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Full Length Research Paper

Salivary flow rate in adult Kenyans and its relationship with chronic periodontitis

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The study is aimed at determining the salivary flow rate (SFR) in adult Kenyans and investigates its relationship with chronic periodontitis. A descriptive cross sectional study was conducted on 333 participants (age between 18 and 45 years) among the patients attending Nairobi University Dental Hospital over a period of five months. Three groups were identified based on their periodontal status as healthy, gingivitis and chronic periodontitis. Unstimulated whole saliva was collected using the spit method. The British Society of Periodontology Basic Periodontal Examination index was used to determine the periodontal status of the participants. The salivary flow rate (g/min) ranged between 0.14 and 1.98 g/min in males and 0.08 and 1.68 g/min in females. The mean SFR was 0.66 ±0.31 g/min SD with a mode of 0.30 g/min. 256 participants were normal secretors within the range of 0.3 and 1.0 g/min, 43 were high secretors with over 1.0 g/min while 32 were low secretors with a range of 0.1 and 0.29 g/min. Participants with chronic periodontitis had a statistically significant higher salivary flow rate (M=0.68±0.33 SD) than those who had gingivitis (M=0.62±0.28 SD) with p=0.039. The unstimulated salivary flow rate in adult Kenyans is 0.66 g/min, which falls within the reported normal range. The salivary flow rate was found to increase with the severity of periodontitis suggesting a link between the two.

Key words: Saliva, salivary flow rate, chronic periodontitis.

INTRODUCTION

Periodontal diseases are the commonest oral health problems with over 90% of the population suffering from at least one form of this disease (Ng'ang'a, 2002). Globally, gingival bleeding is the most prevalent sign of this class of diseases, and the presence of deep periodontal pockets of greater than 6 mm have been reported to range from 10 to 15% in adult populations (Petersen and Ogawa, 2012). The prevalence of chronic periodontitis in Kenya ranges from 1 to 10% (Ng'ang'a 2002). Several studies have linked periodontitis to alteration in saliva composition and flow rate (Shaila et al., 2013).

This rate varies from population to population depending on age, sex, diet, geographica l location and

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genetics. It may also be altered by chronic systemic diseases, medication and radiation therapy (Flink et al., 2008). Its relationship with periodontal disease is still unclear.

Saliva is an important oral fluid with numerous functions that relate to the normal functioning of the body and especially the oral structures. For instance, saliva keeps the oral tissues moistened protecting them from physical injury. The salivary proteins including the antimicrobial peptides also play an important role as a first line of defense against invading microorganisms (Sreebny, 2000). Changes in the quality or quantity of saliva (William, 2009) may therefore have deleterious effects on the oral tissues. Hypo salivation describes a situation where an individual is unable to produce enough saliva, while hyper salivation is the opposite. Both hyper salivation and hypo salivation may be present with challenges to oral health (McDonald and Marino, 1991; Bethesda, 1999; Jellema, 2007).

The quantitative state of saliva is determined using the salivary flow rate (William, 2009). Salivary flow rate is the amount of saliva produced by salivary glands in a given period of time, usually expressed in milliliters per minute or grams per minute (ml/min or g/min). Several studies have shown varying values reported as normal salivary flow rates. The variations could be explained partially by geographical, age, sex, race and genetic differences among the different groups studied (Shern et al., 1993; Percival et al., 1994; Fenoll-Palomares et al., 2004; Flink et al., 2008; Yamamoto et al., 2009; Foglio-Bonda et al., 2013). There is minimal data describing the normal salivary flow rate among Africans. A Nigerian study by Adenji et al. (1996), showed a demonstrable increase in salivary flow rate from age 20 to 23 years thereafter followed by a gradual decrease (Adeniji. 1996). In general, severe reduction in salivary flow rate has been shown to set in at 45 years of age. This phenomenon may partly be due to the advent of other underlying conditions that tend to set in around the same time such as diabetes, hypertension and menopause (Mobile, 2014). Knowing that genetic and environmental factors may affect salivary flow rates, it is imperative that such values are established for a native African population. This will help to set up values for determining the diagnosis of salivary flow abnormalities in this population. The aim of this study was to determine the salivary flow rate (SFR) in adult Kenyans and investigate its relationship with chronic periodontitis.

