Study on the Effect of Consumption of Sugar-Sweetened Beverages on Psychosocial Behavior of Children in Saudi Arabia

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Abstract: *Background and objectives*: The goal of the study was to see how sugar-enhanced beverages affected children's psychosocial behavior. Expansions in the use of sugar-enhanced drinks (SSB) during youth have mirrored global patterns in the epidemic of experience growing up stoutness. Furthermore, the study aims to determine the rates at which Saudi children use SSBs and their relationship to mental effects, as well as the mental aspects that are most affected by SSB use.

Methodology: For this research, 400 guardians from Saudi Arabia were selected as samples, and the probability purposive sampling technique was used to collect samples. Questionnaires were designed and validated through the pilot survey. Three categories were made in the questionnaires to assess the sociodemographic characteristics, consumption patterns of sugar-sweetened beverages, and behavioral problems. Chi-square, t-test, and logistic regression were used to analyze the data statistically using SPSS 23 software.

Results: Results and outcomes of the research demonstrated that mental health issues and physical as well as psychosocial problems were the main effects of excessive use of sugar-sweetened beverages Causes. Restlessness, lack of concentration, loss of temper, lack of confidence, and feelings of sickness were found to be the most experienced symptoms.

Conclusion: The intake of sugar-sweetened beverages negatively impacts children's physical and mental health. It impacts increased heart issues, obesity, diabetes, and aggressive behavior.

Limitations: This is a cross-sectional study, and the causal relationship is unclear.

Keywords: Sugar-sweetened beverages, Psychosocial, obesity, aggressive, depression.

INTRODUCTION

A sugar-sweetened beverage is a drink that has added sugars, for example, cane sugar, which is commonly used in table sugar, high fructose corn syrup, concentrates of fruit sugars, or any other type of sweetening agent [1,2]. The intake of sugar-sweetened beverages negatively impacts the physical and mental health of children. It impacts increased heart issues, obesity, diabetes, and aggressive behavior. It also encourages weight gain in adults [3]. Recent data from Saudi Arabia have shown that almost 84.5 % of youth consume sugar-sweetened beverages daily in Saudi Arabia [2,3]. It means the consumption rate of SSBs is very high in the region. Also, studies claimed that Saudi Arabia is the largest country that consumes sugar-sweetened beverages in the Middle East. Not only this, but it is also evident that psychological issues are also a major effect that is caused by the consumption of SSBs. It is noted that every 2nd child that consumes daily 2 to 3 cans of SSBs have a stress level higher than other children. Also these children are also suffering from aggressiveness due to the high rate of caffeine in the drinks.

The youth in Saudi Arabia are stressed and depressed due to the high rate of consumption of soft drinks. The major issue that is caused by SSBs is obesity [4,5]. There is a strong relationship between

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obesity and depression. Obesity is associated with the secretion of adrenocorticotropin hormone (ACTH) released from the hypothalamic-pituitary-adrenal gland (HPA). This hormone increases the depression level in the individual [6]. It is not wrong to say that the bi-directional relationship between obesity and depression is a major cause of the consumption of SSBs. Saudi youth have reported being more aggressive in their behavior [7]. The major reason is the consumption of soda and sugar-sweetened beverages. Studies revealed that youth in Saudi Arabia are more aggressive [4,5]. Also, it is noted that they are likely to disturb or finish their relationships with others easily. They get into fights very quickly and also attack physically other people. Consumption of soft drinks is associated with depression, aggressive behavior, and suicidal thoughts. Many studies were done to evaluate these factors. These studies revealed that the youth in Saudi Arabia are depressed due to the high use of soda and SSBs in their lifestyles.

It means soft drinks contain ingredients that formulate or secrete hormones of depression and anxiety in them. Surveys found a dose-response relationship between the consumption of soft drinks and aggressive behavior toward others [3,4]. Many factors have contributed to this poor mental health and consumption of soft drinks. These factors are poor dietary routines such as high consumption and use of soda after and before every meal, due to which the sugar level of the body increases, and the person may get type 2 diabetes and excessive use of TV and other technological things like smart phones and tablets. WHO has found the overall percentage of suicide cases in Saudi Arabia [5]. It was found that almost 13.49% of youth have committed suicide in Saudi Arabia due to depression and mental health issues. The reason behind this increased figure is the high rate of use of soft drinks by youth in their lifestyles, which leads to serious mental and physical issues [4,7].

