Çelebi, Begüm, İpek Çiçekli, Duygu Sağlam, and Gözde Arıtıcı Çolak. 2022. "The Association between Daily Beverage Consumption and Risk of Chronic Disease among Adult Women in Turkey." *World Nutrition*, September, 19–30. https://doi.org/10.26596/wn.202213319-30.

Research

The association between daily beverage consumption and risk of chronic disease among adult women in Turkey

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Keywords: beverages, young adult, sugars, diet, obesity, chronic disease, body composition, blood glucose

https://doi.org/10.26596/wn.202213319-30

World Nutrition 2022;13(3):19-30

Introduction

It has been shown that the contribution of beverage energy to total energy intake may increase the risk of diseases in various countries. The aim of this study is to evaluate the relationship between the consumption of added sugar from beverages and nutritional status, anthropometric measurements and biochemical blood parameters in adults.

Materials and Methods

This study was designed as an analytical and cross-sectional study and conducted on 100 adult females aged 18-65 who applied to the private diet outpatient clinic in Istanbul/ Turkey between November 2020 and April 2021. The demographic characteristics of the individuals were applied to the participants using the food frequency questionnaire, eating habits, physical activity habits and beverage consumption frequency questionnaires.

Results

The mean age of the women in the study was 31.8 years . Total energy intake from beverages in women over 25 years old was found to be 145.3 kcal and significantly lower. All women in the study consumed tea and coffee. The consumption rate of all beverages except energy drinks was found to be higher in the younger adults. A positive correlation was found between the results of an insulin resistance test and the total amount of added sugar from the beverages consumed (r=0.297 p=0.043).

Conclusions

Lower levels of consumption of sugar-sweetened beverages may result in a lower burden of chronic diseases. Future studies should explore consumption patterns of added sugar beverages and individual-level associations with such consumption.

INTRODUCTION

Beverage consumption can play an important role in overall diet quality and nutrient intake, as well as total energy intake (Paulsen, Myhre, and Andersen 2016). In recent years, it has been shown that the contribution of beverage energy to total energy intake may increase risks of obesity, cardiyovasculer and diabetes diseases. In addition, higher consumption of sugar-sweetened beverages (SSBs) has been shown to be significantly associated with increased serum uric acid concentrations in adults (Ebrahimpour-koujan et al. 2021).

According to Dietary Guidelines for Americans, SSBs are defined as any liquids sweetened with sugars, such as brown sugar, corn sweetener or syrup, dextrose, fructose, glucose, high fructose corn syrup, honey, lactose, malt syrup, maltose, molasses, raw sugar, and various types of added sugars such as sucrose. Examples of SSBs include, but are not limited to, soda , fruit drinks, sports drinks, energy drinks, sweetened waters, coffee and tea drinks with added sugars (*Dietary Guidelines for Americans 2015-2020* 2015).

Adding caloric sweeteners to foods and beverages is linked to an increased risk of a number of cardiometabolic problems. In addition, evidence for cardiometabolic out-

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comes of low-calorie sweeteners and drinks containing 100% juice is inconclusive (Popkin and Hawkes 2016). For example, the consumption of SSBs has been associated with a higher risk of cardiovascular disease (CVD) morbidity and mortality including a dose-response (Yin et al. 2021). Even low-calorie SSBs were also associated with a higher risk of these outcomes, but interpretation of these findings may be explained by reverse causality and confounder factors (Yin et al. 2021). In addition higher consumption of SSBs is linked with increased risk of obesity, metabolic syndrome, type 2 diabetes (Xu, Park, and Siegel 2018), kidney diseases (Bomback et al. 2010), non-alcoholic liver disease, tooth decay (Valenzuela et al. 2021; Kim, Park, and Lin 2017) and gout, so the health effects of SSBs should be a major focus of public health research (Yin et al. 2021).