MATERIALS AND METHODS

Study population

Three hundred and thirty three (333) participants with age ranging from 18 to 45 years and a mean of 32.2 years ± 8.1 SD were recruited voluntarily into the study. Of these, 190 (57.1%) were females while 143 (42.9%) were males. Among the participants were those found to be healthy, having gingivitis and periodontitis.

All the participants were screened for conditions known to affect normal saliva production (Mobile, 2014).

Saliva collection and determination of salivary flow rate

The participants were clearly informed on the protocol. To reduce the effect of circadian rhythms, all saliva samples were collected within the same period of time on every data collection day between 8:00 am and 10:00am. Unstimulated saliva was collected using the spit method (Navazesh, 1993; Alves, 2010; Beltzer, Fortunato et al., 2010) over a period of five minutes when the participants were comfortably seated on a dental chair. The flow rate was then calculated by using grams per minute (g/min). Collection was done before clinical examination to prevent stimulation of the major and minor salivary glands as a result of introducing examination equipment in the mouth. The participants were clearly informed on the protocol and a stop clock was used to time the period for saliva collection. A 40 ml plastic bottle, approximately 5 cm in diameter with a tight fitting cover was used to collect saliva. The bottle was weighed before and after saliva collection using a calibrated digital balance (JY-09, Twins electronic Kitchen scale) to the nearest 0.1 mg. The difference between the two weights was recorded as the saliva weight collected over the period of five minutes. This was then divided by the duration of collection (five minutes) to get the flow rate for each individual. The flow rate was calculated and expressed as grams per minute (g/min).

Assessment of periodontal health

The periodontal status was assessed using British Society of Periodontology, Basic Periodontal Examination (BPE) protocol (Loe, 1967; CotBSo, 2011). This index integrates gingival inflammation, presence of calculus and overhanging margins and pocket depth to determine a particular score for a given sextant.

All teeth present in a given sextant excluding the third molars were probed using a graduated periodontal probe (Michigan probe) with markings at every 3 mm, and the deepest pocket noted. Factoring in presence or absence of bleeding, calculus and over hangs, a score of zero to four was recorded for each sextant.

Statistical analysis

Statistical Package for the Social Scientists (SPSS version 20.0) was used to perform the tests. Levene's test of homogeneity was used to test for equality of variances among the different parameters. Statistical significance was set at $p < 0.05$

RESULTS

Salivary flow rate

The salivary flow rate (g/min) ranged between 0.14 and 1.98 g/min in males and 0.08 and 1.68 g/min in females. The mean SFR was 0.66 ±0.31 g/min SD with a mode of 0.30 g/min. 256 participants were normal secretors within the range of 0.3 and 1.0 g/min, 43 were high secretors with over 1.0 g/min while 33 were low secretors with a range of 0.1 and 0.29 g/min (Table 1).

There was no difference in the variances of salivary flow rate by gender; Males (M = 0.68±0.31 SD) and Females (M = 0.64 ± 0.31 SD) using Levene's test of

Table 1. Secretors characteristics of participants.

Variable		Gender			
		Male, n(%)	Female, n(%)	X^2	p-value
Secretors	Low	13(9.1)	20(10.1)	1.660	0.646
	Normal	114(79.7)	142(75.1)		
	High	16(11.2)	27(14.3)		
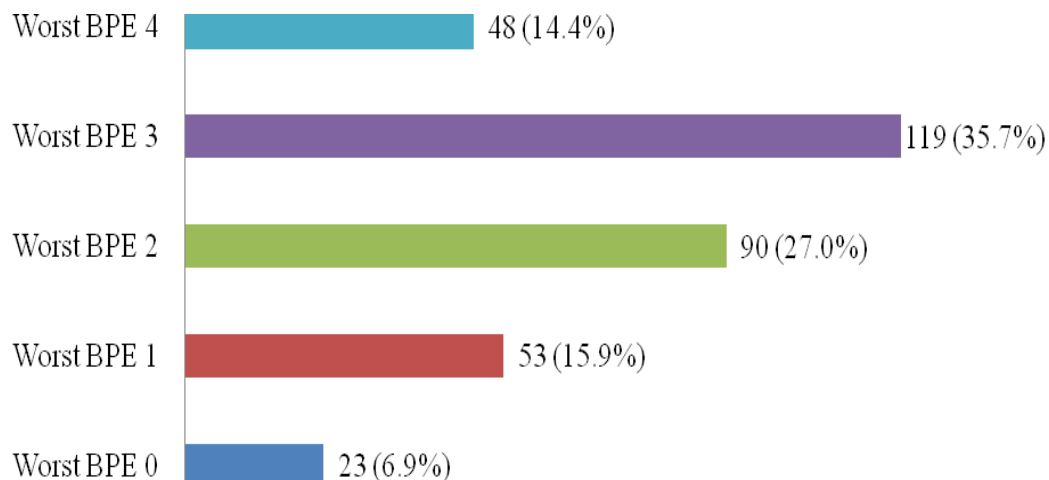
Figure 1. Frequency distribution of participants according to periodontal status based on the highest BPE score (n=333).

