

# Cross-sectional analysis of soft drinks consumption patterns post-taxation in Saudi Arabia

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## Abstract

**Background:** Sweetened soft drinks consumption contributes to the increasing prevalence of obesity in Saudi Arabia. In 2017, Saudi Arabia began imposing tax on sugar-sweetened drinks to combat obesity.

**Aim:** To investigate the determinants of soft drinks consumption patterns among adults in Saudi Arabia 5 years after consumer tax implementation.

**Methods:** This cross-sectional study was conducted among 1935 adults in Saudi Arabia, aged 20–60 years, predominantly female (80.4%). Data were collected using an online questionnaire that focused on the sociodemographic and anthropometric characteristics and consumption patterns of participants, as well as their attitudes towards soft drink consumption. Spearman's correlation and principal component analysis were used to evaluate the factors influencing soft drink consumption. Statistical significance was set at  $P < 0.05$ .

**Results:** A significant majority of the participants (82.9%,  $n = 1605$ ) reported consuming sweetened soft drinks 1–3 times per month. Habitual consumption was the most cited reason (27.1%), followed by consumption at social gatherings (12.9%) and while eating at restaurants (12.4%). Advertising was the least (7.1%) consumption influencing factor. Correlation analysis revealed that availability (0.358,  $P < 0.05$ ), social gatherings (0.357,  $P < 0.05$ ) and affordability (0.336,  $P < 0.05$ ) were significantly associated with consumption frequency.

**Conclusion:** Despite increased taxes on soft drinks in Saudi Arabia, consumption remains largely habitual among adults. The minimal impact of advertising and normalized price perceptions suggest that alternative strategies are required to effectively reduce soft drink consumption among this population.

Keywords: sugar-sweetened soft drinks, taxation, habitual consumption, behaviour, attitude, obesity, Saudi Arabia

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## Introduction

Consumption of soft drinks has contributed to the increased prevalence of obesity in Saudi Arabia (1–4). Soft drinks are considered unhealthy from a nutritional perspective due to their high energy density and lack of essential nutrients, which can lead to an energy imbalance that potentially contributes to obesity (5). In Saudi Arabia, the overall prevalence of obesity is estimated to be around 35%, with a higher prevalence among women (6). An analysis conducted across 75 countries found a positive association between soft drink consumption and being overweight/obese among adults. Specifically, a 1% increase in consumption corresponded with a 4.8% increase in the number of overweight individuals and a 2.3% increase in those categorized as obese (7).

It is widely recognized that food selection and consumption are complex individual choices influenced

by various determinants, such as culture, socioeconomic factors, health values and attitudes (8, 9). Factors such as sensory appeal, familiarity, habits, social interactions, cost, availability, time constraints, personal attitudes, media influence and health perceptions play significant roles in influencing food choices (8, 10, 11). These components interact in complex ways to shape dietary behaviour and affect individuals' choices in different contexts. To better understand the local context, this study explored several of these factors, such as availability, affordability, advertising, social gatherings and personal habits, as they applied to the Saudi adult population. These factors were chosen based on their frequent citation in regional dietary behavioural studies and their perceived impact on consumption patterns (3, 12, 13). Armstrong and Waters (14) emphasized that a detailed understanding of the importance of influential factors was necessary

to develop interventions and prioritize those with the potential to improve outcomes.

Factors affecting food choices include sensory appeal, familiarity and habit, social interactions, cost, availability, time constraints, personal attitudes, media and advertising, and health perceptions (8, 10, 11). However, the importance of these factors can vary between different countries due to the strong sociocultural role of food (15).

In 2017, Saudi Arabia began implementing the world's highest tax on sugar-sweetened drinks to combat obesity, increasing prices of soft drinks and energy drinks by 50% and 100%, respectively (16). This policy, part of a broader initiative within the Gulf Cooperation Council countries, aimed to reduce sugar-sweetened drink consumption. Stakeholder interviews after implementation indicated that the tax was administratively feasible and targeted the more harmful energy drinks (16).

The effectiveness of the policy is supported by regional trends, where similar tax implementation led to a decrease in soft drink sales, indicating a positive public health impact (17). Evaluation of the factors influencing consumption after taxation could provide insights into the efficacy of such measures and suggest further avenues for public health policy and educational campaigns. Therefore, a comprehensive investigation of the context in which a particular food choice is made is essential, as the factors influencing these choices in Saudi Arabia may provide unique insights into effective strategies for reducing sweetened soft drink consumption and associated health risks.

