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IMPACT OF OBESITY ON PERIODONTAL HEALTH IN A SAMPLE OF ADULT EGYPTIAN PATIENTS: A CASE COMPARANT STUDY

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ABSTRACT

Background: The prevalence of obesity in adult Egyptians is 39.8%. Accordingly, this study aimed to explore how obesity affects periodontal health in the adult population of Egypt in a case control design.

Method: A total of 384 dental patients were used in the current study. They were divided into two groups based on their body mass index (BMI): the control group was made up of patients who were normal weight (BMI = 18.5-24.9 kg/m^2), while the study group was made up of obese patients (BMI 30 kg/m^2). The assessments included demographic information as well as clinical periodontal indicators such as bleeding on probing (BOP), clinical attachment loss (CAL), probing depth (PD), and plaque index (PI). The new classification of periodontal disease served as the basis for the periodontal diagnostic and case identification. To compare the two groups, the T-test and Chi-Squared test were applied to numerical and categorical data, respectively. In order to investigate how obesity affects periodontal health, an ordinal logistic regression model was used.

Results: There is no statistical difference regarding BOP and PD meanwhile a statistically significant difference regarding CAL between the study and control group (P value= 0.987, 0.306, 0.001 respectively, significant at 0.01). Obesity is more associated with poor oral hygiene and periodontitis with statistically significant difference than normal BMI patients [(P=0.004, significant at 0.01) and (P=0.000, significant at 0.001) respectively]. Obesity affects periodontal diagnosis significantly.

Conclusion: Obesity has significant association to periodontitis. Poor oral hygiene and CAL is positively related to obese patients.

KEY WORDS: Obesity, periodontal health, relationship.

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INTRODUCTION

Obesity is a compound disorder being multifactorial in origin associated with chronicity leading to excess buildup of fat in the adipocytic tissue. One of the most ignored general health issues is obesity, which impacting both developed and developing nations [1]. Over the latest few years, obesity has become much more prevalent. According to the World Health Organization (WHO), there were 600 million adults having obesity globally in 2014, and more obesity is predicted in the next years as a result of rising intake of high-calorie foods and sedentary daily life [2].

Obesity is commonly distinct by body mass index (BMI = kg/m^2) where it is definite as a BMI of ≥30.0 kg/m^2. BMI is an indicator of total adiposity[1]. Obesity is a chronic metabolic disorder that prompts to a diversity of comorbidities for instance type 2 diabetes mellitus, atherosclerosis, increased blood pressure and cardiac diseases. Additionally, it has been proposed that obesity is a risk cause for periodontal disorder [3].

It's possible to classify obesity as a mild form of systemic inflammation [2]. Obesity is intimately related to chronic inflammatory illnesses, and obese adolescents and adults have higher serum levels of interleukin-6, tumour necrosis factor, C-reactive proteins and leptin [1]. These substances are regarded as markers of inflammation. In light of the fact that periodontal disease is likewise an inflammatory condition brought on by a complicated interplay between pathogenic bacteria and the immune system of the host, these findings suggest rationale basis for the relationship between obesity and this condition [4].

Periodontal disease is an infectious and inflammatory disorder that affects teeth supporting tissues. It is brought on by the interaction of pathogenic bacteria and the immune system of the host. The production and release of cytokines, proinflammatory mediators, and metalloproteinases occurs when the host immune system is activated, primarily for protective purposes [1]. One of the top 10 chronic diseases impacting people worldwide is periodontitis. Recent studies have concentrated on the connection between systemic diseases such diabetes, rheumatoid arthritis, cardiovascular disease, and obesity and periodontitis. A systemic review concluded that one of the newest areas of study in periodontal medicine is the link between obesity and periodontitis, while the reliability of this association among an Egyptian population sample as well as the potential biochemical reasons underlying this association are still unknown [3].

