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ASSOCIATION BETWEEN CONSUMPTION OF CARBONATED DRINKS AND RISK OF CARDIOVASCULAR DISEASE IN IRANIAN PATIENTS

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Abstract

Background: *This study aimed to evaluate the amount of carbonated-drinks in patients with documented cardiovascular disease in Iranian population.*

Material and Methods: *This cross-sectional study analyzed the data of 301 patients (age 40-87 years old) who were admitted in Ghaem hospital and participated in this study. Carbonated-drink intake was defined as the sum of the intakes of carbonated beverages. Participants were categorized into two study groups depending on their angiography reports. The association between angiography reports and carbonated-drink intake was evaluated using a multivariable-adjusted logistic regression model.*

Results*: The study involved 301 patients; 156 patients (51/8%) were male and 145 patients (48/2%) were female. Patients with cardiovascular disease who consumed carbonated drinks everyday compared with those who consumed carbonated drinks ever month, showed a significant ($p<0.001$) for high risk angiography results. Additionally, the risk of cardiovascular disease increased with the increase in the intake of carbonated drinks and high levels of total cholesterol, low-density lipid, triglyceride, High Blood Pressure (Systolic and Diastolic) ($p<0.001$) but there was no association between high-risk angiograph results and smoking.*

Conclusion: *In Iranian patients, every day carbonated-drinks intake is associated with a multivessel involvement cardiovascular disease.*

Keywords: *Carbonated- drinks; Sugar-Sweetened Beverages; SSBs; Cardiovascular Diseases; Iranian; patients*

Introduction

In Iran, population aging has resulted in a progressive increase in the healthcare burden which is caused by chronic diseases such as cancer, cardiovascular disease (CVD), obesity, diabetes, and osteoporosis. In particular, cardiovascular disease follows traffic accidents as the second leading cause of death in Iran. Therefore, decreasing the incidence and prevalence of cardiovascular disease cardiovascular disease has become an important public health target to improve population health and decrease medical expenses. Non-communicable diseases, also known as chronic diseases are the main reason for more than two-thirds of global deaths in lots of countries, in which the unhealthy diet is one of the primary risk factors. In lots of published articles, a high correlation be-

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tween the dietary intake and the occurrence of chronic diseases were shown so dietary improvements are very important technique for chronic disease; Several studies have reported an increased risk of chronic diseases, such as obesity, type 2 diabetes, hypertension, and metabolic syndrome, with the increased intake of calories, salt, sugar, fat intake and Sugar-sweetened beverages. The best solution to reduce cardiovascular disease is to correct the unhealthy diet with reducing these items [*Mozaffarian D., 2016; Vos M. B et al., 2017; Malik V. S et al., 2019*]. Beverages account for the highest proportion (34.3%) of sugar intake from processed foods in lots of countries, in this situation, beverages that contain Carbonated sugar syrup constituting the majority [*Odegaard A. O et al., 2015*]. In lots of countries, the average intake of carbonated drinks has been increased during the last 10 years [*Paganini-Hill A et al., 2007*].

Nonetheless, the association between the high risk of cardiovascular disease and the consumption of carbonated drinks has not been adequately evaluated in Iranian population. This study was done to confirm the association between the intake of carbonated drinks and the high risk of cardiovascular disease in Iranian patients by using the data from the Ghaem hospital in Iran. These kinds of studies provide the requisite evidence for health policy changes with the goal of cardiovascular disease prevention.

Naterial and Methods

Participants: This cross-sectional study used data from cardiology department Ghaemm hospital, which was conducted for 1 year and included all the patients who are candidate for angiography. Data collected from adult males and females (age 40-87 years) were obtained for analysis. A total of 301 patients were participated in this study. The data of individuals who had senilities to contrast were excluded from study. This study was approved by the Medical Research Ethics Review Committee of the Mashhad university of medical science. The requirement for informed consent from individual patients was obtained. Inclusion criteria for entering was angiography candidate and exclusion criteria included failure to cooperate with researchers in research stages and sensitivity to contrast.

Study Variables: The instruments used in the descriptive part of the study included a demographic questionnaire, a carbonated soft drinks consumption checklist and a lab data for lipid profile and FBS. Demographic variables such as age, sex were surveyed. Health-related behaviors such as smoking and drinking were ascertained through the questionnaire survey. Based on the smoking status, participants were categorized as never smokers and current smokers. Never smokers had never smoked or smoked less than 3 cigarettes per day in the last month and were not currently smoking and current smokers had smoked more than 3 cigarettes per day (daily smoking) in the last month and currently smoked. Body mass index (BMI) was calculated by dividing the individual's weight (*kg*) by the square of his height (*m*). Chronic diseases such as hypertension, diabetes, and dyslipidemia were considered only on the basis of diagnosis or treatment by a doctor. Fasting Blood sugar was another variable (Diabetes; FBS.126 *mg/dl*; glucose intolerance FBS:>110 *mg/dl*). Lipid profile for all the participant were checked which was contained Total Cholesterol, high-density lipid (HDL), low-density lipid (LDL) and Trigeleciride. Drinking was defined as the consumption per month (Low dose), per weeks (Intermediate dose) or daily (High dose). Blood pressure assessment also was done for each participant.