This study investigated the factors influencing the consumption of sweetened soft drinks among Saudi adults. Specifically, the authors hypothesized that behavioural factors are associated with the consumption of sweetened soft drinks in this population. We used principal component analysis as a dimension reduction technique to: (1) assess sweetened soft drink consumption patterns among Saudi adults; (2) identify the factors influencing sweetened soft drink consumption; (3) explore the relationship between sweetened soft drink consumption patterns and various factors; and (4) provide an in-depth exploration of how these factors are inter-related.

## Methods

### Study design and population

This was a cross-sectional study of adults aged 20–60 years in Saudi Arabia conducted between October 2022 and March 2023. The cross-sectional design was chosen because of its effectiveness in capturing a snapshot of sweetened soft drink consumption patterns within a specific timeframe. The sample size was determined to ensure a 95% confidence interval, accounting for a design effect of 1. The proportion of individuals with good knowledge and practice was estimated at 50% ( $p$  in the sample size formula), to provide a conservative estimate. The population size, > 10 000, was considered in the

calculation, in which the sample size remains relatively stable for large populations. To accommodate potential data loss or incomplete responses, an additional 10% was added, resulting in a sample size of approximately 422. However, the actual number of participants collected was 1935, significantly exceeding the calculated requirement. This larger sample size strengthened the study by enhancing the statistical power and reliability of the results. However, the study only included individuals who had access to social media platforms, which could limit generalization of the findings to the broader population.

### Data collection

Data collection was performed using a validated questionnaire distributed online via social media platforms (Twitter and WhatsApp), using a snowball sampling technique. To mitigate the potential bias inherent in snowball sampling, efforts were made to initiate the survey distribution among diverse socioeconomic groups across various regions of Saudi Arabia. The questionnaire was previously validated and tested for reliability (3, 12) and included 3 sections: (1) sociodemographic and anthropometric characteristics, including age, monthly income, education level and family structure; (2) patterns of sweetened soft drink consumption, including: frequency [never, rarely (1–3 times/month), usually (3–6 times a week) and daily]; quantity (<1, 1, 2 and > 2 cans); and type of sweetened soft drink consumed. A can was defined as 330 ml, which is the standard volume for a soft drink; (3) eight questions were related to factors influencing sweetened soft drink consumption (advertising, availability, affordability, habit, social gathering, eating out, eating at home and TV/electronic device use), with 5 possible responses (strongly agree, agree, neutral, disagree and strongly disagree).

### Statistical analysis

The analytic plan, including methods and tests to be conducted, was specified before data analysis. The research hypothesis was explicitly specified prior to the initiation of data collection to ensure objective evaluation and interpretation. The statistical analysis was performed using SPSS version 20.0. Categorical data were presented as numbers and percentages.  $P < 0.05$  was considered significant. Spearman correlation was conducted to determine the factors influencing sweetened soft drink consumption. The Kaiser-Meyer-Olkin test and Bartlett's test of sphericity were conducted to assess the suitability of the data for principal component analysis to examine factors influencing sweetened soft drink consumption. A sample was deemed adequate for subsequent factor analysis if the Kaiser-Meyer-Olkin test was > 0.6 and test of sphericity level of significance was  $\alpha < 0.05$  (18). An orthogonal rotation (varimax) was used in the principal component analysis to facilitate interpretation of factors by maximizing the variance of loadings within each factor.

## Ethics approval

The Institutional Review Board at Princess Nourah bint Abdulrahman University granted an exemption (#HAP-01-R-059) from review, because the study posed minimal risk to participants. Consent from all participants was obtained through their affirmative action of clicking an "I agree" button on the questionnaire.

