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Original Research

Estimation of the salivary flow rate and compare it to the composition of patients with and without diabetes

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ABSTRACT:
Background: A chronic metabolic condition called diabetes mellitus (DM) is defined by hyperglycemia abnormalities in the metabolism of proteins, lipids, and carbohydrates. It frequently leads to the emergence of neuropathies, microvascular and macrovascular problems. It is well recognised that the quantity and quality of saliva, both of which may be affected in diabetes, are related to the health of oral tissues. **Aim:** The current study set out to measure the electrolytes, total proteins, and salivary flow rate of Type II diabetes individuals. **Materials and Procedures:** This study involved 120 subjects in total, of whom 40 did not have diabetes and 80 had Type II DM (which included both controlled and uncontrolled diabetes) (controls). Both sexes were represented in the study's population, which ranged in age from 40 to 70. The study participants were split up into three groups. **Results:** In version 16.0 of SPSS software, multiple comparisons between the groups were made using the analysis of variance and post hoc Tukey honestly significant difference analysis based on the values of total protein, sodium, potassium, and salivary flow rate among controls, controlled diabetes, and uncontrolled diabetes. **Conclusion:** The exact pathophysiology of controlled and uncontrolled Type II DM in terms of salivary flow rate, salivary electrolytes, and total protein warrants studies with larger sample size.
Keywords: sodium, total protein, potassium, saliva, and salivary flow rate

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INTRODUCTION

A chronic metabolic condition called diabetes mellitus (DM) is defined by hyperglycemia abnormalities in the metabolism of proteins, lipids, and carbohydrates. It frequently leads to the emergence of neuropathies, microvascular and macrovascular problems. [1] As the condition worsens, tissue or vascular damage results, which triggers serious diabetic side effects like retinopathy, neuropathy, nephropathy, cardiovascular issues, and ulceration. [2,3] As a result, diabetes is recognized as a complicated illness that negatively affects a person's overall health.

Diabetes has been linked in numerous studies to an increased risk of dental disorders in people.[4] It is most likely the most prevalent condition with salivary involvement.

It is well recognized that the quantity and quality of saliva, both of which may be affected in diabetes, are related to the health of oral tissues. Investigations of the salivary composition of participants with different systemic disorders have been made in a number of studies. [5,6] Dental caries and periodontitis are two conditions that have long been recognized as the distinguishing characteristics of DM. Additionally, the majority of diabetic patients complain of xerostomia (dry mouth) as a result of a general decrease in salivary flow brought on by systemic dehydration and an increase in salivary glucose levels. [7] The increased prevalence of oral diseases in people with diabetes has been attributed to a number of underlying pathologies, including decreased salivary flow, sluggish wound healing, and atherosclerosis; however, more research is required to determine how these conditions affect the salivary composition.

The present study was conducted to estimate salivary flow rate, electrolytes, and total proteins in Type 2 diabetes and to evaluate the correlation between the nondiabetic, controlled diabetic, and uncontrolled diabetic patients using standard procedure. Diabetes is known to affect salivary composition and function. The purpose of the current study was to measure the electrolytes, total proteins, and salivary flow rate of Type II diabetic patients in order to monitor and treat their diabetes for oral health issues.

METHOD AND MATERIALS

SELECTION OF PATIENTS

This study involved 120 subjects in total, of whom 40 did not have diabetes and 80 had Type II DM (which included both controlled and uncontrolled diabetes) (controls). Both sexes were represented in the study's population, which ranged in age from 40 to 70.

The study participants were split up into three groups.

Group I: (nondiabetes)

40 patients in Group I, aged 40 to 70, had nonfasting plasma glucose readings at random between 80 and 120 mg/dl.

Group II: (controlled diabetes)

40 diabetic individuals aged 40 to 70 who were receiving treatment and had nonfasting plasma glucose readings that were random>120 mg/dl and 200 mg/dl made up Group II.

Group III: (uncontrolled diabetes)

40 patients in Group III, aged 40 to 70, who were receiving treatment for diabetes and had nonfasting plasma glucose readings above 200 mg/dl at random, made up this group.

INCLUSION STANDARDS

- Individuals with Type II diabetes
- Active participation
- Sexes: both sexes.

EXCLUSION STANDARDS

- Patients using regular treatment for the same systemic condition and additional systemic diseases
- Expectant mothers
- People who are mentally and physically challenged.

SAMPLE GATHERING

To avoid language bias, all participants were fully educated about the study before giving their informed consent in their own languages. After that, saliva was collected from each participant.

