The relation of salivary antioxidants to dental caries among overweight and obese adult aged 30-40 year-old at textile factory in Mosul city

Baydaa A. Yas, B.D.S., M.Sc., Ph.D.[(1)]

ABSTRACT

Background: Overweight and obese people are at higher risk for systemic diseases as well as oral diseases like dental caries. The aim of this study was to explore the relationship of salivary antioxidants (albumin, vitamin E, and vitamin C) in addition to salivary flow rate and magnesium level with dental caries severity among overweight and obese adult aged 30-40 year-old at Textile Factory in Mosul City.

Material and method: The sample for this study consisted of all subjects aged 30-40 year-old (thirty five subjects) at the Textile factory in Mosul city. Body weight can be measured by using the Body Mass Index (BMI). Dental caries was recorded by lesion severity through the application of D_{1-4} MFS index. Salivary flow rate was measured after collection of unstimulated saliva then salivary samples were analyzed for the measurement of salivary antioxidants (albumin, vitamin E, and vitamin C) and magnesium level.

Results: Salivary vitamin E and C levels were higher among overweight and obese subjects respectively compared with non-obese though statistical differences were not significant. Albumin level was significantly higher among overweight than non-obese subjects. In addition Obese and overweight subjects revealed reduced salivary flow rate compared with non-obese but with no significant difference; whereas salivary magnesium level was elevated among obese compared to non-obese individuals though statistical difference was not significant. Regarding caries severity, obese and overweight subjects revealed higher dental caries severity (i.e. DMFS, MS, DS, D_3 and D_4 mean values) compared with non-obese.

Conclusions: Overweight and obesity could be risk factor for increasing dental caries severity thus educational and preventive programs that include dietary counseling (for lowering body weight and caries severity as well), oral hygiene practices, and regular visits for the dentist are needed.

Key words: Overweight, obesity, dental caries, salivary antioxidants, salivary flow rate. (J Bagh Coll Dentistry 2011; 23(sp. issue):141-145).

INTRODUCTION

Overweight and obesity are major public health challenges [(1)]. Obesity can be defined as an excessive accumulation of body fat stores. Overweight and Pre obesity are often used interchangeably [(2)]. Obese people are at higher risk for heart diseases, stroke, diabetes mellitus, hypertension, cancer, gallbladder, joint diseases, and psychological problems [(3, 4)]. Increased oxidative stress in accumulated fatty tissues due to increased reactive oxygen species production and decreased antioxidant enzymes expression is an important pathogenic mechanism for obesity-associated metabolic syndromes [(5)]. Overweight and obesity are related to many aspects of oral health including dental caries [(6)]. Dental caries is an infectious transmissible disease having a multifactorial etiology [(7)] which depends on the interaction of three main group factors that must exist simultaneously for sufficient time including host, microbial and substrate factors[(8)]. Several studies among children and adolescents found that overweight and obese subjects are more likely to have dental caries than the non-obese ones [(9-14)]. While other studies reported no significant association between dental caries experience and obesity [(15, 16)].

(1)Lecturer. Department of Paedodontic and Preventive Dentistry, College of Dentistry, University of Baghdad.

In contrast overweight was found to be associated with reduced dental caries among children [(17, 18)].

Saliva was found to affect oral health through various defense mechanisms such as salivary flow rate, buffer capacity, pH, electrolytes, total protein, etc [(19)], in addition to its antioxidant system [(20)]. Salivary antioxidant system was found to reduce the susceptibility to dental caries [(21)]. The specific role of antioxidants is to neutralize rampaging free radical and thus reducing its capacity to damage. They act as radical scavenger, hydrogen donor, electron donor, peroxide decomposer, singlet oxygen quencher, and synergist [(22)]. To date, no Iraqi studies have been found concerning the relationship of salivary antioxidants (albumin, vitamin E, and vitamin C), salivary flow rate and magnesium level with dental caries severity among overweight and obese adult aged 30-40 year-old at Textile factory in Mosul city, therefore, this study was carried out.