SSBs contribute 10-15% of energy intake among teenagers and are the primary source of added sugar in the diets of children and adolescents. Energy intake from beverages increased 135% between the years 1977-2001 in all age groups in the United States (Keller and Bucher Della Torre 2015). It has been reported that the majority of children and adolescents (88%) consume an average of 271 kcal per day from SSBs (Han and Powell 2013). About 25% of US adolescents consume more than 750 mL of SSB per day, representing more than 350 calories (Keller and Bucher Della Torre 2015). Moreover, adolescents and young adults in particular have been reported to consume more SSBs than children and older adults (Han and Powell 2013). Therefore among young adults it is particularly important to investigate which factors affect their beverage consumption ratio.

Although studies have shown per capita consumption of SSB calories for children and adults, less is known about the trend of both beverage and SSB consumption in young and older adults, and the potential differences in energy and total added sugar intake trends from beverages. According to NHANES, beverages contribute the majority of added sugar in American diets (Kibblewhite et al. 2017). Added sugar intake is about 16.3% of total energy intake in the United States and intake of added sugars about 11-13% of total energy in Canada (United States Department of Agriculture 2015). A study published in 2015 (Singh et al. 2015) found that globally there was significant heterogeneity in the consumption of beverages by age and region, with the highest levels found in the Caribbean.

To our current knowledge, there are no published data on the SSB consumption and its contribution to diets in Turkey. The aim of this study is to evaluate the relationship between the consumption of added sugar from beverages and nutritional status, anthropometric measurements and biochemical blood parameters in adults.

MATERIALS AND METHODS

STUDY DESIGN AND SAMPLE SELECTION

Data for this cross-sectional study were collected via the face-to-face survey questionnaire method. A structured questionnaire designed by the researchers of the present study as well as an existing Beverage Intake Questionnaire (BEVQ-15), Food Frequency Questionnaire (FFQ), and Physical Activity Questionnaire Short Form (IPAQ) were administered to the volunteers. Sociodemographic characteristics, smoking, drug consumption, and disease status were covered in the structured questionnaire.

The present study was carried out among 100 females aged between 18-65 years who applied to the private diet outpatient clinic in Istanbul between November 2020 and April 2021. Using the t-test group with G-Power, the sample size was calculated with a total of 102 participants with an effect size of 0.5, a margin of error of 0.05, and a power of 80%. Approximately 20% more sample size was added to account for possible missed responses, and a total of 123 volunteers (111 female, 12 male) were invited to the study. A total of 23 individuals were excluded from the study; 17 because of their co-morbidities and 6 because they did not want to participate in the study. Since only 2 males remained, they were excluded from the study, as it would disrupt the homogeneity of the analyses.

WHO defines "youth" as individuals between the ages of 15-24 (World Health Organization, 2020), and researchers have begun to define young adulthood as the developmental period between the ages of 18-25, calling it "emerging adulthood" (McDonagh et al. 2018; Society for the Study of Emerging Adulthood 2021). In this study, the age of 25 was taken as the cut-off point and defined the age range of 18-25 as young adults. Adults over the age of 25, are considered "older adults".

ANTHROPOMETRIC MEASUREMENTS

The waist circumference, height, body weight and body mass index (BMI) measurements of the individuals were recorded by the researchers and clinical dietitians in accordance with WHO standards (World Health Organisation 2021). Anthropometric measurements were taken with bioelectrical impedance analysis (BIA).

BIOCHEMICAL PARAMETERS

Fasting blood glucose, fasting insulin, high density cholesterol (HDL), low density cholesterolcholesterol (LDL), triglyceride, total cholesterol, sodium, thyroid stimulating hormone (TSH), triiodothyronine (T3), thyroxine (T4), alanine aminotransferase (ALT), aspartate aminotransferase (AST), uric acid, blood urea nitrogen (BUN), and creatinine levels were recorded retrospectively from the biochemical blood tests performed in the last 6 months before the individuals participated in the study. HOMA-IR (insulin resistance test) was calculated using the formula HOMA-IR=Fasting Blood Sugar (mg/dL) x Fasting Insulin (uU/mL)/405.