## Results

### Sociodemographics and patterns of sweetened soft drinks consumption

The participants were divided by age into 4 categories, with the largest group being 20–29 years, comprising

**Table 1 Sociodemographic characteristics and patterns of sweetened soft drinks consumption (n = 1935)**

Characteristics	No.	%
<b>Age (years)</b>		
20–29	759	39.2
30–39	607	31.4
40–49	316	16.3
50–59	253	13.1
<b>Gender</b>		
Male	380	19.6
Female	1555	80.4
<b>Marital status</b>		
Never married	750	38.8
Married	1072	55.4
Divorced	85	4.4
Widowed	28	1.4
<b>Education level</b>		
Primary school	9	0.5
Secondary school	250	12.9
University degree	1356	70.1
Higher studies (master's or PhD)	320	16.5
<b>Monthly income, SAR</b>		
<5000	820	42.4
5000–10 000	424	21.9
11 000–20 000	413	21.3
>20 000	278	14.4
<b>Frequency</b>		
Never	330	17.1
Rarely (1–3 times/month)	742	38.3
Sometimes (1–2 times/week)	458	23.7
Usually (3–6 times/week)	260	13.4
Daily	145	7.5
<b>Quantity</b>		
<1 can	1007	52.0
1 can	797	41.2
2 cans	95	4.9
>2 cans	36	1.9

39.2% of the total (Table 1). The majority of the sample was female, accounting for 80.4% (n = 1555) of the participants. Most participants were highly educated: 70.1% held a university degree and 16.5% had completed higher studies. This over-representation of females and educated participants should be considered when interpreting the results, as it may not fully reflect the distribution of the wider Saudi population. In terms of income, 42.4% of the participants earned < 5000 SAR per month, while the remainder were distributed evenly across the other income brackets. Most participants reported consuming sweetened soft drinks rarely (1–3 times per month), typically consuming < 1 can per session.

### Factors influencing sweetened soft drinks consumption

Table 2 outlines the factors influencing sweetened soft drink consumption. Participants reported that the most common reasons for consuming sweetened soft drinks were habit (n = 525, 27.1%), social gatherings (n = 250, 12.9%) and eating out (n = 240, 12.4%). Advertising was reported as the least influential factor (n = 137, 7.1%). These findings should be viewed with the understanding that the sample predominantly consisted of young, educated females, which may have influenced the reported consumption patterns and associated factors.

### Factors associated with sweetened soft drinks consumption

All factors were significantly correlated with the frequency of sweetened soft drink consumption, with weak correlation coefficients ranging from 0.212 to 0.358 (Table 3). The factor that had the highest correlation was availability (0.358), followed by social gatherings (0.357) and affordability (0.336). These correlations, while significant, reflected the attitudes and behaviours of the specific demographics and may not be generalized to all Saudi adults. The factors influencing sweetened soft drink consumption were correlated with each other, with the sole exception being that eating at home did not show a significant correlation with either habit or eating out. Given the cross-sectional nature of this study, these findings should be interpreted with caution. The associations observed do not imply causation and were limited to the time and context of the study, and potentially influenced by uncontrolled confounding variables.

Figure 1 illustrates the component plot in rotated space with the factors influencing sweetened soft drink consumption. The act items (component 1) were advertising, availability, affordability, habit, social gathering and eating out. There were only 2 flow items (component 2): eating at home and TV/electronic device use (Kaiser-Meyer-Olkin test = 0.82,  $P < .001$ ).

## Discussion

The study participants were young to middle-aged adults, with more than two-thirds aged 20–39 years,

**Table 2 Factors influencing soft drinks consumption (n = 1935)**

Factors influencing consumption	Strongly disagree		Disagree		Neutral		Agree		Strongly agree	
	No.	%	No.	%	No.	%	No.	%	No.	%
Social gathering	229	11.8	265	13.7	493	25.5	698	36.1	250	12.9
Availability	241	12.5	252	13.0	574	29.7	639	33.0	229	11.8
Affordability	261	13.5	319	16.5	530	27.4	655	33.9	170	8.8
Advertising	497	25.7	421	21.8	531	27.4	349	18.0	137	7.1
Habit	325	16.8	249	12.9	299	15.5	613	31.7	449	23.2
Eating out	155	8.0	192	9.9	343	17.7	720	37.2	525	27.1
Eating at home	329	17.0	472	24.4	405	20.9	489	25.3	240	12.4
TV watching/using electronic devices	405	20.9	449	23.2	439	22.7	465	24.0	177	9.1

**Table 3 Correlations between frequency of sweetened soft drinks consumption and associated factors (n = 1935)**

	1	2	3	4	5	6	7	8	9
1. Frequency of consumption	1.000								
2. Social gathering	0.357*	1.000							
3. Availability	0.358*	0.567*	1.000						
4. Affordability	0.336*	0.407*	0.544*	1.000					
5. Advertising	0.212*	0.336*	0.405*	0.441*	1.000				
6. Habit	0.295*	0.437*	0.520*	0.423*	0.465*	1.000			
7. Eating out	0.347*	0.482*	0.473*	0.367*	0.330*	0.576*	1.000		
8. Eating at home	0.280*	0.127*	0.155*	0.186*	0.149*	0.012	0.027	1.000	
9. TV/electronic device use	0.267*	0.257*	0.269*	0.277*	0.344*	0.247*	0.247*	0.506*	1.000

\*Statistically significant at  $P \leq 0.05$ .