Problem Statement

Diet has a critical role in the maintenance of psychological well-being. The dietary pattern has been linked to worsening mental health and behavioral difficulties in certain studies. Mental health concerns have been linked to SSB intake in several studies. The relationship between SSB consumption and depression and suicidal thoughts in teenagers has been the subject of several prior research. It has been documented in both developing and developed nations that there is a positive link between SSB use and various mental health disorders. However, the reasons are not fully understood. SSB use is associated with mental health difficulties, according to the majority of studies, which postulated that inflammation or oxidative stress generated by SSB was a mediating factor.

In the present study, we targeted to investigate the correlation between sugar-sweetened beverage consumption and behavioral problems in school children from urban areas across Saudi Arabia.

MATERIALS AND METHODOLOGY

For this research, 400 guardians from Saudi Arabia were selected as samples. RAOSOFT software was used to calculate the ideal sample size for the survey, and the minimum recommended sample size was 377, but 400 responses were collected to be analyzed. As inclusion criteria, children of three to ten years who have shown aggression and are facing some mental health issues were selected. As exclusion criteria, children are suffering from malnutrition issues and physical diseases. The proposed study used the probability purposive sampling technique to collect samples. This technique is also known as judgmental, subjective, or selective sampling.

This sampling method is a form of non-probability sampling in which researchers rely on their own judgment when choosing the members of a population to participate in their survey; the samples were selected for this research using this technique. Also, independent and dependent variables were demonstrated in this research. The intake of sugar-sweetened beverages was an independent variable, whereas children's mental health issues and aggressive psychosocial behaviors were the dependent variables of the research. A survey method was used to get information or to find results. The survey method was applied to the chosen 400 parents of children who are facing such issues due to excessive use of SSBs.

Questionnaires were designed and translated into Arabic for ease of understanding and to get data from samples. The questionnaire was validated and modified by a pilot survey on a small sample (10% of the sample) before the actual implementation. In questionnaires, three categories were made. Each category contains almost 5 to 10 sub-questions. This first category was about the sociodemographic characteristics and physical appearance of children. The second category was about the consumption of SSBs by children. The last and third category was the behavioral changes of children due to excessive

consumption of SSBs. After the collection of data, data were summarized in the form of tables. SPSS 23 was used to summarize and analyze the data. Chi-square, t-test, and logistic regression were used to do the statistical analysis of the data.

Statistical Analysis

To conduct the quantitative statistical analysis, first of all, the qualitative data was coded to the quantitative data. The data was coded for the quantitative analysis using MS Excel. The statistical package is used to analyze the data and to conclude the results.

RESULTS

Table **1** represents the descriptive statistics of the sociodemographic data of the study population. Approximately half of the children under study were from the age group 7 to 10 years. 51.2 % of them were females, and 48.8 % were males. Most of the study population were Saudi children (92%), whereas the rest 8% were non-Saudis. The weight of the children varied according to the age group, with some children (2%) having a weight of 50 kg or more. By looking at the income group, it was shown that more than half of the children belong to the high-income group (income more than 15,000 SAR pm) and comprise about 58.3% of the study group. Data on the mother's educational qualifications revealed that more than half (58.5%) of the mothers had high qualifications (university level). After that, 27% were primary school-educated, and 8.5% were illiterate.

Table **2** shows the descriptive statistics for the frequency of consumption of sugar-sweetened

Table 1: Descriptive Statistics of the Study Population

Particulars	Frequency	Percentage
AGE years		
3 - 5	135	33.8
6 - 7	94	23.5
8 - 10	171	42.8
Total	400	100
Gender		
Male	195	48.8
Female	205	51.2
Nationality		
Saudi	268	92
Non-Saudi	32	8
Weight (kg)		
10 – 24	266	66.5
25 – 49	127	31.8
50 and above	7	1.8
Income of parents		
Less than 10,000 pm	20	5.0
10-15,000 pm	147	36.8
Above 15,000 pm	233	58.3
Mothers' education		
Illiterate	34	8.5
Primary	108	27
Intermediate	3	0.8
High school	21	5.3
University	234	58.5
Total	400	100

