Selected Salivary Biomarkers in Relation to Work-related Musculoskeletal disorders among a Group of Dentists in Baghdad City

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ABSTRACT

Background: work-related musculoskeletal disorders represent an important occupational health issues among dentists especially neck and low back complaints. Biomarkers of tissue damage as results of occupational physical demands could be used for detection of work related musculoskeletal disorders.

Aim: The aim of this study was to assess work- related musculoskeletal disorders, physical work load index, selected salivary biomarkers (Creatine kinase and C - reactive protein) and to find the relation among them.

Subjects and Methods: Study participants are consisted of 112 dentists. They were selected from college of dentistry /Baghdad University, health care center in Bagdad city. They were of both gender and aged between 40-45 years .they should fit the study criteria. Self-administered standardized Nordic questionnaires were used to evaluate musculoskeletal complaints. Physical work load was evaluated by used physical work load index. Stimulated saliva were collected from subsample (87) dentists drawn randomly from the total sample, for whom biochemical analysis (measurement of creatine kinase and C - reactive protein) were done.

Results: Results showed that low back and neck complaints is the most complaint experienced by the dentists with percentages of (69.6% and 66.1%), followed by the shoulder complaint (49.1%) while the hip complaint showed the lowest percentage (13.4%).According to severity scores ,both low back and neck musculoskeletal complaints were of score 3 severity (score 3 constituted the highest percentages in both area (27.7% ,23.2%respectively) as compared to other severity scors.For shoulder complaint it was of score 2 severity (score 2 constituted the highest percentage 23.2% as compared to other severity scores, The musculoskeletal complaints(proximal ,neck, shoulder and low back) had higher mean rank values in the highest quartile of Physical work load index with non – significant differences (P<0.05). Regarding salivary creatine kinase the proximal ,total and low back complaints had higher mean rank values among dentists with highest Creatine kinase quartile , while distal manifestations ,neck and shoulder complaints had higher mean rank value in the average interquartile range of Creatine kinase with non – significant differences(P<0.05). For c- reactive protein almost all the complaints(proximal , total ,neck and shoulder) had higher mean rank values in the first lowest quartile with non – significant differences(P<0.05).

Conclusions: Physical work load increase the risk of musculoskeletal disorders occurrence. Salivary creatine kinase could serve as a biomarker that reflects the underlying of musculoskeletal complaints more than C - reactive protein. Further studies that used more objective tools for assessing musculoskeletal disorders is needed.

Keywords: Musculoskeletal disorder, physical work load index, Creatine kinase, C - reactive protein. **(J Bagh Coll Dentistry 2017; 29(1):125-131)**

INTRODUCTION

Musculoskeletal disorders (MSDs) include a wide range of inflammatory and degenerative conditions affecting the body's joints, muscles, nerves, and tendon and structures that support limbs, neck and back [1,2]. Many factors are responsible for MSD, like occupational factors, medical factors, physical disorders, genetic predisposition, age, life style factors and psychological factors. Usually two or more factors will cause MSD [3, 4]. Work-related musculoskeletal disorders (WMSDs) refer to MSDs that are made worse or longer lasting by work conditions [5].

In dentistry the prevalence of musculoskeletal disorder among dentists and dental hygienists was reported to be high [6]. Many longitudinal studies had been carried out over a period of 1 to 5 years and found that over half (60%, 72%, 81%, 65% and 78%) of the participating dentists experienced musculoskeletal pain [7, 8, 9, 10, 11].

In Iraq two studies could be found in which WMSDs were assessed by using self-administrated questionnaire. Al-Tai found that 785 of the examined dentists reported musculoskeletal pain and 86% of them had low back pain[12]. In another Iraqi study recorded that 77% of the examined dentists had complaints of back and neck problem [13].

