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ORIGINAL ARTICLE

Clinical Oral Findings and Salivary Analysis of Patients with and without Diabetes Mellitus

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ABSTRACT

Background: The salivary composition in diabetic patients varies depending on the type of saliva examined (whole or parotid, resting or stimulated) and the choice of participants insulin-dependent diabetes mellitus (IDDM) or non-insulin-dependent diabetes mellitus (NIDDM) patients, or a heterogeneous population with various additional systemic diseases or treatments. In Pakistan there is very few studies done on the clinical significance of saliva amongst diabetic patients.

Objective: Clinical oral findings and salivary analysis of patients with and without diabetes mellitus

Study Design: Case-control study

Study Setting: This study was conducted at Department of Oral Biology Akhtar Saeed Medical and Dental College, Lahore from September 2022 to February 2023.

Methodology: Out of 421 participants 228 were healthy taken as control and 193 were diabetic patients taken as cases were enrolled in this study. The questionnaire was made to describe the demographic variables age, gender, weight and height for BMI, educational status, socioeconomic status, marital status, and ethnicity. The biochemical parameters were estimated in saliva, collected from diabetic and non-diabetic participants. The 5ml saliva was collected from case and control participants in container and aliquoted at -80^{0}C. The samples were thawed at the time of estimation. The salivary biochemical parameters including glucose (mg/dl), insulin (IU/ml), creatinine (umol/L), urea (mml/L), albumin (md/dl), Lactoferrin (ug/ml) and IgA (mg/dl) were done in the lab and estimated through Randox kit according to the manufacturer protocol. The statistical analysis was done by using SPSS version 20.

Results: The research included 421 participants in which 294 men (69.8% of the total) and 127 women (30.2% of the total). The average age was 26.4±5.1 years (range: 16.0 to 48.0) of both groups enrolled participants. While the mean of BMI was 23.4±4.5 Kg/m^2 (range: 15.10 to 41.90). In this study very low- income status (73.9%) and high frequency of married with 84.6% were enrolled. Diabetics also had considerably higher levels of creatinine, urea, lactoferrin and IgA in the saliva of diabetic patients (p=0.0001). However, albumin was significantly low in diabetic saliva as compared to healthy participants (p=0.015).

Practical implication: Studies towards the effects of diabetes mellitus (DM) on oral health has been conducted, but it is not yet known how common oral manifestations of the disease are or how widespread these effects are, especially in Pakistan. The purpose of this research was to compare the effects of diabetes on the dental health and salivary evaluation of people with and without the disease.

Conclusion: New information on salivary parameters and oral results on Pakistani population with and without diabetes was presented in this research. The major results showed that those with diabetes had a decreased salivary flow rate, an increase in salivary glucose, and an increase in urea, creatinine, lactoferrin and IgA concentrations. However, the albumin is low in concentration. The results showed that the clinical significance of saliva amongst diabetic patients and can be used as diagnostic marker.

Keyword: Saliva, biochemical parameters, diabetes mellitus, glucose, urea, Albumin

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder that causes either a severe lack of insulin called type 1 diabetes or an increased resistance to insulin in peripheral tissues called type 2 diabetes[1]. The incidence of diabetes in Pakistan recorded 26.7% in 2022 amongst adults and ranked 3rd worldwide effected from this disease[2]. Health promotion initiatives including prevention, treatment, and control are all a part of the strategy to better care for individuals with these disorders[3]. The mouth is a portal for many systemic disorders, including diabetes[4]. Patients with diabetes are more vulnerable to periodontal disease, fungal infections, and alterations in taste when metabolic management is poor[5]. The link between diabetes and oral lichen planus or dental carries is unknown. Some research suggests that certain medications reduce saliva production, which may lead to oral abnormalities including tooth decay, gum disease, and even the possible promotion of microbial invasion due to weakened soft tissues in the mouth[6]. Drugs such as anticholinergics, antidepressants, diuretics, antihistamines, myorelaxants, diazepine medications, and sympatheticomimetics like hypotensive medicines may all contribute to a sensation of dry mouth or actually reduce saliva production[7]. Patients with diabetes and arterial hypertension are instances of diseases affecting the salivary gland parenchyma and resulting in altered salivary gland function as a systemic consequence of diabetes[8]. Degenerative consequences of diabetes, such as angiopathy, neuropathy, and hormone changes after metabolic derangement, affect the structure and function of acinar cells in these glands, reducing enzyme activity[9]. Xerostomia, angular cheilitis, reduced salivary flow, and higher glucose levels in saliva generated by the parotid gland as a consequence of rising blood glucose were characterized as the oral symptoms of diabetes[10]. Dentures have been linked to an increased incidence of stomatitis and candidiasis in both diabetic patients[11]. The oral mucous membrane relies on saliva for protection and maintain due to saliva's lubricating and soft tissue repairing properties[12]. Antibacterial, antiviral, and antifungal properties may be found in saliva. Saliva's buffer capacity is essential for protecting tooth enamel and sustaining a healthy oral environment[13]. Caries, periodontal disease, and oral mucosal lesions may be more common in those with reduced salivary flow rate and/or changed saliva composition[12]. Dry mouth, an increase in periodontal disease, oral candidiasis, and enlargement of the parotid glands have all been linked to diabetes mellitus[5]. The salivary composition in diabetic patients varies depending on the type of saliva examined (whole or parotid, resting or stimulated) and the choice of participants insulin-dependent diabetes mellitus (IDDM) or non-insulin-dependent diabetes mellitus (NIDDM) patients, or a heterogeneous population