Table 2: Descriptive Statistics for the Frequency of Consumption and Complications of Sugar-Sweetened Beverages

Particulars	Frequency	Percentage
Frequency of consumption		
Daily once	189	47.3
2 – 3 times/day	118	29.5
4 – 5 times/day	93	23.3
Reduced water consumption		
Yes	213	53.3
No	59	14.7
Not sure	128	32
Reduced appetite		
Yes	307	77
No	93	23
Higher satiety		
Yes	188	47
No	60	15
Not sure	152	38
Presence of any complication		
Yes	245	61.3
No	25	6.25
Not sure	130	32.5
Presence of negative behavior		
Yes	266	66.5
No	34	8.5
Not sure	100	25

beverages and the related complications. From the results, it was found that those children who consumed a lot of sugar-sweetened beverages had the tendency to complain of reduced water consumption (53.3%). Approximately 77% of the study population complained of reduced appetite, and 83% said that there was a reduction in the intake of important meals. Further, the results also depicted that around 61% of the children were having different behavioral complications, and approximately 67% of the mothers said that their children had negative behavior toward others.

Table **3** shows the frequency and percentage of the different behavioral problems that were commonly found among the children of the study population. As a whole, 78.7% of the mothers complained that their children experienced different health problems. On the other hand, more than half of the study population (57.5%) had the problem of restlessness, which was found to be a commonly occurring problem. Lack of concentration was found in approximately 41% of the population, followed by easily losing temper, lack of confidence, feelings of sickness, and depression (29%, 25%, 23.5%, and 20%, respectively). Reacting aggressively and misbehaving were the least common conditions, with approximately 15% and 10%, respectively.

Table **4** shows the correlation between the amount and frequency of SSB consumption and children's behavior, performed using a paired sample T-test. The results showed that both the amount and frequency of SSB consumption were found to significantly correlate with negative and aggressive behavior as well as reduced appetite.

Table **5** represents the correlation between the amount of consumption and behavioral problems according to the gender of the study population. Results of the study revealed that the presence of any behavioral problem as a whole was found to be significantly correlated to the amount of SSB

Table 3: Descriptive Statistics for the Different Behavioral Problems

Particulars	Frequency	Percentage
React aggressively		
Yes	59	14.7
No	341	85.2
Lack of concentration		
Yes	165	41.2
No	235	58.7
Feeling depressed		
Yes	79	19.7
No	321	80.3
Lose temper easily		
Yes	116	29
No	284	71
Sickness		
Yes	94	23.5
No	306	76.5
Restless		
Yes	231	57.5
No	169	42.5
Total behavioral problems		
Yes	315	78.7
No	85	21.3

Table 4: Correlation between the Amount and Frequency of SSB consumption and Behavior of Children

Measure 1	Measure 2	t	df	P value
Negative behavior	Amount of consumption	-4.04	398	<0.001
Aggressive behavior	Amount of consumption	2.61	398	0.009
Reduced appetite	Frequency of consumption	-11.7	398	<0.001
Any other behavioral problem	Frequency of consumption	0.92	398	0.354

Table 5: Correlation between the Amount of Consumption and Behavioral Problems According to the Gender of the Child

Particulars	Male				Female				Total			
Amount of consumption Cups/day→	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Negative behavior↓												
Yes	61	38	19	15	68	35	18	11	129	73	37	26
No	8	2	2	2	10	3	4	3	18	5	6	5
Maybe	23	10	9	6	30	10	7	5	53	20	16	11
Chi-square	$\sum^2$ = 2.52 at df 6 P = 0.86 (NS)				$\sum^2$ = 3.19 at df 6 P = 0.785 (NS)				$\sum^2$ = 4.62 at df 6 P = 0.59 (NS)			
Any behavioral problem												
Yes	81	36	23	15	84	39	23	13	165	75	46	28
No	11	14	7	8	24	9	6	6	35	23	13	14
Chi-square	$\sum^2$ = 8.86 at df3 P = 0.03 (S)				$\sum^2$ = 1.34 at df3 P = 0.72 (NS)				$\sum^2$ = 5.64 at df3 P = 0.13 (NS)			