Early diagnosis of musculoskeletal disorder is essential for their prevention and treatment [14]. The use of biomarkers in body fluid had attracted attention of many investigators [15]. One of these biomarkers is Creatine kinase enzyme; it is the most commonly studied intramuscular protein in relation to skeletal muscle damage induced by physical work [16, 17]. Only very few studies have examined serum levels of Creatine kinase in relation to industrial tasks, these studies recorded an increase in serum Creatine kinase levels after 4 days of industrial work and that serum Creatine kinase level was significantly correlated with daily workload [18, 19, 20].

The second biomarker was C - reactive protein that had received attention as a marker of chronic

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inflammation in musculoskeletal conditions [21]. Also few studies could be found regarding C-reactive protein level in relation to musculoskeletal complaints [22, 23]. These studies revealed an association between musculoskeletal complaints and level of C –reactive protein.

Saliva as a diagnostic tool has attracted the attention of numerous investigators because of the noninvasive nature and relative simplicity of collection [24]. However no studies could be found regarding the level of these biomarkers in saliva in relation to musculoskeletal disorders. Therefor this study was carried out in order to evaluate work-related musculoskeletal disorder and physical work load. Also to measure the level of Creatin kinas and C - reactive protein in saliva and relating them with work-related musculoskeletal disorder and physical work load among a group of dentists in Baghdad city.

SUBJECTS, MATERIAL AND METHODS

The sample for this study was consisted of 112 dentists of both gender aged 40-45 years.

They were selected from specialized dental centers, Heath care Centers and Collage of dentistry/ Baghdad University. Informed consent and ethical approval was obtained for their examination. They should fulfill the selected criteria, They should be healthy and free of self-reported (Anemia, diabetes, heart disease and inflammatory conditions include arthritis),non-smoker ,should not been injured in the last six years, should not have blood- borne disease, Should not be on excessive use(>81mg /daily) of Non-steroidal anti-inflammatory drugs, Should not be on lipid lowering medications, Should not have heavy exercises in the last two days, prior to the study or other physical activities beyond those required to perform their normal daily activities , should be without any medical history that compromise salivary secretary mechanisms, should not take any medications with xerostomic effect, should not wear any fixed or removable dental prosthesis and pregnant and women with significant gynecological problems or those during menstruation cycle should be excluded [25].

This study was carried out during the period between December 2015 and March 2016 in Baghdad. Each subject fills out two questionnaire format (self-administered questionnaires). The first one is standardized Nordic Musculoskeletal Questionnaire (SMSQ) [26] in order to assess nature and severity of self-related musculoskeletal symptoms, the questionnaire include items regarding the experience of musculoskeletal problems in nine body areas over the past week and over the past year.

The second questionnaire format is related to physical workload by hollmann et al. to find physical work load index [27].

Body weight status was determined by using body mass index (BMI) which can be obtained by dividing weight in kilogram by height in meter squared kg/m^2, the body mass index was divided into four category included underweight<18.5, normal weight (18.5-24.9), overweight (25-29.9), and obese + 30 [28]. Then stimulated saliva were collected from subsample drown randomly from the total sample that was consisted of 87 dentists of both gender. Saliva collection was performed according to the instruction cited by Tenovuo and Lagerlof [29].then biochemical analysis were performed to measure salivary Creatine kinase and C - reactive protein by using enzyme –linked sorbent assay (ELISA). All the laboratory works were done in poisoning consultation center, Gazi Al-Hariry hospital.

Statistical analyses were done by using IBMSPSS version 23 computer software (Statistical Package for Social Sciences) in association with Microsoft Excel 2016. Most of the outcome (response) variables were non-normally distributed variables. Such variables can be described by median and interquartile range. Statistical tests used were (Mann-Whitney) and Kruskal-Wallis test in addition to Spearman's rank linear correlation coefficient. An estimate was considered statistically significant if its P value was less than a α level of significance of 0.05.

RESULTS

Distribution of the dentists according to gender and body mass index is shown in Table (1), the total sample consist of 112 dentist females form two third of the total sample with 70.5% while males constituted 29.5%.

Concerning the body mass index the higher percentage of the dentists were overweight 44.6% while those who are normal and obese revealed an equal percentages (28.6%, 26.8%).While under- weight was zero.

