Relationship between Stimulated Salivary Factors, Dental Caries Status and Nutritional Condition among Institutionalized Elderly People

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Abstract

Background: Nutrition is one of the important components of health, functional independence and quality of life in elderly population. In this age group, malnutrition is common and the risk of malnutrition increases with the advancing age. Nutritional status acts as a modifying factor in the development of many oral diseases.

Aim: To assess the relationship of salivary factors, dental caries and nutritional status among institutionalized elderly people.

Materials and Methods: A cross-sectional descriptive study was conducted in three old age homes in Nellore city. All the institutionalized elderly aged 50 years and above were included for the study. Pearson co-relation was done to know the relationship of malnutrition, salivary parameters and dental caries experience.

Results: A total of 81 subjects with a mean age of 70.12 ± 7.32 yrs participated in the study. 43% of subjects were at risk of malnourishment and 14% were malnourished. Analysis of salivary parameters in relation to nutritional status of subjects revealed that salivary flow rate decreased among malnourished subjects (0.50 ± 0.100) when compared to well-nourished subjects (0.93 ± 0.260). DMFT scores increased in subjects who were malnourished (12.45 ± 5.574) compared to well-nourished subjects (6.34 ± 5.765). Co-relation of nutritional status with salivary parameters and caries experience revealed a positive co-relation between nutritional status and salivary flow rate, where as a negative co-relation was observed between caries experience.

Conclusion: Prevalence of malnourishment was 14% among the institutionalized elderly. All of them had lower salivary flow rate, buffering capacity and pH with increased caries experience.

Key Words: Malnutrition, Stimulated Salivary Flow Rate, Dental Caries, Elderly People

Introduction

Throughout the world, a demographic revolution is underway. The proportion of older people is growing faster than of any other age group. Approximately 600 million people are aged 60 years and over, and this number will double by 2025 [1]. By 2050, it will be 2 billion, 80% living in developing countries [2]. This poses tremendous challenges to health and social policy planners, particularly because disease patterns will shift concurrently. Chronic diseases such as cardiovascular disease, hypertension, cancer and diabetes are prevalent in old age, are fast becoming the leading causes of disability and mortality.

Nutrition is one of the important components of health, functional independence and quality of life in elderly population and malnutrition is common and the risk of malnutrition increases with the advancing age [3-7]. Age associated reductions in food intake combined with the presence of debilitated diseases, social isolation, economic limitations, altered health status and multiple hospital admissions complicate the nutritional balance in elders.

With the increase in the elderly population and the greater number of teeth being retained into old age elderly people are more prone for many oral diseases. Dental caries is considered to be a significant risk factor for tooth loss leading to reduction in chewing ability in elderly people. In addition, the process of age-related bone loss that occurs throughout the skeleton may also affect the alveolar bone that supports the teeth, resulting in increased risk of tooth loss and edentulism. Periodontal disease also increases with age and are shown to be exacerbated by nutritional deficiencies.

Saliva plays a central role in the maintenance of oral homeostasis. The complex mixture of proteins, glycoproteins, mucins, and ions helps prevent many oral diseases. Saliva is important for oral clearance, buffers acids generated by oral bacteria and has antimicrobial action against many pathogenic microorganisms [8]. Any changes in saliva predispose individuals to be at risk for serious oral complications.

Nutritional status acts as a modifying factor in the development of many oral diseases. Very few studies have assessed the relation between saliva, nutritional status and oral health. Rhodus et al. [9] found an association between low salivary secretion and deficient intake of nutrients in both hospitalized and home-dwelling elderly people. Another study by Dormenval et al. [10,11] showed that there was a relation between poor nutritional status and reduced salivary flow rate in hospitalized elderly. Samnieng et al. [12] showed that the elderly group having hyposalivation had a lower Mini Nutritional Assessment score compared with the group having normal salivation. Study by Syrjälä et al. [13] however; found no such association between salivary flow rate and nutritional status of home dwelling elderly. Most of these studies assessed salivary flow rate without considering other salivary parameters (pH, buffering capacity, total protein and total calcium). Also these studies assessed the oral health status only in terms of masticatory function and majority of these were conducted on hospitalized elderly people.

Hence, the present study was planned to assess the relationship of salivary factors (flow rate, pH, buffering capacity, total protein and total calcium), dental caries and nutritional status among institutionalized elderly people.

Materials and Methods

A cross-sectional descriptive study was conducted in three old age homes in Nellore city in the month of August 2012. A total of nine old age homes are in Nellore city, out of which three old age homes accepted to participate for the study. All the institutionalized

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elderly aged 50 years and above were included for the study. Those participants who were bedridden and unable to communicate verbally were excluded.