Participants were told to eat breakfast no later than 8 a.m., and saliva collection took place between 10 and 11 a.m. Spitting was used to collect saliva that had not been provoked.

For collecting, the "spit technique" was employed.[8] The patient was made to lean forward while seated on the chair. During the process, they were told not to speak, drink, or make any head movements. For ten minutes, the patient was asked to spit into a clean graded container every minute. 2 ml of collected saliva that had not been stimulated was tested for total proteins and electrolytes like sodium and potassium.

Salivary samples were examined under aseptic circumstances. Subjects' unstimulated saliva was collected in pre-weighed vials, which were then checked right away to gauge volume before being kept at 200C until needed for laboratory examination. After being defrosted at room temperature, samples were centrifuged at 6000 rpm for 10 min to remove pollutants such as food particles, oral epithelial cells, and microorganisms, among others.

The samples were evaluated at room temperature and fed into an automated analyzer for the following parameters' interpretation:

Salivary ions testing: Potassium (K^+) and sodium (Na^+) concentrations in the collected saliva were measured. The amounts of K^+ and Na^+ were measured using a Roche 9180 electrolyte analyzer after saliva was diluted at a ratio of either 1/100 or 1/1000.

Analysis of total protein in saliva: Before usage, saliva samples were centrifuged at 6000 rpm for 10 min after being defrosted at room temperature. The amount of total protein was calculated using a dependable automatic analyzer and expressed as mg/dl.

RESULTS

In Version 16.0 of the Statistical Package for the Social Sciences (SPSS), IBM Corporation, Chicago, United States of America, the values of total protein, sodium, potassium, and salivary flow rate among controls, controlled diabetes, and uncontrolled diabetes were gathered, formulated, and subjected to multiple comparisons between groups using analysis of variance and post hoc Tukey honestly significant difference analysis.

The average fasting blood sugar value for Group 1 was 88.9 mg/dL, with values ranging from 79 mg/dL to 96 mg/dL [Table 1]. The average sodium value for Group 1 is 139.05 mEqL, with values ranging from 132 to 149 mEqL [Table 1]. With an average of 4.04 mEqL, the potassium readings for Group 1 ranged from 3.4 mEqL to 4.9 mEqL. Table 1]. With an average of 7.28 g/dL, the Group 1's total protein values ranged from 6.0 g/dL to 9.2 g/dL. Figure 1 and]. The average salivary flow rate in Group 1 was

1.09 ml/min, with values ranging from 0.6 to 1.6 ml/min [Table 1].

Table 1: Quantitative data of fasting blood sugar, sodium, potassium, total protein levels and salivary flow rate between case and control group

	n	Mean	SD	SE
Age				
Control	40	38.87	8.77	1.37
Controlled diabetic	40	51.00	11.78	1.84
Uncontrolled diabetic	40	56.15	8.93	1.42
Total	120	48.67	12.20	1.16
Blood sugar				
Control	40	88.90	4.47	0.62
Controlled diabetic	40	1.60	10.05	1.57
Uncontrolled diabetic	40	2.32	35.33	5.55
Total	120	1.62	64.37	5.89
Sodium				
Control	40	1.32	3.67	0.02
Controlled diabetic	40	1.62	10.24	1.64
Uncontrolled diabetic	40	1.52	7.78	1.03
Total	120	1.52	14.05	1.29
Potassium				
Control	40	4.04	0.83	0.76
Controlled diabetic	40	6.52	0.29	0.19
Uncontrolled diabetic	40	6.75	0.49	0.04
Total	120	5.50	1.23	0.13
Total protein				
Control	40	7.25	0.79	0.16
Controlled diabetic	40	9.25	0.53	0.08
Uncontrolled diabetic	40	9.25	0.57	0.90
Total	120	8.68	1.13	0.12
Salivary flow rate				
Control	40	1.05	0.23	0.08
Controlled Diabetic	40	0.60	0.11	0.07
Uncontrolled Diabetic	40	0.50	0.01	0.03
Total	120	0.78	0.82	0.80

Table 1 show that the values of fasting blood sugar levels in Group 2 ranged from 142 mg/dL to 178 mg/dL, with an average of 160.35 mg/dL. Table 1 show the sodium values for Group 2 in the range of 146 mEqL to 185 mEqL, with an average of 168.15 mEqL. With an average of 9.45 mEqL, the potassium readings for Group 2 ranged from 8.5 mEqL to 10.6 mEqL. Graph 3 and Table 1]. With an average of 6.53 g/dL, the Group 2's total protein values ranged from 5.2 g/dL to 8.2 g/dL. Graph 4 and Table 1]. The average salivary flow rate in Group 2 was 0.63 ml/min, with values in the range of 0.4 to 1.0 ml/min. [Table 1].