Results in Table (2) showed that low back and the neck complaints were the most complaints experienced by the dentists with percentages of (69.6% and 66.1%) respectively, followed by the shoulder (49.1%) and upper back (27.7) while the hip complaint showed the lowest percentages (13.4%).

Musculoskeletal complaints severity score according to body parts is shown in table (3). Results revealed that for both neck and low back

complaints, severity scores were of score 3 (symptoms in both the last 12 months and the last 7 days and, in addition, restrictions).Score 3 constituted the highest percentages (23.2% and 27.7%) for neck and low back complaints respectively than other scores.

Also for shoulder complaint it was of score 2 severity (symptoms in the last 12 months and neither symptoms in the last 7 days or restrictions) that constitute the highest percentage (23.2%) than other scores.

Physical work load index was classified into three quartiles as described in Table (4), results revealed that musculoskeletal complaints (proximal, neck, shoulder and low back) had higher mean rank value in the highest quartiles ,except for total and distal complaints had higher mean rank value in the average interquartile with

non – significant differences (P<0.05).

Relation of musculoskeletal complaints with salivary creatine kinase quartiles is showed in Table (5) Results showed that mean rank values for musculoskeletal complaints were higher in highest quartiles regarding proximal ,total and low back complaints , while distal manifestations ,neck and shoulder complaints had higher mean rank values in the average interquartile range but with non – significant differences(P<0.05). Regarding C- reactive protein it was classified into three quartiles as shown in Table (6) results showed that almost all the musculoskeletal manifestations (proximal , total ,neck and shoulder) had higher mean rank values in the first lowest quartile but with non – significant differences (P<0.05).

Table 1: Distribution of the dentists according to gender and body mass index.

Parameter	Gender			BMI			
	female	Male	total	Normal (<25)	Overweight (25-29.9)	Obese (30+)	Total
No.	79	33	112	32	50	30	112
%	70.5	29.5	100.0	28.6	44.6	26.8	100.0

Table 2: Distribution of dentists according to presence or absence of musculoskeletal complaints by body parts.

Body parts	Musculoskeletal complaints			
	Absent		present	
	No.	%	No.	%
Neck complaints score	38	33.9	74	66.1
Shoulder complaints score	57	50.9	55	49.1
Elbow complaints score	96	85.7	16	14.3
Wrist/hands complaints score	85	75.9	27	24.1
Upper back complaints score	81	72.3	31	27.7
Low back complaints score	34	30.4	78	69.6
Hip complaints score	97	86.6	15	13.4
Knee complaints score	70	62.5	42	37.5
Ankle/feet complaints score	91	81.3	21	18.7

Table 3: Distribution of the dentists according to musculoskeletal complaints severity score by body parts.

Severity scores / Body Part	Score 0 (neither symptoms nor restrictions)		Score 1 (symptoms in the last 12 months but not in the last 7 days and no restrictions)		Score 2 symptoms in the last 12 months and neither symptoms in the last 7 days or restrictions)		Score 3 symptoms in both the last 12 months and the last 7 days and, in addition, restrictions	
Body part	No.	%	No.	%	No.	%	No.	%
Neck	38	33.9	23	20.5	25	22.3	26	23.2
Shoulder	57	50.9	17	15.2	26	23.2	12	10.7
Elbow	96	85.7	10	8.9	3	2.7	3	2.7
Wrist hand	85	75.9	14	12.5	9	8	4	3.6
Upper back	81	72.3	0	0	23	20.5	8	7.1
Low back	34	30.4	21	18.8	26	23.2	31	27.7
Hip	97	86.6	8	7.1	6	5.4	1	0.9
Knee	70	62.5	22	19.6	13	11.6	7	6.3
Ankle feet	91	81.3	9	8.0	9	8.0	3	2.7

Table 4: Musculoskeletal complaints according to physical work load index quartiles.

