ORIGINAL ARTICLE

Taxing Sugar-Sweetened Beverages and Its Impact on Children's Consumption: A Cross-Sectional Study among a Group of Children in Jeddah City

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Abstract

Sugar-sweetened beverages (SSBs) are beverages with added sugars; they include, but are not limited to, soft drinks, fruit juices and drinks, and flavored milk. In 2019, the General Authority of Zakat and Tax announced the application of a 50% excise tax on SSBs in Saudi Arabia. This study aims to evaluate the consumption of sugar-sweetened beverages and the effect of taxing consumption patterns among a group of 6- to 11-year-old children attending King Abdulaziz University Faculty of Dental Hospital (KAUFD) Clinics in Jeddah, Saudi Arabia. This cross-sectional study involved randomly selected parents of 6- to 11-year-old children attending KAUFD for dental treatment. It used a validated Arabic questionnaire, and 128 parents were included. The most common source of SSBs is fruit juices and drinks; 46 (35.9%) participants reported that their children switched to untaxed drinks after taxing. Significantly more children from families with low monthly family income switched to an untaxed product compared to families with high monthly family income (P-value of 0.023). The consumption of sugar-sweetened beverages is relatively high among children in the KAUFD, and fruit juices and drinks are the most commonly consumed SSBs. The effect of tax implementation is more noticeable in the consumption pattern of children from families with low monthly income.

Keywords

Beverages; Flavored milk; Juices; Soft drinks; Sugar; Taxing

Introduction

Non-alcoholic beverages, including sugar-sweetened beverages (SSBs), are the main sources of free sugar among 4-10-year-old children[1]. Sugar-sweetened beverages are sweetened beverages with different forms of added sugars; they include, but are not limited to, soft drinks, fruit juices and drinks, flavored milks, sports drinks, energy drinks, sweetened water, coffee, and tea beverages with added sugars[2]. They have been found to be associated with different health problems such as obesity, type II diabetes, heart disease, liver disease, and dental caries[3].

Dental caries is the most common chronic disease in children worldwide[4]. It is caused by interactions between a susceptible host, cariogenic bacteria, and cariogenic diets[5]. Sugar and cariogenic diets have been reported to be significantly associated with the development of dental caries[6,7]. Therefore, the World Health Organization (WHO) recommends that sugar intake not exceed 10% of total energy intake and should ideally be no more than 5% of total energy intake.[8]

Research has shown that tax implementation on SSBs can be an effective approach to reduce the consumption of sugar and obesity in children[9,10]. In the United States, a study examined the impact of small taxes on soft drinks and children's body mass index. It found a greater impact of tax on the population level, with a more noticeable effect in population subgroups at a higher risk of obesity[10]. A recent study in Mexico reported that the implementation of tax on SSBs resulted in a decrease in the consumption of taxed beverages by 5.5% in the first year and 9.7% in the second[11].

Previous studies on the long-term effects of tax implementation on SSBs have shown that it may substantially improve children's general and oral health.[10-13] In Germany, a reduction in caries development among young low-income males was reported after the implementation of a 20% tax on SSBs after 10 years[12]. Recently, a cost-effectiveness analysis study was conducted in the Netherlands; it reported that the implementation of a 20% tax on SSBs would prevent caries lesion development by 0.55% compared with the current situation. This study found the prevention of 1.03 caries lesions on a population level and 2.13 caries-free teeth yearly on an individual level[13].

In 2019, the General Authority of Zakat and Tax (GAZT) announced the application of a 50% excise tax on all types of SSBs[14]. This is considered the second increase in the tax implemented on SSBs. The first increase in the price of some SSBs, including soft drinks and energy drinks, was in 2017 by 50%, which is considered the largest tax implemented on SSBs worldwide. Therefore, this study aims to evaluate current SSBs consumption and the effect of tax implementation on the consumption pattern among a group of 6-11 year-old children attending the King Abdulaziz University Faculty of Dentistry (KAUFD) Clinics in Jeddah, Saudi Arabia. It also aims to assess parental knowledge and attitudes toward the impact of SSBs consumption on caries development. We hypothesized that tax implementation on SSBs would decrease consumption among a group of 6-11 year-old children attending King Abdulaziz University Faculty of Dentistry clinics in Jeddah, Saudi Arabia.

