to SSB taxes from consumers, the industry, and other stakeholders (Abdool Karim et al., 2023; Manyema et al., 2016). Additionally, doubts have been raised regarding the long-term effectiveness of economic measures in high-income populations (Ogden et al., 2011). In the East Asia and Pacific region, economic measures to address excessive SSB consumption are rarely implemented, with national SSB taxes covering only a limited portion (10%) of the population (Hattersley & Mandeville, 2023). While a few studies in India have supported the feasibility and effectiveness of SSB taxes (Basu et al., 2014), more evidence is needed in developed settings.

Hong Kong, an affluent Asian setting, faces a high prevalence of obesity individuals, with SSB consumption considered a risk factor (Ko et al., 2010). Hong Kong's SSB intake is estimated as 86.07 Litres/person/year, which is approximately 2.8 times lower than the

U.S. but is comparable to some European nations including Netherlands (Ferretti & Mariani, 2019). Non-alcoholic beverages, including non-diet soft drinks, account for 32% of the total sugar consumption (Centre for Health Protection, 2015). Additionally, younger citizens, particularly children, are frequent consumers of SSBs, with a considerable percentage exceeding the recommended daily intake (Abouhala et al., 2021). Understanding consumer behaviors and attitudes towards SSBs is crucial for developing effective interventions and policies aimed at reducing their consumption. This study examined the willingness to pay for the SSB tax, assessed the perceptions on SSB consumption, and determined the factors associated with the willingness to pay for different types of SSBs in Hong Kong. The findings are expected to contribute to understand the drivers behind SSB consumption and provide insights into the implementation of the economic measure on changing consumer behavior and preferences.

1 Methods

1.1 Study design

We conducted a cross-sectional telephone survey among random-sampled adult residents in Hong Kong from May to November 2020. An ethics approval from the Survey and Behavioral Research Ethics Committee of the Chinese University of Hong Kong was obtained (SBRE-18-211) on December 5, 2018. Detailed information regarding the survey data collection procedure has been described elsewhere (Wang et al., 2021). The inclusion criteria for the study were Chinese residents aged 18 or above. The ethics approval was obtained and all subjects were asked to provide verbal consent before participating in the phone interviews.

1.2 Perception

Eight questions in a 5-score Likert Scale were adopted from the 2016 Mexican National Health and Nutrition Survey (ENSANUT 2016) (Shamah-Levy et al., 2019) to evaluate participants' perceptions on SSB products and consumption from the aspects of taste preference, health impacts, accessibility to alternatives, and confidence in moderation.

1.3 Definition and measurement of WTP_M

We used the maximum willingness to pay (WTP_M), defined as the highest accepted price that a subject willing to consume SSB products, to be a measure of willingness to pay. In other words, individuals are willing to *stop* consume if the price went higher than their WTP_M. The definition of WTP_M is similar with that applied in other studies, e.g., Oremus and his colleagues (Oremus et al., 2012).

To assess the WTP_M of the participants, we applied the Contingent Valuation (CV) Method based on the published manual of WTP questionnaire design (Foreit & Foreit, 2004; Klose, 1999). The survey process involved several key steps to minimize biases. Firstly, we presented respondents with a description of the potential future health impacts associated with SSB consumption. Subsequently, respondents were informed about the current market prices of various types of SSB products. These prices served as reference points, allowing respondents to consider the existing costs when evaluating their preferences and willingness to pay. The method minimizes start point bias and range bias in direct WTP_M estimates. By offering a clear framework and context for assessing clients' preferences and reminding them of the current market price, this method ensures that even non-frequent buyers have a consistent understanding (Foreit & Foreit, 2004).

120 Following these preliminary steps, we introduced a hypothetical scenario in which a SSB
121 tax has been implemented, resulting in a proportional increase (0-100%) in the market price
122 of SSBs. Respondents were then asked to vote on whether they would choose to stop
123 purchasing SSB under these circumstances. The proportion of individuals willing to
124 consume SSBs at a given tax rate was determined by dividing the number of individuals
125 with a WTP_M greater than the tax rate by the total number of individuals.

126 To obtain the individual response on WTP_M, an open-ended follow-up question was posed
127 to determine the price that the respondents would stop consume the SSB product. Logical
128 checks were implemented to maintain the coherence of responses. For instance, if a
129 respondent answered "No" in the voting question, signifying their intention to retain their
130 consumption, their WTP_M was expected to excess the pre-set price increase in the voting
131 question. Conversely, if a respondent answered "100% reduction" in the voting question,
132 their WTP_M was expected to be lower than the pre-set tax rate.

133 *1.4 Classification and market prices of SSBs*

134 In this study, we referred the SSBs to all non-alcoholic water-based beverages with added
135 sugar which include five types: non-diet soft drinks/sodas, flavored juice drinks, sweetened
136 tea/coffee drinks, flavored mineral waters, and energy drinks/electrolyte replacement
137 drinks. The SSBs do not include milk-based products, 100% fruit juice and artificial
138 sweetened beverages.

139 To consistently compare the WTP_M between SSB type, we defined the percentage increase
140 of WTP_M as $\frac{WTP_M - Reference\ Market\ Price}{\text{Reference Market Price}}$. We assumed the *Reference Market Price* equals

to: HKD7.0 (USD0.88) for non-diet soft drink, HKD12.0 (USD1.53) for flavored juice drinks, HKD16.0 (USD2.04) for sweetened tea/coffee, HKD15.0 (USD1.91) for flavored mineral waters and energy drinks.