Ethical approval and informed consent

Ethical approval for the study was obtained from the institutional ethics committee, Narayana Dental College and Hospital, Nellore and from the Directors of the respected old age homes. The principal investigator explained the study procedure in detail to the participants and they were also clearly informed that the participation was purely voluntary and consent was taken from all participants.

Study procedure

The study proceeded in three parts. The first was an interview using a specialized proforma for collecting information on the demographic data and nutritional assessment this was followed by clinical examination and finally the third part consisted of salivary collection and analysis.

The specially designed proforma collected basic demographic details of subjects and assessed their nutritional status using Mini Nutritional Assessment, which was developed to be used on elderly populations [14]. The MNA is composed of 18 simple and rapidly measured items, can be performed in less than 15 minutes. The test involves (1) anthropometric assessment (weight, height, arm and calf circumferences, and weight loss); (2) general assessment (six questions related to life style, medication, and mobility); (3) dietary assessment (eight questions related to number of meals, food and fluid intake, and autonomy of feeding); and (4) subjective assessment (nine self-perception of health and nutrition). The scoring for each part categorizes the elderly patients in the following manner: (1) well-nourished (normal); (2) at risk to malnutrition (borderline); (3) malnourished [15].

Following the nutritional assessment, clinical examination was carried out for recording dental caries using dentition status index (WHO 1997 basic methods) [16].

Saliva collection

Participants were advised to refrain from intake of any food or beverages (Water exempted) one hour before collecting saliva, early in the morning as salivary flow rate was affected by circadian rhythms [17]. The participants were then instructed to sit in a relaxed position and asked to chew the paraffin wax for 5 min, spit the saliva into a pre-weighed container [18]. Finally, the collected samples were transported in a thermal insulation box maintaining a constant temperature of 4°C and were sent to the laboratory within 30 minutes for further analysis. Salivary Analysis was performed by trained laboratory technician at the central laboratory of Narayana Medical College, Nellore.

Estimation of Flow Rate of Saliva was calculated in g/ml which is equivalent to ml/min [18]. The pH was measured by a manual pH meter (Systronics, India) and the buffering capacity was determined by the modified Ericsson method for smaller volumes [19]. The total protein and calcium levels of the samples were measured by an auto analyzer (Erba, Chem-7). The principle for estimation of total proteins and calcium levels was based on the end point enzymatic method and were assessed by using gold standard salivary diagnostic kits.

Standardization of instruments

The reliability of the laboratory equipment, was tested with every eighth sample being retested for Flow rate, pH, buffering capacity, Total protein and Calcium levels these values were found to be consistent.

Statistical analysis

Data analysis was performed using the SPSS 16 version. Analysis of Variance (ANOVA) was done to determine the difference between groups and to compare the data between MNA and caries risk and physicochemical properties of saliva. Pearson's rank order correlation was done to determine the association between MNA and caries risk and physicochemical properties of saliva.

Results

A total of 96 elderly people were present in the three old age homes which participated in the study. Out of 96 elderly people 7 were bed-ridden and 8 people were unable to communicate verbally hence, excluded from the study. Analysis of the demographic data among the elderly subjects' revealed the mean age of 70.12 ± 7.32yrs there was a higher representation of females (58.02%) when compared to males (*Table 1*).

The subjects were categorised based on their nutritional status according to the Mini Nutritional assessment (1994) [15] criteria. About 43% of subjects were at risk of malnourishment and 14% were malnourished (*Table 2*). When MNA status was assessed in relation to age and gender the risk of malnourishment increased with age. 63.63% of subjects in the age 80-89 were categorised as at risk of malnourishment and 27.27% were malnourished. When MNA status was assessed for males and females separately it was found that majority of females 65.72% were well-nourished when compared to 34.29% of males (*Table 1*).

Analysis of salivary parameters in ± relation to nutritional status of subjects showed that salivary flow rate was lower in malnourished subjects (0.50.100) when compared to well-nourished subjects (0.93 ± 0.260). Hyposalivation was observed in subjects (0.5ml/min) who were malnourished. The buffering capacity was also lower in the subjects who were malnourished (1.90 ± 0.260) when compared to well-nourished subjects (2.00 ± 0.366) however; this was not statistically significant (*Table 3*).

Analysis of mean DMFT scores in relation to the nutritional status revealed that the DMFT scores was high in subjects who were malnourished (12.45 ± 5.574) compared to well-nourished subjects (6.34 ± 5.765) which was statistically significant (*Table 4*).

