Nutritional Status (Mid Upper Arm Circumference (MUAC)) In Relation To Missing Teeth Among Older Adults Aged (50-65) Years Old.

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Abstract

Background: *With aging both tooth loss and nutritional disturbance will occur and could be related with each other. This study was achieved to evaluate the relation between tooth loss and posterior occluding pairs (POPs) and nutritional status (Mid Upper Arm Circumference (MUAC)) among older adults.*

Subjects and Methods: *323 subjects aged 50-65 years old with a mean ± SD is 57.26±3.83 distributed into two age groups (50-57) and (58-65) years old with 150 and 173 subjects for these two age groups respectively, with 133 and 190 for males and females respectively and they had been collected from prosthodontic department in college of Dentistry/University of Baghdad and private dental clinic and were examined for their MUAC and intra-oral examination according to World Health Organization (WHO, 2006) and (WHO, 1997) respectively, natural teeth present in oral cavity and POPs was categorized according to criteria of (De Anderade et al., 2009) and (Finch et al., 2001) respectively.*

Results: *the mean of the MUAC among the sample is 33.91±3.33, in the total sample and by age and gender, the MUAC among natural teeth and POPs categories is highly significant (p<0.01) revealed that both edentulous and the subjects with no POPs had the lowest mean of MUAC while the dentate subjects (11-20) and those with 5-8 POPs had the highest mean of MUAC, when using multiple comparisons in teeth categories in males only, between 1-10 and 11-20, and in POPs categories, in the first age group(50-57) and in males, when compare 1-4 category with 5-8, the results were not significant (p>0.05), while the other results were highly significant.*

Conclusion: *Results show that dental health is related with nutritional status of those subjects and conclude that the dentitional status should be considered when using both counseling and evaluation of nutritional status of older adults.*

Keywords: *MUAC, POPs, Tooth loss, Older adults.*

I. Introduction

Number of geriatric population in the world finds to be increase as the future expectation which done by United Nations in 2000 as it states that The number of older people aged 60 years and over is estimated to incline from 544 million in 1995 to 1.4 billion by 2030 [1]. As the person gets aged, he/she suffered from many oral health problems as salivary gland changes as xerostomia[2] which can lead to both coronal[3] and root caries [4],oral mucosal changes [5], periodontal diseases [6,] tooth loss or edentuolism[7] and cancerous or precancerous lesions [8]. Anthropometry is the study of the measurement of the human body by taking measurement for dimensions of both hard (bone) and soft tissues (muscle and adipose tissues) [9] thus the nutritional assessment tools include Anthropometrical measurements (Weight, stature (standing height), length for recumbent, thickness of skin fold, waist, head and limb circumferences, limb lengths, and shoulders and wrist (breadths) [10], Dietary intake, clinical and biochemical exams [11]. The most widely used indices in anthropometrical measurements is Body Mass Index (BMI), but it has many limitations as it should have stadiometers and accurate weighing scales [12], so using As Mid Upper Arm Circumference (MUAC) which measures the areas for both muscle and fat, is a simple as it can be carry out without equipment, not harmful, and cheap method, and can be used as an indicator of malnourishment for different age groups and can be used especially for special need groups as handicapped, hospitalized and pregnant women [13]. MUAC was approved in different cross sectional studies in adults and compare it with BMI [14, 15] and in longitudinal ones in adults [16,17], although MUACs' cut-off points in adult man are ≥ 224 and <231 mm while for women are ≥ 214 and 221 mm [18] but it is not known whether these points are optimal [19]., as for suggestion done by Sing et al in 2015 stated that

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general obesity was less preferable than when using central obesity among older adults and portion of visceral fat had been approved to be the most suitable indicator of obesity[20]. Nutritional status is so importance in older adults to detect and evaluate, due to physical changes of ageing lead to malnutrition (under or over nutrition) mostly occur in those people [21], the prevalence of malnutrition among older adults was detected with different results as 33%, 34% and 58.7% [22], as a result of lower metabolic rate among elderly can lead to lower need and consumption of carbohydrate which in turns to decrease level of exercise and lean of muscle , as well as changes in appetite and food intake can result in lower intake of different vitamins, minerals and amino acids [23] this can result in immune system's weakness which leads to both infectious and systemic diseases [24,25] and there is an effect of nutrition on teeth as causes both dental caries and tooth loss [27]. Malnutrition in older adults affect by many factors as physiological, chronic diseases [25], medications uses, physiological changes (aging), socioeconomic, psychological changes , environmental factors [26] and oral health problems [25]. Tooth loss has many causes which are primarily by dental caries [28], periodontal disease [29], extractions due to other causes as orthodontic treatment or trauma [30], aging [31], race and ethnicity[32], gender [33],and other risk factors as smoking and socio-economic status [34] .Tooth loss has many adverse effects , both orally and in general health , its general health effects are gastro-intestinal and cardiovascular disorders [35], noninsulin-independent diabetes mellitus [36], chronic kidney diseases [37],sleep disorders [38], cognitive impairment [39] ,carcinogenesis effects [40] and quality of life effects [41], while its oral effects are bone resorption [42],oral mucosal disorders [43] tooth loss among older adults has been supported in foreign studies [44,45] as well as in Iraqi ones [46,47].