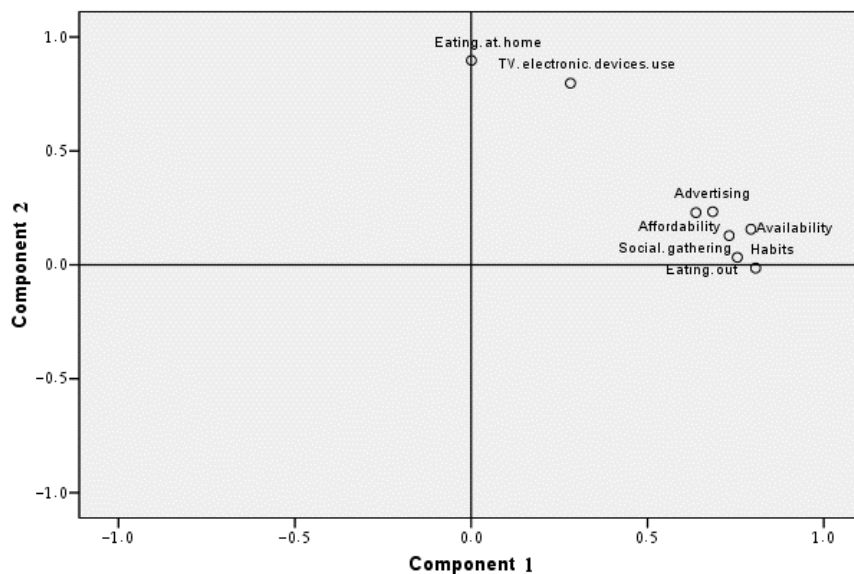
largely female, well-educated but not financially affluent. Most participants reported consuming sweetened soft drinks 1–3 times per month, typically consuming < 1 can each time. Historically, Saudi Arabian males consume dietary sugars at a higher rate than females, but for sugary drinks, their consumption patterns are similar (19). In the United States of America, males consume sugary drinks at significantly higher rates than females, while ethnic groups and lower-income individuals consume sugary drinks at higher rates than Caucasians and middle- to upper-income individuals (20). These trends are consistent with recent European data (21). However, it is important to note that our findings may not fully represent the Saudi population because of over-representation of young, educated females in our sample.

Our study replicated that of Benajiba and Mahboub (3), which was conducted before the taxation was implemented; therefore, it provides a post-taxation perspective 5 years after enactment of the policy. Habitual behaviour was the most common reason given for sweetened soft drink consumption. This is consistent with similar studies conducted in Saudi Arabia (22), the United Kingdom of Great Britain and Northern Ireland (23), and North America(24), where habits were cited as a main or primary reason for sweetened soft drink consumption. Despite or potentially because of 5 years of increased taxation on soft drinks, consumption was

largely driven by habit. What was unclear in our study was how taxation changes affected consumption (via altering habitual behaviour) annually over this period. Social gatherings and eating out were correlated with sweetened soft drink consumption. These findings may have been influenced by the demographic profile, especially the high percentage of young females, who may have particular social and consumption habits compared with the general population.

When comparing the influences of sweetened soft drink consumption patterns and trends, our post-taxation findings resonate with the pre-taxation study of Benajiba and Mahboub (3) in identifying habitual behaviour as a significant driver. However, we noted the persistence of these habits even after taxation implementation, suggesting the limited impact of fiscal measures on changing entrenched behaviours.

The participants in our study believed that advertising had the least influence on sweetened soft drink consumption behaviour. This suggests that pro-consumption advertisements by manufacturers and distributors promoting consumption of soft drinks are not a strong predictor of consumption behaviour. This also suggests that public health communication strategies designed to reduce sweetened soft drink consumption may equally be less effective when

**Figure 1** Component plot in rotated space of factors influencing sweetened soft drinks consumption

compared to individual habits, socializing behaviours and eating out. This observation should be further explored in a more demographically diverse sample to confirm if these trends hold across different segments of the Saudi population.