EVALUATION OF NUTRITIONAL STATUS AND HABITS

A food frequency questionnaire was applied to determine the nutritional habits of the individuals. Consumption of food and food groups was determined as frequency and amount per day, week or month. The daily energy intake and nutrients from participants' diets were calculated using the "Nutrition Information System (BEBIS) 7.2" program (BeBiS (Nutrition Information System) and Computer Software Program Version 7.2, (Ebisprofür Windows, Stuttgart, Germany: Turkish Version), Data Sources: Bundeslebenmittelschlüssel (BLS II.3), German Data Nutrient Composition Database and Other Resources 2011). The results were compared with the Dietary Reference Intake and the adequate consumption level was determined (National Instutes of Health 2019).

STATISTICAL ANALYSIS

Statistical analyses were done using the SPSS package.The descriptive statistical methods for normally distributed variables were mean, standard deviation, median, frequency, ratio, minimum, maximum. Either the Student's t-test or Mann-Whitney U tests were used depending on how normal distributions between age groups were. Spearman's or Pearson Correlation Analysis were also performed based normalality of distributions. Statistical significance was accepted at the p<0.05 level for all results.

ETHICS

This research was conducted in accordance with the Declaration of Helsinki, and the study was approved by Acıbadem Mehmet Ali Aydınlar University Clinical Research Ethics Committee (no. 2020/22 and dated 15/10/2020). Written consent form was obtained from individuals stating that they voluntarily participated in the study.

RESULTS

The distribution of demographic data such as marital status, education and occupation status by age of the participants issummarized in Table 1. The mean age of the women in the study was 31.80±11.46 years old and 53% were older adult women. Overweight and obesity rate, high-risk waist circumference, and being married were found to be significantly higher in older women, while the ratio of current students and education levels were higher in the young adults. There was found no significant difference by age group between alcohol consumption and smoking.

Energy, macro and micronutrients from beverages are shown in Table 2. Total energy intake from beverages in the young adults was 202±133 kcal, significantly higher than in the older age group. Similarly, the total carbohydrate intake, added sugar intake and Vitamin B1, potassium and iron amounts from beverages was found significantly lower in the older adult group. No statistically significant difference was found among other nutrients from beverages.

The amounts of energy, protein, carbohydrates, fat, dietary fiber and water intake calculated according to food consumption records are shown in Table 3. Although there was no significant difference found between total dietary energy intake, fat and carbohydrate intakes, the amounts of water and protein from food was found to be significantly higher in the older group.

Compared according to BMI groups, the ratio of the beverage energy intake to total dietary energy intake was found to be significantly lower in overweight and obese women. Likewise it was observed in the waist circumference groups: The ratio of the beverage energy intake to total dietary energy intake was found significantly lower in women with high-risk waist circumference. BMI, waist circumference and added sugar intake from beverages are shown in Table 4.

Added sugar intake from beverages was not found to be different between BMI groups. The daily amount of added sugar from beverages consumed by women with high-risk waist circumference was higher in young women but this was not statistically significant. Age-adjusted BMI, waist circumference, and added sugar from beverages are shown in Table 5.

All women in the study were consuming tea and coffee. Energy drink consumption rate was higher in the group over 25 years old. Consumption of most other beverages was higher among the young women. The consumption of the beverage types by age group is given in Figure 1.

A positive and medium-level correlation was found between BMI and beverage energy in the young adult women group. HOMA was positively correlated with the total amount of added sugar from the beverages among the young women (r=0.297 p=0.043). A significant positive linear relationship was found between the energy intake from beverages and ALT in the young women (r=0.352 p=0.015). The relation between beverage ratios with BMI, waist circumference and biochemical parameters is summarized in Table 6.

DISCUSSION

To significantly decrease added sugar from beverage consumption and reduce health risks such as obesity, taxes that would substantially raise prices have been proposed (Chaloupka, Powell, and Chriqui 2011). The results from this research suggest that several types of beverage remain important contributors to added sugar consumption among Turkish women. Thus, in Turkey public health beverage policies should cover all beverages to which sugar is commonly added. Policies should also encourage the replacement of added sugar beverages with other energy-free beverages such as water, which could result in a substantial reduction of daily caloric intake (Wang et al. 2009).