Choosing of food and nutrients intake can be affected by dental status, a conclusion done by studies among older adults that 20 or more natural teeth was being effective to oro-functional dentition and to be consistent with a good dietary optimal nutritional intake [48,49] . The main duty of the back teeth is the grinding of food. These teeth consist of two molars and two bicuspid in each arch for a total of 16 teeth or eight pairs. These teeth called posterior occluding pairs of teeth (POPs), the function and position of the posterior teeth seems to be a more preferable indicator of chewing ability and masticatory function than total number of teeth [50], and that dental status as tooth loss and poorly fitted dentures can affect both chewing and perception of tastes of food even when the subjects had been rehabilitated; in that case (rehabilitated subjects with either partial or complete prosthesis) both chewing and masticatory efficiency is less than that when there is intact natural teeth , thus posterior occluding pairs is better than poorly distributed teeth [42,51,52].The link between tooth loss and nutritional status has been approved by many cross-sectional studies among older adults as some studies found that with increase tooth loss the nutritional status will increase [52-56] ,while other found when the edentate subject would lead to decrease the nutritional status [57-59] , this could suggest that having partial or complete tooth loss was related with either a greater risk of being either underweight or obese [58].There are two systematic reviews for this relation , one for cross-sectional studies of 549 articles stated that although there was bidirectional association between tooth loss /edentuolism and obesity but limiting inferences temporally with using longitudinal studies [60], in systematic reviews of latter studies on this relation among adults for 8 studies , their results stated that even when there was an association , but its weak and stated to need high quality of longitudinal studies [61],about the POPs and its relation , Marcenes et al [51] observed that subjects with 5-8 POPs might be obese, while Sahyoun et al [52] and Dheeraj et al [62] found that number of POPs related with dietary intake which were in contrast with Shinkai and colleagues [63], Sheiham et al [49] found weakly correlation between POPS and dietary nutrient intake. As available from these studies which were done among older adults use different dentitional status and nutritional status indicators, so there is no previous Iraqi studies link MUAC with dentitional status as POPs and tooth loss, thus this study was conducted.

II. Subjects And Methods

This study was conducted during the period between January, 2015 and November 2017 with a sample consisted of 323 Iraqi subjects collected from both dental private clinic and Baghdad Dental Teaching hospital \ Prosthodontic department with age range from 50-65 years old distributed into two age groups (50-57 years old) and (58-65 years old) as they consist of 150 and 173 subjects respectively with 133 and 190 for males and females respectively. The first step before collection of data, the examiner took the ethical approval from the participant and explained to him/her the purposes and the details of the study to participate for a detailed interview and a clinical examination. Those subjects with any systemic diseases, and severe periodontal diseases (grade III mobility) were being excluded. Every subject was informed of his or her right to reject the participation or to discard from the study at any moment. Every subject was being asked that his\her skin of the left upper arm being bared using a pencil to mark the midpoint between the olecranon and acromion process using measuring tape by professional examiner in a calm position within standard limits. All anthropometric measurements were taken in duplicated, and the average value was recorded [64], then a subject was conducted for intra-oral examination to indicate his/her number of natural teeth present in mouth and Posterior Occluding Pairs(POPs), the intra-oral examination was done according to the criteria of WHO [65], subjects then divided

according to their number of natural teeth present in mouth into four divisions [66]:totally edentulous,1-10 teeth,11-20 teeth and lastly 21+ teeth found in his/her mouth, while the distribution of subjects by POPs also into four categories[67] as :NO POP, 1-4 POP,5-8 POP and finally 8+ POP.(Third molars or wisdom teeth were not included). Data analysis was done by using the Statistical Package of Social Science (SPSS-21, Chicago In Press) as using One Way ANOVA (Analysis of Variance),Shapiro-Wilk test of normality for MUAC, Levenes Test (Homogeneity of variance test), Multiple comparisons tests after ANOVA as Hochberg GT2 and Games-Howell test. The level of significance (Probability of error; p) is 0.05, for the not significant when p>0.05, and significant when p<0.05 while highly significant when p<0.01.

