Original article

Is beverage consumption associated with increased body weight among adolescents?

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Summary. *Background:* Recently, considerable attention has been given to beverage intake as a source of calories which may be linked to pediatric obesity. *Objective:* To examine the association between beverage consumption and changes in weight status among adolescents. *Material/Methods:* A total of 600 adolescents, aged 14-18 years, were involved in the study. Body weight, height, and waist circumference were measured. BMI percentiles were calculated and adolescents were classified as normal weight, overweight, and obese. For the collection of data on beverage intake, the 24-h recall technique was used. Data on beverages were examined in milliliters. *Results:* Of the total 600 participants in our sample, 79.3% were considered to be of normal weight, 13.3% were overweight and 7.4% were obese. All of the adolescents consumed water. Tea was the second most commonly consumed beverage (80.8%), followed by sugar-sweetened beverages (SSBs, 49.3%), and whole fat milk (24.3%). Elevated consumption of water was associated with elevated weight, BMI and waist circumference. There was no evidence of an association among milk, fruit juice, SSBs, tea, coffee consumption and weight status. *Conclusion:* In this study, water intake was associated with obesity. Further studies investigating the relationship among beverage consumption, total energy intake, and development of obesity are needed.

Key words: adolescents, obesity, beverages

Introduction

The issue of being overweight and obese is becoming an increasingly prevalent problem in both the developed and developing world, and it is one of the most serious public health challenges of the 21st century. The International Obesity Task Force (IOTF) revealed that 25% of children aged between 6-14 years are overweight and 9% are obese (1). According to the Nutrition and Health Survey 2010 reports, obesity is a major health concern for the Turkish population that has increased exponentially and now threatens quality of life. This trend is seen not only in adults but in children and adolescents (2).

This finding is of great concern because obesity is linked with several negative health outcomes, including impaired social and emotional well-being and physical consequences such as type 2 diabetes and cardiovascular impairment, which often continue into adulthood (3-5). Because of the difficulty in treating pediatric obesity, there is a need to identify modifiable risk factors, such as diet, to prevent its onset (6).

Various environmental and social factors relating to diet and physical activity that could contribute to obesity have been identified. One such factor, which has received little attention, is the consumption of sugar-sweetened drinks. The World Health Organization (WHO) has implicated the consumption of

sugar-sweetened beverages (SSBs) as a "probable contributor" to the obesity epidemic (7). Similar to rising obesity rates, the consumption of SSBs is prevalent and is increasing among children and adolescents (8).

The literature on beverage consumption among European populations is just emerging, with studies from France, England and Germany examining trends and patterns among adolescents and children. To date, however, there are no data from a Turkish study of adolescents (9-11).

Therefore, the aim of this study was to characterize beverage consumption patterns among adolescents to investigate possible associations among types of beverages and weight status, and to assess whether overweight/obese adolescents consumed more 100% fruit juice, fruit drinks or soda compared to their normal weight peers.

Materials and Methods

Study design and sample

This cross-sectional study was conducted in 2009, and lasted four months. Based on the chi-square test done for the obesity status of age variable, it was calculated by the bio-statistic expert that 600 students needed to be involved in the study for $\alpha=0.05$, power=0.85, degree of freedom (df)=8, and effect size=0.50.

According to the data obtained from The Kayseri Provincial Directorate for National Education, 67 high-schools located in Kayseri city center are accepted. Sixty students were included from each ten school (two Anatolian high-school, two vocational high-school, two private high-school, four regular high-school) that were selected amongst the 67 high-schools using the random cluster sampling method.

A total of 600 adolescents aged 14-18 years were enrolled in the study. The objective of the research was explained, then survey forms and informed volunteer consent forms for parent permission were handed out to the students who accepted to participate in the study, and these forms were collected the following day. The study was approved by the Ethics Committee of the Faculty of Medicine, Erciyes University, Kayseri, Turkey (Approval number 2008/508).

Body weight was measured using a digital scale

(Oncomed SC 102) with an accuracy of ± 100 g. All subjects were weighed without shoes and in light clothes. Height was measured using a tape measure with the subjects standing barefoot, keeping their shoulders in a relaxed position, arms hanging freely and held in the Frankfort horizontal plane (12).