MATERIALS AND METHODS

The sample for this study consisted of all subjects (thirty five subjects) aged 30-40 year-old at the Textile factory in Mosul city. They should be non-smoker, with no medical history that compromises salivary secretory mechanism

(depending on the medical report supplied by the medical unit at the factory), shouldn't take any medications with xerogenic effect or any nutritional supplementation, and shouldn't wear any fixed or removable dental prostheses. The collection of unstimulated salivary samples was performed according to the instructions cited by Tenovuo and Lagerlöf [23]. Salivary flow rate was expressed as milliliter per minute (ml/min). Then salivary samples were taken to the laboratory for biochemical analysis at the College of Veterinary and College of Dentistry, University of Mosul. Salivary antioxidants were determined colorimetrically by using the spectrophotometer (Cecil Instrument Limited CE 1021, England). Some were measured by manual methods as in case of vitamin E depending on Emmerie-Engel reaction [24], and vitamin C by using 2, 4-dinitrophenyl hydrazine (DNPH) method [25]. While albumin was measured by using ready kit (BioMérieux sa, France). Concerning salivary magnesium, it was measured colorimetrically by using ready kit supplied by (Human, Germany).

Dental caries was recorded by lesion severity through the application of D_{1-4} MFS index [26]. Body weight can be measured by using the Body Mass Index (BMI) which can be obtained by dividing weight in Kilogram by height in meter squared [4]. BMI can be divided into three categories which include non-obese (<25 Kg/m^2), overweight (≥25-<30 Kg/m^2), and obese (≥30 Kg/m^2) [27]. Data analysis was conducted through the application of the SPSS (version 12). Analysis of variance was applied. The confidence limit was accepted at 95% ($P < 0.05$).

RESULTS

Sample distribution is shown in **Table 1**. Non-obese subjects revealed the highest percentage (45.71%) followed by obese subjects (37.14%) while overweight (17.14%) revealed the lowest percentage. **Table 2** reveals statistically no significant differences concerning salivary antioxidants among BMI categories. However, vitamin E was higher among overweight than obese and non-obese; while vitamin C level was higher among obese in comparison with overweight and non-obese. Further analysis using L.S.D. test showed that albumin level was significantly higher among overweight than non-obese individuals (m.d.=-1.76, $P<0.05$). Although salivary flow rate and magnesium levels showed statistically no significant differences among BMI categories using ANOVA test; however, salivary flow rate was lower among obese and overweight than non-obese. While magnesium level was higher among obese compared to overweight and non-obese individuals (**Table 3**).

Regarding dental caries, **Table 4** shows that the only highly significant difference was recorded for D_3 grade of caries severity that was higher among obese and overweight than non-obese ($F= 6.60$, $P<0.01$). In addition L.S.D. analysis revealed statistically highly significant difference for D_3 grade between obese compared with non-obese individuals (m.d.=-2.38, $P<0.01$). Also data analysis showed that DMFS, MS, DS, and D_4 grade of caries severity was higher among obese and overweight than non-obese while filled surface (FS) value was lower among obese and overweight than non-obese with no significant differences. Furthermore, obese individuals revealed higher DS and D_4 values compared with non-obese with statistically significant differences (m.d.=-3.34, $P<0.05$; m.d.=-1.26, $P<0.05$ respectively).

DISCUSSION

Results of the current study revealed that dental caries (i.e., DMFS, MS, DS, D3, and D4) was higher among obese and overweight than non-obese. The same result was also reported by other studies among children and adolescents [9-14]. But contradict with findings of other studies among children and adolescents [15-18]. Higher dental caries severity among obese and overweight than non-obese probably related to reduced salivary flow rate among obese and overweight compared to non-obese but with no significant difference since the washing action of saliva plays an important role in the clearance of food debris and bacteria also its protective constituents increase with increasing flow rate [28]. Another explanation for higher caries severity among obese than non-obese might be higher magnesium level among them but with no significant difference. This is probably related to the finding that magnesium could act as caries promoting element [29, 30]. Furthermore, unhealthy dietary patterns such as increasing intake of sugar and fat containing foods in addition to psychological stress associated with obesity that may affect oral health behaviors as regular brushing, flossing, fluoride use and/or seeking preventive dental services [31, 32]. This is supported by lower filled surface (FS) value among obese and overweight compared with non-obese with no significant difference.

