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Original Research

Correlation of Salivary Glucose Levels with Dental Caries: A Biochemical Study

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Abstract

Context: Oral fluids are often called the 'mirror of the body' or 'window on health status' and are the perfect medium to be explored for health and disease surveillance. Saliva is an organic fluid that is easy to collect by non-invasive methods and is not costly to preserve. Elevated levels of blood glucose may cause oral alterations such as: a higher incidence of cavities, periodontal disease and candidiasis. **Aim:** Evaluate the levels of salivary glucose and their effect on dental caries. **Settings and Design:** Thirty nine patients were randomly selected and saliva was collected by the spitting method with all the necessary precautions. The saliva was then centrifuged and dried. The salivary glucose levels were measured by using the ERBA® GOD-POD and readings were obtained from ERBA® CHEM 5 analyzer in mg/dl. The data thus obtained was statistically analyzed by Pearson's Correlation Test. **Results:** A significant correlation was obtained between the salivary glucose levels and dental caries, salivary glucose and the age of the patients and the Decayed Missing Filled teeth Index (DMFT index) and Age of the patients. **Conclusions:** Salivary glucose levels increase with increasing DMFT index and play a significant role in high caries incidence. Modification of the already available glucose monitoring kits to suit saliva could provide a novel chair-side aid in patient education and dental caries prevention.

Keywords: Saliva, Glucose Levels, Dental Caries, Salivary Glucose, GOD-POD technique, DMFT index.

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Introduction

Oral fluids are often called the 'mirror of the body' or 'window on health status' and is the perfect medium to be explored for health and disease surveillance.[1] Saliva is one of the most important protective body fluids but remains the least understood.[2] The general term "saliva" refers to the fluid that surrounds all oral hard and soft tissues. This oral fluid (that is, whole saliva) represents a mixture of individual fluids and components derived from several sources i.e secretions of major and minor salivary glands and gingival crevicular fluid, etc.[3] Saliva is an organic fluid that is easy to collect by non-invasive methods and is not costly to preserve. The concentration of some components of saliva may be associated with certain systemic illnesses, reflecting the hormonal, immunological, neurological, emotional, nutritional and metabolic states of the patient. Glucose is a small molecule that diffuses easily through the membrane of the blood vessels, passing through the blood serum into the gingival fluid, by way of the gingival sulcus, and making its way into the saliva.[4] Elevated levels of blood glucose may cause oral alterations such as: a higher incidence of cavities, periodontal diseases and candidiasis.[5-7] Considering the limited amount of literature available on evaluation of glucose levels in saliva and its correlation with dental caries, the study was designed to evaluate the same.

Subjects and Methods

Thirty nine patients from the Department of Oral medicine and radiology at Yerala Dental College were randomly selected, clinically examined, given a detailed explanation about the study and their consent was obtained. A detailed case history with Decayed Missing Filled teeth Index (DMFT) Index was then noted. The patients selected were free from all systemic diseases and oral diseases except dental caries if present. Patients currently on medication or indulging in any adverse habits like tobacco chewing, smoking, etc were excluded and those with space infection due to caries were also excluded.

The saliva collection method was adapted from Vissink et al.[8] and carried out only between 9:00 to 11:00am. Patients were advised not to take any food or drink, at least two hours prior to the collection. They were also instructed to avoid all major oral

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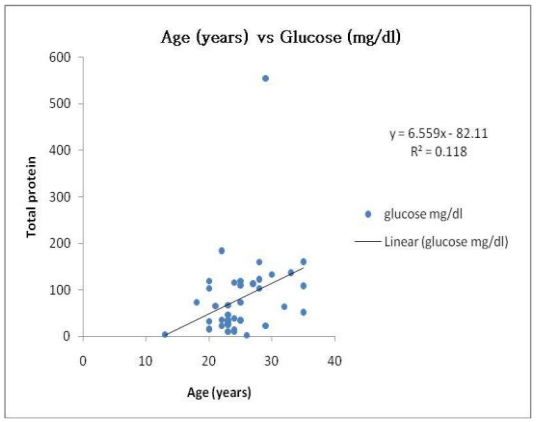
and body movements like, talking. Saliva was collected by spitting method into a sterile labelled container placed on ice and then stored at -20^{o}C. It was centrifuged using the Rota 4R - V/Fm, Plasto Crafts® centrifuge at 4^{o}C at 4000rpm for 45 minutes. The 500 µl of the supernatant was transferred into the Eppendorf tube, sealed with punctured Parafilm®, dried in Labconco® speed evacuator and stored at -20^{o}C. The dried saliva was reconstituted using 10µl of distilled water and glucose levels were estimated using the ERBA® GOD-POD kit and readings were obtained from ERBA® CHEM 5 analyzer in mg/dl. The data obtained was subjected to a statistical study, Pearson's correlation test was used to compare the measurements, where values of $p<0.05$ were considered significant.

Results

Of the given samples 39, 53.85% (21) are male and 46.15% (18) are female. The age distribution of the patients is as follows: 2.56% (1) is between 11-15 years, 15.38% (6) are between 16-20 age group, 48.72% (19) fall under 21-25 years, 20.51% (8) belong to 26-30 years and 12.82% (5) belong to >30 years of age.

