

The relationship between diet soda soft drinks, artificial sweeteners, and diabetic retinopathy: A cross-sectional study

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RESEARCH

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ABSTRACT

Background

The relationship between diabetic retinopathy and diet-drink (soft soda), non-nutritive sweeteners have not been fully determined. We here attempted to determine it.

Aims

The study aimed to assess the association between soda soft drinks, non-nutritive sweeteners, and diabetic retinopathy.

Methods

A cross-sectional descriptive study was conducted at a diabetes center in Tabuk city, Saudi Arabia from September 2019 to April 2020: 174 patients with type 2 diabetes mellitus (DM) were interviewed using a structured questionnaire: demographic data, the DM duration, the

lifestyles (exercise, smoking, and diet), and the medications. The weekly amount of diet soda and daily consumption of non-nutritive sweeteners were assessed. These were analysed with association with retinopathy.

Results

The glycated haemoglobin per cent was 8.50 ± 1.60 , the diet soda and artificial sweeteners consumptions were 1.18 ± 1.57 cans/week and 0.89 ± 1.26 sachets/day, respectively. No association was found between artificial sweeteners, diet soda, and diabetic retinopathy (Wald, 1.251, and 0.213, P-values, 0.263, and 0.644, 95 per cent CI, 0.583–7.204, and 0.190–2.793 respectively). Retinopathy incidence was associated with the DM duration (Wald, 8.095, P-value, 0.004, and 95 per cent CI, 0.766–0.952).

Conclusion

Diet soda and non-nutritive sweeteners were not associated with diabetic retinopathy, irrespective of gender or body mass index. Diabetic retinopathy was associated with the duration of DM after its first diagnosis.

Key Words

Diabetic retinopathy, diet soda soft drinks, non-nutritive sweeteners

What this study adds:

1. What is known about this subject?

The literature assessing the relationship between diet soda and non-nutritive sweeteners on diabetic retinopathy are lacking. This is the first study to assess this important issue in Saudi Arabia

2. What new information is offered in this study?

The study found no association between diet soda, non-

nutritive sweeteners, and diabetic retinopathy.

3. What are the implications for research, policy, or practice?

Diet soda and non-nutritive sweeteners in moderate amount may not affect diabetic retinopathy.

Background

We are in the diabetes epidemic. Currently, 350 million are affected by this lifelong morbid disease, and the projection for the year 2030 is 438 million. Furthermore, 8 million people suffer from prediabetes and with every diagnosed patient, another person is undiagnosed, so the number is double.¹⁻⁴ The Kingdom of Saudi Arabia is among the countries with the highest prevalence (21.1 per cent). Patients with type 2 diabetes could present with microvascular complications including diabetes retinopathy at the time of diagnosis with deleterious consequences on the affected person, healthcare providers, and the community at large. People suffering from diabetes mellitus have three times the health expenditure compared to others without the disease mainly due to retinopathy.^{5,6}

Worldwide in 2010, 32.4 million people are blind and 191 million visually impaired, from them 0.8 million were blind, and 3.7 million were visually impaired because of diabetes retinopathy, with an alarming increase of 27 per cent and 64 per cent, respectively.⁷ The prevalence of diabetic retinopathy in Saudi Arabia ranged from 19.7 per cent to 36.8 per cent in different regions.⁸⁻¹⁰ Non-nutritive sweeteners (Acesulfame-K, Aspartame, sucralose, and Cyclamate) are widely consumed in soft drinks and canned food and have been linked to various diseases including diabetes mellitus, obesity, and cancer.¹¹

To our best of knowledge, no researchers have assessed the relationship of diet soda and NNSs to diabetic retinopathy in the Kingdom of Saudi Arabia, and it is a few worldwide types of research study that relationship. Thus we conducted this research, in the present study, we thought to assess the relationship of diet soda and non-nutritive sweeteners to diabetic retinopathy in Tabuk, Saudi Arabia.

Method

A cross-sectional hospital-based study was conducted in the diabetes center, King Fahd Specialist Hospital, Tabuk, Saudi Arabia during the period from September 2019 to April 2020; One hundred seventy-four participants with type 2 diabetes were enrolled in the study. Children with diabetes mellitus and pregnant ladies were not included.