Consumption of added sugar should be reduced to <10% of total daily energy intake, as recommended in the Dietary Guidelines for Americans 2015-2020 (*Dietary Guidelines for Americans 2015-2020* 2015). In somewhat stricter guidelines, WHO recommends that consumption of free sugars (including sugars in fruit juices) should be reduced to <10% of total energy intake (World Health Organization Guidelines Approved by the Guidelines Review Committee 2015).

WHO uses the term "free sugar" in the recommendation, while the American Heart Association (AHA) uses the term "added sugar". Although the terms free sugar and added sugar are similar, the term free sugar also includes the

Table 1. The demographic and antropometric data of sample women (N=100)

		Age ≤25 years n (%)	Age >25 years n (%)	*p*
BMI (mean±SD)		21.09±2.37	26.14±4.85	***<0.001***
BMI	*underweight or recommended weight*	44(93.6)	22(41.5)	***<0.001***
	overweight or obese	3(6.4)	31(58.5)	
Waist Circumference	*Recommended*	34(72.3)	20(37.7)	***<0.001***
	At risk	9(19.1)	7(13.2)	
	High risk	4(8.5)	26(49.1)	
Physical activity level	*Sedentary*	45(95.7)	51(96.2)	
	Active	2(4.3)	1(1.9)	
	Vigorous	0(0)	1(1.9)	
Education	*Primary or High school*	6(12.8)	20(37.7)	***0.004***
	Bachelor's degree	41(87.2)	33(62.3)	
Job	*Public officer*	7(14.9)	17(32.1)	***<0.001***
	Private sector	19(40.4)	17(32.1)	
	Student	20(42.6)	0(0)	
	Unemployed	1(2.1)	19(35.8)	
Marital status	*Married*	6(12.8)	34(64.2)	***<0.001***
	Single	41(87.2)	19(35.8)	
Smoking	*Yes*	7(14.9)	15(28.3)	*0.106*
	No	40(85.1)	38(71.7)	
	No	26(55.3)	30(56.6)	

Chi-square Test; One-way ANOVA test; p<0.05. BMI=body mass index; PAL= physical activity level; SD= standard deviation

sugar naturally found in juices, juice concentrates and honey (Johnson et al. 2009).

Added sugar intake from beverages, total energy, and carbohydrate intakes were significantly higher in the young women. Gómez-Miranda et al. (Gómez-Miranda et al. 2022) hypothesised that high consumption of SSB in young adults is in part due to the 'nutrition transition' phenomenon characterized by the consumption of processed foods. These foods are often consumed as fast food meals and are affordable. Consumption of high-energy meals may in turn have led to increased consumption of sugar-added beverages.

It should be noted that varying definitions and uses of free sugar versus added sugar may lead to differences in research results. In addition, the beverages included in the SSB in the studies may differ between cultures, for example, turnip juice can also be considered as a sugary drink in Turkey, so we focused only on added sugar.

According to a national study aimed to describe changes (1988–1994 to 1999–2004) in the type of beverage among Unites States adults, per capita, SSB consumption was the highest among US young adults and lowest among the elderly. (Bleich et al. 2009). Likewise, according to the NHANES, 63% of individuals aged 2-19 and 49% of adults consume at least one sugar-added beverage every day (Centers for Disease Control and Prevention National Center for Health Statistics 2017). Similarly in our study daily caloric intake and added sugar from beverages was found significantly higher among young adults. However the aforementioned studyyoung adults defined adults aged between 20-34 years, we defined the young adults aged between 18-25 years. Moreover we did not separate the beverages as SSB, we just examined the amount of added sugar from the beverages and its contribution to daily dietary energy.

A robust body of evidence indicates that SSBs are a key risk factorin weight gain. They are often the largest source of added sugar in the diet (Malik and Hu 2022). There is a linear correlation between the increase in consumption of added sugar from beverages and epidemics of obesity (Gross et al. 2004). Those who consume one or more servings of SSB per day have an important risk of having higher BMI (Malik and Hu 2022).