1.5 Socio-demographics and health factors

Socio-demographics, including sex, age, height, weight, marital status, education level, employment status, monthly household income level, medical history of chronic disease, children's age, sex, weight, and height, were collected from the participants in the survey.

1.6 Sample size determination

A minimum sample size of 1,015 random-selected adults is able to generate a precision of <2% for the estimate of proportion of individuals willing to change their behavior owing to the SSB taxation, assuming a 3%-12% consumption from public households (Caro et al., 2018; Colchero et al., 2016) and 5% types I error.

1.7 Statistical analysis

Descriptive statistics (e.g., relative frequency, mean, median, interquartile range [IQR], and standard deviation [SD]) were used to describe the characteristics of the participants and children, their behaviors and perceptions on SSB consumption, and WTP_M by types. Univariate analysis (t-tests for continuous variable and chi-square test for categorical variables) was conducted to assess the significance of associations between different factors and WTP_M. To determine the independent factors associated with the WTP_M of the participants, a multiple linear regression analysis was conducted for each of the SSB types.

161 A *p*-value <0.05 is declared as statistically significant and all statistical tests were two-
162 sided. Software *SAS 9.4* was used to conduct the analysis.

163 **2. Results**

164 *2.1 Characteristics of participants*

165 A total of 15,166 telephone numbers were randomly sampled, out of which 13,062 were
166 identified as invalid numbers (e.g., fax lines or non-contact numbers). Among the 2,104
167 valid numbers, 1,250 participants completed the survey. The response rate of the study was
168 59.1%. Among the participants, data on 277 children aged between 2 and 18 years old were
169 reported by 188 parents. Participants' and their children's characteristics were shown in
170 Table 1.

171

172 **Table 1. Characteristics of participants (N = 1,250)**

Characteristics	n (%) [a]
Sex	
Male	407 (32.6)
Female	843 (67.4)
Age, years	
18-33	153 (12.2)
34-63	588 (47.0)
64-78	361 (28.9)
79 or above	134 (10.7)
Refuse to answer	14 (1.1)
Education	
6 years (primary school) or below	323 (25.8)
6-12 years (secondary school)	587 (47.0)
12 years (Tertiary education) or above	324 (25.9)
Refuse to Answer	16 (1.3)
Occupation	
Retired	445 (35.6)
Full-time/Part-time employed	344 (27.5)
Housekeeper	339 (27.1)
Student	72 (5.8)
Unemployed	37 (3.0)
Refuse to answer	13 (1.0)
Monthly household income, HKD	
0-30,000 (USD0-3,842)	757 (60.6)
30,001-60,000 (USD3,843-7,684)	163 (13.0)
60,000 or above (USD7,685 or above)	57 (4.6)
Refuse to answer	273 (21.8)
Marital status	
Married	939 (75.1)
Single and never married	211 (16.9)
Separated/divorced/widowed	86 (6.9)
Refuse to Answer	14 (1.1)
Housing condition	
Private permanent housing	512 (41.0)
Public rental housing	447 (35.8)
Housing Authority Subsidized sale flats	193 (15.4)
Refuse to Answer	93 (7.4)
Weight, kg, Median (IQR)	56.7 (50.0-64.0)
BMI, kg/m^2, Median (IQR)	22.0 (20.4-24.0)
Self-rated health	
Very good	36 (2.9)
Good	697 (55.8)
Fair	490 (39.2)
Poor	25 (2.0)
Very poor	2 (0.2)
Medical history of selected chronic disease	
Hypertension	339 (27.1)
Diabetes	121 (9.7)
Hyperlipidemia	35 (2.8)
Heart disease	18 (1.4)
Fatty liver	7 (0.6)
None of the above	872 (69.7)
Number of children aged 2 to 18 years old	
0	1062 (85.0)
1	102 (8.2)
2	83 (6.6)
3 or more	3 (0.2)
Sex of children (N=277)[b]	
Male	139 (50.2)
Female	138 (49.8)
Age of children, years (N=277)[b]	
2-4	31 (11.2)
5-9	48 (17.3)
10-14	116 (41.9)
15-18	82 (29.6)
Weight of children, kg, Median (IQR) (N=162)[b]	43.0 (31.8-50.0)

BMI of children, kg/m^2, Median (IQR) (N=162)[b]	19.4 (16.9-22.2)

[a] Values presented in this column are n (%) unless otherwise stated.

[b] 188 subjects had 277 children aged 2 to 18 years old, among them the weight and height of 162 children were reported.

177 *2.2 Perception*

178 Thirty-three percent of the participants expressed a preference for the taste of SSBs (Table
179 2). Regardless of their liking for SSBs, around half of the participants were aware of
180 associated health risks, including diabetes (49%), obesity (55%), dental caries (55%), and
181 high blood pressure (58%). Sixty-seven percent agreed that drinking water was easily
182 accessible at low or no cost in Hong Kong. Two-thirds intended to consumer fewer SSBs
183 (65%), and were confident to drink one or fewer units of sugary drinks a week (64%).