Pearson correlation of nutritional status with salivary parameters and caries experience revealed a positive co-relation between nutritional status and salivary flow rate (*Figure 1*), where as a negative co-relation was observed between caries experience and improved nutritional status of subjects (*Figure 2*), which was statistically significant ($P < 0.01$).

Discussion

Past few decades have witnessed a slight revolution in the demography of population in the world with many nations recording longer life expectancies. India is a vast country with unique geographic and population profile of one billion. Sizeable population of India is greying, it is predicted that elder people of country shall be highest among world by 2025, i.e. 127 million [20].

In the course of recent years, many reports have been published pointing to malnutrition among elderly being frequently associated with morbidity and mortality [21-26]. Malnutrition may be caused

Table 1. *Demographic characteristics of the study subjects in relation to their MNA status*

Characteristics of the study subjects	n (%)	n (%) of subjects by MNA		
Age group in years		**Malnourished**	**Risk of mal-nourishment**	**Well-nourished**
50-59	5(6.17%)	1(20%)	1(20%)	3(60%)
60-69	30(37.03%)	2(6.66%)	11(36.63%)	17(56.66%)
70-79	35(41.97%)	5(14.28%)	16(45.72%)	14(40%)
80-89	11(14.81%)	3(27.27%)	7(63.63%)	1(9.09%)
Gender				
Males	34	6(54.54%)	16(45.72%)	12(34.29%)
Females	47	5(45.45%)	19(54.28%)	23(65.71%)

Table 2. *Categorization of the subjects based on their nutritional status.*

MNA groups	n	Percentage of subjects
Malnourished	11	14%
At risk of malnourishment	35	43%
Well nourished	35	43%

Table 3. *Salivary parameters of the subjects in relation to their nutritional status.*

Salivary parameters	Groups	Mean±S.D	p-value*
Flow rate (ml/min)	Malnourished At Risk of malnourishment Well nourished	0.50 ± 0.100 0.82 ± 0.209 0.93 ± 0.260	p<0.001*
pH	Malnourished At Risk of malnourishment Well nourished	6.68 ± 0.354 6.81 ± 0.227 6.78 ± 0.266	p>0.365
Buffer Capacity (ml)	Malnourished At Risk of malnourishment Well nourished	1.90 ± 0.286 2.04 ± 0.340 2.00 ± 0.366	p>0.5040
Total Protein	Malnourished At Risk of malnourishment Well nourished	2.06 ± 0.587 2.41 ± 0.716 2.38 ± 0.809	p>0.3803
Total Calcium	Malnourished At Risk of malnourishment Well nourished	7.32 ± 1.391 7.18 ± 1.706 6.72 ± 1.809	p>0.4313

* Significant p<0.05 level; Tukey HSD

Table 4. *Dental caries experience of the subjects in relation to their nutritional status.*