Table 6: Logistic Regression Analysis for the Behavioral Problems and other Variables

Model summary – Behavioral problems										
Model	**Deviance**	**AIC**	**BIC**	**df**	**X^2**	**p**	**McFadden R^2**	**Nagelkerke R^2**	**Tjur R^2**	**Cox and Snell R^2**
H_0	197.693	199.6	202.9	188						
H_1	184.002	204.0	236.4	179	13.6	0.134	0.069	0.108	0.074	0.070

					Wald Test			95% Confidence interval (odds ratio scale)	
	Estimate	Standard Error	Odds Ratio	z	Wald Statistic	df	p	Lower bound	Upper bound
(Intercept)	-2.595	0.639	0.075	-4.058	16.468	1	<0.001	0.021	0.261
Amount of consumption	0.305	0.205	1.357	1.487	2.210	1	0.137	0.907	2.030
Sex (female)	0.163	0.385	1.176	0.422	0.178	1	0.673	0.553	2.504
Nationality (non-Saudi)	-0.440	0.840	0.644	-0.523	0.274	1	0.601	0.124	3.345
Income (above 15000)	0.183	0.415	1.201	0.441	0.195	1	0.659	0.532	2.709
Income (less than 10000)	1.224	0.581	3.401	2.108	4.445	1	0.035	1.090	10.611
Education of mother (intermediate)	1.730	1.507	5.642	1.148	1.318	1	0.251	0.294	108.250
Education of mother (High school)	0.476	0.767	1.609	0.620	0.384	1	0.536	0.357	7.240

consumption (P< 0.05) for only male children. On the other hand, this correlation was found to be statistically insignificant for the female population and for the presence of negative behavior.

Table **6** represents the Logistic regression analysis for the behavioral problems and the demographic characteristics of the study population. It was found from the table that female children tend to be 1.18 times more affected by the increase in consumption of sugar-sweetened beverages than males. Whereas when comparing the study population according to nationality, the non-Saudi population tends to have 0.64 times lower occurrence of behavioral problems as compared to the Saudis. On the other hand, the children of families with high incomes were 1.2 times more likely to have the same outcome as middle-income families. However, none of the results were found to be statistically significant. Results of the table also indicated that each cup increase in the consumption of sugar-sweetened beverages resulted in an increase of 1.2 times the behavioral problems. (0.305 estimate for amount of consumption$\times 4$ cups per day = 1.2 times increase in outcome).

DISCUSSION

Researchers struggled to find out the negative impacts of sugar-sweetened beverages on children. For this purpose, the authors examined some official reports of the health sector, such as CAB abstracts, PubMed reports, and PAIS international reports on the impacts of sugar-sweetened beverages. The results of the research have shown that these beverages have negative impacts on the physical health of children. They added that children are facing obesity/overweight, lack of energy, and poor willpower due to over and excessive use of sugar-sweetened beverages. This means excessive use of these beverages can cause major physical health issues in children [4,5]. Furthermore, research has been done to investigate the impacts of the overuse of sugar-sweetened beverages on the mental health of children. For this purpose, the authors collected data from children's families. The authors mostly used the survey method of

data collection. Results showed that excessive use of sugar-sweetened beverages has various mental health issues [6-8]. Children who intake sugar-sweetened beverages on a daily basis are facing both physical and mental health issues [9].

Results and outcomes of the research demonstrated that mental health issues and physical problems are the main effects of excessive use of sugar-sweetened beverages Causes. Mental health issues can lead to chronic mental health problems. For example, aggressive behavior of the children that have been found in the results may lead to violence. Research has found that aggression is intended to cause extreme and severe physical harm [7]. It means children may harm themselves in the form of injury. It means overconsumption of sugar-sweetened beverages can lead to aggressive behavior that may form into violent actions by children.