Material and Methods

This cross-sectional quantitative study used a validated Arabic questionnaire. This study was conducted at King Abdulaziz University Faculty of Dentistry clinics (KAUFD) in the Pediatric Dentistry Department between December 2019 and March 2020. The study protocol was approved by the Research Ethics Committee of King Abdulaziz University (34-12-19).

The study included parents of healthy 6-11 year-old children seeking dental treatment at KAUFD. Medically compromised children or children on daily medication were excluded from the study.

Sample Size and Sampling Technique

Sample size calculation revealed that 113 participants were needed in this study, based on the hypothesis that the true difference in the percentage of parents who reported that tax has an impact on their children's consumption is $\delta=1$, with a standard deviation (SD). The probability power $\beta=0.90$, and the type I error probability associated with this test of the null hypothesis was $\alpha=0.05$[15].

The sample was selected randomly from newly screened patients in the electronic filing system of pediatric dentistry specialty clinics using the systematic random method. All newly eligible screened children are listed in alphabetical order. From the first ten

numbers, we randomly selected a starting point: 7. From number 7 onward, every tenth person on the list was selected (7, 17, 27, 37, etc.); we ended up with a sample of 150 children.

The parents/guardians of eligible children were contacted by phone and the research aim was introduced to them

Study Questionnaire

The study used an online Arabic questionnaire. The first part of the questionnaire included questions from a previously validated English oral health behavior questionnaire (OHBQ). The OHBQ includes questions about the participants' demographic data and history of previous dental pain[16]. Monthly family income was divided into three groups based on central statistics and information websites of Saudi Arabia[17]. High for families with a monthly family income of more than 10,000 Saudi Riyal (SAR), moderate for families with a monthly family income between 10,000 and 7,000 SAR, and low for families with a monthly family income of less than 7,000 SAR.

The second part included questions regarding children's daily consumption pattern of SSBs (soft drinks, fruit juices and drinks, and flavored milk) during weekdays and weekends and the impact of tax implementation on their consumption of SSBs. The consumption pattern was divided into three categories: more than three times a week, three times a week, twice a week, at least once daily, occasionally, rarely, and none. Parental knowledge and attitudes toward the effects of SSBs consumption on caries development were also evaluated.

Ten parents of children receiving dental treatment at the pediatric dentist at KAUFD were asked to read the questions and offer their opinions for face validity. Later, five expert pediatric consultants at KAUFD individually assessed the questions. After addressing all the changes based on face validity and expert opinions, five pediatric consultants at KAUFD individually assessed each question based on the clarity, simplicity, ambiguity of the questions, and relevance to the aim of the study on a four-point scale ranging from 1 to 4, where 1 = very important, 2 = important, 3 = moderately important, and 4 = not important. The validity of the questionnaire was evaluated by calculating the content validity index (CVI). Content validity was assessed in both languages, whereas face validity was assessed only for the Arabic version.

Statistical Analysis

The participants completed an online questionnaire, and the data were sorted using an Excel sheet. All the data were anonymized and saved on a password desktop. Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) (version 22.0 (SPSS Inc., Chicago, II, USA). Descriptive analyses reported the frequencies and percentages of the outcomes and independent variables. The associations between demographic variables, children's oral health, current consumption of SSBs, and the impact of taxation were analyzed using bivariate analysis, including Fisher's exact tests.

Results

The five chosen experts rated the item content of the data collection tool; further, agreement was recorded at 92.5% for the English Language questionnaire parts. For the Arabic version, the item content of the data collection tool and agreement were tested to record of 95.5% agreement.

Table 1. Demographic characteristics of the participants (N=128)

Characteristics	Number	Percentage (%)
Mother	93	72.7
Father	31	24.2
Other	4	3.1
Mother's Level of Education		
Primary	9	7
Secondary	39	30.5
University	61	47.7
Higher education	19	14.8
Father's Level of Education		
Not educated	10	7.9
Primary	9	7
Secondary	43	33.6
University	41	32.0
Higher education	25	19.5
Monthly Family Income		
High	53	41.4
Moderate	31	24.2
Low	44	34.4
Number of Children		
One	8	6.3
Two	20	15.6
Three	34	26.6
More than three	66	51.5
Child Lives with		
Mather and father	116	90.6
Mother only	12	9.4
Dental Pain		
Yes	96	75
No	32	25

A total of 128 participants out of the 150 selected and conteacted, agreed to answer the questionnaire through an online link and were included in the study. The response rate of participants was 85.33%. Almost half of the participants (41.4%) reported a high monthly family income. Table 1 lists the participants' demographic characteristics. Ninety-six (75%) participants reported that their children complained of dental pain at least once within the previous year.