homogeneity (F = 1.158, p = 0.283). An Independent Sample t test was thus run on the data which showed a non-statistically significant difference in saliva flow rate (g/min) between Males (M = 0.68±0.31 SD) and Females (M = 0.64±0.31 SD), t (331) = 1.245, p = 0.214.

Periodontal status

The Basic Periodontal Examination (BPE) score ranged between 0 and 4.0 as seen in Figure 1. Forty eight participants (14.4%) presented with at least one sextant in the mouth with severe periodontitis (BPE score of 4), one hundred and nineteen (35.7%) with mild periodontitis (BPE of 3), one hundred and forty three (42.9%) with gingivitis (BPE of 2 and 1) and twenty three participants (6.9%) were healthy (BPE of 0)

Relationship between salivary flow rate and periodontal status

There was a statistically significant difference between participants with gingivitis and those with periodontitis, showing a higher flow rate in those with periodontitis (M=0.68± 0.33 SD) compared with those with gingivitis

(M=0.62±0.28 SD) p=0.039 as shown in Figures 2 and 3, respectively.

A linear regression test elicited a statistically significant prediction of saliva flow rate (g/min) from severity of sextant – BPE scores, F (1.308) = 4.298, R^2= 014, n=310, p=0.039 (Figure 4).

DISCUSSION

