

Research Report

Sugary drink consumption and tooth decay relationship in diabetes mellitus patients

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ABSTRACT

Background: Diabetes mellitus is a chronic metabolic disorder characterized by high blood sugar levels. It is a global health problem that can increase the risk of tooth decay and requires conservative dental treatment. Several factors impact the severity of tooth decay, sugary drink consumption is one of them. **Purpose:** This study aimed to investigate the association between tooth decay in patients with diabetes mellitus who regularly consume sugary drink versus those who do not. These patients visited Conservative Dentistry Section, Universitas Airlangga Dental Hospital Surabaya, Indonesia, during Jan-Mar 2023. **Methods:** This study involved 37 patients with diabetes mellitus and posterior tooth decay. Demographic data were gathered from personal interview and dental records. Statistical analysis was done using chi-square analysis. **Results:** sugary drink consumption has a significant difference ($p < 0.05$) among the patients with posterior tooth decay and diabetes mellitus. **Conclusion:** sugary drink consumption influences the severity of tooth decay in diabetes mellitus patients.

Keywords: tooth decay, caries, sugary drinks, diabetes mellitus, diabetics

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INTRODUCTION

Tooth decay or caries is a major oral health problem which disturbs day-to-day activities. It is a multifaceted disease characterized by demineralization of tooth hard tissues such as enamel, dentin, and cementum. Caries is a disease that occurs due to the activity of bacteria in the oral cavity. The following factors contribute to the development of caries: host (teeth and saliva), substrate, microorganism (bacteria), and time.¹ These four factors interact with each other causing caries to occur. In addition to the four previously mentioned factors, individual characteristics can also influence the occurrence of caries.² These include age, education level, economic status, and daily eating patterns. An eating pattern is related to the type and frequency of food consumption, food portion, and daily food quality.¹

Diabetes Mellitus (DM) is a chronic metabolic disorder categorized by hyperglycemia or high blood sugar levels resulting from either insufficient insulin secretion or ineffective insulin action. Diabetes mellitus can be grouped into four main categories.³ Type 1 diabetes mellitus is an autoimmune disease where beta cells of the pancreas which produce insulin are attacked by one's own body. Type 2

diabetes mellitus is a multifactorial disease that can result from an unhealthy lifestyle, including an unhealthy diet and obesity.⁴ Gestational diabetes mellitus develops and usually resolves during pregnancy. Secondary diabetes mellitus is caused by certain medications or other underlying illnesses.⁵ This condition has been linked to various negative effects on oral cavity and other structures.^{6,7}

A multitude of studies have indicated that oral manifestations are associated with diabetes mellitus. Intraoral alterations associated with diabetes mellitus are frequently linked to neuropathy, a lengthier diabetic condition, and hyperglycemia. Diabetic patients frequently exhibit lower saliva flow rates compared to normal patients.^{8,9} Furthermore, patients with diabetes mellitus are have tendency to develop oral infection with tissue degeneration characteristics, such as periodontal disease and caries.⁸ Lowered salivary flow rates, a common condition in patients suffering diabetes mellitus, reduced saliva remineralization and buffer capacities, and rose the predisposition to develop gingivitis and carious lesions.¹⁰

The altered buffering activity of saliva resulting from a reduction in the availability of phosphate and calcium ions, which are crucial for remineralization, and an increase in the

availability of fermentable carbohydrates to oral bacteria, increases the risk of developing new carious lesions.^{11,12} This study evaluate the association between sugary drink consumption and tooth decay, especially in posterior teeth, in diabetes mellitus patients.

MATERIALS AND METHODS

This study is cross-sectional observational analytic study, conducted from January to March 2023. The study has been ethically approved by Universitas Airlangga Dental Hospital (No. 17/UN3.9.3/2022). Secondary data were gathered from the dental records of 37 patients at the Conservative Dentistry Department of Universitas Airlangga Dental Hospital who had been diagnosed with diabetes mellitus and experiencing tooth decay in the posterior teeth. The diabetes mellitus was determined through personal interviews and an examination of the patients’ dental records. The patients’ sugary drink consumptions were assessed through an interview. Tooth decay or carious lesions was checked on maxillary and mandibular premolars and molars. Informed Consent statements were obtained from subjects participated in this study.

All patients agreed to partake in this study anonymously. Sugary drink consumption is defined by patients who consume any sugary drinks more than once in a day (sugar containing teas, coffees, soft drinks, juices, milks, shakes, ice creams, yogurts or other instant drinks). The patients were then grouped according to gender and age categories, with the age groups classified by the World Health Organization as young (25-44 years old), middle age (45-54 years old), and elderly (55-65 years old). The participants were anonymized and coded to maintain their privacy. The statistical analysis was done by SPSS chi-square analysis.

RESULTS

A total of 37 patients were involved in the study, consisting 22 males and 15 females. Among the male patients, 14

(37.8%) did not involve in sugary drink consumption, while 21.6% of males reported in sugary drink consumption. Among the female patients, 8 (21.6%) reported sugary drink consumption, while 18.9% did not. The Chi-square Pearson test revealed that there was no significant correlation between gender and sugary drink consumption and the incidence of posterior caries (p=0.000). The patients were grouped according to age into three categories: young (25-44), middle-aged (45-54) and elderly (55-65). Eight young patients were identified, all of whom had sugary drink consumption. A total of 13 middle-aged patients were involved in the study, with 18.9% (7) of them did not involve in sugary drink consumption and 16.2% (6) consume sugary drinks. Among the elderly patients, 24.3% (9) did not involve in sugary drink consumption, while 18.9% (7) consume sugary drinks. The Chi-square Pearson test on age group and sugary drink consumption yielded a significant result in relation to the incidence of posterior tooth decay (p=0.020).