with various additional systemic diseases or treatments. Submandibular saliva in diabetes individuals has also received surprisingly little research attention[14, 15]. In Pakistan there is very few studies done on the clinical significance of saliva amongst diabetic patients. Hence, this study was designed to determine the clinical oral findings and salivary analysis of patients with and without diabetes mellitus. The goal of this research was to examine the demographic details and biochemical parameters in saliva. The participants in the current research were divided into two groups diabetes patients (cases) and the healthy individuals (controls).

METHODS

Sample design and setting: This case control study was conducted at Department of Oral Biology Akhtar Saeed Medical and Dental College, Lahore from September 2022 to February 2023.This study was approved by the Ethical review committee. In this study the demographic details were recorded on a questionnaire. This questionnaire was made to describe the demographic variables age, gender, weight and height for BMI, educational status socioeconomic status, marital status, and ethnicity. The biochemical parameters were estimated in saliva, collected from diabetic and non-diabetic participants.

Inclusion and exclusion criteria: The patient with diabetes and agreed for saliva sampling were included in this study. If the patients were confirmed any comorbidity like neuropathy, nephropathy, heart stroke, heart failure, trauma were excluded from the study.[35,36]

Sample size calculation: On the WHO sample size calculator, a total of 421 participants were chosen in this study based on a prevalence of 28% of diabetes prevalence with 95% confidence interval and margin of error was 5%. Out of 421, 228 were selected as control group and 193 were selected as cases.

Saliva sampling: Saliva was collected using the spitting technique as described by Muneed Ahmed et al. in 2011[16]. To reduce the impact of diurnal fluctuation on the amount and quality of saliva, samples were taken between 10 and 12 hours. Before the treatment, participants were advised to fast for one hour. Researchers were observed participants spit into a container for five minutes. A stopwatch was used to time the duration of the saliva collection. The salivary flow rate (in milliliters per minute) was determined by dividing the total amount collected by 5. The samples of saliva were then sent to the lab for further examination.

Salivary Biochemical Estimation: The 5ml saliva was collected from case and control participants in container and aliquoted at -80^{0}C. The samples were thawed at the time of estimation. The salivary biochemical parameters including glucose (mg/dl), insulin (IU/ml), creatinine (umol/L), urea (mml/L), albumin (md/dl), Lactoferrin (ug/ml) and IgA (mg/dl) were done in the lab and estimated through Randox kit according to the manufacturer protocol. All samples were run twice for each estimation to minimize the error. The data were collected and analyzed though SPSS version 20.

Statistical analysis: The data analysis for this study was carried out using version 20.0 of the IBM-SPSS. Descriptive analysis was performed on demographic factors. The Independent-t test was used to determine the biochemical parameter for the comparison between case and control data. If the p-value was lower than 0.05, the data were statistically significant.

RESULTS

The research included 421 participants in which 294 men (69.8% of the total) and 127 women (30.2% of the total). The average age was 26.4±5.1 years (range: 16.0 to 48.0) of both groups enrolled participants. While the mean of BMI was 23.4±4.5 Kg/m^2 (range: 15.10 to 41.90). In this study very low- income status (73.9%) and high frequency of married with 84.6% were enrolled. However, the large sample size was covered by Punjabis with 31.8%. The frequency of both groups is shown in Table I. Even among individuals without diabetes (p=0.17), more than 77% of participants had never been to the dentist. Patients with diabetes were more likely to report a history of dental pain, tooth loss, gum bleeding, taste impairment, and bad breath (p=0.0001, 0.006, 0.043, 0.0065, and 0.0001 respectively). Most people only use a toothbrush and toothpaste to brush their teeth once every day.