Participant Children's Current Consumption Pattern of SSBs

Table 2 lists the consumption patterns of different SSBs among the participating children on weekdays and weekends. Seventy (54.68%) children consumed SSBs at least once a day during weekdays, while 49.2% of children consumed SSBs during weekends. Figure 1 demonstrates the percentage of children who consumed different types of SSBs (soft drinks, fruit juices and drinks, flavored milk) at least once a day on weekdays and weekends. The consumption of SSBs is considered relatively high; further, the most common source of SSBs among this group of children is fruit juices and drinks. Almost half of the participants reported the consumption of SSBs at least once or occasionally during the weekend.

Implementation of Tax on SSBs

When the effect of tax implementation on soft drinks was evaluated, 42.96% of participants claimed that their children either switched to untaxed products or to a smaller size can of the same soft drinks. Almost (25%) of the participants declared that the implementation of taxes on soft drinks had no impact on their children's consumption patterns. Figure 2 shows the effect of implementing tax on fruit juices and drinks on consumption patterns. Moreover, 32.81% of participants declared that the implementation of tax on diet (without sugar) soft drinks (e.g., diet Pepsi) influenced their children's consumption. Thirty-six (28.12%) participants reported that their children switched to untaxed products, while the remaining 4.65% switched to smaller-sized cans of the same diet soft drinks. Thirty-one (24.2%) participants mentioned that the tax implementation on diet soft drinks had no impact on their children's consumption pattern of diet soft drinks.

Table 3 shows the association of the impact of taxing fruit juices and drinks, which are the most common sources of SSBs among this group of children, with other independent variables. The effect of tax implementation is significantly associated with

Table 2. Participating children's consumption of sugar-sweetened beverages during the weekdays and the weekends (N=128)

Characteristics	Impact of Taxing Fruit Juices and Drinks					
	No Effect	Switched to Untaxed Products	Switched to Smaller Size drinks	I Don't Know	My Child Doesn't Drink Them	#*P*-value
	N(%)	*N*(%)	*N*(%)	*N*(%)	*N*(%)	
Mother's Level of Education						
Primary	1(2.7)	4(8.7)	0(0.0)	4(11.4)	0(0.0)	0.329
Secondary	5(16.2)	21(45.7)	3(50)	9(25.7)	0(0.0)	
University	18(48.6)	9(41.3)	1(16.7)	19(54.3)	4(100)	
Higher education	12(32.4)	2(4.3)	2(33.3)	3(8.6)	0(0.0)	
Monthly Family Income						
High	20(54.1)	13(28.3)	1(16.7)	15(42.9)	4(100)	***0.001**
Moderate	13(35.1)	11(23.9)	1(16.7)	6(17.1)	0(0.0)	
Low	4(10.8)	22(47.8)	4(66.7)	14(40)	0(0.0)	
Number of Children						
One or two	13(35.1)	7(15.2)	1(16.7)	5(14.3)	1(25)	0.152
Three or more	14(64.9)	39(84.8)	5(84.8)	30(85.7)	3(75)	
Child Lives with						
Mather and father	33(86.5)	42(91.3)	6(100)	33(94.3)	3(75)	0.494
Mother only	2(13.5)	4(8.7)	0(0.0)	2(5.7)	1(25)	
Dental Pain						
Yes	23(62.2)	38(82.6)	6(100)	27(77.1)	3(75)	0.154
No	14(37.8)	8(17.4)	0(0.0)	8(22.9)	1(25)	
SSBs Consumption Pattern						
Twice or more a day	4(10.8)	9(19.6)	2(33.3)	9(25.7)	1(25)	0.357
At least once a day	9(24.3)	14(30.4)	1(16.7)	8(22.9)	0(0.0)	
Occasionally	14(37.8)	13(28.3)	0(0.0)	8(22.9)	1(25)	
Rarely	10(27)	10(21.7)	3(50)	10(28)	2(50)	