Global Literature has shown a high variability in the value of unstimulated whole salivary flow rate. For instance, Yamamoto (2009) reported 0.053 m/min, Fenoll-Palomares et al. (2004) 0.48 m/min, Percival et al. (1994) 0.33 m/min, Shern et al. (1993) 0.61 m/min and Foglio et al (2013) 0.64 m/min. The current study found the unstimulated salivary flow rate to be 0.66 g/min. This variability in flow rate reported by various studies is thought to be due to gender, age, collection method, temperature and diurnal changes. These factors however, seem not to be sufficient in explaining the high variability of the flow rate. The assumption is that there are other variables like diet, geographical location and genetics that could contribute to the observed differences. The above studies have been conducted in different geographical locations and racial groups.
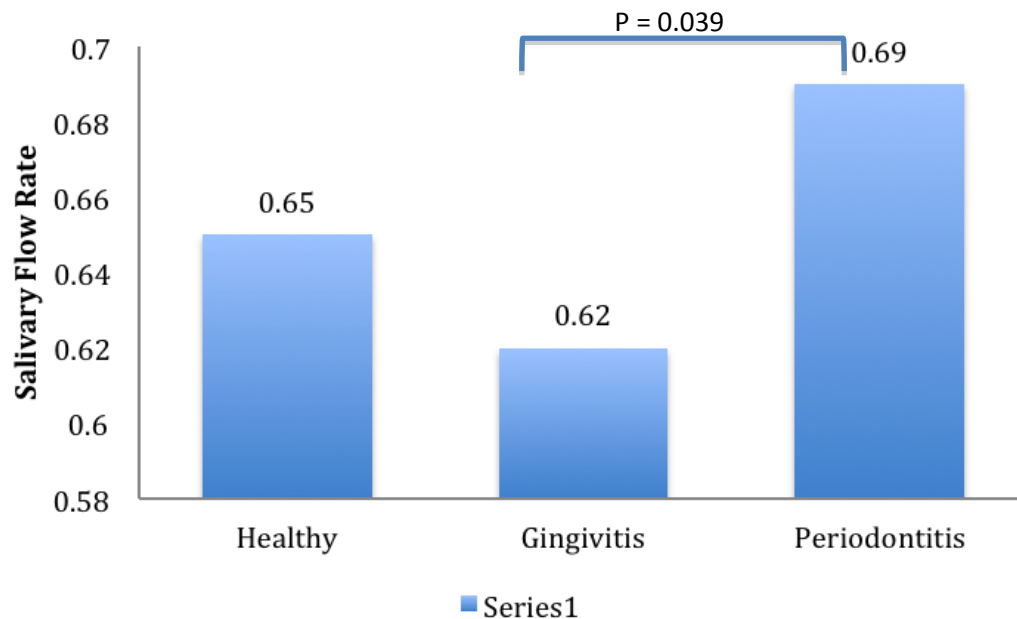
Figure 2. Independent sample T Test of salivary flow rate (g/min) and periodontal status.
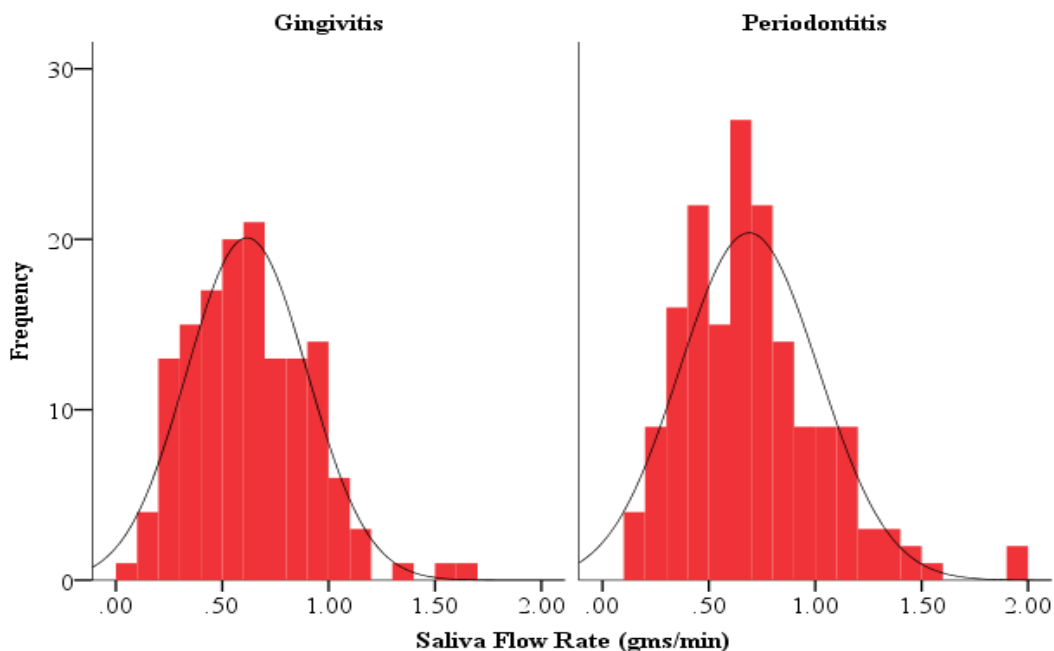

Figure 3. Distribution of mean salivary flow rate of participants with gingivitis and periodontitis.

The current study did not find a statistically significant salivary flow rate difference between the healthy individuals (M=0.65, SD=0.29, p=0.583) and gingivitis or periodontitis (M=0.69, SD=0.33, p=0.60). However this could have been due to the very small number (23/333) of participants that were considered healthy. However there was a statistically significant difference between gingivitis and periodontitis (M=0.62, SD=0.28), t(331)=2.020, p=0.04). Participants with periodontitis produced more saliva than their counterparts who had gingivitis.