In Group 3, the readings for fasting blood sugar ranged from 186 mg/dL to 303 mg/dL, with an average of 237 mg/dL. Graph 1 and Table 1]. With an average of 156.3 mEqL, the sodium readings for Group 3 ranged from 144 mEqL to 178 mEqL. [Table 1]. The potassium readings for Group 3 ranged from 5.3 to 6.9 mEqL, with an average of

6.05 mEqL. Graph 3 and Table 1]. Total protein values for Group 3 ranged from 8.5 to 10.7 g/dl, with an average of 9.3025 g/dl. [Table 1]. The average salivary flow rate in Group 3 was 0.54 ml/min, with values ranging from 0.4 to 0.7 ml/min.
Between the controlled diabetic and uncontrolled diabetic groups, there was a clear increase in the values of total protein, salt, and potassium as well as a decrease in salivary flow rate. Statistics was used to determine the significance of the values (P 0.05) [Table 2]. There appeared to be an increase in the values of the controlled diabetic group compared to the uncontrolled group among the groups of people with controlled and uncontrolled diabetes, which also demonstrated statistical significance [Table 3]. Although the values in the controlled diabetic group were greater than those in the uncontrolled group, total protein and salivary flow rate were not statistically significant [Table 4].

Table 2: Comparative analysis of total protein, sodium, potassium levels and salivary flow rate between controlled and uncontrolled diabetes mellitus group

Parameter	Groups (mean±SD)			*P*
	Control	Controlled diabetic	Uncontrolled diabetic	
Age	52.58±9.27	51.3±11.34	56.23±8.97	0.06
Blood sugar	88.6±4.32	160.25±10.37	237.22±35.32	0.00
Sodium	139.45±3.40	168.25±10.23	156.4±7.71	0.01
Potassium	4.03±0.43	6.34±0.73	6.3±0.40	0.01
Total protein	7.9±0.74	9.35±0.23	9.23±0.34	0.00
Salivary flow rate	1.0±0.27	0.63±0.12	0.34±0.33	0.00

Table 3: ANOVA analysis between and within groups

	Sum of squares	Mean square	*F*	Significance
Age				
Between groups	6277.7	3138.958	32.078	0.000
Within groups	11428.70	97.853		
Total	17722.67			
Blood sugar				
Between groups	439012.31	219501.158	481.293	0.000
Within groups	53353.65	456.066		
Total	492371.92			
Sodium				
Between groups	17440.61	8565.300	144.496	0.000
Within groups	6923.43	59.277		
Total	24336.00			
Potassium				
Between groups	149.53	69.756	240.012	0.000
Within groups	32.02	0.291		
Total	153.57			
Total protein				
Between groups	126.93	58.466	153.813	0.000
Within groups	44.43	0.380		
Total	151.46			
Salivary flow rate				
Between groups	7.162	3.583	102.006	0.000

	Sum of squares	Mean square	*F*	Significance
Within groups	4.112	0.035		
Total	12.246			

Table 4: Multiple comparisons between the case group (controlled and uncontrolled diabetes mellitus) and control group

Dependent variable	Groups (I)	Groups (J)	Significant
Age	Control	Controlled diabetic	0.000
		Uncontrolled diabetic	0.000
	Controlled diabetic	Control	0.000
		Uncontrolled diabetic	0.047
	Uncontrolled diabetic	Control	0.000
		Controlled diabetic	0.067
Blood sugar	Control	Controlled diabetic	0.000
		Uncontrolled diabetic	0.000
	Controlled diabetic	Control	0.000
		Uncontrolled diabetic	0.000
	Uncontrolled diabetic	Control	0.000
		Controlled diabetic	0.000
Sodium	Control	Controlled diabetic	0.000
		Uncontrolled diabetic	0.000
	Controlled diabetic	Control	0.000
		Uncontrolled diabetic	0.000
	Uncontrolled diabetic	Control	0.000
		Controlled diabetic	0.000
Potassium	Control	Controlled diabetic	0.000
		Uncontrolled diabetic	0.000
	Controlled diabetic	Control	0.000
		Uncontrolled diabetic	0.000
	Uncontrolled diabetic	Control	0.000
		Controlled diabetic	0.000
Total protein	Control	Controlled diabetic	0.000
		Uncontrolled diabetic	0.000
	Controlled diabetic	Control	0.000
		Uncontrolled diabetic	0.583
	Uncontrolled diabetic	Control	0.000
		Controlled diabetic	0.523
Salivary flow rate	Control	Controlled diabetic	0.000
		Uncontrolled diabetic	0.000
	Controlled diabetic	Control	0.000
		Uncontrolled diabetic	0.075
	Uncontrolled diabetic	Control	0.000