Study population and sampling:

Subjects with the diagnosis of type 2 diabetes in King Fahd Specialist Hospital and are coming for regular visits were approached. Pregnant ladies, severely ill patients, patients with renal impairment and liver cirrhosis, and patients with malignancies were excluded. A face to face interview will be conducted using a structured questionnaire that inquires about socio-demographic data, duration since the diagnosis of type 2 diabetes, cigarette smoking, hypertension, physical exercise, and if following a healthy dietary habit. The medications used by the patient including lipid-lowering medication (may affect the development and progression of diabetes retinopathy), diabetic retinopathy also documented (consisted of funduscopy examination by using slit-lamp with 90 D lenses and indirect ophthalmoscopy). DR was defined as the presence of one or more of the following lesions: microaneurysms, blot or flame-shaped haemorrhages, hard exudates, cotton-wool spots, or evidence of laser treatment for DR at baseline. DR was categorized as nonproliferative (NPDR) or proliferative (PDR), determined by the presence of retinal neovascularization.

The consumption of soda soft drinks was reported as follows: No consumption, <1 can of 350ml/week (mild), 1–4 cans (moderate), and > 4cans/week (high).¹¹ The amount, duration, and frequency of non-nutritive sweeteners were also reported in sachets/tabs per day.

Weight, height, and Body Mass Index (BMI) as measured using the formula: Weight in Kg/height in (meters) were recorded. Obesity was defined as a BMI ≥ 30 , overweight 25–29, and 18–25 as normal. The most recent glycated haemoglobin (HbA1c per cent) was collected from the patient's records to assess the degree of glycaemic control, and glycated haemoglobin of <7 was regarded as good glycaemic control.⁴ Written informed consent was signed by all the participants, and an approval letter was obtained from the ethical committee of the University of Tabuk (ref. number, UT-93-1-2020, date, 27/1/2020).

Statistical analysis:

Data were exported to the Statistical Package for Social Sciences for the analysis. Descriptive and summary statistics were carried out to describe study participants according to different characteristics and proportions were computed to find out the relationship between soda soft drinks, non-nutritive sweeteners, and diabetic retinopathy. A-P-value of <0.05 was considered significant.

Results

There were 174 patients with diabetes (49.5 per cent women), their ages ranged from 25–94 years with a mean of 49.80 ± 13.45 years, the duration since the diagnosis of diabetes was 9.36 ± 6.56 years, the body mass index of the participants was 26.96 ± 4.51 , the glycated haemoglobin was 8.50 ± 1.60 , the diet soda and artificial sweeteners were 1.18 ± 1.57 cans/week and 0.89 ± 1.26 sachets/tabs/day respectively. In the present study, less than half (49.4 per cent) were adherent to regular exercise, family history of diabetes, hypertension, and coronary artery disease were reported in 71.3 per cent, 55.2 per cent, and 14.9 per cent respectively. Regarding medications, 37.9 per cent were on anti-hypertensive drugs, 23 per cent on lipid-lowering medications, 35.6 per cent were on oral hypoglycaemic drugs. 12.6 per cent were on insulin only, while 51.7 per cent were using both oral therapy and insulin combination. In the present study, nearly one third (31 per cent) suffer from diabetic retinopathy (both non-proliferative diabetic retinopathy and proliferative diabetic retinopathy), and 66.6 per cent were either overweight or obese Table 1.

In the current study, no association was found between artificial sweeteners, diet soda, and diabetic retinopathy (Wald, 1.251, and 0.213, P-values, 0.263, and 0.644, 95 per cent CI, 0.583–7.204, and 0.190–2.793 respectively) which was associated with the duration of diabetes mellitus (Wald, 8.095, P-value, 0.004, and 95 per cent CI, 0.766–0.952). Table 2 depicted the association of diabetic retinopathy and other patient's characteristics.

