Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(4), 1830-1834 | ISSN:2251-6727

# Clinical and Microbial Oral Health Status in Children with Diabetes and Non-Diabetes

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***(Received: 16 June 2025 Revised: 20 July 2025 Accepted: 04 August 2025)***

**KEYWORDS**

Diabetes mellitus,

Salivary flow rate, microbial colony count,

Quality of life.

**ABSTRACT:**

**Introduction:** Diabetes mellitus (DM) is considered hyperglycemia secondary to disturbed insulin secretion insulin function or both. Environmental and Genetic factors indicate multifactorial aetiology leading to the disease. Unfortunately, diabetic patients neglect dental care and it is important to know the state of oral health so as to inform the parents of diabetic children about the need for dental treatments and the needful preventive measures for them. Our study aimed to evaluate oral health status among type 1 diabetes mellitus children related to salivary components (flow rate, S mutants, Lactobacillus, and caries index).

**Objectives:** Our study aimed to evaluate oral health status among type 1 diabetes mellitus children related to salivary components (flow rate, S mutants, Lactobacillus, and caries index).

**Methods:** A prospective randomized clinical trial was performed on Type I DM children and non-diabetic children aged 4-16. The unstimulated salivary flow rate was calculated, and the Streptococcus mutans and Lactobacillus colonies in saliva were determined. Oral status was estimated using the Decay, Missing, and Filled Teeth index for primary (DMFT) &permanent teeth (DMFT) and oral hygiene index. Chi-Square test and Mann-Whitney test was used to statistically compare the obtained data at the significant level of $p<0.05$.

**Results**: Unstimulated salivary flow rate was seen less in type 1 DM children when compared to the healthy group ($p<0.001$). Caries prevalence (DMFT) was notably higher in T1DM compared to healthy children ($p<0.97$). T1DM children had an increased count of *S. mutans* and *Lactobacillus* compared to the control group ($p<0.07$ and $p<0.04$).

**Conclusions**: Based on our findings children with diabetes are exposed to a greater risk of caries and dental health problems compared to non-diabetic children. Our emphasis is centered on educating the parent and the child regarding caries prevalence and good oral health.

## 1. Introduction

A metabolic condition known as type 1 diabetes mellitus (T1DM) is typified by hyperglycemia, which is brought on by a permanent reduction in insulin secretion. In India, the incidence rate is approximately 3.4 per 100,000 people year [1].Type 1 diabetes mellitus (T1DM) is utmost among childhood chronic disorders. The patient's lifestyle as well as the prevention of consequences depends heavily on early diagnosis, prompt treatment, and ongoing management [2].

Saliva is a popular medium for clinical diagnostics and is occasionally referred as "mirror of the body."[2]. In addition to harming several bodily systems, hyperglycemia can impair salivary gland function, which can change the composition of saliva and cause a decrease in salivary flow. As a result, many alterations to the mucosa and teeth may transpire, including the proliferation of certain harmful germs [3]. Diabetes does not appear to have a significant effect on dental caries, despite reports of dry mouth and decreased salivation. [4]

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www.jchr.org
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Research has indicated that uncontrolled diabetes patients had far higher serum glucose levels than those with controlled diabetes in their children. Additionally, they have demonstrated a notable reduction in flow rate of saliva in diabetics [5].

The possibility of dental cavities may be increased by impaired metabolic regulation, decreased flow rate of saliva, and altered composition of saliva, particularly in diabetic children who also have poor oral hygiene and a high fermentable carbohydrate intake.

## 2. Objectives

The study's objective was to compare and contrast juvenile diabetic children and those non-diabetes in terms of salivary flow rate, salivary pH, and the number of S mutants and Lactobacillus microbe colonies in each sample.

## 3. Methods

The study was conducted among 80 children aged between 4-16 years. 40 Type 1 DM children (Group I) were selected from Rajarajeswari Medical College and Hospital where they were diagnosed and are undergoing treatment. In the control group (Group II), 40 non-diabetic children visiting the Department of Paediatric and Preventive Dentistry, Rajarajeswari Dental College were selected. Ethical committee clearance was obtained. Parental consent was obtained before the start of the study. Early morning samples were collected.