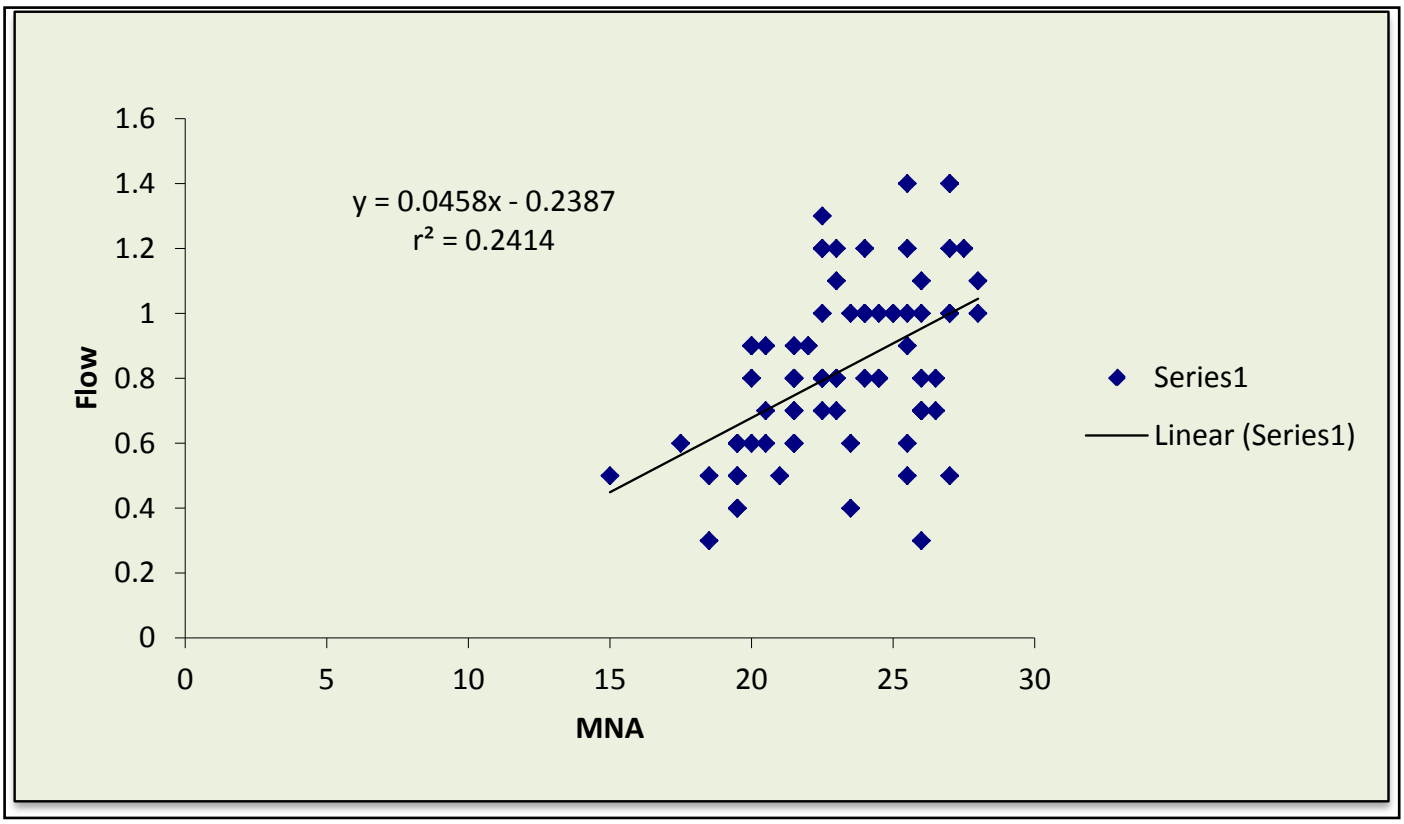
MNA groups	[DMF(T)]	p-value
Malnourished	12.45 ± 5.574	P<0.05*
At Risk of malnourishment	10.51 ± 8.535	
Well nourished	6.3 4 ± 5.765	

*Significant p<0.05 level; Tukey HSD

by inadequate dietary habits or reduced appetite due to disease perse and/or intake of drugs. A number of important physiologic variables decline substantially with ageing and compromise the individual's ability to respond the pathologic insults. Thus, the present study was planned to assess the relationship of salivary factors (flow rate, pH, buffering capacity, total protein and total calcium), dental caries in relation nutritional status among institutionalized elderly people.