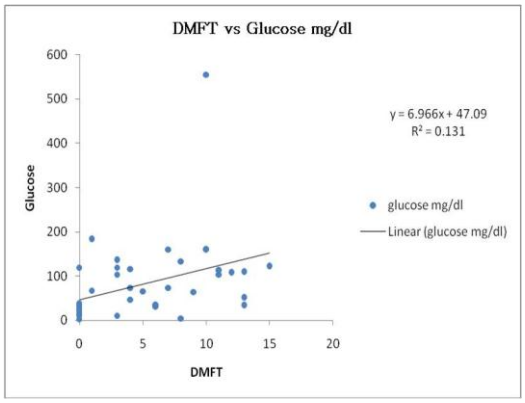
Correlation between DMFT and glucose level was evaluated by Pearson's correlation test. The Pearson's coefficient (r) = 0.363, p-value = 0.023 were obtained; hence a positive correlation was noted. (Graph 1)



Graph 1: Illustration of salivary glucose levels in relation to patient age.

Pearson's correlation coefficient (r) = 0.344, p-value = 0.032 was calculated between age (years) and glucose (mg/dl). The p-value being <0.05, the result is significant. (Graph 2)

Comparison of glucose to gender was done by applying 2 independent sample t-tests; mean value of glucose was 103.78 $\pm$ 117.13 mg/dl in male and 54.50 $\pm$ 40.16 mg/dl in female patients. The p-value= 0.082 (p-value > 0.05) therefore, there is no significant difference between gender with respect to glucose. DMFT and age significantly related as the Pearson's correlation coefficient (r) = 0.445, p-value = 0.005 was also seen.



Graph 2: Correlation of Total Salivary glucose levels to the DMFT score of subjects.

Discussion

Shannon et al., (1963) analysed parotid fluid for glucose concentration by the glucose oxidase procedure. The presence of glucose in parotid fluid was confirmed. Parotid fluid glucose level was not found to be related to caries experience[9]. In our study whole salivary levels were calculated and significant increase was noted with rise DMFT index scores. Shannon et al., also detected mean salivary glucose levels of 0.75 (S.D. ± 0.68) mg% in the parotid fluid.[9] Our study calculated it as 34.83mg/dl. This large difference can be attributed to the choice of study design, were subjected the saliva to drying in speed evacuator. Also, the general term "saliva" refers to the fluid that surrounds all oral hard and soft tissues. This oral fluid (that is, whole saliva) represents a mixture of individual fluids and components derived from several sources. Major and minor salivary glands make the bulk contribution to whole saliva, with minor contributions from non-glandular sources such as crevicular fluid, oral microorganisms, host-derived cells, and cellular constituents, as well as diet-related components[3]. Saliva contains electrolytes like sodium, potassium, magnesium, calcium, bicarbonate and phosphates, as well as immunoglobulins, proteins, enzymes and mucins[4].

During our literature search not many studies were found correlating salivary glucose levels with caries incidence; but several studies were found associating salivary glucose levels and diabetes, with varying results. However, dental caries is one the oral symptoms and conditions associated with diabetes, both Non-insulin dependent diabetes mellitus (NIDDM) and Insulin dependent diabetes mellitus (IDDM).[10] Therefore, these studies have also been considered for discussion.

Tenovo et al., (1986) reported prevalence of dental caries was as high in the diabetic group as in the controls.[11] Swaljung et al., (1992) detected no difference in caries incidence, but increased levels of salivary glucose in IDDM than control patients. Amer et al., (2001) showed NIDDM patients to have statistically significant increase in glucose levels in saliva than controls. Aydin (2006) results proved salivary glucose were significantly higher in obese and non-obese diabetic subjects than in controls.[12] Cedric Jurysta et al., (2009) confirmed that the glucose concentration in saliva was higher in diabetic patients than in control subjects.[13] Vasconcelous et al., (2010) also reported similar findings.[14]

Strep. mutans is one of major etiologic significance in human dental caries and their ability to initiate dental caries depends on its capacity to release organic acids and to produce adhesive extracellular polysaccharides. This requires frequent intake of fermentable substrates, especially sucrose. Glucose or other carbohydrates will also promote the growth and acid production of Strep. mutans but not its adherence, since the extracellular polymers are synthesized exclusively from sucrose. Lactobacilli are aciduric and acidogenic bacteria which are present in large numbers in the mouths of caries-active persons. The fermentable carbohydrates required for the growth of these bacteria are likely to derive from saliva and/or gingival crevicular fluid. This fact together with the leakage of blood glucose into the oral cavity is the likely explanations for the presence of cariogenic bacteria and for the subsequent development of dental caries among many adult diabetics.[11]

Swaljung et al., (1992) reported 9.71µg/ml of salivary glucose levels.[15] While, Di Gioia et al., in 2004 reported 5.57mg/dl and Aga - Hossieni et al., in 2006 as 13.69gm/dl.[13] Maria Soares et al., in 2009 reported a mean salivary glucose value in healthy individuals as 5.94mg/dl.[4] Our study calculated it as 34.83mg/dl. This large difference can be attributed to the choice of study design, were subjected the saliva to drying in speed evacuator.

To conclude, salivary glucose levels increase with increasing DMFT index and play a significant role in high caries incidence. However this should be confirmed with better techniques and larger sample size. Salivary glucose measurement kits are already available in developed countries for monitoring glucose levels in diabetics. This offers a promising future if it could be adapted into chair side or self-evaluation kits for dental caries as well.

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