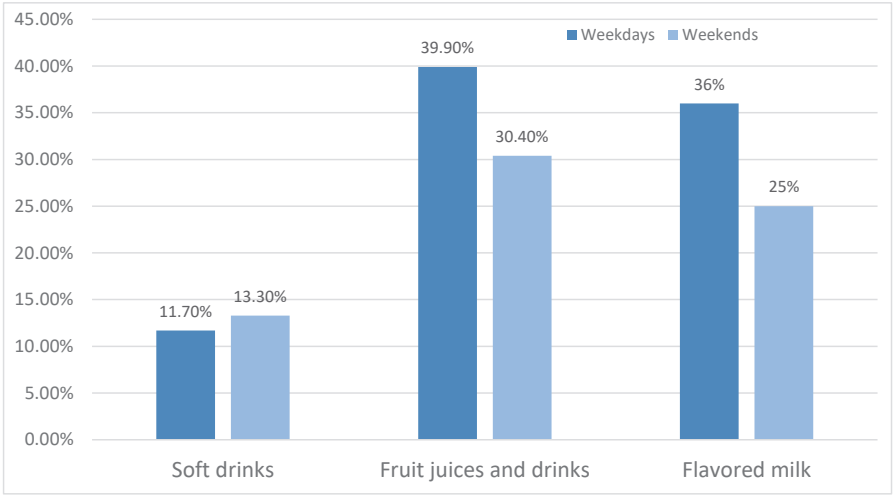

Figure 1. **Percentage of Participating children who consumed sugar-sweetened beverages (soft drinks, fruit juices and drinks, and flavored milk) at least once a day during weekdays and weekends (N=128).**

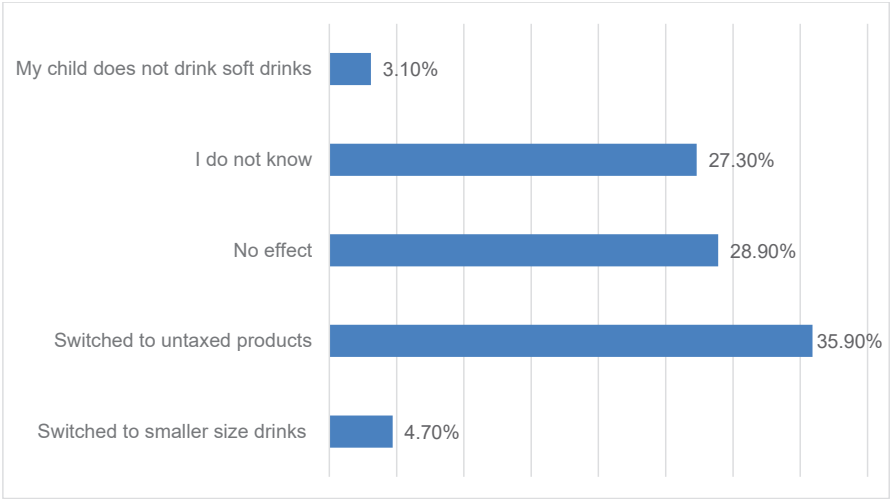

Figure 2. **Parents' response to the effect of tax implementation on fruit juices and soft drinks (N=128).**

Table 3. **Bivariate analysis of independent variables and the impact of taxing on sugar-sweetened beverages (N=128)**

Consumption Frequency	During the Weekdays				During the Weekends			
	SSBs *N* (%)	Soft Drinks *N* (%)	Fruit Juices and Drinks *N* (%)	Flavored Milk *N* (%)	SSBs *N* (%)	Soft Drinks *N* (%)	Fruit Juices and Drinks *N* (%)	Flavored Milk *N* (%)
> three times	9(7)	3(2.3)	5(3.9)	6(4.7)	6(4.7)	1(0.8)	4(3.1)	5(3.9)
Three times	5(3.9)	0(0)	2(1.6)	2(1.6)	5(3.9)	3(2.3)	4(3.1)	4(3.1)
Twice	20(15.6)	5(3.9)	11(8.6)	10(7.8)	22(17.2)	5(3.9)	10(7.8)	6(4.7)
At least once daily	36(28.1)	7(5.5)	33(25.8)	28(21.9)	30(23.4)	8(6.3)	21(16.4)	17(13.3)
Occasionally	35(27.3)	25(19.5)	40(31.3)	30(23.4)	32(25)	31(24.2)	43(33.6)	31(24.2)
Rarely	20(15.6)	35(27.3)	20(15.6)	26(20.3)	30(23.4)	33(25.8)	35(27.3)	36(28.1)
None	3(2.3)	53(41.4)	17(13.3)	26(20.3)	3(2.3)	47(36.7)	11(8.6)	29(22.7)
Total	128(100)	128(100)	128(100)	128(100)	128(100)	128(100)	128(100)	128(100)

#Fisher's exact test;
**Significant level at *P-value < 0.05*
N=Total number of participants

family monthly average income. Significantly more children from families with low monthly family income switched to untaxed products compared to families with high monthly family income (*P*-value = 0.023). Of the families whose children consumed fruit juices and drinks occasionally or rarely, 24(64.8%) declared that taxing fruit juices and drinks had no effect on their purchase; however, the difference in the impact of taxing fruit juices and drinks among children with different consumption patterns was not statistically significant (*P*-value = 0.357).