Definition of Sugar-Sweetened Beverages: In 2017, the Global Burden of Disease Risk Factor Collaborators included carbonated drinks, sodas, energy drinks, and fruit juices as Sugar Sweated Beverages (SSB) and excluded juices that were made entirely from fruits or vegetables from the SSB group. In the food intake-frequency survey, coke, cider, and carbonated fruit beverages were included as carbonated drinks. Therefore, in this study, the intake of SSBs was defined as the sum of the intakes of carbonated beverages (colas).

Statistical Analysis: The Kolmogorov-Smirnov test was used to survey the normality of the distribution for quantitative variables. In this study, continuous variables were reported as mean and standard deviation. Age; BMI; and daily carbohydrate intake were all calculated as the mean and standard error. By variance analysis was performed to compare the means of quantitative variables. One-way analysis of variance was used to verify

the differences between the groups based on the intake of carbonated drinks.

Smoking, drinking, regular physical activity, hypertension, diabetes and dyslipidemia were all calculated frequencies and percentages (%). The chi-square test was used to verify the inter-group differences based on the intake of carbonated beverages. To evaluate the association between the intake of SSBs and high risk of CVD, a multivariable-adjusted logistic regression analysis was conducted for each group stratified by SSB intake. After adjusting the variables in the three models developed for this study, the odds ratios for each SSB intake group were calculated. All analyses were conducted using SPSS software (version 23) and were interpreted as significant only when the P-value was less than 0.05.

Results

Among the study population, 156 (52%) were female and 145 (48%) were male. The mean BMI was 26.42 ± 3.39 kg/m^2 (min:18.46; max: 40.05). Also, we found that the total cholesterol ranged (min:19; max: 300) had an average of 197.68 ± 45.439. The highest LDL was 195 *mg/dl* while the lowest was 56 mg/dl. Furthermore, the mean fasting blood sugar (FBS) was 114.87±33.38 *mg/dl*. Table 1 shows the baseline characteristics of the study population.

The study subjects were divided into four groups according to their angiography results; (i) Normal; (ii) 1-vessel disease; (iii) 2-vessel disease; and (iv) 3-vessel disease. The majority of males had a normal angiography result (61 patients), while among the females, the 2-vessel disease was the most common finding (49 patients). Furthermore, while a 3-vessel angiography result was more common among the females, it was the least common finding in both sexes. Table 2 shows the grouping of patients according to their angiography findings.

We categorized the patients into five groups in terms of the volume of SSB consumption. The highest number of patients had a moderate consumption and the lowest number of patients had no history of SSB consumption. Furthermore, the highest number of patients had a 2-vessel disease angiography report. The results of Kurskal-Wallis showed that there was a significant association between the amount of SSB consumption and the angiography report (Table 3).

We also assessed the association between study variables and the angiography results. As evident in Table 4., there was a significant association between BMI, total cholesterol, triglyceride, HDL, LDL, FBS, SBP, and diastolic blood pressure (DBP) and the result of angiography.

Discussion

The present study assessed the association between the consumption of SSBs and the risk of cardiovascular diseases represented by angiography

Table 1.

The baseline characteristics of study patients

Variables	Mean	SD	Min.	Max.
BMI	26.42	3.39	18.46	40.05
Total cholesterol	197.68	45.44	19	300
Triglyceride	165.93	77.80	16	426
Low-density lipid	116.70	31.16	56	195
High-density lipid	36.31	6.85	20	63
Fasting blood sugar	114.87	33.38	100	262
Systolic blood pressure	132.76	12.59	145	185
Diastolic blood pressure	83.19	6.91	70	100

Table 2.

The gender distribution of study groups

Gender	Angiography result n(%)				Chi-square result
	Normal	1-vessel	2-vessel	3-vessel	
Female	48 (44)	31 (47)	49 (57.6)	28 (68.3)	
Male	61 (56)	35 (53%)	36 (42.4)	13 (31.7)	0.031
Total	109 (100)	66 (100)	85 (100)	41 (100)	

Table 3.

The association between the amount of SSB consumption and angiography result

SSB consumption	Angiography result n(%)				Kruskal–Wallis
	Normal	1-vessel	2-vessel	3-vessel	
None	3 (2.8)	2 (3)	3 (3.5)	5 (12.2)	
Little	53 (48.6)	17 (25.8)	16 (18.8)	2 (4.9)	
Moderate	41 (37.6)	27 (40.9)	32 (37.6)	20 (48.8)	<0.001
Large	12 (11)	20 (30.3)	34 (40.0)	14 (34.1)	
Total	109 (100)	66 (100)	85 (100)	41 (100)	

Table 4.