This may also be true for the costs associated with sweetened soft drink consumption following 5 years of increased taxation (25, 26). Costs were reported as the factor with the second-lowest influence over consumption behaviour. This is supported by a recent study in Madinah, Saudi Arabia that showed that soft drink taxation reduced consumption and had a positive influence on overall health, such as reduced risk of obesity and improved lifestyle and quality of life (27).

The frequency of sweetened soft drink consumption appeared to be affected by the availability of these products in the home and while eating out. Although there may have been an impact on availability shortly after the taxation came into effect, there was no indication 5 years later that sweetened soft drinks were more difficult to obtain inside or outside the home. This was compounded by social gatherings, where there was an expectation that sweetened soft drinks would be available.

In contrast to the original intent of the taxation policy, the perceived affordability of sweetened soft drinks was correlated with consumption. This suggests that, after 5 years of uninterrupted taxation increases, consumption patterns were not greatly affected from a public health perspective. As a variable, affordability was not significantly correlated with any other variable in our study than availability. Strong intervariable correlations with consumption included availability, social gatherings, eating out and habit.

One strength of this study was the large number of participants (1935), which enhanced the statistical power and representativeness of the findings. The study replicated a study published prior to taxation

implementation (3) and used the same previously validated and reliability-tested tool (12). This replication enhanced the robustness of the comparative analysis after tax implementation. The main limitation of the study relates to its nonprobability sampling technique. Although we attempted to overcome this bias by initiating sampling from diverse starting points across different socioeconomic segments, the sample was homogeneously skewed, particularly in terms of gender and level of education. However, it should be noted that this imbalance is common in online surveys as previous studies have reported that women tend to participate more in online questionnaires (28). Another potential limitation was the self-reported nature of the questionnaire, which carried a risk of bias caused by possible under-reporting or inaccurate recall of consumption (29). The potential influence of uncontrolled confounding variables may have affected the validity of the correlations observed between consumption patterns and influencing factors. The study did not incorporate qualitative methods or triangulation of results, which may have provided deeper insights into the inter-relationships among the factors influencing consumption. The results of this study should be interpreted with caution with regard to generalization but they do provide specific insights into the studied demographic population.

## Conclusion

Sweetened soft drink consumption continues to be a public health concern in Saudi Arabia. Increased taxation was intended to reduce consumption among habitual consumers and prevent new habits from forming. Five years after a soft drink tax increase, consumption was still fundamentally determined by habit. The findings suggest that the impact of taxation on altering consumption habits was limited, especially in the context of the specific demographic characteristics of our sample. This current

trend may have been due to normalization of current soft drink prices, where the increase was perceived as substantial 5 years ago but more accepted today. Factors such as availability in the home and social settings, rather than advertising, more strongly influenced consumption. To counter these entrenched habits effectively, it is crucial to develop innovative public health campaigns, re-evaluate pricing strategies and encourage healthier alternatives in various social contexts. Future research should focus on longitudinal methods to observe changes in behaviour over time, qualitative studies to explore the reasons behind sweetened soft drink consumption, and economic analyses to evaluate the effects of taxation.

The influence of demographic variables on consumption patterns should be further investigated to tailor public health interventions more effectively. Finally, research involving representative samples is needed to ensure the generalizability of the findings and to inform more effective public health strategies.

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**Competing interests:** None declared.

## Analyse transversale des tendances de consommation des boissons sucrées après taxation en Arabie saoudite

### Résumé

**Contexte:** La consommation des boissons sucrées contribue à l'augmentation de la prévalence de l'obésité en Arabie saoudite. En 2017, le pays a entrepris d'appliquer une taxe sur ces produits afin de lutter contre cette affection.

**Objectif:** Étudier les facteurs déterminant les tendances de la consommation de boissons sucrées chez les adultes en Arabie saoudite, cinq ans après la mise en place de la taxe à la consommation.

