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Comparison of Salivary Total Antioxidants in Protein Energy Malnutrition and Normal Children and its Relation with Dental Caries

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Abstract

Aim: To study the correlation between dental caries and the salivary antioxidants in protein energy malnutrition children.

Study Design: Total 80 children were selected within the age group of 3 to 9 years and were segmented into normal healthy children and children suffering from protein energy malnutrition.

Materials and Methods: Protein energy malnutrition was assessed using Waterlow's classification; Dental caries was recorded using DMFT and Salivary Antioxidant levels were assessed using DPPH radical spectrophotometric method.

Result: The salivary antioxidants were altered in the protein energy malnutrition children, which was statistically significant, thus, establishing the fact that there is a major contribution of adequate nutrition in early growth and development of the child and has a substantial impact on maintaining general and oral health.

Keywords: Malnutrition, Protein energy malnutrition, Dental caries, Salivary Antioxidants

Introduction

Nutrition is an essential component of human growth and development and is crucial in preventing dental caries, dental erosion, developmental defects, oral mucosal diseases and periodontal diseases.[1,2]

Nutritional deficiencies are one of the most predominant diseases affecting children in India. A study published by Awate RV (1997) put the prevalence rate of various nutritional disorders as high as 47.42%.[3] One of the more noticeable among the deficiencies is Malnutrition and Protein Energy Malnutrition (PEM).PEM is a syndrome of chronic nature in which there is inadequate intake of protein, energy and micronutrients.[4] The nutritional deficiency not only leads to a stunted physical and mental growth but also influences the degree of hypo-mineralization and increased dental caries susceptibility of erupting teeth.[5] It is associated with decreased flow rate, reduced buffering capacity and the altered composition of saliva.[6]

Salivary antioxidants, a major constituent of saliva, play a key role in prevention of oral infection and dental caries.[7] They are critical to the body's defence system because of their ability to neutralize free radicals, thus eliminating reactions that cause excessive oxidations.[8] The levels of antioxidants change in response to an infection, inflammation or disease.[7]

Dental caries is the most prevalent chronic infectious disease affecting the human race worldwide which involves dissolution of the dentin and demineralization of the enamel[8].

It is postulated that imbalance of free radicals and antioxidants, which establish a first line of defence against free radical mediated oxidative stress, may play a vital role in the onset of dental caries.[9] An interesting correlation was found in the study done by Awate et.al in which he found that 68% of the malnutrition children had poor oral & personal hygiene.[3]

This study is a hypothesis towards an association between the salivary total antioxidant levels in children affected by protein energy malnutrition and their normal counterparts and to find out if a co-relation exists with the respective dental caries status.

Materials and Methodology

A total of 400 subjects between 3 to 9 years of age, both male and female, from Anganwadis were screened with the approval from institutional ethical committee and the respective Anganwadis.

Subjects free from systemic diseases which affect the salivary secretions were selected according to the inclusion and exclusion criteria followed by a complete medical history. Children who were uncooperative, physically and medically compromised, having history of medications for long term illness and undergoing any treatment for protein energy malnutrition were excluded.

A general examination including weight, height and mid-arm circumference (anthropometric measurements) were recorded for every subject. A measuring tape was used for the measurement of mid-arm circumference. Following the inclusion and exclusion criteria a total 80 subjects were selected to be a part of the study.

The subjects were equally divided into two groups of forty each:

(Group I) healthy children and (Group II) children diagnosed with Protein Energy Malnutrition according to Water-low's classification (1972) [Table-1].

The dental caries scores were recorded as per the WHO criteria (1997).

The study was explained in the provincial language to the Anganwadi workers and parents of the participating subjects. An informed written consent was obtained from

the parents before the collection of saliva samples. For the collection of saliva, the subjects were asked to sit in Coachman's position. 5ml of un-stimulated saliva collected was stored at 4ºC till further processing. Salivary total antioxidants level was determined using DPPH Assay described by Blois (1958)[10] and the absorbance was noted at 517nm.

Results

The data collected was subjected to statistical analysis by using Epi Info Software version 6. Comparison between the parameters was done by using the unpaired student - t test.

The general examination revealed that the weight, height and mid-arm circumference was significantly low in Group II as compared to Group I. On the basis of the recordings of weight and height, the Body Mass Index (BMI) was calculated for every subject which showed a low mean BMI in Group II (10.573) as compared to Group I (21.584) [Table-1]. The anthropometric measurements recorded in both the groups were statistically significant (p<0.001).