musculoskeletal complaints	Physical load index quartiles	First (lowest) quartile <= 4.2	Average (interquartile range) 4.3 - 12.0	Fourth (highest) quartile 12.1+	P- value
Proximal musculoskeletal complaints score (/100)	No.	28	57	27	0.95
	Median	26.7	26.7	33.3	
	Mean rank	56	55.9	58.3	
Distal musculoskeletal complaints score (/100)	No.	28	57	27	0.16
	median	0	8.3	8.3	
	Mean rank	48	61.3	55.2	
Total musculoskeletal complaints score (/100)	No.	28	57	27	0.82
	median	22.2	22.2	22.2	
	Mean rank	53.2	57.7	57.4	
Musculoskeletal manifestations score for Neck complaint (/100)	No.	28	57	27	0.98
	median	28.6	28.6	28.6	
	Mean rank	55.8	56.3	57.5	
Musculoskeletal manifestations score for Shoulder complaint (/100)	No.	28	57	27	0.54
	median	0	7.1	14.3	
	Mean rank	51.7	56.9	60.6	
Musculoskeltal manifestations score for Low back complaint (/100)	No.	28	57	27	0.32
	median	42.9	28.6	35.7	
	Mean rank	60.8	52	61.5	

Table 5: Musculoskeletal complaints according to salivary Creatine kinase quartiles:

Musculoskeletal complaints	Creatine kinase quartiles	First (lowest) quartile <= 381.1	Average (interquartile range) 381.2 - 549.5	Fourth (highest) quartile 549.6+	P- value
Proximal musculoskeletal complaints score (/100)	No.	22	44	21	0.45
	Median	20	33.3	26.7	
	Mean rank	38.4	45.1	47.5	
Distal musculoskeletal complaints score (/100)	No.	22	44	21	0.86
	Median	4.2	8.3	0	
	Mean rank	42.1	45.3	43.4	
Total musculoskeletal complaints score (/100)	No.	22	44	21	0.57
	Median	18.5	22.2	14.8	
	Mean rank	39.1	45.4	46.2	
Musculoskeletal manifestations score for Neck complaint (/100)	No.	22	44	21	0.18
	Median	14.3	35.7	28.6	
	Mean rank	35.9	47.8	44.6	
Musculoskeletal manifestations score for Shoulder complaint (/100)	No.	22	44	21	0.1
	Median	0	10.7	7.1	
	Mean rank	34.9	47.7	45.9	
Musculoskeletal manifestations score for Low back complaint (/100)	No.	22	44	21	0.89
	Median	21.4	28.6	42.9	
	Mean rank	43	43.4	46.2	

Table 6: musculoskeletal complaints according to Salivary C-RP quartiles.

Musculoskeletal complaints	C- reactive protein quartiles	First (lowest) quartile <= 1.55	Average (interquartile range) 1.56 - 2.16	Fourth (highest) quartile 2.17+	P-value
Proximal musculoskeletal complaints score (/100)	No.	23	43	21	0.6
	Median	26.7	26.7	26.7	
	Mean rank	48.5	42.2	42.7	
Distal musculoskeletal complaints score (/100)	No.	23	43	21	0.32
	Median	8.3	0	8.3	
	Mean rank	46.5	40.2	49	
Total musculoskeletal complaints score (/100)	No.	23	43	21	0.66
	Median	22.2	22.2	14.8	
	Mean rank	47.7	41.8	44.3	
Musculoskeletal manifestations score for Neck complaint (/100)	No.	23	43	21	0.65
	Median	28.6	28.6	28.6	
	Mean rank	48	42.9	41.9	
Musculoskeletal manifestations score for shoulder complaint (/100)	No.	23	43	21	0.19
	Median	21.4	0	0	
	Mean rank	51.2	40.2	44	
Musculoskeletal manifestations score for low back complaint (/100)	No.	23	43	21	0.96
	Median	14.3	42.9	28.6	
	Mean rank	42.8	44.7	43.8	