184 **Table 2. Perceptions (n (%)) about sugar-sweetened beverage (SSB) consumption (N=1,250)**

Questions of perceptions	Strongly disagree	Slightly disagree	Slightly agree	Strongly agree	Don't know
1. I like the taste of sugary drinks	47 (3.8)	731 (58.5)	10 (0.8)	404 (32.3)	58 (4.6)
2. SSB consumption contributes to high blood pressure	4 (0.3)	84 (6.7)	231 (18.5)	493 (39.4)	438 (35.0)
3. SSB consumption contributes to obesity	0 (0.0)	43 (3.4)	25 (2.0)	656 (52.5)	526 (42.1)
4. SSB consumption contributes to diabetes	0 (0.0)	36 (2.9)	60 (4.8)	555 (44.4)	599 (47.9)
5. SSB consumption contributes to dental caries	0 (0.0)	61 (4.9)	25 (2.0)	659 (52.7)	505 (40.4)
6. It is easy to drink potable water at low cost or for free when I am thirsty	20 (1.6)	69 (5.5)	5 (0.4)	839 (67.1)	317 (25.4)
7. I am confident to drink one or fewer units of sugary drinks (such as sodas, juices, nectars, and sweetened water) a week	14 (1.1)	255 (20.4)	133 (10.6)	671 (53.7)	177 (14.2)
8. I should purchase less SSBs	19 (1.5)	258 (20.6)	126 (10.1)	684 (54.7)	163 (13.0)

185

186 *2.3 Impact of tax rates on SSB consumption*

187 Figure 1 illustrated the percentage of individuals willing to maintain their purchasing
188 behavior for SSBs over a range of tax rates. At a tax rate of 30%, approximately 70% of

individuals were willing to maintain their SSB consumption. Less than half were willing to maintain their consumption when taxes reached 60% of the current price. Parents consistently expressed a higher willingness to purchase SSBs for their children compared to adults purchasing for themselves. To further understand the trends observed in Figure 1, linear regression analyses were conducted to model the relationship between tax rate and the percentage of individuals willing to maintain their SSB consumption. Results revealed a significantly steeper decline in willingness to purchase for adults (β = -0.816, 95% CI: -0.834, -0.799) compared to children (β = -0.453, 95% CI: -0.497, -0.408; p-value < 0.001).

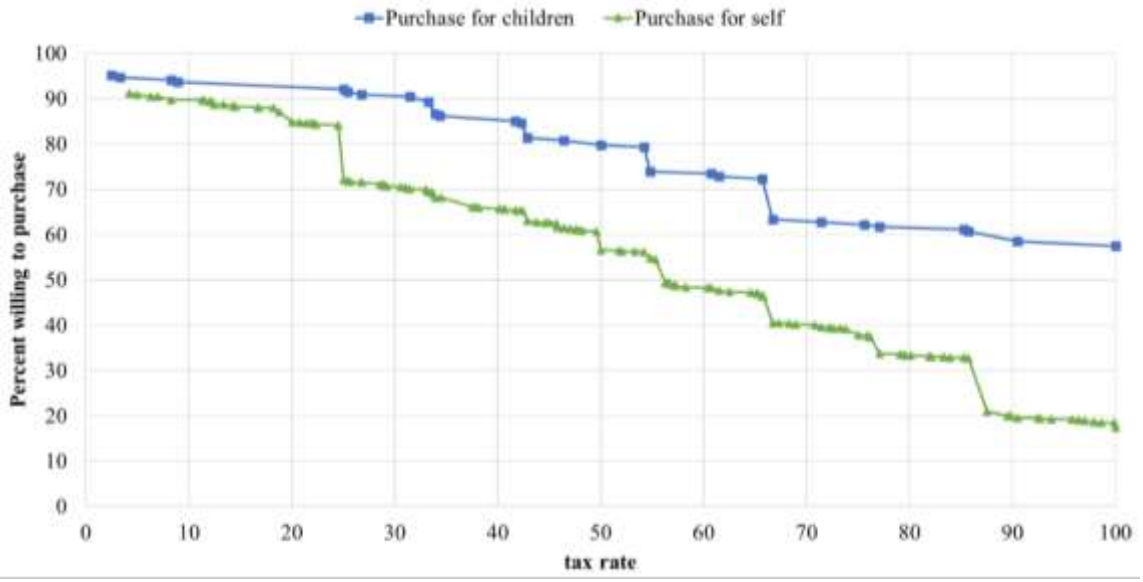

Figure 1. Percentages of participants willing to consume sugar-sweetened beverages (SSBs) at different tax rates. The proportion of individuals willing to consume sugar-sweetened beverages is determined by dividing the number of individuals having their WTP_M greater than the tax rate by the total number of individuals.

2.4 WTP_M

Of the participants, 1,095 had consumed at least one of the five popular types of SSB products in the past week and completed the WTP_M questions (Table 3). In general, the mean (±SD) WTP_M of all SSBs in adults was USD 2.68 (± USD 1.29) (i.e., 66% (±55%) increase of the current price). Except for the soft drinks, which had a mean WTP_M of 83% (±87%) increase of the current price, the mean WTP_Ms were similar (around 60%-70% of the current price) in other SSB products. The mean (±SD) WTP_M for all SSBs was higher (i.e., 74% ± 59%) in parents, compared to that in children. Type-specific mean WTP_Ms for children were all above 75%, except for flavored mineral waters and energy drinks which, according to our survey results, was merely on parents' shopping list for children.