Age and sex specific BMI percentiles were calculated and adolescents were classified as normal weight (≥15th-<85th percentile) overweight (≥85th-<97th percentile), and obese (≥97th percentile) according to the WHO criteria (13). Waist circumference (WC) was obtained from the narrowest point between the lower edge of the cage framework and the iliac crest using a flexible tape measure, but not an elastic one.

Beverage groups

A questionnaire was administered to the adolescents in order to determine the consumption frequency of beverages. For the collection of data on beverage intake, the 24-hour recall technique was used. 24-hour dietary recall was obtained in person by a trained interviewer and reflected the beverages that were consumed by the participant during the previous day.

We created nine beverage groups and categorized them into water, low-fat milk (1.5%, 1%, and non-fat), whole fat milk (≥2% fat), ayran, fruit juice (100% fruit juice, without sweetener), sugar-sweetened beverages (SSBs including fruit drinks sweetened fruit juice, fruit-flavored drink or drink that contained fruit juice in part, sweetened soft drinks, calorically sweetened soda, sports drinks, sweetened coffee, sweetened tea, sweetened milk beverages including chocolate milk and flavored yogurt drinks all with added sugar), unsweetened tea, unsweetened coffee, and non caloric sweetened beverages (diet sodas or other diet beverages). Data on beverages were examined in milliliters (mL).

Statistical analysis

All of the data obtained during the study were assessed using SPSS 16.0 (Statistical Package for the Social Sciences, SPSS Inc. Chicago, USA) software under the supervision of academicians from Erciyes University, Faculty of Medicine, Department of Biostatistics and Medical Informatics. Analysis of variance (ANOVA) was used to assess the descriptive characteristics of participants by body weight status, as well

as beverage intake by body weight status. Beverage consumption was presented as median, 25%–75% percentages among BMI categories. Spearman correlation was performed between beverage consumption and BMI, as well as waist circumference. A p value less than 0.05 was considered statistically significant.

Results

Table 1 describes the demographic characteristics and prevalence of types of beverages consumed per day by adolescents. Of the total 600 participants in our sample, 79.3% were considered to be of normal weight (≥15th-<85th percentile), 13.3% were overweight (≥85th-<97th percentile) and 7.4% were obese (≥97th percentile). The mean age of the adolescents was 15.7 ± 1.2. The mean height (cm), BMI (kg/m^2) and WC (cm) of the boys and the girls were 171.6 ± 7.7 cm, 159.4 ± 6.0 cm, 22.3 ± 3.6 kg/m^2, 21.7 ± 3.3 kg/m^2 and 74.9 ± 9.6 cm, 68.3 ± 7.6 cm, respectively. There were statistically significant differences in height, weight, BMI, and WC between boys and girls (data not shown). In the sample of Turkish adolescents, all consumed water. Tea was the second most commonly consumed beverages (80.8%), followed by sugar-sweetened beverages (SSBs, 49.3%), whole fat milk (24.3%) and other beverages (Table 1).

Table 2 presents the distribution of some bevera-

Table 1. Demographic characteristics and prevalance of types of beverages consumed per day by 600 adolescents

Variables	n	%
Gender		
Boys	300	50.0
Girls	300	50.0
Age		
14-14.9	131	21.8
15-15.9	147	24.5
16-16.9	143	23.8
17-17.9	151	25.1
18-18.9	28	4.6
BMI (percentiles)		
≥15-<85	476	79.3
≥85-<97	80	13.3
≥97	44	7.4
Beverage groups		
Water	600	100.0
Low fat milk	29	4.8
Whole fat milk	146	24.3
Ayran	60	10.0
100% fruit juice	41	6.8
SSBs	298	49.3
Unsweetened tea	486	80.8
Unsweetened coffee	12	2.0
Diet sodas/beverages	33	5.4