**Méthodes:** La présente étude transversale a été réalisée en Arabie saoudite auprès de 1935 adultes âgés de 20 à 60 ans, majoritairement des femmes (80,4 %). Les données ont été recueillies à l'aide d'un questionnaire en ligne portant sur les caractéristiques sociodémographiques et anthropométriques et les habitudes de consommation des participants, ainsi que sur leurs attitudes à l'égard de la consommation de ce type de boissons. La corrélation de Spearman et l'analyse des composantes principales ont été utilisées dans le but d'évaluer les facteurs influençant la consommation des boissons sucrées. La signification statistique a été fixée à  $p < 0,05$ .

**Résultats:** Une majorité importante des participants (82,9 %,  $n = 1605$ ) ont déclaré consommer des boissons sucrées une à trois fois par mois. La consommation par habitude était la raison la plus citée (27,1 %), suivie par la consommation lors de rassemblements sociaux (12,9 %) et lors de repas au restaurant (12,4 %). La publicité était le facteur ayant le moins d'influence sur la consommation (7,1 %). L'analyse de corrélation a révélé que la disponibilité (0,358,  $p < 0,05$ ), les rassemblements sociaux (0,357,  $p < 0,05$ ) et l'accessibilité économique (0,336,  $p < 0,05$ ) étaient fortement associés à la fréquence de consommation.

**Conclusion:** Malgré l'augmentation des taxes sur les boissons sucrées en Arabie saoudite, la consommation reste largement répandue chez les adultes. L'impact minimal de la publicité et la perception normalisée des prix suggèrent que d'autres stratégies sont nécessaires afin de réduire efficacement la consommation de ce type de boissons au sein de cette population.

### تحليل مقطعي لأنماط استهلاك المشروبات الغازية في المملكة العربية السعودية بعد فرض الضرائب عليها

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### الخلاصة

**الخلفية:** يسهم استهلاك المشروبات الغازية المحلاة في زيادة انتشار السمنة في المملكة العربية السعودية. وفي عام 2017، بدأت المملكة فرض ضريبة على المشروبات المحلاة بالسكر لمكافحة السمنة.

**الهدف:** هدفت هذه الدراسة الى بحث محددات أنماط استهلاك المشروبات الغازية بين البالغين في المملكة العربية السعودية بعد 5 سنوات من فرض ضريبة على سعر البيع للمستهلك.

**طرق البحث:** أُجريت هذه الدراسة المقطعية على 1935 بالغاً في المملكة العربية السعودية تراوحت أعمارهم بين 20 و60 عاماً، وأغلبهم من الإناث (80,4%). وُجمعت البيانات باستخدام استبيان إلكتروني ركز على السمات الاجتماعية السكانية والسمات الأنثروبومترية للمشاركين، وأنماط استهلاكهم، فضلاً عن مواقفهم من تناول المشروبات الغازية. واستُخدم تحليل ارتباط سبيرمان وتحليل المكونات الرئيسية لتقييم العوامل التي تؤثر في استهلاك المشروبات الغازية. وحُدِدت الدلالة الإحصائية بأن يكون الاحتمال أقل من 0.05.

**النتائج:** أفادت الغالبية العظمى من المشاركين (82.9%، العدد = 1605) بتناول المشروبات الغازية المحلاة مرة واحدة إلى 3 مرات شهرياً (38%). وكان السبب الذي ذكره أكثر المشاركين هو اعتياد تناولها (27.1%)، يليه تناولها في المناسبات الاجتماعية (12.9%)، ثم تناولها في أثناء تناول الطعام في المطاعم (12.4%). وكانت الإعلانات أقل عامل مؤثر في الاستهلاك (7.1%). وكشف تحليل الارتباط أن عوامل التوفر (0.358)، الاحتمال أقل من (0.05) وحضور المناسبات الاجتماعية (0.357)، الاحتمال أقل من (0.05) والقدرة على تحمّل تكلفة المنتج (0.336)، الاحتمال أقل من (0.05) ارتبطت ارتباطاً كبيراً بتواتر الاستهلاك.

**الاستنتاجات:** على الرغم من زيادة الضرائب المفروضة على المشروبات الغازية في المملكة العربية السعودية، لا يزال الاعتياد هو سبب الاستهلاك السائد بين البالغين. ولم يكن للإعلانات إلا أثر بسيط جداً واعتاد المستهلكون على الأسعار، وهذا يشير إلى الحاجة إلى اتباع استراتيجيات بديلة للحد بفاعلية من تناول المشروبات الغازية بين هذه الفئة من السكان.

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