Table 3. Mean and standard deviation (SD) of maximum willingness to pay (WTP_M) for sugar-sweetened beverages (SSBs) among adults and children

		in USD	in % *
		Mean ± SD	Mean ± SD
Adults	All SSBs (n=1095)	2.71 ± 1.32	65.9 ± 55.4
	Non-diet soft drinks (n=304)	1.57 ± 0.92	82.7 ± 87.2
	Flavored juice drinks (n=466)	2.56 ± 0.95	67.8 ± 53.3
	Sweetened tea/coffee (n=751)	3.2 ± 1.51	65.5 ± 52.2
	Flavored mineral waters and Energy drinks (n=64)	3.08 ± 0.99	61.3 ± 43.3
Children	All SSBs (n=106)	2.21 ± 1.03	73.5 ± 58.9
	Non-diet soft drinks (n=59)	1.72 ± 0.75	89.5 ± 82.2
	Flavored juice drinks (n=78)	2.74 ± 0.78	75.6 ± 49.8
	Sweetened tea/coffee (n=9)	3.71 ± 1.03	78.5 ± 49.4
	Flavored mineral waters and Energy drinks (n=10)	2.64 ± 1.17	45.3 ± 39.6

* Defined as $\frac{WTP_M - Reference\ Market\ Price}{Reference\ Market\ Price}$. Reference Market Price equals to: HKD7.0 (USD0.88) for non-diet soft drink; HKD12.0 (USD1.53) for flavored juice drinks; HKD16.0

(USD2.04) for sweetened tea/coffee; HKD15.0 (USD1.91) for flavored mineral waters and energy drinks.

Figure 2 showed the willingness to pay pattern by different types of SSB products. WTP_Ms for non-diet soft drinks and flavored juice drinks were higher than that for sweetened tea/coffee and flavored mineral waters and energy drinks in children. Specifically, when the tax rate reached 50% of the current price, approximately 60% of parents were willing to cease purchasing non-diet soft drinks for their children, while the corresponding percentage was 32% for flavored juice drinks.

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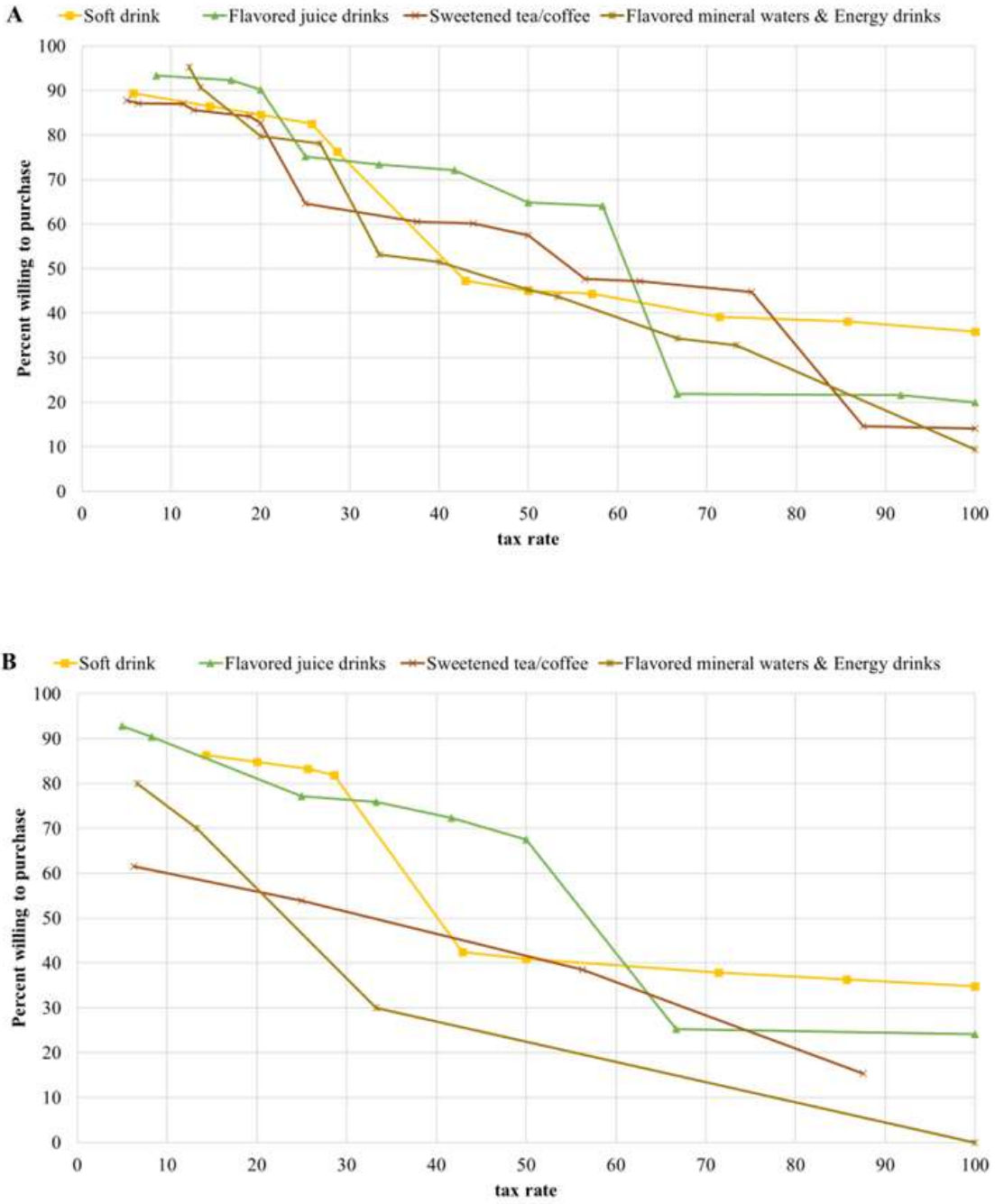

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227 **Figure 2**. **Percentages of (A) adults and (B) children willing to consume different types of**

228 **sugar-sweetened beverages (SSBs)**. The proportion of individuals willing to consume a sugar-

sweetened beverages product is determined by dividing the number of individuals having their WTP_M greater than the tax rate by the total number of individuals.