Dependent variable	Groups (I)	Groups (J)	Significant
		Controlled diabetic	0.085

DISCUSSION

DM is a common metabolic disorder that alters the composition of saliva by compromising the salivary glands' ability to operate.[9] Murrah et al.'s[10] research has established that modifications to the parotid gland's basement membrane can affect how well the glands can transport molecules, electrolytes, and water, changing the amount of saliva produced.

This study's objectives were to determine the salivary flow rate, electrolytes, and total protein in diabetic patients and to compare those measurements across diabetic patients with and without managed diabetes. The study population (n = 120) was split into three groups: Group 1, which consisted of 40 healthy subjects; Group 2, which consisted of 40 subjects with controlled diabetes; and Group 3, which consisted of 40 subjects with uncontrolled diabetes. From the sample population, saliva was taken and examined biochemically.

When compared to non-diabetic subjects in the current investigation, the total protein level is higher in the diabetic patients (Group 3). According to Aratiet al.[11] and Streckfus et al.[12], uncontrolled and controlled diabetic groups showed highly significant positive correlations in salivary total protein levels. This could be explained by an increase in the permeability of the basement membrane, which would make it easier and more likely for serum proteins to flow through the crevices of the gingiva and salivary glands and into the whole saliva.

Diabetes patients had higher protein concentrations in their saliva, which Mata et al.[13] linked to less salivary fluid flow. This research supports our findings that salivary flow rate is inversely correlated with total protein concentration [Table 4].

In the current investigation, we discovered statistically significant variations in salivary flow rate between the healthy non-diabetic group, the controlled, and the uncontrolled diabetic groups. When compared to the healthy participants, diabetes patients' salivary flow rate is lower.

Due to fatty cell infiltration into the salivary glands, dehydration brought on by polyuria or microvascular illness, or physical changes to the mucosal cells as a result, the decrease in salivary flow rate that occurs in diabetes can be caused by a variety of factors. It might also be brought on by metabolic issues, neuropathy that affects the salivary glands, localised oral inflammation and irritation, pharmacological therapy for diabetes, or concurrent medications.

The findings of the present investigation conflicted with those of the study by Meurmanet al.[14], which found no statistically significant variations in salivary flow rates. This might be explained by the many environmental influences and variations in sample selection.

In the current investigation, it was discovered that diabetic patients had higher salivary concentrations of the ion potassium than nondiabetic people did. The findings reported by Lasisi and Fasanmade,[15] Mata et al., and others were similar .[13]

The Ben-Aryeh et al. study .[16] is also consistent with what we discovered. The increased potassium concentration in diabetic patients' saliva is likely a result of the diabetes-related decrease in salivary fluid flow. [13] This may be as a result of Type 2 diabetes having intact salivary gland secretory capability. Streckfuset al.[12] and Marder et al.[17] on the other hand, reported in their investigations that there is no difference in the potassium level in diabetes patients.

In the current investigation, it was discovered that the diabetes group's salivary sodium concentration was higher than the managed group's. This result is in good accordance with the research done by Basavaraj et al. [18] The cause may be related to a decrease in salivary flow rate, which elevates the sodium ion concentration in diabetic individuals' saliva.

The salivary sodium level in the sample from the diabetic patient in Lasisi and Fasanmade'sstudy[15] did not differ significantly from that of the control patient.

In the current study's intergroup comparison, electrolytes like sodium and potassium revealed a statistically significant rise in controlled diabetics compared to uncontrolled diabetics, with the exception of salivary flow rate and total protein level. These are the likely causes, according to this:

- More limited sample size
- Salivary flow compromise in poorly managed diabetes. According to the research done by Rosamund and William[19], this results in a changed salivary flow rate.
- The impact of specific medications used by research group participants for systemic disorders that they may not have revealed.

CONCLUSION

In order to fully understand the pathophysiology of managed and uncontrolled Type II DM in terms of salivary flow rate, salivary electrolytes, and total protein, bigger sample size investigations are therefore necessary.

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