One study from Turkey evaluated the overall effect of each beverage group on obesity/overweight. It was found that alcoholic beverages were more closely associated with obesity than non-alcoholic beverages (Gunes et al. 2013). However, among Turkish university students, caloric beverage consumption accounted for 1% or less of the explained variance in BMI in Turkish university students (Karabudak and Kiziltan 2008).

We found that the ratio of beverage energy intake to total dietary energy intake was significantly lower in overweight and obese women. However, this lost significance when the BMI groups were adjusted for age. In our study, BMI in young adult women was significantly lower. Therefore, this may have resulted in bias in the results. Results may vary in larger, more homogeneous populations. Gunes et al. (2013) did not separate the beverages as SSBs. A

Table 2. Energy, water, micro and macronutrients from daily beverage consumption

	Mean		
	Age ≤25 years	Age >25 years	*p*
Energy (kcal)	202.59±132.6	145.39±111.28	***0.021***
Water (mL)	2460.12±851.2	2414.54±700.44	*0.770*
Protein (g)	4.5±2.75	3.68±2.42	*0.116*
Total Fat (g)*	3.28±2.47	2.66±2.34	*0.203*
Total Carbohydrates (g)*	28.19±24.38	18.46±19.84	***0.005***
Added sugar (g)	11.59±13.69	5.58±9.17	***0.005***
Fibre (g)*	0.76±1.59	0.69±1.19	*0.817*
Alcohol (g)*	4.05±8.75	3.64±6.14	*0.782*
Polyunsaturated fat (g)*	0.18±0.14	0.14±0.13	*0.090*
Cholesterol*	11.18±9.11	9.17±8.24	*0.197*
Vitamin A (µg)	32.04±22.4	25.78±20.96	*0.152*
Carotene (mg)*	0.04±0.05	0.03±0.04	*0.125*
Vitamin E equivalents (µg)	0.16±0.15	0.12±0.13	*0.090*
Vitamin B1 (mg)*	0.05±0.05	0.03±0.05	***0.034***
Vitamin B2 (mg)	0.22±0.13	0.19±0.12	*0.293*
Vitamin B6 (µg)*	0.12±0.17	0.08±0.15	*0.066*
Total Folic acid (µg)	21.74±11.87	21.04±9.08	*0.740*
Vitamin C (mg)*	10.42±12.92	8.58±11.85	*0.286*
Sodium (mg)*	258.36±191.92	255.68±165.91	*0.607*
Potassium (mg)	463.16±210.02	372.55±173.38	***0.020***
Calcium (mg)	271.23±124.27	252.92±104.22	*0.425*
Magnesium (mg)	69.50±24.66	64.85±23.03	*0.333*
Phosphor (mg)	117.23±75.50	94.27±69.5	*0.117*
Iron (mg)*	1.47±0.73	1.19±0.64	***0.023***
Zinc (mg)	2.32±0.82	2.25±0.69	*0.652*

*: Mann Whitney U test; **SD**: Standard deviation

Table 3. Water, fibre and macronutrients from foods

	Age ≤25 years	Age >25 years	*p*
Energy (kcal)	1716.06±624.77	1960.94±627.25	*0.054*
Water (mL)	620.6±219.91	819.02±218.05	***<0.001***
Protein (g)	80.35±30.4	93.28±27.58	***0.028***
Total Fat (g)	98.49±41.71	109.85±42.96	*0.184*
Total Carbohydrates (g)	128.58±60.79	151.57±61.28	*0.063*
Fibre (g)	26.96±16.66	31.25±16.14	*0.195*

*: Mann Whitney U test; SD: Standard deviation

large proportion of their sample was made up of college freshmen, possibly influencingtheir results. Karabudak and Kiziltan (2008) collected data in 2004 using 3 day dietary records, rather than the BEVQ-15 we used. Thus differences in data collection methods may have explain our differing results. In addition, beverage consumption habits that have changed over the years.