Results of the current study also showed higher salivary vitamin E and C levels among overweight and obese subjects respectively compared with non-obese with no significant difference; in addition to significantly higher

albumin level among overweight than non-obese subjects. The elevated antioxidant levels might provide protection against elevated dental caries activity [33]. These antioxidants might adversely affect the oxidative carbohydrate metabolism within dental plaque thereby reducing bacterial activity and growth and consequently dental caries severity [21]. Vitamin C acts as a powerful water-soluble antioxidant [34]. Furthermore, it inhibits lipid peroxidation by reduction of tocopheroxyl radical to tocopherol and so protects the cell membrane from external oxidants [35]. While vitamin E as lipid-soluble antioxidant prevents Reactive Oxygen Species (ROS)-induced lipid peroxidation of the cell membrane because of its localization in the cell membrane [34]. Accordingly vitamin E has immunenhancing effect since it protects cells of the immune system against the oxidative damage ([36]. Salivary albumin acts as antioxidant by non-specific binding of transition metals involved in ROS generation and by oxidation of albumin sulfhydryl groups [37].

Table 1: Sample distribution according to BMI categories.

BMI categories	No.	%
Non-obese (<25 Kg/m$^{2)}$	16	45.71
Over weight (≥25-<30 Kg/m^2)	6	17.14
Obese (≥30 Kg/m^2)	13	37.14

Table 2: Salivary antioxidants level (Mean ±S.D.) according to BMI categories.

Variable (mg/dl)	Non-obese (<25 Kg/m$^{2)}$			Over weight (≥25-<30 Kg/m^2)			Obese (≥30 Kg/m^2)			ANOVA test df=2	
	No.	Mean	±SD	No.	Mean	±SD	No.	Mean	±SD	F-value	P-value
Albumin	16	16.74	1.67	6	18.50	2.14	13	17.07	1.21	2.66	0.09
Vitamin E	16	0.21	0.17	6	0.32	0.29	13	0.18	0.09	1.37	0.27
Vitamin C	16	0.26	0.70	6	0.24	0.38	13	1.30	2.32	1.99	0.15

Table 3: Salivary flow rate and magnesium level (Mean ±S.D.) according to BMI categories.

Variable	Non-obese (<25 Kg/m$^{2)}$			Over weight (≥25-<30 Kg/m^2)			Obese (≥30 Kg/m^2)			ANOVA test d.f.=2	
	No.	Mean	±SD	No.	Mean	±SD	No.	Mean	±SD	F-value	P-value
Flow rate (ml/min)	16	0.48	0.25	6	0.47	0.19	13	0.43	0.18	0.17	0.85
Magnesium (mg/dl)	16	0.38	0.28	6	0.33	0.23	13	0.59	0.38	2.03	0.15

Table 4: Dental caries experience (Mean ±S.D.) according to BMI categories.

Variable	Non-obese (<25 Kg/m$^{2)}$			Over weight (≥25-<30 Kg/m^2)			Obese (≥30 Kg/m^2)			ANOVA test df=2	
	No.	Mean	±SD	No.	Mean	±SD	No.	Mean	±SD	F-value	P-value
D_1	16	0.44	0.81	6	1.00	1.09	13	1.15	1.14	2.01	0.15
D_2	16	4.94	4.04	6	4.33	1.86	13	3.92	2.60	0.35	0.71
D_3	16	1.31	1.19	6	2.00	2.45	13	3.69	2.016	6.60	0.004**
D_4	16	0.13	0.50	6	1.17	2.86	13	1.38	1.85	2.34	0.11
DS	16	6.81	4.48	6	8.50	4.59	13	10.15	3.74	2.24	0.12
MS	16	6.81	9.07	6	10.83	9.70	13	12.46	7.43	1.62	0.21
FS	16	4.44	8.12	6	2.17	3.43	13	0.92	1.32	1.36	0.27
DMFS	16	18.06	9.39	6	21.50	9.93	13	23.54	6.02	1.56	0.23

