Determinants of Sugar-Sweetened Beverage Consumption among Indian Adults: Findings from the National Family Health Survey-4

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Abstract

Background: Sugar-sweetened beverages (SSBs) are associated with obesity, and various other noncommunicable diseases (NCDs). The aim of the study was to study the patterns of consumption of SSBs and association of SSB consumption with various socioeconomic factors and fried food consumption. **Methodology:** We used data of the 4th round of National Family Health Survey. We used multiple logistic regression to estimate the extent of the relationship between consumption of aerated drinks and various predictors. Furthermore, generalized structural equation modeling (GSEM) was used to derive a path diagram that showed a significant linkage between aerated drinks and observed variables. **Results:** Our study showed a clear association between consumption of aerated drinks with socioeconomic variables age, sex, marital status, and wealth index. The consumption of aerated drinks was also significantly associated with watching television and eating fried foods. **Conclusion:** Aerated drinks are a popular source of added sugar in the Indian diet. Limiting such factors can prove to be beneficial in reducing their consumption and further help in reducing the burden of NCDs.

Keywords: Aerated drinks, GSEM, India, National Family Health Survey-4, sugar-sweetened beverages

INTRODUCTION

Sugar is one of the major sources of energy in our diets today. A substantial amount of this sugar is consumed as sugar-sweetened beverages (SSBs).[1] The World Health Organization defines SSBs as "all types of beverages containing free sugars and these include carbonated or noncarbonated soft drinks, fruit/vegetable juices and drinks, liquid and powder concentrates, flavored water, energy and sports drinks, ready-to-drink tea, ready-to-drink coffee, and flavored milk drinks."[2] An increase in the consumption of SSBs in our diets is an independent risk factor for obesity[3-5] and various other noncommunicable diseases (NCDs) such as hypertension,[6-8] cardiovascular diseases,[6] type 2 diabetes,[8-10] dental erosion, and dental caries.[11,12]

There are a number of demographic and socioeconomic factors such as age, gender, education, and socioeconomic position associated with the intake of SSBs.[13,14] SSBs consumption has been reported to be the highest in the age group of 18–39 years. The consumption of SSBs has been reported to

decrease with increasing age thereafter.[13-16] In most of the available literature, men have been found to consume more SSBs in comparison to women.[13,14,17] A number of studies have also reported lower educational level associated with higher consumption of SSBs.[13,16,18] Similarly, lower socioeconomic position and being unmarried/divorced have also been found to be associated with an increased SSBs intake.[13,17,19] Other factors such as watching television for a long duration and consumption of fried foods is associated with an increase in SSB intake and obesity.[20,21]

The evidence around factors associated with SSB consumption is mainly from high-income countries or countries which have

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a robust policy controlling the consumption of sugary drinks. Very few studies have assessed the consumption patterns of SSBs across different socioeconomic and demographic groups in low- and middle-income countries like India. There is a paucity of literature looking at various factors that affect the consumption pattern of SSBs among Indian adults. We tried to address this gap in literature using a nationally representative sample of Indian adults from the recently concluded National Family Health Survey Round-4 (NFHS-4) to study the pattern of SSB consumption and to assess the role of various behavioral, demographic, and societal factors that affect the consumption pattern of SSBs among Indian adults. We have also assessed the extent of association by building a predictive model between the consumption of SSBs, socioeconomic factors, and fried food consumption.

METHODOLOGY

This study utilizes data from 4th round of NFHS which was conducted in 2015-16. The NFHS is an Indian version of Demographic and Health Survey. NFHS is a large scale periodic national survey conducted by the Government of India to obtain nationwide data on health and family welfare. Twenty-nine Indian states and seven union territories were covered for data collection in NFHS-4. Separate questionnaires were used for men, women, and households. Biomarker details for different disease conditions were also recorded. The data collected for the variables were self-reported. Details of the survey, methods, sampling frame, and questionnaire have been published elsewhere.[22] A total of 699,686 women between the age of 15–49 years and 112,122 men between the ages of 15–54 years participated in the survey, and the overall response rate was 98%.