A meta-analysis of prospective cohort studies investigating the relationship between sugar-sweetened beverages and waist circumference in adult populations found that the consumption of SSB can increase waist circumference by 14%; however this was not statistically significant (Ardeshirlarijani et al. 2021). Similarly, we did not find a relationship between waist circumference and added sugar from beverages. The ratio of energy intake from beverages to total energy intake was significantly in women whose waist circumference was largest. However, when adjusted for age, it lost its significance. Further studies are needed to examine the association between SSB consumption and waist circumference.

Many studies show that the consumption of SSBs causes rapid increases in blood sugar and insulin levels (O'Connor

Table 4. BMI, waist circumference and added sugar intake from beverages

		Bev. energy (kcal)		**Added sugar (g)**		**Energy of added sugar/ Total diet energy**		**Bev. Energy/total diet energy**		**Energy of added sugar/ Total bev. energy**	
		Mean	*p*	Mean	*p*	Mean	*p*	Mean	*p*	Mean	*p*
Age	*≤25 years*	202.59±132.64	**0.021**	11.59±13.69	**0.013**	0.56±0.62	**0.005**	10.43±5.84	**0.002**	5.34±5.15	**0.016**
	>25 years	145.39±111.28		5.58±9.17		0.28±0.48		7.18±5.48		2.98±4.53	
BMI	*underweight or recommended*	186±130.92	0.125	9.27±12.9	0.307	0.46±0.6	0.219	9.86±6.19	**0.005**	4.38±5.11	0.42
	overweight or obese	145.64±107.88		6.71±9.44		0.31±0.49		6.46±4.4		3.53±4.65	
Waist circumference	*Recommended*	175.75±121.8	0.164	8.72±12.42	0.447	0.44±0.61	0.295	9.67±6.38	**0.024**	4.31±5.38	0.479
	At risk	215.43±121.73		11.01±12.71		0.54±0.55		9.97±5.11		4.94±3.78	
	High risk	143.01±127.3		6.44±10.28		0.28±0.49		6.29±4.5		3.23±4.69	

Table 5. BMI, waist circumference and added sugar intake from beverages (Adjusted for age)

		Bev. energy (kcal)								Added sugar from bev. (g)								Energy of added sugar/Total diet energy							
		Total (n=100)		≤25 years (n=47)			>25 years (n=53)			Total (n=100)		≤25 years (n=47)			>25 years (n=53)			Total (n=100)		≤25 years (n=47)			>25 years (n=53)		
		Mean	*p*	n	Mean Rank	*p*	n	Mean Rank	*p*	Mean	*p*	n	Mean Rank	*p*	n	Mean Rank	p	Mean	*p*	n	Mean Rank	*p*	n	Mean	*p*
BMI	*underweight or recommended*	186±130.92	0.125	44	23.23	0.139	22	23.23	0.134	9.27±12.9	0.307	44	23.48	0.315	22	26.64	0.884	0.46±0.6	0.219	44	23.32	0.192	22	24.45	0.312
	overweight or obese	145.64±107.88		3	35.33		31	29.68		6.71±9.44		3	31.67		31	27.26		0.31±0.49		3	34		31	28.81	
Waist circumference	*Recommended*	175.75±121.8	0.164	34	23.76	0.731	20	23.7	0.101	8.72±12.42	0.447	34	22.38	0.412	20	26.05	0.142	0.44±0.61	0.295	34	23.38	0.823	20	26	0.319
	At risk	215.43±121.73		9	22,67		7	19.86		11.01±12.71		9	27,67		7	37.57		0.54±0.55		9	24.67		7	20	
	High risk	143.01±127.3		4	29		26	31.46		6.44±10.28		4	29,5		26	24.88		0.28±0.49		4	27.75		26	29.65	

Table 6. The relation between beverage ratios with BMI, waist circumference and biochemical parameters