III. Results

Results in Table 1 find that the second age group is the prominent one than the first one with mean ±SD is 57.26±3.83; the percentage of females is higher than that of males, regarding natural teeth present in mouth, highest percentage in categories of teeth distribution finds in 1-10 followed by first category while the lowest one is that last category, for the posterior occluding pairs (POPs), Subjects with 1-4 POPs finds the highest percentage followed by those with no POPs while lowest percentage are those with 5-8 POPs.

Table1: Distribution of subjects by age, gender, teeth present and posterior occluding pairs (POPs).

Variables	Categories	NO.	%
Age (Year)	50-57	150	46.4
	58-65	173	53.6
Gender	Males	133	41.2
	Females	190	58.8
Teeth present	Edentulous	40	12.4
	1-10	254	78.6
	11-20	29	9.0
Posterior occluding Pairs POPs	NO POP	72	22.3
	1-4	239	74.0
	5-8	12	3.7

Table 2: Descriptive and statistical test of Mid Upper Arm Circumference by age groups and in the total sample among natural teeth categories.

Age (Year)	Teeth categories	N	%	Min.	Max.	Mean	±SD	F	P-value
50-57	Edentulous	24	16	24.00	34.00	28.96	2.54	53.169	0.000 HS
	1-10	104	69.33	27.00	38.00	33.56	2.89		
	11-20	22	14.67	31.00	41.00	37.45	2.67		
58-65	Edentulous	16	9.25	28.00	32.00	30.31	1.25	40.603	0.000 HS
	1-10	150	86.70	28.00	39.00	34.52	2.58		
	11-20	7	4.05	38.00	41.00	40.00	1.29		
Total	Edentulous	40	12.40	24.00	34.00	29.50	2.21	90.234	0.000 HS
	1-10	254	78.60	27.00	39.00	34.13	2.74		
	11-20	29	9.0	31.00	41.00	38.07	2.63		

DF=2, HS=highly significant at P<0.01.

Results of Shapiro wilk test of normality for MUAC among teeth and (POPs) found that MUAC is normally distributed (P>0.05), findings of One-Way ANOVA analysis in Table 2 illustrate that the edentulous subjects have the lowest mean of MUAC while the subjects with 11-20 have the highest mean of MUAC when compared with other groups with highly significant difference among them within each age groups and in the total sample (p<0.01); using multiple comparisons within each age groups and in the total sample ,all results find to be highly significant difference when compare each category of teeth with each other (p<0.01), Table 3.

Table 3: Multiple comparisons of Mid Upper Arm Circumference (MUAC) by age groups and in the total sample among natural teeth categories.

Post hoc test	Age (Year)	(I) Teeth	(J) Teeth	Mean Difference (I-J)	Sig.	
HochberGT2	50-57	Edentulous	1-10	-4.599	.000	
			11-20	-8.496	.000	
		1-10	11-20	-3.897	.000	
Games-Howell	58-65	Edentulous	1-10	-4.208	.000	H S
			11-20	-9.688	.000	
		1-10	11-20	-5.480	.000	
HochberGT2	Total	Edentulous	1-10	-4.626	.000	
			11-20	-8.569	.000	
		1-10	11-20	-3.943	.000	

As same as in age groups, by gender, results in Table 4 find that the highest mean of MUAC in each gender is in subjects with more teeth (11-20) followed by those with lower teeth have (1-10) while the lowest mean of MUAC found in those with edentulous ones with highly significant difference among them ($p<0.01$), Table 5 shows that with using multiple comparisons , all findings found to highly significant difference between each other except when compare the 1-10 category with the last one (11-20) in males ,the result was found to be not significant difference ($p>0.05$).