The association between study variables and angiography results (M ± SD)

Variables	Angiography result				Kruskal–Wallis
	Normal	1-vessel	2-vessel	3-vessel	
Age	59.82 ± 11.73	61.58 ± 10.31	59.08 ± 10.0	60.58 ± 8.78	0.504
BMI	24.76 ± 2.71	27.37 ±3.40	27.07 ± 3.56	27.94 ± 2.91	<0.001
Total cholesterol	178.7 ± 42.74	201.12 ± 47	209.62 ± 38.89	217.88 ± 45.41	<0.001
Triglyceride	139.61 ± 52.66	191.89 ± 96.88	160.80 ± 75.74	204.71 ± 77.56	<0.001
Low-density lipid	108.91 ± 29.320	113.39 ± 32.37	115.73 ± 28.01	144.78 ±24.79	<0.001
High-density lipid	36.74 ± 6.32	113.39 ± 32.37	115.73 ± 28.01	144.78 ± 24.79	0.024
Fasting blood sugar	100.09 ± 16.71	103.52 ± 23.25	125.38 ± 25.39	150.66 ± 54.92	<0.001
Systolic blood pressure	124.86 ± 8.26	131.89 ± 12.17	137.12 ± 10.89	146.1 ± 10.98	<0.001
Diastolic blood pressure	80.33 ± 5.79	82.50 ± 6.69	84.41 ± 6.61	88.05 ± 7.73	<0.001

results. The results of our study showed that there was a significant relationship between the intake of SSBs and the severity of cardiovascular diseases. Furthermore, we found that the results of angiography were significantly associated with gender, BMI, total cholesterol, triglyceride, LDL, HDL, FBS, SBP, and DBP.

Several previous studies back up the present study on the association between the intake of SSBs and the risk of cardiovascular diseases [*Mozaffarian D., 2016; Kim S. O et al., 2021*]. Namely, a large meta-analysis of seven cohorts reported a 9% increase in the risk of CVD among those with a heavy consumption pattern [*Yin J et al., 2021*]. Furthermore, a review of pediatric clinical trials has shown that the consumption of SSBs is associated with increased cardio-metabolic risk [*Vos M. B et al., 2017*]. Another study showed that those subjects who had two or more servings per day had a 31% higher risk of CVD compared to infrequent drinkers [*Malik V. S et al., 2019*]. Also, the findings of an analysis on National Health and Nutrition Examination Survey showed a 29% increase in CVD risk among those with a 7/week drinking pattern compared to 1/week drinkers [*Yang Q et al., 2014*]. However, there were contradicting results as well; although it was shown in the US-based Reasons for Geographic and Racial Differences in Stroke study that a 12-oz serving/day was associated with increased all-cause mortality, they showed no significant association with death due to CVD [*Collin L. J et al., 2019*]. Furthermore, two studies in Singapore [*Odegaard A. O et al., 2015*] and the US [*Paganini-Hill A et al., 2007*], found no significant association between intake of SSBs and death; however, it should be mentioned that both studies had a low-level drinking pattern. In addition to the independent impact of SSBs on the risk of CVDs, it has been shown that this habit impacts the known risk factors of CVDs, thus further attributing to the increased risk. For example, cohort studies have reported a significant association between drinking SSBs and increased risk of metabolic syndrome [*Yan T et al., 2023*]. Also, different short-term RCTs have shown that a high SSB diet leads to increased serum levels of total cholesterol, LDL cholesterol, and blood pressure, which is in line with the present study [*de Menezes M. C et al., 2023*]. The impact of drinking SSBs on the increased risk of CVD and its conventional risk factors have been explained by previous studies. Drinking SSBs is associated with weight gain, which is known as a risk factor for CVDs [*Malik V. S., Hu F. B. 2019*]. Furthermore, SSBs have been shown to induce sudden spikes in serum glucose and insulin levels [*Calcaterra V et al., 2023*]. Also, given that these beverages have a moderate-to-high glycemic index, they lead to a high glycemic load, which is associated with insulin tolerance [*Buziau A. M et al., 2023*]. Another explanation for this phenomenon is the presence of fructose in SSBs in large amounts. Typically, fructose is metabolized by hepatic enzymes into glucose, lactate, and fatty acids, which are consumed by cells [*Diaz C et al., 2023*]. However, when consumed in large amounts, fructose leads to hepatic lipogenesis, dyslipidemia, and insulin tolerance [*Stanhope K. L et al., 2015*]. Furthermore, fructose is associated

with increased levels of uric acid, which inhibits the functions of endothelial nitric oxide, which might explain the pathophysiology of the increased risk of CVD [*Richette P et al., 2017*].

The present study had a few limitations. First, the study was a cross-sectional study, which is associated with limitations in nature, i.e., no causal relationship can be deducted. Second, the drinking pattern among the subjects was not strict and would change over time, thus negatively impacting the results. Third, compared to previous studies, our sample size was not large. Fourth, we were not able to exclude the residual confounding variables, such as changes in the medication or lifestyle of the subjects.

Conclusion

As a conclusion, the present study approved the previous studies on the association between intake of sugar sweated beverages and increased risk of cardiovascular diseases. The present study also showed that the intake of sugar sweated beverages s is associated with the conventional risk factors of cardiovascular diseases. However, the study population was not too large to represent the Iranian population and thus cannot be generalized. These findings could be used to enlighten the gravity of such dietary habits and initiate efforts to find substitutes for these drinks. We suggest that future studies examine a larger study population and include a follow-up plan.

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