2.5 Determinants of WTP_M

Males showed 35.9% higher WTP_M for soft drinks (p-value=0.022). Elderly had 18.8% lower WTP_M for sweetened tea/coffee (p-value=0.004). Full/part-time work increased WTP_M by 14.6% for all SSBs (p-value=0.008), with larger effects for flavored juice drinks (20.5%, p-value=0.009) and sweetened tea/coffee (15.5%, p-value=0.010). High income (≥HKD60,000) reduced WTP_M for all SSBs (-20.1%, p-value=0.038), with the strongest reduction in sweetened tea/coffee (-39.6%, p-value<0.001). Good self-rated health decreased WTP_M for all SSBs (-9.4%, p-value=0.046). Chronic disease history reduced soft drink WTP_M (-37.0%, p-value=0.043). Marginal associations included BMI effects on flavored juice drinks (-1.5%, p-value=0.075) and self-rated health on juice drinks (-13.3%. p-value=0.056).

Table 4. Coefficient (β), 95% confidence intervals (CI), and *p*-values of independent variables for a multiple linear regression analysis on maximum willingness to pay (WTP_M) in percentage increase in prices by types of sugar-sweetened beverage (SSB).

	All SSBs		Soft Drink		Flavored juice drinks		Sweetened tea/coffee	
Variables	**β (95% CI)**	***p*-value**	**β (95% CI)**	***p*-value**	**β (95% CI)**	***p*-value**	**β (95% CI)**	***p*-value**
Male	2.8 (-6.2 to 11.7)	0.540	35.9 (5.3 to 66.5)	**0.022**	4.5 (-9.7 to 18.8)	0.531	1.6 (-8.1 to 11.2)	0.749
Elderly*	-9.8 (-21.6 to 1.9)	0.102	-14.8 (-59.1 to 29.5)	0.511	0.5 (-18.1 to 19.2)	0.954	-18.8 (-31.5 to -6.0)	**0.004**
Body mass index, kg/m^2	-0.2 (-1.4 to 1.04)	0.796	3.2 (-0.5 to 6.8)	0.087	-1.5 (-3.2 to 0.16)	0.075	0.1 (-1.1 to 1.4)	0.828
Education (Ref: Primary school or below)								
Secondary school	5.4 (-6.5 to 17.2)	0.374	3.9 (-46.5 to 54.6)	0.881	2.6 (-16.3 to 21.5)	0.786	4.5 (-8.4 to 17.3)	0.496
Tertiary education or above	5.8 (-9.4 to 21.1)	0.455	17.4 (-39.7 to 74.5)	0.548	5.5 (-18.1 to 29.0)	0.650	6.9 (-9.9 to 23.8)	0.420
Full-time or part-time in occupation	14.6 (3.8 to 25.3)	**0.008**	11.9 (-18.6 to 42.4)	0.443	20.5 (5.1 to 35.8)	**0.009**	15.5 (3.7 to 27.3)	**0.010**
Monthly household income (Ref: ≤HKD30,000 or USD3,842)								
30,001-60,000 (USD3,843-7,684)	-4.8 (-16.7 to 6.9)	0.417	16.5 (-16.2 to 49.1)	0.321	-0.3 (-17.1 to 16.5)	0.973	-12.9 (-25.7 to -0.1)	**0.049**
60,000 or above (USD7,685 or above)	-20.1 (-39.2 to -1.1)	**0.038**	-26.5 (-76.2 to 23.2)	0.294	-11.5 (-39.3 to 16.2)	0.414	-39.6 (-61.3 to -17.9)	**<0.001**
Married	5.4 (-4.9 to 15.7)	0.306	14.4 (-19.3 to 48.1)	0.399	12.0 (-3.5 to 27.4)	0.129	8.3 (-3.0 to 19.7)	0.150
Private housing	3.4 (-5.4 to 12.2)	0.454	-6.7 (-35.1 to 21.7)	0.644	10.8 (-2.4 to 23.9)	0.108	8.6 (-1.0 to 18.2)	0.078
Good or very good in self-rated health	-9.4 (-18.6 to -0.2)	**0.046**	-15.2 (-46.0 to 15.7)	0.333	-13.3 (-26.9 to 0.3)	0.056	-8.2 (-18.3 to 1.9)	0.113
Medical history of chronic disease	-5.4 (-15.3 to 4.5)	0.285	-37.0 (-72.8 to -1.1)	**0.043**	-13.7 (-28.4 to 1.1)	0.069	6.5 (-4.4 to 17.3)	0.242
Had children aged 2 to 18 years old	-7.5 (-15.3 to 4.5)	0.285	-17.0 (-51.6 to 17.6)	0.333	-9.9 (-26.6 to 6.8)	0.246	-3.1 (-18.2 to 12.0)	0.684

*Because of an existence of multi-collinearity in the regression model (i.e., variance inflation factor >5 for age group "34-63 years"), variable age was regrouped into two levels i.e., non-elderly (<64 years old) and elderly (≥64 years old). The variance inflation factors kept below 3 in the regression model.