Table 4: Descriptive and statistical test of Mid Upper Arm Circumference by gender among natural teeth categories

Gender	Teeth categories	N	%	Min.	Max.	Mean	±SD	F	P-value
Males	Edentulous	17	12.78	24.00	34.00	29.12	2.87	28.041	0.000 HS
	1-10	106	79.70	28.00	39.00	33.88	2.57		
	11-20	10	7.52	31.00	41.00	35.70	2.87		
Females	Edentulous	23	12.11	27.00	33.00	29.78	1.57	68.783	0.000 HS
	1-10	148	77.89	27.00	39.00	34.30	2.86		
	11-20	19	10.00	37.00	41.00	39.32	1.38		

DF=2.

Table 5: Multiple comparisons of Mid Upper Arm Circumference (MUAC) by gender among natural teeth categories.

Post hoc test	Gender	(I) Teeth	(J) Teeth	Mean Difference (I-J)	Sig.	
HochberGT2	Males	Edentulous	1-10	-4.760	.000	
			11-20	-6.582	.000	HS
		1-10	11-20	-1.823	.110	NS
Games-Howell	Females	Edentulous	1-10	-4.521	.000	HS
			11-20	-9.533	.000	
		1-10	11-20	-5.012	.000	

Results of One-Way ANOVA analysis in Table 6 show that subjects having no POPs have the lowest mean of MUAC while the subjects with 5-8 POPs have the highest mean of MUAC when compared with other groups with highly significant difference among them within each age groups and in the total sample ($p<0.01$); using multiple comparisons within each age groups and in the total sample, all results find to be highly significant difference when compare each category of teeth with each other ($p<0.01$) except when compared (1-4) with (5-8) in the first age group, the result was found to be not significant difference ($p>0.05$),Table 7. By gender, results in Table 8 find that subjects having no POPs have the lowest mean of MUAC while subjects with 5-8 POPs have the highest mean when compared with other groups with highly significant difference among them ($p<0.01$); using multiple comparisons within gender, all results find to be highly significant difference when compare each category of POPs with each other ($p<0.01$) except when compared (1-4) with (5-8) in males, the result was found to be not significant difference ($p>0.05$),Table 9.

Table 6: Descriptive and statistical test of Mid Upper Arm Circumference by age groups and in the total sample among POPs.

Age (Year)	Teeth categories	N	%	Min.	Max.	Mean	±SD	F	P-value
50-57	NO POP	39	26	24.00	35.00	29.26	2.46	65.693	0.000 HS
	1-4	103	68.67	28.00	41.00	34.68	2.78		
	5-8	8	5.33	34.00	41.00	37.00	2.33		
58-65	NO POP	33	19.08	28.00	33.00	30.09	1.47	103.352	0.000 HS
	1-4	136	78.61	29.00	41.00	35.22	2.12		
	5-8	4	2.31	39.00	41.00	40.00	1.15		
Total	NO POP	72	22.29	29.64	2.09	24.00	35.00	160.185	0.000 HS
	1-4	239	74.00	34.99	2.44	28.00	41.00		
	5-8	12	3.71	38.00	2.45	34.00	41.00		

Table 7: Multiple comparisons of Mid Upper Arm Circumference (MUAC) by age groups and in the total sample among POPs.

Age (Year)	(I) POP	(J) POP	Mean Difference (I-J)	Sig.	
50-57	NO POP	1-4	-5.423	.000	
		5-8	-7.744	.000	HS
	1-4	5-8	-2.320	.057	NS
58-65	NO POP	1-4	-5.130	.000	
		5-8	-9.909	.000	
	1-4	5-8	-4.779	.000	
Total	NO POP	1-4	-5.349	.000	HS
		5-8	-8.361	.000	
	1-4	5-8	-3.013	.000	

Table 8: Descriptive and statistical test of Mid Upper Arm Circumference by gender among POPs.

Gender	Teeth categories	N	%	Min.	Max.	Mean	±SD	F	P-value
Males	NO POP	29	21.81	24.00	35.00	29.69	2.67		
	1-4	99	74.44	28.00	39.00	34.32	2.30	47.006	0.000 HS
	5-8	5	3.75	34.00	41.00	36.80	2.68		
Females	NO POP	43	22.63	27.00	33.00	29.60	1.62		
	1-4	140	73.69	28.00	41.00	35.46	2.43	125.514	0.000 HS
	5-8	7	3.68	35.00	41.00	38.86	2.04		

DF=2, HS=highly significant at P<0.01.

Table 9: Multiple comparisons of Mid Upper Arm Circumference (MUAC) by gender among POPs.