Participant's Knowledge and Attitude Data

Ninety-eight participants (76.56%) were knowledgeable about the association between SSBs and dental caries in children. Moreover, 100 (78.12%) participants were aware of decreasing the amount and frequency of SSBs consumption, which would result in fewer dental caries.

Almost all participants (125 [97.65%]) agreed that soft drinks contain a high amount of sugar. One hundred and thirteen (88.28%) participants usually checked the nutrient labels of drinks before their children's consumption. Finally, 88 (68.7%) participants supported the implementation of taxes on SSBs.

Discussion

This cross-sectional study aims to evaluate the effect of SSB tax implementation on children's consumption patterns. Among the included groups of children, the consumption of SSBs was relatively high during weekdays and weekends; furthermore, the most common source of SSBs was fruit juices and drinks. After-tax implementation, almost half of the participants reported that their children either changed the old taxed fruit juices and drinks to untaxed products or replaced them with a smaller size can of the same drink.

In Saudi Arabia, the prevalence of dental caries in children is considered high; furthermore, SSBs are reported to be among the main sources of free sugar in children and adolescents[18,19]. In 2017, a 50% tax was applied to soft drinks and energy drinks in Saudi Arabia; these taxes were part of Saudi Arabia's Vision 2030 fiscal balance program.(20) Additionally, there was a 50% tax on SSBs that started in December 2019.(14) Furthermore, in response to the COVID-19 pandemic, the GAZT added tax on all goods and services from 5% to 15%, which started in July 2020[21].

Our study showed that fruit juices and drinks were among the major sources of SSBs in this group of children. Similarly, a cross-sectional national survey of 1700 children in England showed that the main source of free sugar among 4-10 year-old children was sugar-sweetened drinks and fruit juice[1]. This finding adds to the increasing body of evidence suggesting that high intake of SSBs is a significant risk factor for caries in modern societies[22]. The consumption of SSBs has increased significantly and has been associated with other child health issues such as obesity and diabetes, under a common risk factor approach[2,23].

Several studies have found that children with a low socioeconomic status consume a higher amount of sugar[24]. Our findings also showed that significantly more children from families with low monthly family incomes switched to untaxed products compared to families with high monthly family incomes. Lal et al[25]. predicted that the implementation of a 20% tax on SSBs will decrease the purchase and consumption of SSBs, especially among the two lowest quintiles in Australia, thus leading to healthcare expenditure savings across all SES quintiles of socioeconomic deprivation.

Our findings showed that the majority of participants were from families with high to middle monthly family income. In addition, most of the children had toothaches during the last year. This could be related to the high consumption of SSBs, as more than half of the children consume SSBs more than once daily, which is considered relatively high based on WHO guidelines. Additionally, this may be related to sample selection, as families were recruited from a dental hospital and their children were seeking dental treatment.

The results of this study showed that tax implementation could be an effective method to decrease the consumption of SSBs and, consequently, decrease the prevalence of dental caries among children. However, tax implementation had no impact on the consumption patterns of some children in this sample. This could be because parents did not notice that the price had changed, or because their children wanted to consume these products[26]. It could also be related to a family's socioeconomic level.

The WHO recommends that children reduce their free sugar consumption to less than 10% of their total energy intake[8]. The result showed that most participants reported that their children switched

to untaxed products, although these products may contain even more sugar. This finding provides implications for reassessment of the sugar content of all SSBs products available in the market and ensures that tax implementation is applied to all types of SSBs to aid in reducing children's sugar consumption.

In this study, most participants were knowledgeable about the relationship between dental caries and sugar consumption, and the importance of decreasing both the amount and frequency of SSBs consumption. Biological plausibility supports the key oral health message to reduce the amount and intake frequency of food and drinks containing free sugars as a caries-preventive strategy supported by animal experiments[27]. Moreover, most participants strongly supported the taxation, which could raise awareness of the population and hopefully reduce consumption.