Regression analysis for flavored mineral waters and energy drinks was not conducted due to a limited sample.

3. Discussion

In this study, we examined the willingness to pay for the SSB and its associated factors in Hong Kong, an affluent Asian setting. Our study showed that most participants were aware of the potential health risks of SSB consumption and agreed that they should purchase fewer SSBs. However, a substantial willingness to pay was reported, with mean WTP_M values ranging from 66% to 83% above current prices. These findings demonstrate the complex interplay between self-motivation, health awareness, and SSB consumption decisions. While increasing awareness of the health risks associated with SSBs is crucial, interventions and policies should also consider the importance of addressing other factors such as taste preferences and palatability, media and marketing influences, and accessibility to effectively reduce SSB consumption (Hess et al., 2019).

To our knowledge, this is the first study to assess the potential impacts of increased SSB price due to taxation for the consumption preferences in parents for their children. We found that, in comparison to the SSB consumption for adults themselves, parents reported higher WTP_{MS} for children, indicating that it is particularly difficult to affect SSB consumption in children an affluent setting such as Hong Kong. Health behavior studies have noticed that parents' consumption decisions for their children are often influenced by a number of factors, including convenience, resistance or objections from their children, parental guilt, and desire to please the children (Mis et al., 2017; Ndiaye et al., 2013). Meanwhile, one popular parental belief in the Chinese society is that sugar is an important component maintaining dietary diversity and promoting children's development. Existing evidence suggests combining taxation with education, family interventions, and marketing

restrictions to more effectively address SSB-related health risks among children (Mis et al., 2017; Vargas-Garcia et al., 2017).

Our data suggest a variation in price elasticity across the SSB types, with non-diet soft drinks showing the highest WTP_M values for both adults and children. Studies conducted in Chile (Guerrero-López et al., 2017), Mexico (Colchero et al., 2015), and Guatemala (Chacon et al., 2018) reported similar findings, and identified factors such as product availability, accessibility, and marketing and packaging strategies as the determinants of price resistance. Moreover, non-diet soft drinks are often considered as a habitual consumption that is less price-sensitive than discretionary food items. In addition to the strong willingness to maintain consumption, non-diet soft drinks were found to have a high sugar content of 10–13 g/100g, comparable to juice drinks (8.1–13 g/100g) and exceeding that of sweetened tea/coffee (6.4–10 g/100g) (Centre for Food Safety, 2021). These findings remind further studies to examine how the interplay between sugar content and tax responsiveness across SSB types influences long term health outcomes.

Our regression analysis also revealed a notable gender disparity in response to soft drink taxation, with males demonstrating 35.9% higher WTP_M compared to females (p-value=0.022). This aligns with global studies showing males' stronger preference for SSBs, particularly in high-income countries (Lara-Castor et al., 2023). Previous studies suggested distinct brain activation patterns in response to sweet tastes in males and females, with greater activation observed in reward-related brain regions among males (Haase et al., 2011). Cultural and marketing influences may further reinforce this gender gap, as soft

290 drink advertising often associates these products with masculine identity, potentially
291 increasing males' willingness to pay (Islentyeva & Zimmermann, 2023).

292 As shown in Table 4, we identified unemployed individuals had a lower willingness to pay,
293 compared with individuals working full-time/part-time, being in line with a study
294 conducted in the Netherlands (Eykelenboom et al., 2021). Additionally, individuals with
295 higher income levels (monthly household income ≥ USD3,843) demonstrated greater price
296 sensitivity for sweetened tea/coffee (Centre for Food Safety, 2021). This contrasts with
297 studies in Mexico and South Africa, where low-socioeconomic status groups reduced
298 consumption most significantly post-taxation (Colchero et al., 2016). We suspect this
299 inverse income-WTP_M relationship may reflect high-income groups' greater awareness and
300 acceptance of healthier alternatives including unsweetened coffees or teas. Additionally,
301 studies noted that low-income households tend to prioritize consumable and immediate
302 gratification in their food choices, such as consuming SSBs, over long-term nutritional
303 quality and health outcomes. High-sugar foods including the sweetened tea and coffee may
304 also act as a psychological coping strategy in response to financial stress.

305 This study has several limitations. First, previous studies usually involved 2-3 iterative
306 bidding dichotomous choice questions to narrow the upper and lower bounds for WTP_{MS},
307 while this study only involved one voting question for each individual participant. This is
308 because we investigated the perspectives of both adults and children on five different types
309 of SSBs. To reduce subject fatigue from repetitive questions and improve data quality, each
310 type of SSB requires a simplified survey design. Second, the perceptions and willingness
311 to pay for SSBs among children were not directly assessed. Instead, the parents of the
312 children were surveyed and asked about their willingness to pay for their children's SSB

consumption. Although parents play a significant role in shaping and influencing their children's dietary choices, surveying children directly could have provided additional insights. Third, our study investigated respondents' willingness, instead of their actual consumption behaviors. The process of turning minds into behaviors is complex and can be affected by additional factors such as hot advertising and/or new flavors of SSBs. More real-world evidence is needed before implementing the study results.