1 hr before the sample collection subjects were asked to avoid oral hygiene procedures like brushing with fluoridated toothpaste. Subjects were asked to rinse mouth with drinking water. After 5 minutes, unstimulated saliva was collected in 2 ml plastic tubes (sterile)by spitting method. The patient was asked to remain still and collect the saliva in the floor of the mouth for 1 minute. The patient use to spit the saliva every 60 s for a total of 5 min into the plastic tube and salivary flow rate was calculated. The volume of saliva was estimated in millilitres per minute (mL/min). After salivary collection of 2 ml from each patient the containers were sealed immediately and refrigerated at -80˚C before transporting to the laboratory.

Centrifugation was done at 2,500 rpm for 5 mins to reduce salivary debris and viscosity followed by microbial colony count determination.To blood agar 15 microliter of salivary sample was plated. The plates were incubated at 37˚C for 2 days. The S.mutans colony appeared elevated, dome shaped, undulated, white colonies from other species. A colony measuring device was used to calculate the S. mutans and Lactobacillus count.The obtained colony count was measured in colony-forming units per milliliter (CFU/ml). The colonies were scored according to Berkowitz criteria. Score 0 with no growth, score 1 for 1-$10^3$, score 2 for 10 -$10^5$, and score 3 ≥ $10^5$CFU per ml of saliva.1

All participants were examined by single investigator to avoid inter-examiner bias and a assistant for recording was present throughout the examination to help in filling the case sheet. The caries status among participants was examined by using (dmft) index in primary teeth and (DMFT) index in permanent teeth. Scores was obtained using WHO Oral Health Survey Basic Methods manual for dentition charting of caries (2013). Silness and Loe plaque index gave the dental plaque scores on mesial, buccal, distal, and palatal/lingual surfaces of teeth: 16, 12, 24, 32, 36, and 44. The nominal scale for evaluation of plaque score was: 0 for excellent hygiene; 0.1–0.9 for good hygiene; 1.0–1.9 for fair hygiene; and 2.0–3.0 for poor hygiene.

We used Windows Version 22.0 Released 2013Statistical Package for Social Sciences [SPSS]. Armonk, NY: IBM Corp., for data entry and analysis. Mean and standard deviation data has shown quantitative data, whereas frequency and proportions were used to express categorical variables. For the comparison of two independent groups of qualitative data, Chi-Square test was performed. Comparison of non-parametric and parametric quantitative data was done using Mann-Whitney U test and independent-Samples t-test respectively. Excel spreadsheet was utilised for Statistical Analysis Data; descriptive analysis of all the explanatory and outcome parameters was done using frequency and proportions for categorical variables whereas Mean & Standard deviation for continuous variables were evaluated. Statistical analysis between groups T1DM (Group A) and (Group B) was carried out using the Mann-Whitney Test was used to compare the mean age & DMFT, DI & CI Scores, and Chi Square Test helped to compare the gender distribution between 2 groups. While, Independent Student t Test compared the mean Saliva Flow rate, CFUs/ml of S. Mutans & L. Bacillus counts (in log10) between 2 groups. Multivariable analysis was used to assess the association of independent variables with DMFS using Statistical

Journal of Chemical Health Risks

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JCHR (2025) 15(4), 1830-1834 | ISSN:2251-6727

Package for Social Sciences [SPSS] for Windows Version 22.0 Released in 2013. Armonk, NY: IBM Corp. The confidence intervals (CI) of 95% were evaluated; a p-value of 0.05 was determined as statistically significant.

## 4. Results

The study was conducted among children in the age range of 4-16years with a mean age of 9.15 and 8.93 years for group A and group B respectively. In Type 1 diabetes mellitus 39% of were males and 61% of females and in control group50% of were males and 50% of females respectively. T1DM children had statistically significantly higher ($p<0.03$) cavities when compared to healthy group with the mean DMFS score of 5.13 and 3.93 in group B.T1DM had a statistically evident higher ($p<0.07$) DI with the mean score of 1.23 and 0.80 in the controlgroup.T1DM had a statistically evident higher ($p<0.04$) CI with a mean of 0.98 and 0.68 among the controlled group.