Discussion

Diet soda soft drinks and non-nutritive sweeteners are widely used for calorie restriction among patients with diabetes mellitus and high body mass index. However, literature assessing the relationship of soda soft drinks to diabetic retinopathy in the Kingdom are scarce. We found a single recent study¹² that evaluated the relationship in Australia and found that high consumption of soda diet drinks is associated with the severity of diabetic retinopathy. A decreased additive sugar intake is recommended by many organizations, substitution with non-nutritive sweeteners is among strategies to achieve this goal.¹³ Previous studies from Australia found 18.2 per cent of the adult population consumed non-nutritive sweeteners, with the most common food sources being carbonated soft drinks, tabletop sweeteners, and yogurt and their benefit in energy reduction and weight loss are controversial.¹⁴ The association of non-nutritive sweeteners with diabetes, cardiovascular disease, obesity, depression, and cognitive impairment is inconclusive.¹¹ NNSs interfere

with learned responses that contribute to control glucose and energy homeostasis, interfere with gut microbiota and induce glucose intolerance, and interact with sweet-taste receptors expressed throughout the digestive system that plays a role in glucose absorption and trigger insulin secretion.¹⁵ The effects of non-nutritive sweeteners and diet soda on plasma sugar and glycaemic control is a matter of debate, while their effects on diabetic retinopathy were not studied in the Kingdom of Saudi Arabia.^{16,17}

In the present study, artificial sweeteners and diet soda consumption were not associated with diabetic retinopathy. A study conducted in Australia¹⁸ found that diet soda is associated with proliferative diabetic retinopathy in contradiction to the present findings in which diet soda was not associated with diabetic retinopathy, another study from Australia¹² found the association of artificial sweeteners and the severity of diabetic retinopathy, a plausible explanation could be the lower amount of daily consumption of soda soft drinks and artificial sweeteners observed in the current sample and the fact that the majority of our patients had mild non-proliferative diabetic retinopathy. The current data showed that 47.1 per cent of patients with diabetes were consuming non-nutritive sweeteners and diet soda in line with Fenwick et al.¹⁸ who observed diet soda consumption in 46.8 per cent of patients. The current data showed that 66.6 per cent were obese or overweight and the BMI was not associated with diabetic retinopathy, similar findings were concluded by Sujanitha et al.¹⁹ who found no association between diabetes complications and BMI, the association between diabetes complications and BMI seems to occur at levels ≥ 27.5 in particular among men,²⁰ in the present study most patients BMI was less than 27.5. In the present study, diabetic retinopathy was associated with the duration of diabetes in similarity to previous observations,^{21,22} a study published in Hong Kong²³ found no association between gender and diabetic retinopathy in line with the current observations.

The limitations of the study were the relatively small size of the study group and the study was conducted at a single diabetes center, so generalization to the whole Kingdom of Saudi Arabia cannot be insured.

Conclusion

Diet soda and non-nutritive sweeteners were not associated with diabetic retinopathy with no differences by gender or body mass index. Diabetic retinopathy was associated with the duration since the diagnosis of diabetes.

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PEER REVIEW

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CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

Table 1: The characters of the study group

| | |
|-------------------------------------|-------------|
| Age (25-94) | 49.80±13.45 |
| Duration of diabetes | 9.36±6.56 |
| BMI | 26.96±4.51 |
| HbA1 _c | 8.50±1.60 |
| Soda soft drinks /week | 1.18±1.57 |
| Artificial sweeteners /day | 0.89±1.26 |
| Sex | |
| Males | 88 (50.6%) |
| Females | 86 (49.4%) |
| BMI | |
| Obese | 36 (20.7%) |
| overweight | 80 (45.9%) |
| Exercise | 86 (49.4%) |
| Family history of diabetes | 124 (71.3%) |
| Family history of hypertension | 96 (55.2%) |
| Family history of coronary syndrome | 26 (14.9%) |
| Hypertension drugs | 66 (37.9%) |
| Lipid-lowering medications | 40 (23%) |
| Diabetes medications | |
| Oral therapy | 62 (35.6%) |
| Insulin | 22 (12.6%) |
| Both | 90 (51.7%) |
| Retinopathy (NON-PDR, PDR) | 54 (31%) |
| Diet soda consumers | 82 (47.1%) |

Table 2: The association between diabetic retinopathy, soda soft drinks, artificial sweeteners, BMI, duration of diabetes mellitus, and gender

| Character | Wald | P-value | 95 % CI |
|-----------------------|-------|---------|-------------|
| Soda soft drinks | 1.251 | 0.263 | 0.583-7.204 |
| Artificial sweeteners | 0.213 | 0.644 | 0.190-2.793 |
| BMI | 2.459 | 0.117 | 0.776-1.029 |
| Duration of diabetes | 8.095 | 0.004 | 0.766-0.952 |
| Gender | 0.223 | 0.637 | 0.369-5.092 |
| Constant | 4.691 | 0.030 | |