****Highly Significant**

REFERENCES

1. Carmiel-Haggai M, Cederbaum AI, Nieto N. Binge ethanol exposure increases liver injury in obese rats. Gastroenterology 2003; 125(6): 1818-33.
2. Flegal Katherine M, Carroll Margaret D, Johnson Clifford L, Johnson CL. Prevalence and Trends in Obesity Among US Adults, 1999-2000. *JAMA* 2002; 288 (14): 1723–1727.
3. Roth RA and Townsend CE. Nutrition and Diet therapy. 8th ed. Thomson Delmar Learning. USA; 2003. p. 295-309.
4. Insel P, Turner RE, Ross D. Discovery nutrition. Jones and Bartlett publishers. USA; 2003. p. 269-293.
5. Furukawa S, Fujita T, Shimabukuro Y, Nakayama O, Makishima M, Matsuda M, Shimomura I, Nakajima Y. Increased oxidative stress in obesity and its impact on metabolic syndrome. J Clin Invest 2004; 114(12): 1752-61.
6. Mathus-Vliegen EM, Nikkel D, Brand HS. Oral aspects of obesity. Int Dent J 2007; 57(4): 249-56.
7. Featherstone J.D.B. Prevention and reversal of dental caries: role of low level fluoride. Community Dent Oral Epidemiol 1999; 27: 31-40.
8. Fejerskove O, Thylstrup A. Different concepts of dental caries and their implications. In textbook of clinical cariology edt. By Thylstrup A and Fejerskov O. 2nd ed. Munksgarrd, Copenhagen; 1994. p. 209-217.
9. Al-Isa AN. Factors associated with overweight and obesity among Kuwaiti kindergarten female teachers. Nutr Health 2004; 18(1): 67-71. (IVSL)
10. Willershausen B, Haas G, Krummenauer F, Hohenfellner K. Relationship between high weight and caries frequency in German elementary school children. Eur J Med Res 2004; 9(8): 400-4.
11. Bailleul-Forestier I, Lopes K, Souames M, Azoguy-Levy S, Frelut ML, Boy-lefevre ML. Caries experience in a severely obese adolescent population. Int J Paediatr Dent 2007; 17(5): 358-63.
12. Willershausen B, Moschos D, Azrak B, Blettner M. Correlation between oral health and BMI in 2071 primary school pupils. Eur J Med Res 2007; 12(7): 295-9.
13. Sadeghi M and Alizadeh F. Association between Dental Caries and Body Mass Index-For-Age among 6-11-Year-Old Children in Isfahan in 2007. J Dent Res 2007; 1(3)
14. Alm A, Isaksson H, Fåhraeus C, Koch G, Andersson-Gäre B, Nilsson M, Birkhed D, Wendts LK. BMI status in Swedish children and young adults in relation to caries prevalence. Swed Dent J. 2011;35(1):1-8.
15. Moreira PV, Rosenblatt A, Severo AM. Prevalence of dental caries in obese and normal weight Brazilian adolescents attending late and private schools. Comm Dent Health 2006; 23(4): 251-3.
16. Hong L, Ahmed A, McCunniff M, Overman P, Mathew M. Obesity and dental caries in children aged 2-6 years in the United States, national health and nutrition examination survey 1999-2002. J Public health Dent 2008; Mar 31 [Epub ahead of print].
17. Macek MD and Mitola DJ. Exploring the association between overweight and dental caries among US children. Pediatr Dent 2006; 28(4): 375-80.
18. Kopycka-Kedzierawski DT, Auinger P, Billings RJ, Weitzman M. Caries status and overweight in 2- to 18-year-old US children: findings from national surveys. Community Dent Oral Epidemiol 2008; 36(2): 157-67.