Outcome and predictor variables

The consumption of sugary aerated drinks was the variable that was included for the first time in the fourth round of NFHS. We have used this as an outcome variable to assess the consumption of SSBs. Participants were asked about their consumption of aerated drinks through their intake frequency which was coded as *"daily, weekly, occasionally, or never?"* For analysis, we re-categorized the frequency of consumption of aerated drinks into two mutually exclusive and exhaustive categories: respondents reporting drinking aerated drinks (daily, weekly, and occasionally) and respondents reporting not drinking aerated drinks (never).

The predictor variables used were age (categorized into 15–19, 20–29, 30–40, 41, and above years); education (no education, primary, secondary, and higher); religion (Hindu, Muslim, Christian, Sikh, Buddhist Jain, and others); wealth index (based on household amenities and the assets owned);[22] current marital status (not married, married, widowed/divorced/separated); and place of residence (urban and rural). The variable for the consumption of fried food was also included in the analysis as it has been reported to be associated with the consumption of aerated drinks. It was asked as "*How often*

do you yourself eat the following food items (fried foods): daily, weekly, occasionally, or never?" The variable (fried foods) was dichotomized in the following two categories: respondents reporting eating fried foods (daily, weekly, and occasionally) or respondents reporting not eating fried foods (never) for the analysis. Exposure to media was also included as a predictor variable. The two questions included in our analysis to assess exposure to media were "*Do you read a newspaper or magazine*?" and "*Do you watch television*?" The responses were dichotomized as respondents reporting reading newspaper and watching television (daily, weekly, and occasionally) and respondents reporting not reading newspaper and watching television (never).

Statistical analysis

Univariate analysis was done to calculate the frequency distributions of the continuous and categorical variables for the sample segregated by gender. Bivariate analysis was carried out to explore the difference between the consumption of aerated drinks and the predictor variables using Pearson's Chi-square test at 5% significance level. Multiple logistic regression (MLR) analysis was then used to assess the effect of multiple statistically significant predictor variables (categorical) on a dichotomous outcome variable aerated drinks (1 = drinking aerated drinks and 0 = not drinking aerated drinks).

We further applied generalized structured equation models (GSEMs) to make a path diagram using aerated drink as the latent variable (unobserved) and socioeconomic variables (observed). Since the latent variable was dichotomous in nature, errors were assumed to follow a "Bernoulli distribution" and the Generalized Linear Model (GLM) GLM link function was used as the "logit." We used GSEM to fit a standard logistic regression which is equivalent to the logit model of the GLM framework. All statistical analyses were performed using STATA (Stata Corp LLC, version: 13.0).

RESULTS

Descriptive statistics of the respondents

The NFHS-4 has 699,686 women and 103,525 men as respondents with a mean age of 29.8 and 32, respectively. A majority of the women participants (70.7%) belonged to the rural areas. A greater part of the sample has completed secondary education (48% women and 58% men) exposure to print media like newspaper/magazine was found to be less among women (12%) than men (28.6%). More than half (56.5%) women and men (57.3%) watch television daily. Females (50%) consumed more fried foods than males occasionally (46.3%) in the study sample.

About 6.4% – men and 4.9% – women reported daily intake of aerated drinks; almost one-fourth (24% – men and 19% – women) reported weekly consumption of aerated drinks and (13.7% – men and 16.5% – women) in the age group of 15–19 years (6.9%) of adolescents were found to drink aerated drinks daily [Table 1]. Around (30%) males with higher education and (27%) females consumed aerated drinks

on a weekly basis. Similarly, weekly consumption of aerated drinks was more among people belonging to a higher wealth index. Unmarried males also showed a higher frequency of consuming aerated drinks than females [Table 1]. Aerated drinks were consumed more by those who read newspaper/magazine and watched newspaper/TV daily. The consumption of aerated drinks was also higher among the people who ate fried foods on weekly basis [Table 2].