Gender	(I) POP	(J) POP	Mean Difference (I-J)	Sig.	
Males	NO POP	1-4	-4.634	.000	
		5-8	-7.110	.000	HS
	1-4	5-8	-2.477	.076	NS
Females	NO POP	1-4	-5.852	.000	
		5-8	-9.252	.000	
	1-4	5-8	-3.400	.000	
					HS

IV. Discussion

As available, many Iraqi cross-sectional studies highlighted the oral health status of older adults ([46, 47, 68, 69]) but they didn't clarify their nutritional status and its relation to dentitional status and its effect on their general health., this study can't compare the percentage of both edentuolism and nutritional disturbances due to that it is not representative that it took people from local areas to find the relation between the nutritional and dentitional statuses. When nutritional status based on only Body mass index (BMI), it didn't cover the aspects of qualification in older people as self perception, diet and presence of diseases [75], this study used MUAC as nutritional status indicator not as many studies which used different nutritional status indicators and assessments with different and complicated statistical methods as bi- or multivariate logistic regression, so the comparison with them is difficult. Findings in this study in the total sample and by age and gender showed that edentate subjects (edentulous) had lower mean of MUAC than those subjects with 1-10 and 11-20 natural teeth present in their oral cavity, these findings are in agreement with studies [57-59] while are contradicted with studies [52-56], this is due to people with fewer than 20 teeth had dietary restrictions [70] and nutritional deficiency when compared with those with 20 or more teeth and suggest that number of teeth is the acceptable functional dentition in old age [48,49], and this functional dentition could be affect both chewing, masticatory efficiency and swallowing on patterns of food selection of those subjects [51,58,70]. Sheiham et al in 2002[58] stated that the relation between oral health and BMI is relatively complex as tooth loss may be due to poor quality of diet, It can be more difficult to provide adequate function, as a result adequate and varied diet, where there are a few poorly distributed teeth than where there are none at all. The studies which suggest that edentate subjects or those with fewer teeth with higher BMI conclude that those subjects will tend to decrease the general intake of fiber-rich foods as raw vegetables and fruits and adaptation to decreased chewing ability to towards processed diet with highly caloric intake (carbohydrate and fat) causes the obesity which can lead to systemic diseases as hyperlipidemia and cardiovascular diseases [51,52,58,59,66,71,72] and this healthy diet (rich in fruits ,vegetables and grains and low of sugars and fat) could have benefit effect on oral health [73]. Arthur et al (2010) [74] concluded that studies [51,58] were done in heterogeneous characteristics, including people with advanced age and limited function, which possibly limited comparison with elderly with maximum age is 74 years old in a good functional state, as were

those selected for the previous study. Regarding the POPs, The same findings as natural teeth present in oral cavity , subjects with no POPs had lower mean of MUAC than those with 1-4 and 5-8 POPs, this could suggest the effect of POPs on the nutritional status as in agreement with studies [51,52,62] while in contrast with studies [49,63], this could be as suggested by studies [51,58] who concluded that number of teeth could not influence the masticatory efficiency; the most functional occlusion is in the posterior teeth (POPs either natural or artificial), this could clarify that when either number of natural teeth or number of occluding posterior pairs were used as oral health assessment, thus subjects with reduced number of POPs have limited food choice ;lower intake of strong fibrous food as (meat, fruits and vegetables) and incline towards the unhealthy diet rich in carbohydrate and fat and cause obesity, thus these teeth (POPs) affect chewing ability [66,76] ,satisfaction ,oral quality of life of subject [77] and nutritional status [62], this choice of food intake was independent of confounding variables as age, gender, ethnicity, education, poverty index, and smoking status [52].Another indirect mechanism of effect of tooth loss on nutritional status is by bite force, studies [78-80] stated that the masticatory performance could be affected by maximum bite force which in turns affected by oral health status as decayed or missing teeth with that the increasing the number of posterior occlusal contacts could be a result of stronger bite force, but Ching-Ming Su et al [78] found that effect in preschool children while other two studies among older adults.In conclusion, preservation of good and functional dentition among older adults has a principal role in maintaining their nutritional status and this could happen by co-operation of both well dieticians and profesionality of dentists to get better promotion of overall health of people.There are some limitations in this study; it is not representative cross-sectional study which means its sample size is small, which reflects deficiency in power to find this bi-directional cause effect relationship, to find that a longitudinal study among large representative with either Institutionalized and community dwelling elderly such as taking more governmental and specialized centers in Iraq not from Baghdad city only and taking many confounding variables and adjust them in multivariate logistic regression model to find such correlation.

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