Table 1: Comparison of demographic detail of case and control participants

Grouping	Case	Control
Gender		
Male	158 (81.9)	136 (59.6)
Female	35 (18.1)	92 (40.4)
Marital Status		
Married	165 (85.5)	191 (83.8)
Unmarried	28 (14.5)	37 (16.2)
Socioeconomic Status		
Very Low-Income Status	158 (81.9)	153 (67.1)
Low Income status	5 (2.6)	30 (13.2)
Middle Income Status	5 (2.6)	30 (13.2)
High Income Status	25 (13.0)	15 (6.6)
Ethnicity		
Punjabi	49 (25.4)	85 (37.3)
Sindhi	17 (8.8)	16 (7.0)
Urdu Speaking	45 (23.3)	49 (21.5)
Baloch	12 (6.2)	29 (12.7)
Pathan	70 (36.3)	49 (21.5)

Table 2: Comparison of demographic detail of case and control participants

Biochemical Parameter		Mean	Std. Deviation	P Value
Salivary pH	control	7.66	0.05	
	case	7.26	0.05	0.205
Salivary flow rate (ml/minute)	control	0.72	0.12	
	case	0.30	0.05	0.001
Glucose (mg/dl)	control	78.44	8.88	0.0001
	case	106.00	20.73	
HBA1c (%)	control	4.60	1.20	0.0001
	case	5.73	1.34	
Insulin (IU/ml)	control	12.19	1.82	0.0001
	case	36.96	7.83	
Creatinine (µmol/L)	control	0.74	0.12	0.0001
	case	172.45	4.63	
Urea (mml/L)	control	0.78	0.08	0.0001
	case	9.60	0.60	
Albumin (mg/dl)	control	10.17	0.43	0.015
	case	8.35	0.38	
Lactoferrin (ug/ml)	control	0.81	0.05	0.0001
	case	1.62	0.10	
IgA (mg/dl)	control	6.57	0.22	0.0001
	case	16.83	0.51	

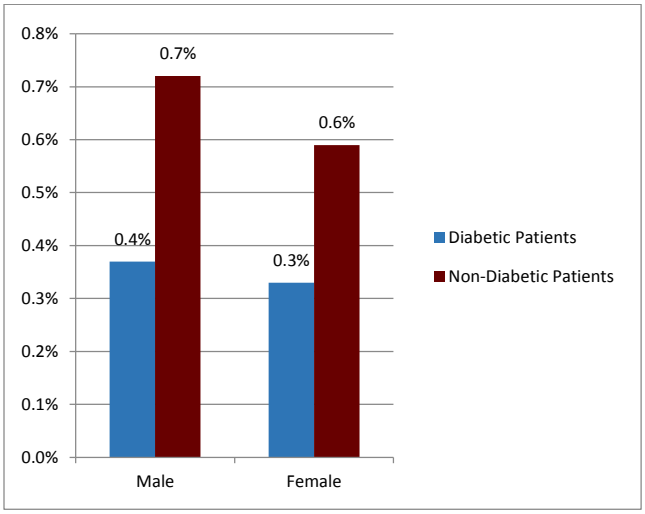

Figure 1: Mean salivary flow rate in males and females in diabetic and non-diabetic patients groups respectively

Males had a greater mean salivary flow rate than females, and those with diabetes have a considerably lower rate (p=0.0089). Those with diabetes were found to have considerably higher acidic saliva than controls (p=0.0096). Female diabetes participants had a significantly higher salivary glucose level (p=0.0054). Diabetics also had considerably higher levels of creatinine, urea, lactoferrin and IgA in the saliva of diabetic patients (p=0.0001) as shown in Table II. However, albumin was significantly low in diabetic saliva as compared to healthy participants (p=0.015). Those older than 40 had a slightly higher mean salivary flow rate and saliva acidity although this difference was not significant (p=0.226, 0.356, respectively)