The dental caries status of the study revealed that the mean DMFT scores was 0.98 and 3.00 in Group I and Group II respectively. DMFT score was higher (p<0.001) in Group II. (Table-2). Coincidentally the total antioxidant levels of saliva were higher (p<0.001) in Group I when compared to Group II. (Table 3)

Table 1: Anthropometric measurements in Group I and Group II

	Group	N	Mean	Standard Deviation	Standard Error Mean	T value	p value
Weight (Kgs)	Group I	40	16.31	1.191	0.188	19.01	<0.001*
	Group II	40	11.47	1.087	0.172		
Height(meters)	Group I	40	1.1505	0.052	0.0083	19.04	<0.001*
	Group II	40	.9599	0.036	0.00565		
MAUC (cms)	Group I	40	15.18	0.848	0.134	24.38	<0.001*
	Group II	40	10.23	0.963	0.152		
BMI	Group I	40	21.584	1.689	0.267	34.86	<0.001*
	Group II	40	10.573	1.066	0.168		

p- value <0.001 indicates significance.

Table 1 describes the mean weight, height, mid-arm circumference(MAUC) and BMI of sample in Group I and Group II. The table clearly indicates that group II had lower mean BMI value.

Table - 2 DMFT score in Group I and Group II

	Group	N	Mean	Standard Deviation	Standard Error Mean	T value	p value
DMFT Score	Group I	40	.98	0.832	0.131	-9.92	<0.001*
	Group II	40	3.00	0.987	0.156		

p-value< 0.001 indicates significance.

Table 2 describes the mean DMFT score of samples in Group I and Group II. The result indicate that group had a comparatively significant higher DMFT score.

Table - 3 The total antioxidant levels of saliva in Group I and Group II depicted as % inhibition

	Group	N	Mean	Standard Deviation	Standard Error Mean	T value	p value
DPPH 50mM Absorption	Group I	40	1.105	0.013	0.0021	184.37	<0.001*
	Group II	40	0.613	0.0105	0.0016		
Sample Absorption	Group I	40	0.836	0.102	0.0161	13.07	<0.001*
	Group II	40	0.591	0.060	0.0095		
% Inhibition	Group I	40	24.348%	9.426%	1.490%	9.928	<0.001*
	Group II	40	3.549%	9.311%	1.472%		

p-value< 0.001 indicates significance.

Table 3 describes the mean absorption of total antioxidants in the standard solution and the study sample at 50Mm wavelength. It clearly depicts group II has higher mean absorption value.

Discussion

Malnutrition is defined as any deviation from normal nutrition.[11] Nutrition systemically influences teeth during the pre-eruptive stage, including prenatal, peri-natal, and postnatal periods namely the timing of eruption and the alveolar height. Malnutrition has been associated with enamel hypo-plasia and increased caries susceptibility.[2,5,12] The present study was consummated to recognise the possible relation between early childhood malnutrition and the prevalence of dental caries.[13,14,15]

Saliva may constitute a first line of defence against dental caries and free radical-modified oxidative stress.[16,17,18,19] Oxidative stress occurring as a result of an imbalance between free radicals/reactive oxygen species and antioxidant system, has been implicated as one of the important contributory etiologic factors in many of the oral inflammatory pathologies and dental caries.[9]

The salivary antioxidant system is made of enzymes like peroxidase, catalase, super oxide dismutase, gluthation peroxidase and small molecules of uric acid, vitamin E and C and is an important defence mechanism, promoting healing and providing protection against bacteria, viruses and fungi. The antioxidant system of saliva, such as glutathione additionally participates in the weakening of resistance to the bacteria colonizing the oral cavity, ensuring their increased vulnerability to different kinds of stress.[9,18,19]

Normal physical growth is defined as achievement of gradual increments in weight, height, head and mid arm circumference. Weight is used to monitor growth and provides an indication of both acute and chronic nutritional status and is typically described with respect to age or height. The BMI is the weight for height relationship, most reflective of body fat and is calculated by dividing the weight (kilograms) by the height (meters), squared.[17,20]

PEM is described as weight or height less than the 5th to the 10th percentile for age or a weight-for-height ratio less than the 5th to the 10th percentile. The severity of PEM is assessed by calculating BMI. J.C. Waterlow (1972) established a classification for assessment of malnutrition which combines weight-for-height (indicating acute

episodes of malnutrition) with height-for-age to show the stunting that results from chronic malnutrition.

In the present study, the mean weight was 16.31 Kgs in Group I and 11.47 Kgs in Group II. The mean height (meters) in Group I was 1.1505m and 0.9599m in Group II. The mean value of mid arm circumference in Group I was 15.18cm and in Group II was10.23cm. Based on the data collected, the BMI was calculated for every subject. The mean BMI calculated for Group I was 21.584 and for Group II was 10.573. Therefore, the anthropometric measurements recorded in both the groups were statistically significant ($p<0.001$). Based on the statistically analysis and Water-low's classification (1972), the subjects belonging to Group II were labelled as protein energy malnourished.