Juvenile diabetic children had statistically significantly reduced ($p<0.001$) unstimulated flow rate of saliva with the mean of 0.32ml/mincompared to control group 0.66 mL/min. T1DM had a significantly increased ($p<0.007$) S.mutans colony count with a mean of 0.658 compared to a control group of 0.565 CFU/ml. T1DM had significantly higher ($p<0.04$)lactobacillus colony count with a mean of 0.660 compared to control group of 0.488CFUs/ml.

**Note:** Group A-Juvenile Diabetic Children & Group B-Healthy Children Group

A) Mann Whitney Test & B) Chi Square Test

TABLE NO. 1 - Comparison of mean DMFT Scores between 2 groups

| Comparison of mean Debris & Calculus Scores between 2 groups using Mann Whitney Test | | | | | | |
|---|---|---|---|---|---|---|
| Parameters | Groups | N | Mean | SD | Mean Diff | p-value |
| DI | Group A | 40 | 1.23 | 0.73 | 0.43 | 0.007* |
| | Group B | 40 | 0.8 | 0.61 | | |
| CI | Group A | 40 | 0.98 | 0.66 | 0.3 | 0.04* |
| | Group B | 40 | 0.68 | 0.57 | | |

* - Statistically Significant (DMFT- Decayed, Missing and Filled Teeth)

NOTE- DMFT score were seen higher in T1DM children compared to healthy children.

TABLE NO 2.- Comparison of mean Debris & Calculus Scores between 2 groups

| Comparison of mean DMFT Scores between 2 groups using Mann Whitney Test | | | | | | |
|---|---|---|---|---|---|---|
| Parameters | Groups | N | Mean | SD | Mean Diff | p-value |
| Decayed | Group A | 40 | 3.15 | 2.24 | 0.87 | 0.04* |
| | Group B | 40 | 2.28 | 1.34 | | |
| Missing | Group A | 40 | 1.1 | 1.41 | 0.22 | 0.68 |
| | Group B | 40 | 0.88 | 1.07 | | |
| Filled | Group A | 40 | 0.88 | 1.18 | 0.1 | 0.8 |
| | Group B | 40 | 0.78 | 0.8 | | |
| DMFT | Group A | 40 | 5.13 | 2.38 | 1.2 | 0.03* |
| | Group B | 40 | 3.93 | 1.4 | | |

* - Statistically Significant

NOTE- Debris and calculus scores were observed higher in T1DM children compared to healthy children

TABLE NO.3- Comparison of mean Salivary Flow Rate (ml/min) between 2 groups

| Comparison of mean Salivary Flow Rate (ml/min) between 2 groups using Independent Student t Test | | | | | | |
|---|---|---|---|---|---|---|
| Parameters | Groups | N | Mean | SD | Mean Diff | p-value |
| Flow Rate | Group A | 40 | 0.32 | 0.13 | -0.34 | <0.001* |
| | Group B | 40 | 0.66 | 0.17 | | |

* - Statistically Significant

NOTE- Salivary flow rate was seen to be reduced in T1DM children compared to healthy children.

Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(4), 1830-1834 | ISSN:2251-6727

TABLE NO. 4- Comparison of mean CFUs / ml of S. Mutans & L.Bacillus (in Log10) between 2 groups

| Comparison of mean CFUs / ml of S. Mutans & L.Bacillus (in Log10) between 2 groups using Independent Student t Test | | | | | | |
|---|---|---|---|---|---|---|
| Organism | Groups | N | Mean | SD | Mean Diff | p-value |
| S. mutans | Group A | 40 | 0.658 | 0.081 | 0.09 | 0.007* |
| | Group B | 40 | 0.565 | 0.097 | | |
| L. Bacillus | Group A | 6 | 0.66 | 0.05 | 0.17 | 0.04* |
| | Group B | 13 | 0.488 | 0.123 | | |

* - Statistically Significant (CFU- Colony Forming Unit)

NOTE- S.mutans and Lactobacillus colony count was found to be higher in T1DM children compared to healthy children

## 5. Discussion

Juvenile diabetes is considered an immune–associated or immune-mediated disease. The onset of symptoms of the disease mostly starts in the early years of life or at puberty when the hormones enrage the action of insulin. [6]