DISCUSSION

Saliva's physical and chemical characteristics are highly correlated with internal and external environmental changes[17]. Changes in the saliva of diabetic patients may thus be used as an indicator in both diagnosis and disease monitoring. Salivary parameters, gender, and age were shown to be correlated in this investigation of diabetes patients' chemical and physical characteristics. The main objective of the study was to estimate the clinical oral findings and salivary analysis of patients with and without diabetes mellitus. Males were found to have a 3:1 female to male prevalence of diabetes mellitus in this investigation. This confirms the results of a study conducted in the South India and United Kingdom and published by A. Ramachandran et al[18] and Siddiqui et al[19] respectively, in which they found that the prevalence of DM was greater in men. Changes in lifestyle, susceptibility to predisposing factors, genetics, and surroundings are thought to contribute to the sex difference in diabetes mellitus[20]. According with the results of Geiss, Linda S et al. 2010 who stated that the risk equation of diabetes is successful in middle age adult than young population, this demonstrated that diabetes is more prevalent among population of older age group[21]. Individuals with diabetes mellitus often present with oral difficulties due to the nature of the illness, the frequency of oral symptoms among people with diabetes, and the potential for consequences[22]. This agrees with those of earlier research, which found that almost a third of those with diabetes also have oral symptoms, such as tooth pain, bleeding gums, bad breath, and impaired taste. Impaired immunity, vasculopathy, and changes in salivary parameters are common causes of severe periodontitis and repeated periodontal abscesses, both of which may cause considerable pain in the teeth. Oral malodor is often related to acetone breath and poor oral hygiene, both of which are more common in diabetes patients. Taste impairment may be caused by changes in saliva production, or vasculitis[23, 24].

Salivary flow rate is decreased in those with diabetes compared to those without the disease, according to many studies[24]. Compared to non-diabetic individuals, those with diabetes had a considerably reduced unstimulated salivary flow rate (0.32+0.13 ml/min, vs 0.68+0.32 ml/min) determined by Olufemi Elijah et al[25.] This data was consistent with that of Hoseini et al., who found that the salivary flow rate of diabetes and non-diabetic individuals was 0.35+0.11 and 0.5+0.07 ml/min, respectively[26]. Dehydration, pharmaceutical side effects, and neuropathy of the salivary gland's parasympathetic stimulation may all contribute to decreased salivary output in diabetes individuals[27]. Diabetics also have problems with the pH scale, which quantifies how acidic or basic items are. Those with diabetes were found to have a considerably lower (acidic) pH. This agrees with the results found by M.P et al. (2013), who evaluated the pH of saliva from diabetic and non-diabetic individuals and found that the pH was lower in the diabetic group. Saliva may be more acidic in people with diabetes mellitus because of organic acid production after gluconeogenesis and decreased osmoregulation from kidney disease. The effects of sex hormones are likely to blame for women's much lower (acidic) pH[28]. The amount of glucose in saliva is indicative of the amount of glucose in the blood. Consistent with previous research, people with diabetes had considerably greater levels of glucose in their saliva than those without the disease. The glucose concentration in the blood is reflected directly in the concentration of glucose in the primary saliva, from which the secondary saliva in the mouth is created. Consistent with prior research, guys have been shown to have much larger levels of urea in their saliva[25, 29].

Our findings showed that the urea and creatinine concentrations in saliva are also considerably greater in diabetes individuals, mirroring plasma levels consistent with Jovan et al. Elevated plasma urea levels are a primary indicator of renal dysfunction. Higher readings may be due to renal impairment (nephropathy), which is frequent in people with diabetes mellitus[30]. Albumin has found low concentration in diabetic patient according to Mrag et al., in which album is a diagnostic marker has suggested[31]. However, our study showed the low levels of lactoferrin and IgA which is similar to other previous studies[32-34].

This study showed that the comparing diabetes and non-diabetic individuals' saliva samples indicated substantial differences. Further supporting the feasibility of saliva in the diagnosis and monitoring of diabetes patients is the correlation between salivary and plasma concentrations of the chemicals tested on large sample size.

CONCLUSION

New information on salivary parameters and oral results on Pakistani population with and without diabetes was presented in this research. The major results showed that those with diabetes had a decreased salivary flow rate, an increase in salivary glucose, and an increase in urea, creatinine, lactoferrin and IgA concentrations. However, the albumin is low in concentration. The results revealed that saliva showed the clinical significance amongst diabetic patients and can be used as diagnostic marker. As well as improving the multidisciplinary management of this distressing metabolic disease in our resource-limited environment, the strong correlation between the prevalence of oral lesions among diabetics and the significant qualitative changes in saliva of diabetics may serve as a non-invasive tool for monitoring treatment outcomes of diabetes.

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