In conclusion, despite a large proportion of participants demonstrating high awareness of the potential health consequences associated with SSB consumption and confidence to reduce SSB consumption, only high tax rates seem to have the potential to reduce SSB consumption. As parents reported an even higher willingness to pay for their children, it seems particularly difficult to affect SSB consumption in children an affluent setting such as Hong Kong. Our study also identified several factors associated with a higher willingness to pay for SSBs, such as individuals with full/part-time occupations and poorer self-rated health. This study enhanced the understanding about the implementation of the economic measure on changing consumer behavior and preferences, and indicate that targeted interventions would be needed for several specific populations.

Declarations

Ethics approval and consent to participate: An ethics approval from the Survey and Behavioral Research Ethics Committee of the Chinese University of Hong Kong was sought (SBRE-18-211).

Data sharing statement: The sharing of data is restricted by Hong Kong Health Bureau.

Consent for publication: All subjects were asked for verbal consents before the phone interviews. No subject identification was collected.

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Author's contributions: JW: Conceptualization, Methodology, Software, Formal analysis, Investigation, Data Curation, Writing - Original Draft, Project administration; EKY: Resources, Writing - Review & Editing, Supervision, Funding acquisition; MMG: Writing - Review & Editing, Supervision; HSK: Conceptualization, Methodology, Writing - Review & Editing; BCYZ: Resources, Writing - Review & Editing, Supervision; TKCY: Conceptualization, Methodology, Writing - Review & Editing; ELYW: Writing - Review & Editing; YwW: Writing - Review & Editing; HW: Writing - Review & Editing; QY: Writing - Review & Editing; MKLL: Methodology, Writing - Review & Editing; YcW: Methodology, Software, Formal analysis, Investigation, Data Curation, Writing - Original Draft; KCC: Conceptualization, Methodology, Validation, Resources, Writing - Original Draft, Supervision, Funding acquisition

Reference

Abdool Karim, S., Kruger, P., Mazonde, N., Erzse, A., Goldstein, S., & Hofman, K. (2023). Stakeholder arguments during the adoption of a sugar sweetened beverage tax in South Africa and their influence: a content analysis. *Global Health Action*, *16*(1), 2152638.

Abouhala, S., Hamidaddin, A., Taye, M., Glass, D. J., Zanial, N., Hammood, F., Allouch, F., & Abuelezam, N. N. (2021). A National Survey Assessing COVID-19 Vaccine Hesitancy Among Arab Americans. *J Racial Ethn Health Disparities*, 1-9. https://doi.org/10.1007/s40615-021-01158-6

Basu, S., Vellakkal, S., Agrawal, S., Stuckler, D., Popkin, B., & Ebrahim, S. (2014). Averting obesity and type 2 diabetes in India through sugar-sweetened beverage taxation: an economic-epidemiologic modeling study. *PLoS medicine*, *11*(1), e1001582.

Caro, J. C., Corvalán, C., Reyes, M., Silva, A., Popkin, B., & Taillie, L. S. (2018). Chile's 2014 sugar-sweetened beverage tax and changes in prices and purchases of sugar-sweetened beverages: An observational study in an urban environment. *PLoS medicine*, *15*(7), e1002597.

Centre for Food Safety. (2021). *Risk assessment studies report No. 11: Nutrient values of local foods*.

Centre for Health Protection. (2015). *The Bitter Truth about Sugars*. Hong Kong Special Administrative Region Government.

Chacon, V., Paraje, G., Barnoya, J., & Chaloupka, F. J. (2018). Own-price, cross-price, and expenditure elasticities on sugar-sweetened beverages in Guatemala. *PloS one*, *13*(10), e0205931.

Cobiac, L. J., Tam, K., Veerman, L., & Blakely, T. J. P. m. (2017). Taxes and subsidies for improving diet and population health in Australia: a cost-effectiveness modelling study. *14*(2), e1002232.

Colchero, M. A., Popkin, B. M., Rivera, J. A., & Ng, S. W. J. b. (2016). Beverage purchases from stores in Mexico under the excise tax on sugar sweetened beverages: observational study. *352*.

Colchero, M. A., Salgado, J. C., Unar-Munguía, M., Hernández-Ávila, M., & Rivera-Dommarco, J. A. (2015). Price elasticity of the demand for sugar sweetened beverages and soft drinks in Mexico. *Economics & Human Biology*, *19*, 129-137.

Essman, M., Taillie, L. S., Frank, T., Ng, S. W., Popkin, B. M., & Swart, E. C. (2021). Taxed and untaxed beverage intake by South African young adults after a national sugar-sweetened beverage tax: A before-and-after study. *PLoS medicine*, *18*(5), e1003574.

Eykelenboom, M., Van Stralen, M. M., Olthof, M. R., Renders, C. M., & Steenhuis, I. H. (2021). Public acceptability of a sugar-sweetened beverage tax and its associated factors in the Netherlands. *Public health nutrition*, *24*(8), 2354-2364.

Ferretti, F., & Mariani, M. (2019). Sugar-sweetened beverage affordability and the prevalence of overweight and obesity in a cross section of countries. *Globalization and health*, *15*, 1-14.

Foreit, K. G., & Foreit, J. R. (2004). Willingness to pay surveys for setting prices for reproductive health products and services a user's manual.