Factors associated with consumption of aerated drinks

Results of MLRs revealed that socioeconomic factors, exposure to media, and intake of fried foods are associated with consumption of aerated drinks. Respondents who ate fried foods were seven times more likely to consume aerated drinks than those who did not (odds ratio confidence interval [OR-CI], 6.81 [6.67–6.96]) [Table 3]. Adolescents in the age group of 15–19 years were around 1.7 times more likely to consume aerated drinks than adults 40 years and above (OR-CI, 1.67 [1.63–1.72]). Males consume a significantly higher amount of aerated drinks than females(OR-CI, 1.33 [1. 30–1.36]). People living in urban areas were more likely to consume aerated drinks than those from rural areas(OR-CI, 1.06 [1.04–1.08]). Respondents with higher education were significantly more likely to consume aerated drinks as compared to illiterates (OR-CI, 1.05 [1.02–1.08]). Unmarried persons were more likely to consume aerated drinks than married(OR-CI, 1.22 [1.19–1.25]) while widowed/divorced/separated were less likely to take aerated drinks than married (OR-CI, 0.86 [0.84–0.89]). People belonging to higher socioeconomic status were three times more likely to consume aerated drinks than lower class (OR-CI, 3.23 [3.15–3.32]). People who watch television were more

Table 1: The percentage distribution of males and females by the frequency of consumption of aerated drinks and socioeconomic characteristics

Characteristic	Men			n^m	Women			n^f
	Daily	Weekly	Occasionally		Daily	Weekly	Occasionally	
Age								
15-19	6.9	27.4	56.6	19,082	4.8	19.8	62.8	124,878
20-29	7.2	26.9	55.8	32,781	5.1	19.4	60.8	238,031
30-40	5.9	23.5	56.8	32,548	4.6	17.7	59.5	213,577
41 and above	5.5	20.7	54.9	27,711	4.6	16.8	57.5	123,200
Place of residence								
Rural	5.5	22.2	57.8	76,596	4.3	15.9	61.0	494,951
Urban	8.3	29.4	52.2	35,526	5.9	24.7	58.2	204,735
Education								
No education	4.4	18.2	57.3	15,008	3.6	14.2	59.0	196,556
Primary	4.9	20.0	57.2	14,351	4.2	15.8	60.7	88,290
Secondary	6.5	25.4	56.4	65,259	5.1	19.7	61.4	334,927
Higher	8.8	30.0	52.4	17,504	6.6	27.2	57.3	79,913
Marital status								
Never married	7.5	27.8	55.5	40,273	5.3	21.4	61.8	171,797
Married	5.8	22.7	56.2	70,215	4.7	17.7	59.8	499,627
Widowed/divorced/separated	3.4	20.1	57.0	1634	4.0	15.3	57.8	28,262
Wealth index								
Lowest	3.5	15.6	60.6	18,412	4.1	9.9	57.7	133,249
Second	4.5	19.4	59.9	23,220	3.6	13.6	63.0	149,466
Middle	5.6	23.6	58.2	24,331	3.8	18.4	63.2	147,168
Fourth	7.5	28.6	53.4	23,383	4.8	22.7	60.9	138,502
Highest	10.2	33.6	48.5	22,776	7.8	28.6	55.4	131,301
Frequency of reading newspaper/magazine								
At least once a week	6.1	28.6	55.3	23,839	5.9	26.2	56.5	86,196
Almost every day	9.7	30.7	50.4	32,068	8.1	27.9	54.4	83,797
Frequency of watching TV								
At least once a week	4.9	25.18	56.5	18,918	4.5	17.8	60.4	81,777
Almost every day	8.0	28.1	53.2	64,502	5.8	22.5	59.9	394,599
Frequency eats fried food								
Daily	16.9	19.6	48.5	12,907	16.4	13.4	52.2	81,836
Weekly	8.4	41.7	42.0	38,487	5.4	31.8	50.2	236,157
Occasionally	2.6	14.9	71.8	51,930	1.8	11.4	71.1	350,013
Percentage	6.4	24.5	55.9		4.8	18.5	60.2	
Total (*n*)	7141	27,447	62,769	112,122	33,418	129,469	421,169	699,686

Table 2: Results of Chi-square test of association between outcome and predictors