		Beverage Energy (kcal)			Added sugar from bev. (g)			Added sugar Energy/Total energy			Added sugar energy/bev.energy		
		total (n=100)	≤25 years (n=47)	>25 years (n=53)	total (n=100)	≤25 years (n=47)	>25 years (n=53)	total (n=100)	≤25 years (n=47)	>25 years (n=53)	total (n=100)	≤25 years (n=47)	>25 years (n=53)
BMI (kg/m^2)	r	-.154	.322	.128	-.103	.232	-.052	-.124	.264	.247	-.082	.136	-.032
	p	.125	**.027**	.360	.307	.117	.711	.219	.073	.075	.420	.361	.818
Waist circumference (cm)	r	-.109	.113	.144	-.104	.059	-.039	-.149	-.012	.129	-.109	-.029	.014
	p	.281	.450	.303	.302	.695	.783	.140	.937	.358	.280	.846	.921
Fasting glucose (mg/dL)	r	.068	.070	.143	.139	-.029	-.090	.041	-.262	-.025	.149	-.290	.014
	p	.501	.676	.384	.166	.865	.586	.689	.112	.882	.139	.077	.932
Fasting insülin (uU/mL)	r	.035	.262	-.029	-.064	.232	-.009	-.062	-.065	-.023	-.080	.005	-.027
	p	.729	.076	.839	.530	.117	.949	.537	.665	.871	.428	.972	.849
HOMA	r	.086	.193	.059	.032	**.297**	-.108	-.009	-.042	-.012	.016	-.002	.078
	p	.396	.194	.674	.751	**.043**	.441	.927	.780	.930	.877	.990	.578
HDL-C mg/dL	r	.024	.042	.169	-.005	.230	.251	-.061	-.174	.156	-.055	-.028	.113
	p	.811	.778	.227	.960	.120	.070	.546	.243	.265	.588	.850	.421
LDL-C mg/dL	r	-.031	.004	.160	-.001	.205	.126	-.036	-.010	.196	-.065	-.029	.072
	p	.763	.981	.252	.993	.167	.369	.723	.946	.160	.520	.847	.610
Triglyceride (mg/dL)	r	.033	.162	.142	-.055	-.171	.074	-.111	-.239	.136	-.109	-.125	.141
	p	.743	.277	.309	.584	.250	.597	.271	.106	.333	.280	.403	.314
Total cholesterol (mg/dL)	r	.082	.119	.084	-.019	-.067	.065	-.088	.189	-.205	-.178	.009	-.072
	p	.417	.426	.548	.854	.656	.645	.384	.204	.141	.076	.950	.610
ALT (U/L)	r	-.128	**.352**	.159	-.134	.194	-.164	-.154	.029	-.075	-.154	.146	-.048
	p	.206	**.015**	.256	.184	.191	.239	.126	.846	.596	.126	.327	.735
AST(U/L)	r	-.080	.199	.142	.026	.043	.169	-.017	.230	-.109	-.019	.132	-.070
	p	.428	.181	.312	.798	.773	.227	.869	.120	.438	.855	.376	.617

HOMA-IR: Homeostasis model assessment-estimated insulin resistance; **HDL-C:** High-density lipoprotein cholesterol; **LDL-C:** Low-density lipoprotein cholesterol; **ALT:** Alanine Aminotransferase; **AST:** Aspartate Aminotransferases