Table 2. Distribution of beverage consumption by weight status

Fluid (mL/d)	Normal			Overweight			Obese		
	n	%	x±S	n	%	x±S	n	%	x±S
Water	476	79.3	1400±0.0	80	13.3	1600±0.0	44	7.3	1900±0.0
Low fat milk	23	79.3	71.9±112.0	5	17.2	46.0±91.8	1	3.4	39.1±94.6
Whole fat milk	109	74.6	205.3±133.4	21	14.3	186.5±123.5	16	10.9	199.5±141.7
Ayran	46	76.6	226.3±136.9	9	15.0	226.7±125.4	5	8.0	190.9±161.1
100% fruit juice	33	80.4	140.7±133.4	5	12.1	142.0±133.1	3	7.3	150.0±123.5
SSBs	87	84.4	336.6±277.8	13	12.6	303.0±237.7	3	2.9	370.7±301.6
Tea	334	83.0	314.4±237.4	48	11.9	286.7±207.5	20	4.9	287.0±187.6
Coffee	10	83.3	60.0±0.0	2	16.6	60.0±0.0	0	0.0	0.0
Diet soda/beverages	5	71.4	38.0±102.2	1	14.2	30.6±89.3	1	14.2	46.6±110.9

ges' consumption by weight status. Overweight (1600 ± 0.0 ml) and obese adolescents (1900 ± 0.0 mL) consumed significantly more water compared to their normal weight peers (1400 ± 0.0 mL) (p < 0.05). Obese students were less likely than normal weight individuals to consume milk (10.9% versus 74.6%, p> 0.05). A higher percentage of normal weight students (76.6%) consumed ayran compared to overweight (15.0%) or obese (8.0%) students. Normal weight students were more likely than obese individuals to consume 100% fruit juice (174.9 ± 138.4 mL versus 116.4 ± 111.7 mL, p>0.05). SSBs were consumed by 84.4% of the normal weight students. The mean volume of SSBs that was consumed by the normal and obese students was 336.6 ± 277.8 mL and 370.7 ± 301.6 mL, respectively (p>0.05). Across all adolescents, normal weight students were more likely to consume tea than obese adolescents (83.0% versus 4.9% respectively, p>0.05). (Table 2 and Table 3).

The correlations of beverage consumption with weight (kg), BMI (kg/m²) and waist circumference (cm) are presented in Table 4. Elevated consumption of water was associated with elevated weight (r=0.232,

p<0.001), BMI (r=0.160, p<0.001) and waist circumference (r=0.182, p<0.001). Although not statistically significant, a negative relationship was found among tea consumption, weight (r = ⁻0.102, p = 0.082), and BMI (r = - 0.027, p = 0.584). Similar to tea consumption, a negative relationship was found among diet soda/beverages consumption, weight (r= -0.257, p=0.303), BMI (r=-0.210, p=0.402), and waist circumference (r= -0.211, p=0.401).

Discussion

To the best of our knowledge, this is the first study to characterize beverage consumption patterns among Turkish adolescents and to investigate possible associations among types of beverages and weight status.

In the present study, the prevalence of overweight and obesity was 13.3% and 7.4%, respectively. Similar to the present study, 11.3% of adolescents were overweight according to Öner et al (14). In addition, the prevalence of obesity in adolescents was consistent with the results of Krassas et al. (15).

Table 3. Distribution of some beverage consumption by weight status

Beverage category	Normal weight Median (25% p-75% p)	Owerweight Median (25% p-75% p)	Obese Median (25% p-75% p)	p
Water	1400.00 (1000.0-2000.00)a	1600.00 (1200.00-2200.00)b	1900.00 (1200.00-2400.00)b	<0.001*
Total milk	200.00 (200.00-240.00)	200.00 (200.00-220.00)	240.00 (200.00-400.00)	0.129
Ayran	200.00 (200.00-400.00)	200.00 200.00-300.00)	200.00 (200.00-400.00)	0.786
Fruit juice (100%)	200.00 (200.00-200.00)	200.00 (200.00-220.00)	200.00 (200.00-480.00)	0.741
SSBs	330.00 (330.00-660.00)	330.00 (200.00-660.00)	330.00 (330.00-1200.00)	0.656
Tea	240.00 (200.00-400.00)	200.00 (100.00-460.00)	220.00 (125.00-275.00)	0.567
Coffee	240.00 (240.00-240.00)	240.00 (240.00-420.00)	240.00 (240.00-360.00)	0.096

*ANOVA test; *p<0.001; Median (25%–75%) represents median, 25th percentile and 75th percentile; Different letters represents the differences between groups, same letters refers to the similarity between groups.*

Table 4. The correlation of beverage consumption with weight, BMI and waist circumference