DISCUSSION

Dentistry represents an important and critical occupation since dentists are subjected to many hazards; one of the most important of these hazards is musculoskeletal disorder probably because of the nature of this occupation [30]. Musculoskeletal complaint were evaluated by using standardized Nordic questionnaire, self – administered questionnaire was used ,this type of questionnaire is suitable for cross sectional studies, easy, clear, less time consuming and can provide an additional diagnostic tool for the analysis of work environments and work conditions [26]. Results of the current study revealed that highest percentages of the dentists were suffer from low back , neck and shoulder complaints their percentages were 69.6% , 66.1% and 13.4% respectively. According to severity score of musculoskeletal complaints both low back and neck complaints were of score 3 severity (symptoms in both the last 12 months and the last 7 days and, in addition, restrictions). For shoulder complaint it was of score 2 severity (symptoms in the last 12 months and neither symptoms in the last 7 days or restrictions).The same finding was also reported by other studies that showed higher prevalence rate of low back, neck and shoulder musculoskeletal complaints [31, 32, 33, 34]. The possible explanation of higher low back, neck and shoulder musculoskeletal complaints among dentists is probably related to their poor posture ,repetitive movements, elevated and unsupported arm, bent and twisted back position, use of vibrating tools and prolonged sitting or standing posture [35]. This is further supported by the study finding that dentists with highest physical work load quartile and those with average physical work index quartiles revealed higher musculoskeletal complaints mean rank (proximal, neck, low back and shoulder) for highest Physical work load index quartile and distal and total musculoskeletal complaints for those with average Physical work load index quartile. This was consistent with many studies which Found a relationship between physical load and musculoskeletal complaints in dentistry [36, 37].Since Physical work load index is related to body posture and lifting weight, activities that need heavy loads can result in acute injury to the musculoskeletal system. This mean as the physical load increase the musculoskeletal complaints increase, therefor physical workload itself was considered as a risk factor for musculoskeletal complaints [38, 39, 40].

Results from several clinical and experimental studies indicate that pathological and adaptive tissue changes could occur as a results of performing repetitive and forceful tasks, these tissue changes could revealed by biomarker of inflammation like C- reactive protein and biomarker of cell injury like Creatine kinase

[16,21,38]. Results of the current study showed that according to Creatine kinase quartiles dentists with average (interquartile range) and those with highest Creatine kinase quartiles had higher muscskeltal complaints mean rank value regarding distal, neck and shoulder for the average (interquartile range) and proximal and low back complaints for the highest quartiles although statistical differences were non – significant. Regarding C-reactive protein results showed that dentists with lowest quartile had highest musculoskeletal complaints mean rank values except for distal and low back complaints however statistical differences were non – significant. This mean that creatine kinase is more related to musculoskeletal complaints than c-reactive protein probably due to the fact that c-reactive protein enzyme is considered a biomarker of inflammation that mean there is a state of inflammation associated with musculoskeletal disorder but muscle cell injury still not occur [39]. While creatine kinase is more related to musculoskeltal complaints probably because it is a biomarker of cell injury that mean there is cell damage, muscle cell disruption, or disease. These cellular disturbances can cause CK to leak from cells into blood stream [17] and its level will increase in saliva, since saliva is considered as mirror that reflect normal internal characteristics and disease [24]. The study finding goes with that of many studies [18, 19, 20]. This might open the way for the possible use of salivary creatine kinase and c-reactive protein as a biomarkers of musculoskeletal disorder [15]. It is important to mention that in the current study musculoskeletal complaints were evaluated by using the standardized Nordic questionnaire that measure the symptoms only (subjective method),while more objective methods like clinical examination ,radiograph, magnetic resonance image (MRI) etc. did not use in the current study because of technical difficulties. This might explain the non-significant differences in musculoskeletal complaints according to creatine kinase and C- reactive protein quartiles. There for further study that used more objective methods for measuring musculoskeletal complaints is required.