Predictors	Aerated drinks	Total (*n*)	χ² (significant)
Sex			
Female	584,056 (83.5)	699,686	*P*<0.00
Male	97,357 (86.8)	112,122	
Age			
15-19	126,496 (87.9)	143,960	*P*<0.00
20-29	232,430 (85.8)	270,812	
30-40	202,833 (82.4)	246,125	
41 and above	119,654 (79.3)	150,911	
Place of residence			
Rural	467,561 (81.8)	571,547	*P*<0.00
Urban	213,852 (89.0)	240,261	
Education			
No education	162,936 (77.0)	211,564	*P*<0.00
Primary	83,048 (80.9)	102,641	
Secondary	346,363 (86.5)	400,186	
Higher	89,066 (91.4)	97,417	
Marital status			
Married	469,743 (82.4)	569,842	*P*<0.00
Not married	188,547 (88.9)	212,070	
Widowed/divorced/separated	23,123 (77.3)	29,896	
Wealth index			
Lowest	110,258 (72.7)	151,661	*P*<0.00
Secondary	139,499 (80.8)	172,686	
Middle	146,926 (85.7)	171,499	
Fourth	143,295 (88.5)	161,885	
Highest	141,435 (91.8)	154,077	
Total	681,413 (83.9)	811,808	
Reading newspaper/magazine			
No	372,304 (79.9)	465,956	*P*<0.00
Yes	309,109 (89.4)	345,852	
Watching TV			
No	138,194 (73.7)	187,463	*P*<0.00
Yes	543,219 (87.0)	624,345	
Eat fried foods			
No	20,028 (49.5)	40,478	*P*<0.00
Yes	661,385 (85.7)	771,330	
Total	681,413 (83.9)	811,808	

Table 3: Results of multiple logistic regression showing factors associated with the consumption of aerated drinks

Aerated drinks	OR	SE	95% CI
Sex			
Female®			
Male	1.33***	0.01	1.30-1.36
Age			
41 and above®			
15-19	1.67***	0.03	1.63-1.72
20-29	1.49***	0.01	1.47-1.52
30-40	1.25***	0.01	1.23-1.27
Place of residence			
Rural®			
Urban	1.06***	0.00	1.04-1.08
Education			
No schooling®			
Primary	0.92***	0.01	0.90-0.94
Secondary	0.92***	0.01	0.90-0.94
Higher	1.05**	0.02	1.02-1.08
Marital status			
Married®			
Not married	1.22***	0.01	1.19-1.25
Widowed/divorced/separated	0.86**	0.01	0.84-0.89
Wealth index			
Lowest®			
Second	1.44***	0.01	1.41-1.47
Middle	1.91***	0.02	1.87-1.95
Fourth	2.35***	0.03	2.30-2.41
Highest	3.23***	0.04	3.15-3.32
Reading newspaper/magazine			
No®			
Yes	1.22***	0.01	1.20-1.24
Watching TV			
No®			
Yes	1.44***	0.01	1.41-1.46
Eat fried foods			
No®			
Yes	6.81***	0.08	6.67-6.96

®=Reference Category, ***P<0.00, **P<0.01. OR: Odds ratio, SE: Standard error, CI: Confidence interval

likely to consume aerated drinks than who do not (OR-CI, 1.44 [1.41–1.46]).

GSEM-based path diagram revealing the linkage of aerated drinks with observed variables

We used generalized structural equations modeling (GSEM) as it combines the features of both structural equations model (SEM) and GLM in unified ways. GSEM provides a reliable estimate, as the use of latent variable minimizes the impact of errors inherent in the logistic model. Furthermore, GSEM is suitable when latent variable ("consumption of aerated drinks" in this case) is of dichotomous nature. In our analysis, GSEM was performed to derive a high precision estimate that contained high predictive ability. For our analyses,

we included "aerated drinks" as an unobserved variable. We treated socioeconomic variables (age, sex, education, marital status, and wealth index), exposure to mass media (newspaper/ magazine and television), and consumption of fried foods as observed variables. The path diagram illustrates a linkage of the latent variable (aerated drinks) with different observed variables created through this modeling. This path diagram further strengthened the direct linkage between observed and unobserved variables [Figure 1].