Type of beverages	Weight (kg)		BMI (kg/m²)		WC (cm)	
	r	p	r	p	r	p
Water	0.239	<0.001*	0.160	<0.001*	0.182	<0.001*
Total milk	0.161	0.052	0.007	0.934	0.127	0.126
SSBs	0.103	0.298	-0.038	0.702	0.029	0.770
Diet sodas/beverages	-0.257	0.303	-0.210	0.402	-0.211	0.401
Tea	-0.102	0.082	- 0.027	0.584	0.029	0.567
Coffee	0.196	0.159	0.193	0.166	0.125	0.371

*Spearman correlation, *p < 0.001; WC: waist circumference*

Beverages represent an important source of fluids which are essential for maintaining adequate levels of hydration (16). Milk and 100% fruit juice are a source of water and provide key nutrients such as calcium and vitamin C. Other beverages, referred to as sugar drinks or sugar-sweetened beverages (SSBs), also are a source of water but have poor nutritional value (17).

The results of this study showed that water is the largest contributor to fluid consumption. Tea was the second most commonly consumed beverage, followed by sugar-sweetened beverages, milk and other beverages. In the present study, higher water consumption was consistent with the results of the HELENA study (16) that evaluated beverage consumption among European adolescents. This study finding was contrary to the results of Striegel-Moore et al. (18) who reported very low tea intake.

As shown in several meta-analyses and reviews of the role of sugar-sweetened beverages (SSBs), increased intake is associated with higher energy intake, weight gain, obesity, and diabetes (19, 20). Contrary to our finding, recent data from European countries showed that SSBs were the largest contributors of total beverage intake (16).

There is strong evidence of an association between consumption of milk throughout life and health status (21). Adolescence is a critical period for accumulating peak bone mass (22). Previous studies have shown that beverage consumption is strongly associated with demographic characteristics. For example, milk is the beverage of choice among young children, but with increasing age milk intake decreases and the intake of other beverages, especially sodas, increases (22). Our results revealed that about 29.1% of adolescents consumed milk. The Dietary Guidelines for Turkey (23) recommend 3-4 servings of milk per day. In our study, adolescents consumed 1 serving per day. Milk consumption in this study was lower than the values observed in previous studies (24, 25).

Studies have also been conducted on milk intake and adiposity in children and have reported conflicting results. Barba et al. (26) found a statistically significant inverse relationship between milk consumption and Body Mass Index (BMI). In contrast, Noel et al. (27) found that milk intake is not associated with body fat prevention in children aged 10-13 years. In our study finding, obese adolescents were less likely than normal weight individuals to consume milk.

Our results revealed that about 6.8% of adolescents consumed 100% fruit juices. Normal weight students were more likely than obese individuals to consume 100% fruit juice. The amount of SSBs consumed by adolescents in this study was higher compared to 100% fruit juices. Elevated consumption of fruit juice was associated with overweight in one study (28) but not in others (29-31). Moreover, caffeinated sodas have been associated with increased risk for bone fractures. Soda consumption was also associated with a considerably decreased intake of calcium, as has been shown in some (32) but not all studies (33, 34).

This study also investigated the contributions of beverages to BMI. Fruit juice, SSBs, and milk inta-

kes were not associated with BMI which is consistent with the results of the National Heart, Lung and Blood Institute Growth and Health Study (18). Similar to Heuberger et al.'s finding (35), this study points to an inverse relationship between caffeine consumption from tea and BMI, however statistical significance was not achieved.

In this study, we investigated whether overweight and obese adolescents were more likely to consume water than normal weight adolescents. Moreover, elevated consumption of water was associated with elevated weight, BMI, and waist circumference consistent with the results of Sichieri et al. (36).

The main finding of this study is that the adolescents who reported high consumption of water also had high consumption of other beverages. Therefore, the study did not confirm the hypothesis that drinking water is associated with drinking less of other beverages.

Limitations

The present study has some important limitations. Several factors that might have influenced adolescents beverage choices were not taken into account in this study. This analysis was performed in a small sample in Kayseri. Thus, it was not a national representative sample. In conclusion, longitudinal data on beverage intake among Turkish adolescents are needed to determine beverage intake patterns.

Acknowledgements

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