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الخلاصة

خلفية: الصلة بين العمل والاضطرابات العضلية الهيكلية تمثل قضية مهمة من القضايا الصحة المهنية بين أطباء الأسنان. ويمكن استخدام المؤشرات الحيوية للتلف الأنسجة كنتائج من المطالب المادية المهنية للكشف المستقبلي عن اضطرابات الجهاز العضلي الهيكلي والمتعلقة بالعمل.كان الهدف من هذه الدراسة لتقييم الاضطرابات العضلية والهيكلية ، مؤشر حجم العمل البدني، ومجموعة مختارة من المؤشرات الحيوية اللعابية (الكرياتين كيناز وسي – رياكتف بروتين) وإيجاد العلاقة بينهم.

الادوات وطريقة العمل : يتألف المشاركون في الدراسة من 112 من أطباء الأسنان. وقد تم اختيارهم من كلية طب الأسنان / جامعة بغداد و مراكز الرعاية الصحية والتخصصية في مدينة بغداد. وكان المشاركين من كلا الجنسين والذين تتراوح أعمارهم بين 40-45 عاما و مواصفاتهم يجب أن تتلاءم مع معايير الدراسة. استخدمت الاستبيانات التي تدار ذاتيا لتقييم الشكاوى المتعلقة بالاضطرابات العضلية الهيكلية و تقييم عبء العمل الجسدي من خلال استخدام مؤشر حجم العمل البدني. تم جمع اللعاب المحفز من عينة فرعية من (87) طبيب اسنان تم استخلاصها بصورة عشوائية من مجموع العينة من اجل القيام بالتحاليل الكيمياء الحيوية لقياس(كرياتين كاينز و سي –ريكتف بروتين).

النتائج : وأظهرت النتائج أن الالم أسفل الظهر والرقبة هي الأكثر شكوى من ذوي الخبرة من قبل أطباء الأسنان مع نسبة (69.6 ٪ و 66.1٪)، تليها شكوى الكتف (49.1٪)، في حين اظهرت النتائج ان شكوى الم الورك تمثل أدنى نسبة (13.4٪).ووفقا لدرجة الشدة لاضطرابات العضلية الهيكلية كانت كل من الالم الظهر و الرقبة لها درجة 3 شدة (شدة درجة 3 تشكل أعلى النسب في كل من منطقة اسفل الظهر والرقبة (27.7٪، 23.2٪ على التوالي) بالمقارنة مع شدة شكوى الكتف كانت 2 درجة شدة (يسجل 2 تشكل أعلى نسبة 23.2 ٪. وكانت الشكاوى العضلية الهيكلية بالنسبة لمناطق القريبة والعنق والكتف واسفل الظهر لها قيم عليا في الربع الاعلى من مؤشر حجم العمل البدني مع غير - فروق ذات دلالة إحصائية (0.05< P).

بالنسبة لموشر الكرياتين كيناز اللعابي والدائي، كان المظاهر القريبة و الكلية واسفل الظهر تسجل اعلى قيم في الربع الأعلى من الكرياتين كيناز ، في حين أن المظاهر البعيدة والرقبة والكتف تسجل اعلى قيم في الربع المتوسط الرتبة في المدى المتوسط من الكرياتين كاينز مع غير - فروق ذات دلالة إحصائية (P <0.05). بالنسبة لسي – ريكاتف بروتين –اغلب الشكاوى تقريبا كل (القريبة، الكلية والعنق والكتف) تسجل اعلى قيم في الربع الاسفل الادنى من سي – ريكاتف بروتين مع غير - فروق ذات دلالة إحصائية (0.05< P).

الاستنتاجات: حجم العمل البدني يزيد من خطرحدوث الاضطرابات العضلية الهيكلية. المقاييس اللعابية بالنسبةالكرياتين كيناز يمكن أن تكون من العلامات البيولوجية التي تعكس الصورة الكامنة وراء الشكاوى العضلية الهيكلية أكثر من سي –ريكاتف بروتين . هناك حاجة إلى إجراء المزيد من الدراساتو استخدام أدوات أكثر موضوعية لتقييم الاضطرابات العضلية الهيكلية .

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