Within the limitations of this study, we were able to demonstrate the relationship between salivary flow rate and periodontitis. It was observed that there was an
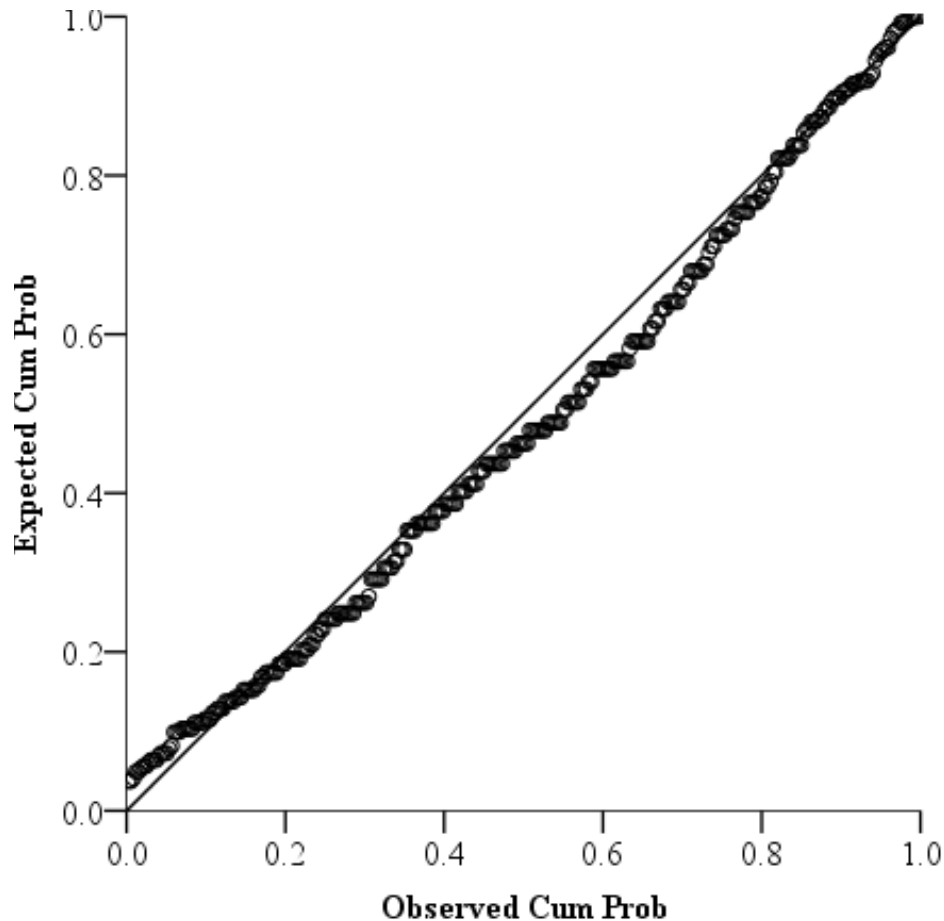
Figure 4. Normal P-P of regression standardized residual of salivary flow rate (g/min) from severity of sextant – BPE scores. Dependent variable: Salivary flow rate.

increase in the salivary flow rate of the respondents who had periodontitis as compared to those with gingivitis or were healthy.

This was different from Mulki et al. (2013) findings which did not find a difference in saliva flow rate between the participants who had periodontitis and those who were considered normal. This could be as a result of the saliva collection protocol that was used. In Mulki and co-workers protocol, 5 ml of saliva were collected regardless of how long it took, and then the flow rate was calculated from the time duration which differed for each patient. 5 ml of saliva were required in his study to allow for determination of qualitative composition of saliva. In addition, the criterion for periodontitis that was used was based on loss of attachment with pocket depth of ≥5 mm in at least eight sites. This could have led to elimination of localized periodontal disease. Also patients with gingivitis on a reduced periodontium could have been mistaken for periodontitis.

Periodontitis is an inflammatory condition of the periodontal tissue. The observed increase in saliva flow rate could be in part attributed to increase in inflammatory exudates (crevicular fluid) and in part to the body's defense mechanism by increasing saliva flow rate so as to deliver inflammatory mediators and immune cells to the site of infection. Saliva possesses many important functions most importantly its antimicrobial activity, mechanical cleansing action, control of pH (Mulli, 2012; Hamada, 1999) among others. The presence of antimicrobial peptides, neutrophils, thiocynates and other antimicrobial molecules in whole saliva play an important role in protecting the oral cavity from infectious microorganisms. Therefore it is expected that in response to an inflammatory attack to the oral tissues, salivary flow rate increase is a reasonable response.

Conclusion

The unstimulated mean salivary flow rate for adult Kenyan population was 0.66 g/min, which falls within the reported normal range. The salivary flow rate was found to increase with the severity of periodontitis suggesting a link between the two.

Conflict of Interests

The authors have not declared any conflict of interests.

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