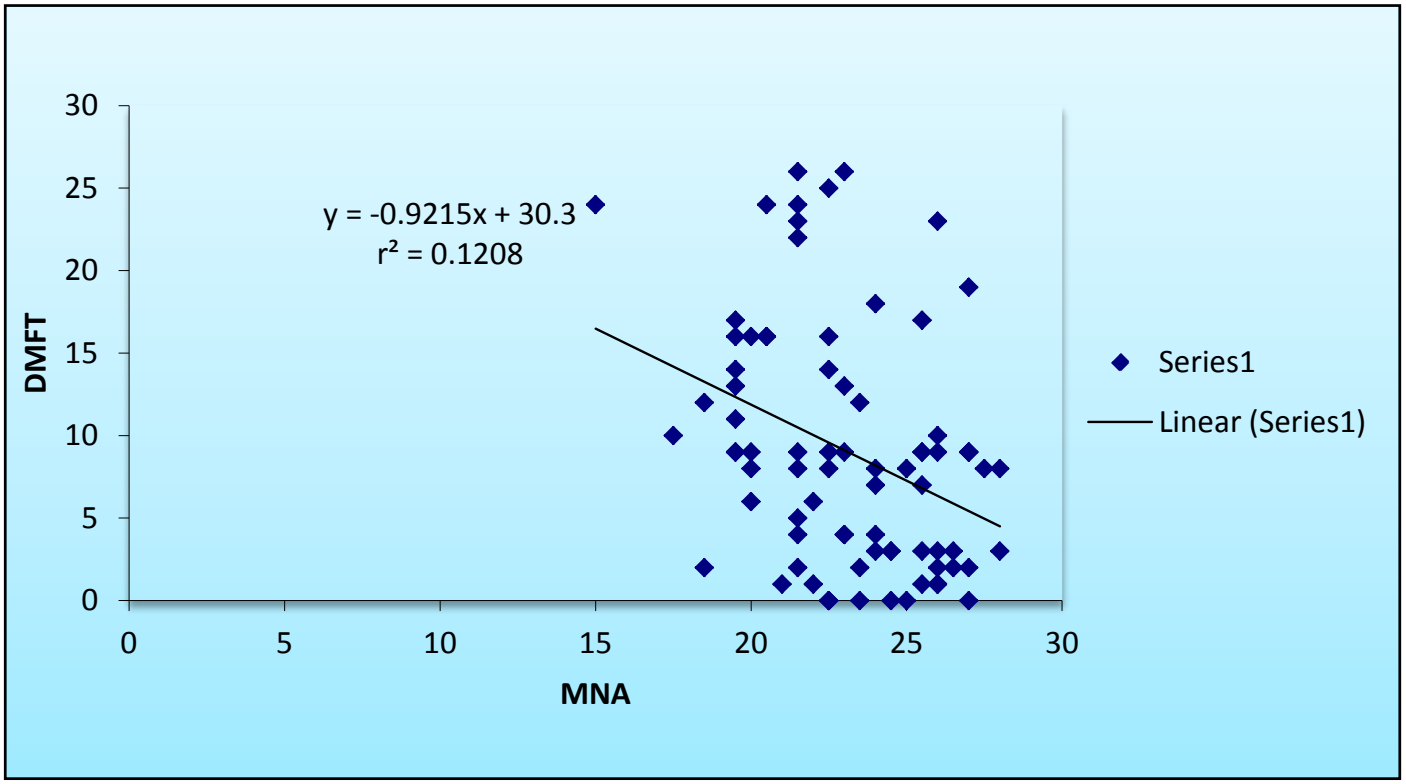
The MNA was used for screen subjects at risk to malnutrition. In spite of being an appropriate screening tool, MNA was developed to screen for malnutrition among institutionalized subjects. The sensitivity of the MNA is 96%, specificity 98% and positive predicted value for malnutrition 97% when compared with a malnutrition state determined by a physician using other methods. The validated version of MNA as an instrument for assessment of nutritional status in elderly was used in the present study. MNA questionnaire has been validated against the clinical assessment by experienced physicians [14]. The mean MNA score in the present study conducted among 81 institutionalized elderly in Nellore, India (23.14 ± 2.79) which was comparable to the MNA scores (22.7 ± 5) in studies conducted among elderly [27]. On the contrary it was bit high (27.18 ± 1.8) in a study conducted among 350 healthy elderly people [28].

In the present study, stimulated salivary flow rate was measured since; it is a measure of functional capacity of salivary gland [29]. Malnourished institutionalized elderly subjects had lower stimulated salivary flow rate when compared to well-nourished subjects. These findings were similar to the findings of studies conducted among elderly malnourished [12] and Swiss subjects [10,11]. The low salivary flow rate in malnourished elderly can be consequence of poor nutritional status which in turn affects the salivary gland function and can cause atrophy of the gland. Though there was a decrease in salivary flow rate in malnourished elderly people, age can be considered as a confounding factor in the present study. Since, the salivary flow rate decreases with age as a physiologic process of aging, conflicting observations have been made on flow rates of whole saliva in relation to age in the literature. Some have found no association between these rates and age for stimulated flow



**. Correlation is significant at the 0.01 level (2-tailed).

Figure 1. *Co-relation of Nutritional status with Salivary flow (Pearson's r^2=0.24).*



**. Correlation is significant at the 0.01 level (2-tailed).

Figure 2. *Co-relation of Nutritional status with DMFT (Pearson's r^2=0.12).*

[30-32]. However, several investigators have noted a decrease in un-stimulated flow with age [31,33,34]. Even animal experimental studies have proved that low salivary flow rate and change in the composition of saliva is associated with malnutrition [35].

In contrary, study conducted among elderly in eastern Finland has found that there was no significant relationship between salivary flow rate and nutritional status in their study [13]. The probable reason which has been quoted was that they have not followed the circadian rhythm for collection of saliva which can affect the salivary flow rate in individuals.

DMFT scores were high in subjects who were malnourished when compared to well-nourished and there was a negative co-

relation between caries experience and nutritional status among institutionalized elderly subjects. Low salivary flow rate combined with low buffering capacity and pH in malnourished subjects may have been responsible for high caries experience in the present study. Without significant salivary flow rate, food debris remains in the mouth, where it is fermented by dental plaque bacteria to organic acids that initiate the dental caries process. High total calcium levels in malnourished group compared to well-nourished group can be attributed to the demineralization process due to increased caries activity in malnourished.

In conclusion, the institutionalized elderly who were malnourished had a lower salivary flow rate, buffering capacity and pH with a high caries experience.

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