Foremost difficult health issues of the 21stcentury are glucose disorder, which affects roughly 6-7% of the global population [7.] Diabetes mellitus primarily affects tissues and organs with abundant blood arteries, like kidneys, eyes, and nerves. Furthermore, the oral cavity's epithelial tissues, abundant in tiny blood vessels, cover the cavity. Diabetes mellitus (DM) is linked to several oral signs and symptoms, such as poor salivary flow rate, dental decay, gingival and periodontal disorders, oral lesions, etc. However, Lalla et al. found in their research that periodontal disorders can begin in childhood (6–11 years old)[7.] Dental caries are miscellaneous disease and the attribute of this is demineralization which is drove acidogenic plaque flora and diminished salivary flow leading to poor clearance, deficient buffering, and decreased supply of calcium to repair the damaged dental tissues. Our research aimed to evaluate the clinical and microbial oral health status of T1DM children compared to healthy children and we have found that DMFS score was significantly increased in T1DM children compared to the control group.

Many studies suggested that one of the reasons for gingival disease is metabolic instability which leads to a poor defence mechanism against infection.[7]As the growth was increased by a low plaque pH which limited rise in acid-intolerant bacteria and enhanced the elevation in aciduric micro-organisms.In our study, we found that mean scores of DI and CI were higher in T1DM compared to healthy children due to poor metabolic control.

The oral cavity is the sole region in the human body where calcified tissues are directly exposed to the outer environment, leading to intricate interactions among various surfaces that are consistently in contact with saliva. Research has established a strong correlation between Streptococcus mutans and colonies of Lactobacillus with the onset of oral cavities and the advancement of carious lesions. Numerous studies have been undertaken, yet the findings regarding the connection between diabetes mellitus (DM) and dental caries remain inconclusive[8]. Our current findings align with several studies that have indicated elevated levels of Streptococcus mutans and colonies of Lactobacillus in patients with juvenile diabetes compared to a non-diabetic group.

Saliva plays a vital role in regulating oral health by continuously cleansing the teeth and oral mucosa, serving as a clearing agent, lubricant, buffer, and reservoir for ions such as calcium and phosphorous, which are crucial for the mineralization of incipient carious lesions. Furthermore, Dodds et al. indicated that the unstimulated state is the primary condition regarding salivary gland activity, with unstimulated salivary flow being a key factor in salivary clearance.[9] Consequently, this study focused on measuring the salivary flow rate and microbial colony count in unstimulated saliva.

Studies performed on diabetes to evaluate salivary secretion have reported both a decreased flow rate of saliva and an increased flow rate of saliva when compared to controls. [9]. Our study results revealed the mean flow rate of saliva in T1DM children was lesser compared to healthy group. Thus, our study beholds the strengths to put forward saliva as a diagnostic biomarker in T1DM children for their oral health and hygiene. Further, more studies and researches are required using saliva as a diagnostic tool.

Journal of Chemical Health Risks

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JCHR (2025) 15(4), 1830-1834 | ISSN:2251-6727

## 6. Conclusion

Our findings indicate that the risk of caries in individuals with Type 1 Diabetes Mellitus disease (T1DM) is greater than that observed in healthy counterparts. This disparity is associated with elevated plaque scores and a reduced salivary flow rate. The increased plaque accumulation in juvenile diabetic patients may be linked to suboptimal dental hygiene practices relative to non-diabetic children. Additionally, the heightened incidence of caries in T1DM may be influenced by elevated glucose levels. Given that caries is a multifactorial condition, it is essential to take dietary factors into account when evaluating caries prevalence.

Children diagnosed with Type 1 Diabetes Mellitus (T1DM) often experience feelings of sadness, loneliness, anxiety, and irritability. Consequently, their psychological and emotional health is influenced by their metabolic regulation. As healthcare professionals, in addition to bringing joy back to our young patients, it is essential to conduct a thorough analysis of the factors leading to the development of dental caries, regardless to whether the children are healthy or have special healthcare requirements. Providing education to parents and children on this matter will aid in preventing the emergence of new lesions in the future.

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