DISCUSSION

Diabetes is a chronic systemic disease that represents a significant global public health concern. It is a metabolic disorder of the body, characterized by a failure of the insulin hormone to perform its normal functions.¹³⁻¹⁵ Insulin is a hormone formed by the pancreas gland and functions to control the concentration of glucose in the bloodstream.¹⁶ This will lead to the increased advanced glycation end products (AGEs) in the system.¹⁷ Diabetes mellitus has the potential to manifest in a multitude of bodily organs.

Prolonged and unmanaged hyperglycemia can precipitate diabetic vascular complications that affect both the macro- and microvasculature, resulting in a myriad of physical and metabolic alterations, as well as those within the oral cavity. When metabolic control of hyperglycemia is deficient, the likelihood of developing oral complications, such as periodontal issues, tooth decay, pulp necrosis, tooth loss, and apical periodontitis, is increased significantly.¹³ It has been demonstrated that there is a consistent relationship between a change in the microbial communities of the

Table 1. Comparison of posterior tooth decay on patients with diabetes mellitus who consume sugary drinks and who did not consume sugary drinks based on age groups

Presence of posterior tooth decay on diabetes mellitus patients	Young	Middle Age	Elderly
Sugary drink consumption	21.6% (8)	16.2% (6)	18.9 % (7)
Non sugary drink consumption	0% (0)	18.9% (7)	24.3% (9)

Pearson Chi-Square Test on sugary drink consumption, stratified by age, exhibits a notable correlation with the prevalence of posterior tooth decay among individuals with diabetes mellitus (p=0.020). Pearson chi-square p=0.020* significant

Table 2. Comparison of posterior tooth decay on patients with diabetes mellitus who consume sugary drinks and who did not consume sugary drinks based on gender

Presence of posterior tooth decay on diabetes mellitus patients	Male (22)	Female (15)
Sugary drink consumption	21.6% (8)	21.6% (8)
Non sugary drink consumption	37.8% (14)	18.9% (7)

The Pearson Chi-Square test on gender revealed no significance in the prevalence of posterior tooth decay in diabetes mellitus patients between those who consume sugary drinks and those who did not (p=0.306). Pearson Chi-Square p=0.306 (not significant)

tooth-adherent dental plaque and the advancement from oral health to disease.

Another study indicates in diabetic patients, there is an increase in *Streptococcus mutans* bacteria and a decrease in salivary pH, which is significantly correlated with higher prevalence of tooth decay or caries.¹⁸ Microbial biofilms adherence to the tooth are supported by sucrose from sugary drinks, especially in areas where natural cleaning mechanism by the oral tissues is not optimal. These areas consist of proximal surfaces as well as the buccal, lingual, and occlusal surfaces, will eventually lead to plaque accumulation and caries initiation.¹⁸ Therefore, interdental sites are the most susceptible to plaque accumulation, and interproximal surfaces of premolars and molars, which are the primary locations of residual plaques.¹⁹

One common manifestation of diabetes mellitus in the oral cavity is hyposalivation, which is a reduction in the production of saliva. Saliva has a crucial role in the process of caries. Its constant presence on the teeth maintains a moist environment, which in turn affects the oral cavity's overall pH balance and the concentration of minerals and bacteria present.¹⁸ Saliva has a distinct composition and concentration that influence salivary secretion conditions. The composition and concentration of saliva are influenced by various factors, including salivary volume, pH, flow rate, and buffer capacity.²⁰ Salivary components, such as inorganic phosphate, protein, calcium, and organic content, along with salivary viscosity, buffer capacity, flow rate, and pH, have been identified as key contributors to the occurrence and development of dental caries.²¹ This condition can lead to a decrease in oral self-cleaning, resulting in the accumulation of plaque on the surface of tooth enamel. This plaque can accelerate the process of tooth decay.

In diabetes mellitus individuals, high glucose levels in saliva can stimulate the production of acids through a fermentation process involving bacteria in the mouth.²² This results in a demineralization process, which can lead to the development of dental caries. Individuals with diabetes mellitus are at significantly higher risk of developing tooth decay because salivary flow is reduced, resulting in a dry mouth and an increased propensity for food particles to adhere to the teeth.²¹ Hyperglycemia in individuals with diabetes mellitus can alter the microflora environment of the oral cavity, creating an optimal milieu for bacterial proliferation. This would result in increased acid production by bacteria. When mixed with food or drink residue, a demineralization process occurs, which results in dental caries. Decreased saliva flow in diabetics will inhibit the function of saliva and alter remineralization of teeth.²³ Dental plaque or biofilm that persists in an organized state on the surface of teeth represents the primary etiological factor for caries, gingivitis, and periodontal disease.²⁴

Sugary drink consumption by the younger age, could be a result of lifestyles. Children presented a strong association with their preference of sweet drinks.²⁴ Other study has indicated that women are more likely to care for oral hygiene than men. In addition to associating optimal oral health, women may demonstrate superior oral health practices

as a consequence of their superior oral health awareness. Oral health literacy is related to better oral hygiene. Many studies demonstrate that women possess superior oral health literacy and awareness than men.^{25,26}

In conclusion, sugary drink consumption in patients with diabetes mellitus increase the risk of tooth decay or caries. This is worsened by diabetic oral manifestations such as xerostomia, which impairs oral hygiene and elevates glucose levels in saliva, therefore, other actions such as maintaining oral hygiene is crucial for reducing the risk of tooth decay in diabetes mellitus patients.

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