DISCUSSION

In this study, we analyzed a large-scale population-based, nationally representative cross-sectional data to understand the pattern of aerated drinks consumption and associated covariates in India. Our findings established a clear association
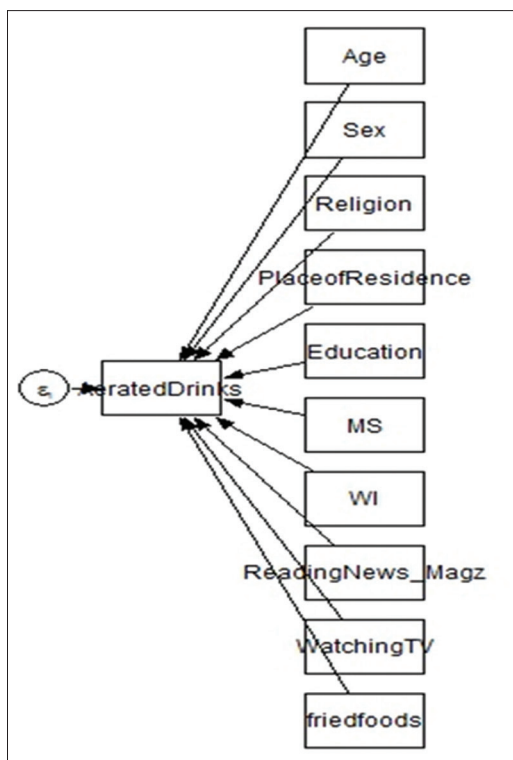
Figure 1: Generalized structured equation model-based path diagram derived from multiple logistic regression

between sociodemographic and economic factors with the consumption of aerated drinks. Adolescents (15–19 years) were found to be the highest consumers with a significant association between consumption of fried foods, media (print media and television), and aerated drinks consumption.

A complexity of factors can be attributed to our study findings. There have been a number of studies from high and low middle-income countries which shows an association among those who watch television at an early age with an increased consumption of fried foods, sugary drinks, and snacks but a lower intake of fruit and vegetables.[21,23,24] The current snacking behavior can also be explained by the fact that the snacks are easily accessible and easy to cook as compared to regular food items. This ease of availability can trigger snacking behavior among those from higher socioeconomic background. An increased SSBs consumption has also been reported in association with higher intake of discretionary food in adults.[25] Similar findings have been observed in children and adolescents.[21,26] An influencing factor associated with the consumption of aerated drinks can be television viewing and screen time. Advertisements and programs featuring *"role models"* in the television and movie house can promote the use of aerated drinks and enhance poor eating habits.[23,24,27-30] Falbe *et al*. found that an increase in total screen time was associated with an increased consumption of foods and beverages of low nutritional quality.[31] However, on the other hand, mass media when applied to raising awareness has proved to be favorable by reducing the consumption and sales of SSBs.[32,33]

This is the first of its kind study using a nationally representative study sample, which allows comparisons of SSBs consumption between men and women in an adult population. The study also has its strength in the usage of GSEM. It has the advantage of measuring model errors of the predictor variables and the overall fit of the models. In comparison to the regression model, GSEMs has an advantage for analyzing complex cause-effect relationship patterns. Another advantage of GSEM is that the model can be developed further to include more factors if the analysis provides evidence for further research. However, the study has some limitations. Being a cross-sectional study, causal associations cannot be established. Psychosocial factors that are likely to influence eating behavior were not taken into consideration. There can be concealment of the correct information as the data are self-reported, especially in rural areas where there is lack of awareness and low educational status. The study definition used for aerated drinks was not known.

CONCLUSION

The above findings show that aerated drinks are a popular source of added sugar in the Indian diet. Limiting such factors can prove to be beneficial in reducing their consumption and further help in reducing the burden of NCDs. Future studies should look at behavior change interventions aimed at reducing the consumption of sugary drinks by influencing the socio-ecological environment of an individual.

Conflicts of interest
There are no conflicts of interest.

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