The aetiology of PEM is multifaceted.[21] Occurrence of overall and Grade I, II, III PEM is highest amongst the age group 1-3 year in India.[22] According to Joshi at. el[23] (2011) the occurrence of PEM is more in children of 3-6 age group specially in females, which may be due to lack of attention to this age group in rural areas. Dental caries and increase plaque accumulation is associated with both high and low BMI.[24,25] Antagonist observations were made by Panwar (2014)[26] where in children with normal BMI for age had more caries in their primary teeth, as well as in their permanent teeth. Protein energy malnutrition has shown a reduced salivary secretion rate, reduced buffering capacity, lower calcium, lower protein secretion in stimulated saliva.[6] Malnutrition delays the tooth emergence, development, exfoliation, affects the age distribution of dental caries and results in increased caries experience in the primary teeth.[27,28] Chronic malnutrition reduces the secretion rate of stimulated saliva. In the present study, the dental caries status was determined using the WHO criteria (1997). The mean DMFT scores were 0.98 and 3.00 in Group I and Group II respectively which was a statistically significant ($p <0.001$) value. W.J. Psoter (2005) demonstrated a positive association of early childhood malnutrition with dental caries, enamel hypo-plasia, salivary gland hypo-function and delayed eruption.[4] Enamel defects are strongly associated with early childhood caries in poor socioeconomic status, malnutrition and infection rates as stated by AFB Oliviera (2006).[29]

F. Katge (2011) stated that chronic malnutrition is associated with development of dental caries as well as it deteriorates the periodontal health.[30] S. Parkar (2013) indicated a positive relationship between the nutritional status and dental caries and stated that underweight children are more apt to have dental caries.[31] Childhood stunting is a significant risk factor for dental caries increment in permanent teeth.[32]

The study results were contrasting with the studies done by A. Edalat (2014)[33] and L. Bafti (2015)[34] in which there was no significant relationship between increasing dental caries and decreasing height, weight, and body mass index (BMI) and the caries rate in the deciduous teeth. S. Jamelli (2010)[35] found no significant association between nutritional indices and incidence of dental caries in school going children, thus stating that malnutrition does not act as a risk factor for dental caries. E. Perez (2014)[36] in a retrospective study found an inverse consequence of early childhood malnutrition on dental caries where in dental caries decreased as the early childhood nutritional status severity increased.

In the present study, the total antioxidant capacity was detected using DPPH method and total antioxidant were calculated in the terms of % inhibition. 2,2-Diphenyl-1-picrylhydrazyl (DPPH) is one of the widely used procedures for measurement of antioxidant capacity as it is rapid, simple, accurate and an inexpensive assay for measuring the ability of different compounds acting as

free radical scavengers and to evaluate the antioxidant activity.[10] The mean % inhibition was 24.348% in Group I and 3.549% in Group II which was statistically significant (P <0.001) inferring that the total antioxidant levels of saliva was higher in Group I when compared to Group II suggesting lower amount of total antioxidants in subjects (Group II) suffering from protein energy malnutrition (PEM).

The antioxidant capacity of saliva tends to favour the development of dental caries, more notable in primary teeth.[37] F. Motamayel (2013)[7] concluded that total antioxidant capacity (TAC) was higher in caries active group and there is a positive association between total antioxidant capacity (TAC) of saliva and dental caries. The severity of caries was observed with increased total antioxidant capacity (TAC) of saliva.[8,9] Similar study results were obtained where the total antioxidant capacity (TAC) of saliva and its relation with early childhood caries and rampant caries was investigated and total antioxidant capacity (TAC) was found to be increased in children with caries. Also, the total antioxidant capacity (TAC) increased with the age of the children.[9,38]

An increase in total antioxidant and total protein level was directly proportional to increased caries activity. Tulunoglu (2006)[39] J. Uberos (2008)[37], B. P. Preethi (2010)[40] and M. Hegde (2011)[8] evaluated the total antioxidant capacity of saliva and concluded that total antioxidant capacity (TAC) of saliva increases with caries activity. In the present study, dental caries incidence was higher and statistically significant in children with altered salivary total antioxidant capacity. An increase in the prevalence of dental caries predisposes to the increase in the total antioxidant capacity of saliva with severe early childhood caries.[41,42]

A study carried out in 2016 depicts the dental caries prevalence as significant in children with poor oral hygiene practices and those suffering from malnutrition attending the Anganwadis.[43] Dental problems in early childhood have been shown to be predictive of future dental problems, growth, and development by interfering with the wellbeing, diet, nutrition, attentiveness, concentration and school involvement of children below 10 years.[44]

Conclusion

The present study showed that dental caries incidence was significant in children with protein energy malnutrition with altered salivary total antioxidant capacity which was statistically significant. It appears that reduction of BMI have a long term impact on growth and development of individuals in early growth age. PEM appears to have multiple effects on the oral tissues and in subsequent oral disease development. Adequate nutrition during early growth and development of the child has a major contribution in maintaining the general as well as the oral health. Nutrients such as vitamins A and D, calcium and phosphorus have an effect on the gross and microscopic morphology, chemical composition and tooth eruption patterns. These factors, in turn, determine the susceptibility of a tooth to dental caries.

Saliva is one of the imperative factors that influence the progress of dental caries. Therefore, a positive relationship between saliva, tooth decay and protein energy malnutrition and the salivary properties in the present study should be considered as an alarming factor and further studies and more investigations on salivary properties in regards of prevention of dental caries in early childhood should be emphasized.

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