19. Lenander-Lumikari M, Loimaranta V. Saliva and dental caries. Adv Dent Res 2000; 14: 40-47.
20. Gorelik S, Kohen R, Ligumsky M, Kanner J. Saliva plays a dual role in oxidation process in stomach medium. Arch Biochem Biophys 2007; 458(2): 236-243.
21. Marquis RE. Oxygen metabolism, oxidative stress and acid-base physiology of dental plaque biofilms. J Ind Microbiol 1995; 15(3): 198-207.
22. Bagchi K and Puri S. Free radical and antioxidants in health and disease. Eastern Med HJ. 1998; 4: 350-360.
23. Tenovuo J and Lagerlöf F. Saliva. In Textbook of clinical cardiology. Etd. By Thylstrup A and Fejerskov O. 2nd ed Munksgaard Copenhagen; 1994.p. 17-43.
24. Varley H. Practical clinical biochemistry. 4th ed. The white friars press limited, London and Tonbridge, Great Britain; 1967.
25. Colowick SP, Kaplan NO. Methods in enzymology. Vol. 62, part D, Academic press, USA; 1979. p. 7.
26. Mühleman HR. Oral epidemiology-caries. In Introduction to oral preventive medicine. Buch-und Zeitschriften-Verlag, Die Quintessenze (Translated in English); 1976. p. 73-100.
27. Wu FCW, Tajar A, Pye SR, Silman AJ, Finn JD, O'Neil TW, Bartfai G, Casaneuva F, Forti G, Giwercman A, Huhtaniemi IT, Kula K, Punab M, Boonen S, Vandershueren D, EMAS group. Hypothalamic pituitary testicular axis distribution in older men is differentially linked to age and modifiable risk factors. J Clin Endocrin Metab 2008; 93 (7): 273-45.
28. Mandel ID. The role of saliva in maintaining oral homeostasis. JADA 1989; 119: 298-304.
29. Alfano MC. Nutrition in dental caries. In: The biologic basis of dental caries Etd. By Menaker L. 1st ed. Harper and Row Publishers; 1980. p. 343-364.
30. El-Samarrai SK. Major and trace elements of permanent teeth and saliva among a group of adolescent in relation o dental caries, gingivitis and *Mutans Streptococci*. A Ph.D. thesis. College of Dentistry, University of Baghdad, 2001.
31. Al-Zahrani MS, Bissada NF, Borawski EA. Obesity and periodontal disease in young, middle-aged, and older adults. J Periodontol 2003; 74: 610-615.
32. Eisenberg ME, Neumark–Sztainer D, Story M. Associations of weight-based testing and emotional well-being among adolescents. Arch Pediatr Adolesc Med 2003; 157: 733-738.
33. TuLunoglu O, De Mirtas S, TuLunoglu I. Total antioxidant levels of saliva in children related to caries, age and gender. Int J Paediatr Dent, 2006; 16(3): 186-91.

34. Stahl W and Sies H. Antioxidant defense, Vitamin E and C and carotenoids Diab 1997; 46: 514-516.
35. Yochum LA, Folsom AR, Kushi LA. Intake of antioxidant vitamins and risk of death from stroke in postmenopausal women. Am J Clin Nutr 2000; 72: 476-483.
36. Meydani SN, Barklund MP, Liu S, Meydani M, Miller RA, Cannon JG, et al. Vitamin E supplementation enhances cell-mediated immunity in healthy elderly subjects. Am J Clin Nutr 1990; 52: 557-63.
37. Chapple ILC. Role of free radicals and antioxidants in the pathogenesis of the inflammatory periodontal diseases. J Clin Pathol Mol Pathol 1996; 49: 247-255.