To our knowledge, this study is the first to evaluate the implementation of taxation on SSBs and its effect on consumption patterns in Saudi Arabia. It highlights the benefits of tax implementation in Saudi Arabia; however, no study is without limitations. Further, since this is a cross-sectional study, its nature only allows for associations and cannot infer causality[28]. Second, we assessed the current consumption of SSBs using an Arabic validated questionnaire; furthermore, the limitation of self-reported data is participant bias[29]. Moreover, the sample in this study was only from patients attending the clinic in KAUFD for dental treatment, which makes generalization of the clinical samples to community population acceptable with caution. King Abdulaziz University is one of the main governmental hospitals in Jeddah City, and the sample includes a range of participants from different socioeconomic groups.

Recommendations

WHO guidelines recommend reducing the frequency and amount of free sugar consumption to less than 10% of the total energy intake[30]. More benefits will result from changing the tax system to be applied to the sugar content, not volume only. We acknowledge the implementation of taxes in Saudi Arabia; however, we strongly recommend a reassessment of the sugar content of all SSB products available in the market and to ensure that tax implementation is applied to all types of SSBs. Finally, more studies are needed to assess the effect of taxes on families with different socioeconomic backgrounds.

Conclusion

The consumption of SSBs is high among a group of children attending King Abdulaziz University Dental Hospital; where fruit juices and drinks are the most commonly consumed SSBs. The effect of tax implementation is more noticeable in the consumption pattern of children with low monthly family income.

Conflict of Interest

The authors declared that there is no conflict of interest that is related to this study and this article.

Disclosure

The authors did not receive any type of commercial support either in the form of compensation or financial support for this case report. The authors have no financial interest in any of the products, devices, or drugs mentioned in this article.

Ethical Approval

The study was approved by the Ethics Committee of the KAUH in Jeddah, Kingdom of Saudi Arabia, also known as the Institutional Review Board of Hospitals.

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فرض الضريبة الانتقائية على المشروبات المحلاة وتأثيرها على استهلاك الأطفال لها. دراسة مقطعية لمجموعة من الأطفال بمدينة جدة

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[٣]طبيب أسنان عام بجامعة الملك عبد العزيز، جدة ، المملكة العربية السعودية.
[٤]أستاذ مساعد طب أسنان الأطفال، كلية طب الأسنان ، جامعة الملك عبد العزيز، جدة ، المملكة العربية السعودية

المستخلص. المشروبات المحلاة هي مشروبات تحتوي على السكريات المضافة وتشمل على سبيل المثال المشروبات الغازية وعصائر ومشروبات الفاكهة والحليب ذو النكهات. في عام ٢٠١٩م، أعلنت الهيئة العامة للزكاة والدخل عن تطبيق ضريبة بنسبة ٥٠٪ على المشروبات المحلاة. الهدف من الدراسة هو تقييم مدى استهلاك مجموعة من الأطفال الذين تتراوح أعمارهم بين ٦ إلى ١١ سنة والذين حضروا لتلقي العلاج في عيادات مستشفى الأسنان بجامعة الملك عبد العزيز في جدة، للمشروبات المحلاة وتأثير فرض الضريبة الانتقائية على استهلاكهم لها. شملت هذه الدراسة المقطعية مجموعة عشوائية من الآباء والأمهات لأطفال تتراوح أعمارهم بين ٦ و ١١ سنة. كما اشتملت الدراسة على استبيان معتمد باللغة العربية. تمت مشاركة مائة وثمانية وعشرين من الآباء والأمهات؛ حيث شكلت العصائر ومشروبات الفاكهة المصدر الأكبر للمشروبات المحلاة في هذه المجموعة.أعرب ستة وأربعون (٣٥.٩٪) مشتركا انه بسبب فرض الضريبة الانتقائية، بدأ اطفالهم باستهلاك مشروبات اخرى غير خاضعة للضريبة. تحول عدد أكبر من الأطفال من العائلات ذات الدخل الشهري المنخفض إلى منتج غير خاضع للضريبة مقارنة بالأطفال من العائلات ذات الدخل الشهري المرتفع. استهلاك المشروبات المحلاة يعد مرتفعاً نسبياً ويبدو أن فرض الضريبة الانتقائية له اثر في تقليل الاستهلاك خصوصا بين أطفال العائلات ذات الدخل الشهري المنخفض.

الكلمات المفتاحية: المشروبات المحلاة، الحليب ذو النكهات، العصائر، المشروبات الغازية، السكر، الضريبة