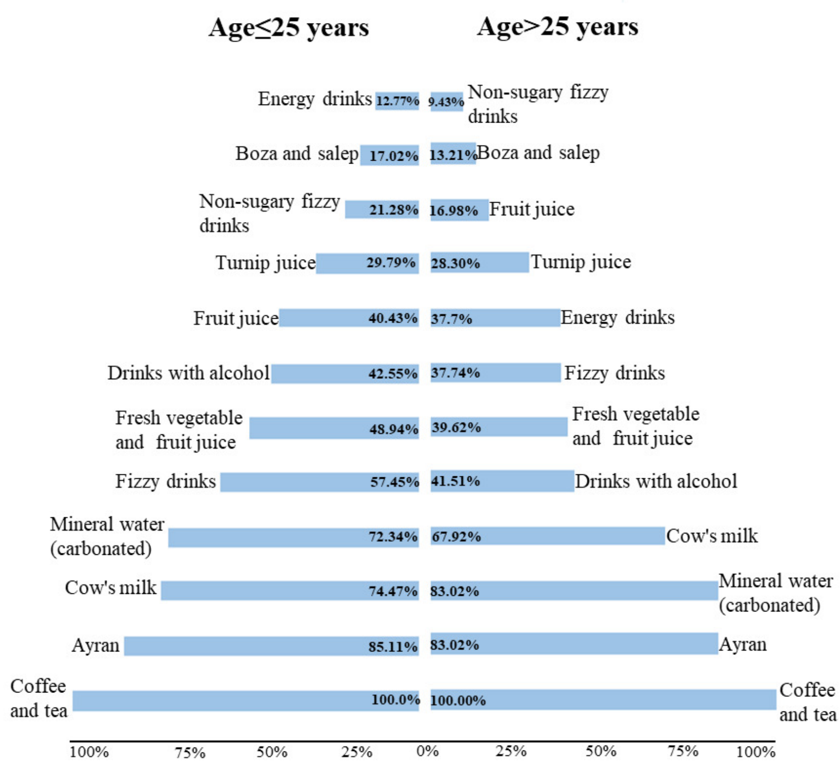

Figure 1. The preferred beverage types and consumption rates by age

** Ayran, known as the non-alcoholic national drink of Turkey, is made of yogurt, water and salt.*
** Boza is a non-alcoholic fermented drink made from grains such as corn, barley, rye, oats, wheat or millet.*
** Salep is a powder made from dried root tubers of a range of orchids. It is a traditional and non-alcoholic winter beverage.*

et al. 2018; Solomi, Rees, and Redfern 2019; Tey et al. 2017). Multiple experimental and long-term prospective studies have shown that consumption of beverages with high added sugar increases the risk of cardiovascular diseases, dislipidemia, diabetes and obesity (Elliott et al. 2002; Schulze et al. 2004; Vartanian, Schwartz, and Brownell 2007; Yang et al. 2014). A review of 17 prospective cohort studies and clinical trials reported that excessive consumption of SSBs, a marker of lower diet quality, is related to elevated risks of individual cardiometabolic abnormalities (Malik and Hu 2019). Another study found that increased consumption of sugar-added beverages resulted in a reduction in HDL cholesterol and increases in plasma glucose and triglyceride levels (Mashhadi et al. 2016). We found a positive correlation between HOMA and the added sugar from the beverages consumed by the young women in our sample. Likewise, a positive relationship was found between fasting insulin and the ratio of the beverage energy intake to total dietary energy in this age group. However, in larger research populations, such results may also be significant in older adults.

Limitations in the present study includethat the sample was exclusively women. In addition, our research population had a medium-high socioeconomic. Third, our sample was selected from a private clinic, an additional factor indicating it does not represent the whole population. Finally, we did not examine the beverages per se; we just examined the amount of added sugar from them and its contribution to daily dietary energy.

CONCLUSIONS

This research showed that consumption of added sugars was higher but also BMI was lower in young adult women. Therefore, this was a confounding factor in our study. An important finding was that sugar added to beverages was was associated with HOMA-IR, an indicator of insulin resistance. While further studies with a larger sample size, including all ages and both sexes would be useful, we believe there is a clear need of public health policies aiming to reduce consumption of sugar-sweetened beverages in Turkey.

AUTHORS' CONTRIBUTIONS

B.Ç. in the organization of the study and İ.Ç. contributed to the writing of the article. D.S. and G.A.Ç. supported to İ.Ç. and supervised this work. All phases of the study were re-examined by all authors. All authors have read and approved the final version.This study was the Master of Nutrition and Dietetic thesis of the first author in Acibadem University published in 2021.

FINANCIAL SUPPORT

This research received no specific grant from any funding agency, commercial or not-for-profit sectors.

CONFLICT OF INTEREST

None.

Submitted: August 01, 2022 BRT, Accepted: September 27, 2022 BRT

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