Guerrero-López, C. M., Unar-Munguía, M., & Colchero, M. A. (2017). Price elasticity of the demand for soft drinks, other sugar-sweetened beverages and energy dense food in Chile. *BMC public health*, *17*(1), 1-8.
Haase, L., Green, E., & Murphy, C. (2011). Males and females show differential brain activation to taste when hungry and sated in gustatory and reward areas. *Appetite*, *57*(2), 421-434.
Hattersley, L., & Mandeville, K. L. (2023). Global coverage and design of sugar-sweetened beverage taxes. *JAMA Network Open*, *6*(3), e231412-e231412.
Hess, J. M., Lilo, E. A., Cruz, T. H., & Davis, S. M. (2019). Perceptions of water and sugar-sweetened beverage consumption habits among teens, parents and teachers in the rural south-western USA. *Public health nutrition*, *22*(8), 1376-1387.
Imoisili, O. E., Park, S., Lundeen, E. A., Yaroch, A. L., & Blanck, H. M. (2020). Daily adolescent sugar-sweetened beverage intake is associated with select adolescent, not parent, attitudes about limiting sugary drink and junk food intake. *American Journal of Health Promotion*, *34*(1), 76-82.
Islentyeva, A., & Zimmermann, E. (2023). "Tall, Dark and Tasty": Masculinity in Food and Beverage Advertising. *Zeitschrift für Anglistik und Amerikanistik*, *71*(3), 265-292.
Klose, T. (1999). The contingent valuation method in health care. *Health policy*, *47*(2), 97-123.
Ko, G., So, W., Chow, C., Wong, P., Tong, S., Hui, S., Kwok, R., Chan, A., Chan, C., & Chan, J. (2010). Risk associations of obesity with sugar-sweetened beverages and lifestyle factors in Chinese: the 'Better Health for Better Hong Kong'health promotion campaign. *European Journal of Clinical Nutrition*, *64*(12), 1386-1392.
Lara-Castor, L., Micha, R., Cudhea, F., Miller, V., Shi, P., Zhang, J., Sharib, J. R., Erndt-Marino, J., Cash, S. B., & Mozaffarian, D. (2023). Sugar-sweetened beverage intakes among adults between 1990 and 2018 in 185 countries. *Nature communications*, *14*(1), 5957.
Manyema, M., Veerman, L. J., Tugendhaft, A., Labadarios, D., & Hofman, K. J. (2016). Modelling the potential impact of a sugar-sweetened beverage tax on stroke mortality, costs and health-adjusted life years in South Africa. *BMC public health*, *16*, 1-10.
Mis, N. F., Braegger, C., Bronsky, J., Campoy, C., Domellöf, M., Embleton, N. D., Hojsak, I., Hulst, J., Indrio, F., & Lapillonne, A. (2017). Sugar in infants, children and adolescents: a position paper of the European society for paediatric gastroenterology, hepatology and nutrition committee on nutrition. *Journal of pediatric gastroenterology and nutrition*, *65*(6), 681-696.
Ndiaye, K., Silk, K. J., Anderson, J., Horstman, H. K., Carpenter, A., Hurley, A., & Proulx, J. (2013). Using an ecological framework to understand parent–child communication about nutritional decision-making and behavior. *Journal of Applied Communication Research*, *41*(3), 253-274.
Ogden, C. L., Kit, B. K., Carroll, M. D., & Park, S. (2011). Consumption of sugar drinks in the United States, 2005-2008.
Oremus, M., Tarride, J.-E., Raina, P., Thabane, L., Foster, G., Goldsmith, C. H., & Clayton, N. J. P. (2012). The general public's willingness to pay for tax increases to

support unrestricted access to an Alzheimer's disease medication. *30*(11), 1085-1095.
Shamah-Levy, T., Romero-Martínez, M., Cuevas-Nasu, L., Méndez Gómez-Humaran, I., Antonio Avila-Arcos, M., & Rivera-Dommarco, J. A. (2019). The Mexican national health and nutrition survey as a basis for public policy planning: Overweight and obesity. *Nutrients*, *11*(8), 1727.
Tappy, L., & Lê, K.-A. (2010). Metabolic effects of fructose and the worldwide increase in obesity. *Physiological reviews*.
Te Morenga, L., Mallard, S., & Mann, J. J. B. (2013). Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. *346*.
Te Morenga, L. A., Howatson, A. J., Jones, R. M., & Mann, J. J. T. A. j. o. c. n. (2014). Dietary sugars and cardiometabolic risk: systematic review and meta-analyses of randomized controlled trials of the effects on blood pressure and lipids. *100*(1), 65-79.
Thow, A. M., Rippin, H. L., Mulcahy, G., Duffey, K., & Wickramasinghe, K. (2022). Sugar-sweetened beverage taxes in Europe: learning for the future. *European Journal of Public Health*, *32*(2), 273-280.
Vargas-Garcia, E., Evans, C., Prestwich, A., Sykes-Muskett, B., Hooson, J., & Cade, J. (2017). Interventions to reduce consumption of sugar-sweetened beverages or increase water intake: evidence from a systematic review and meta-analysis. *Obesity Reviews*, *18*(11), 1350-1363.
Wang, J., Yeoh, E. K., Yung, T. K. C., Wong, M. C. S., Dong, D., Chen, X., Chan, M. K. Y., Wong, E. L. Y., Wu, Y., & Guo, Z. (2021). Change in eating habits and physical activities before and during the COVID-19 pandemic in Hong Kong: a cross-sectional study via random telephone survey. *Journal of the International Society of Sports Nutrition*, *18*(1), 33.