Also, suicide attempts can happen due to aggressiveness. Many children who have aggression in their behavior due to the high consumption rate of sugar-sweetened beverages are likely to attempt suicide if any issue or problem occurs to them, like pressure from studies and fewer financial resources. Another mental issue that has faced my children due to the overuse of sugar-sweetened beverages is restlessness. Children are found to have less energy, which can lead to making them lazy, and they will face severe issues in the future. For example, poor performance in their academic life. In addition, many children have been found to be more depressed [5]. While conducting the research, it was noted that the majority of children are depressed and stressed in their lives. It also explored that they usually take one to two cans of beverages daily as their habit. It means that stress and depression are caused by the overuse of sugar-sweetened beverages.

These beverages contain some ingredients that cause depression. However, this depression can lead to chronic mental health issues. The depression is caused by them as they have a habit of consuming beverages that have large amounts of caffeine and other harmful ingredients [10]. These things can also cause physical issues for them. Obesity is one of the major physical issues that is caused by the excessive use of these beverages. Obesity can give them depression because these two have a relationship that is previously discussed in this research. It can be said that mental and physical issues can also be faced by children if they continue to use such amounts of these beverages.

In addition to these results, the child's sex also has a confounding effect, which is reflected in the child's behavior and expression of emotions. These differences were found in the distribution of different psychosocial problems. When boys are compared with girls with respect to conduct problems, peer adjustments, aggressive behavior, and total problems, these results were shown in previous studies [11-13]. When comparing the psychological and emotional problems, female children are more likely to experience these than male children [12,13]. It is also worth noting that children with low socioeconomic status, as compared to those with high socioeconomic status, were more prone to various psychosocial problems; and also, children of parents with lower education were more likely to report behavioral problems than those with parents having higher educational level [14-16].

Previous research has focused more on examining the link between SSB consumption and physical function, with fewer studies exploring its connection to mental health, particularly among school children who experience high and fluctuating psychological stress [17]. In our study, we investigated the relationship between SSB consumption and psychological symptoms among Saudi school Children. The findings revealed a notable association between SSB consumption and psychological symptoms. Additionally, our research indicated that the rate of psychological symptoms was significantly higher among females as compared to males, aligning with similar studies' results [18, 19].

CONCLUSION

The present study reveals that the consumption of sugar-sweetened beverages among children is related to multiple health problems and is seen in the form of several social and psychological factors. The increase in the intake of sugar-sweetened beverages in the young population is a disturbing fact as it is going to affect not only the physical but also the psychological health of the children. Furthermore, it is also predictable for adult health. Therefore, it has been recommended that more longitudinal studies be done to determine the correlation between sugar-sweetened beverage consumption and the resulting health effects. For the purpose of intervention, it has been recommended that the researchers should also consider parents' role in the children's behavior. Also, the parents should be included in the research because their perception and attitude towards the consumption of sugar-sweetened beverages will be helpful in having an impact on the child's routine of the use of sugar-sweetened beverages.

LIMITATIONS

Our study also has several limitations. First, as a cross-sectional survey, it only allowed us to analyze the association between SSB consumption and psychological symptoms, without providing insight into the causal relationship between the two. Second, the study's investigation of covariates was limited, as it only considered family factors, parental education, socioeconomic status (SES), diet, sleep, and physical activity. Future research should explore additional factors, such as screen time and academic stress, to more comprehensively analyze the relationship between SSB consumption and psychological symptoms. Third, accurately measuring SSB consumption is challenging due to the potential biases in participants' recall abilities. Additionally, mental health assessments through questionnaires may lead to underreporting, as students might feel embarrassed to answer certain questions.

RECOMMENDATIONS

Parents should remove SSB products from their homes and decrease their use in front of children, which will discourage them from intake these sugar-sweetened beverages. Also, parents should encourage their children to drink more water instead of SSBs with their main meals and replace snacks with fruit, sugar-free fruit, and vegetable juices or milk, which would help to reduce their sugar intake, especially those children who are three to five years old. Also, parents should keep checking the diet routine of their children and make sure that they are punctual and have their meals on time. These recommendations will help parents decrease their children's excessive use of sugar-sweetened beverages.

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ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of King Faisal University, KSA. Written informed consent to participate in this study was provided by the children's legal guardian.

CONFLICT OF INTEREST

The authors declare that there was no conflict of interest.

DATA AVAILABILITY STATEMENT

The manuscript incorporates all datasets produced or examined throughout this research study.

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