Egypt is ranked as having the 18th highest global obesity prevalence rate by the World Health Organization (WHO) [5]. According to the "100 million health" survey, which was carried out in Egypt in 2019 and involved 49.7 million adult Egyptians, 39.8% of Egyptian adults are obese, with a BMI of more than 30 kg/m^2 [6]. Accordingly, the present study was carried out aimed to determine the influence of obesity on periodontal health in a sample of adult Egyptians in a case control design where to the authors' knowledge, no previous research has examined this aim in the adult population of Egypt in a case-control pattern.

METHODS

Study design and setting

The Oral Diagnostic Centre at the Faculty of Dentistry, Cairo University, which is a public healthcare facility, and a referral center, was the site of this observational case control study, which ran from December 2022 to March 2023, on adult Egyptian dental patients. The study protocol, which had the 241122 code, was approved by the research ethics committee of the faculty of dentistry at Cairo University, and all participants gave their written consent. Additionally, it had the ClinicalTrail.gov ID of NCT05676736.

Calculation of the sample size

Sample size calculation

In order to determine the sample size, open Epi (proportion) was used (7). Khader et al. 2009 reported a disease frequency of 51.9% (8). The sample size was estimated at 384 at 95% confidence interval.

Participants & selection method

A total of 384 dental patients from the Cairo University's, Faculty of Dentistry outpatient Diagnostic Centre were included in a sequential order. The inclusion criteria included patients who were between the ages of 18 and 60 years, gave informed consent, had at least 20 natural teeth, and hadn't undergone any periodontal treatment in the previous four months. People with chronic systemic diseases such cancer, autoimmune disorders, osteoporosis, endocrine disorders, and haematological disorders were excluded from the study. In addition, smoker subjects and pregnant or lactating women, patients who can't open their mouths, have orthodontic appliances, or are having intermaxillary fixation can't be examined orally were not included in the study. Patients having psychological disorders or with alcohol or drugs abuse were also omitted.

Demographic and Anthropometric data

A (closed-ended) questionnaire was utilized to collect socio-demographic data for instance age, gender, academic standing, marital condition, and occupation through interview. Patients were divided into four groups based on their age: 18-30, 31-40, 41-50, 51-60 years. The BMI, which the WHO regards as the most appropriate population-level measure of overweight and obesity for both genders, was used to quantify obesity [(2)]. Body weight (kg) divided by height squared (m^2) yielded the body mass index (kg/m^2). Participants were requested to take off their heavy outerwear (such as coats and jackets) and shoes before having their weight taken. Digital electronic platform scale (DETECTO, made in United State) with capacity 180 kg calibrate weight and height was used in this study and patients were categorized into:

Group C (control group): involved patients with normal body weight (BMI =18.5-24.9 kg/m^2).

Group S (study group): involved patients with obesity (BMI ≥ 30 kg/m^2).

Clinical periodontal assessments

For case identification, to diagnose the periodontal condition; the plaque index (PI), bleeding on probing (BOP), clinical attachment loss (CAL), and probing depth (PD) were measured[(8)]. These parameters were recorded by UNC 15 periodontal probe and were rounded up to the closest millimeters. Six sites were evaluated for each permanent fully erupted tooth: the mesio-buccal, mid-buccal, disto-buccal, disto-lingual, mid-lingual and mesio-lingual[(9)]. Third molars were not included in this analysis.

The plaque index was used to evaluate the state of oral hygiene. A burst of air was used to dry the teeth in each quadrant, and the amounts of supragingival calculus and visible dental plaque were noted. The buccal, lingual, mesial, and distal surfaces of the teeth were given scores ranging from 0 to 3. The plaque index for the tooth, which includes the next scores and criteria scores, is calculated by adding the scores from the four sides of the tooth and dividing the result by four. 0 means there is no plaque. 1 = a layer of plaque that has adhered to the free margin of the gingiva and tooth's surrounding region. Only after employing a revealing solution the plaque can be visualized in its place or via utilizing a probe tip running on the tooth surface. 2= Moderate buildup of soft deposits that are visible to the naked eye within the gingival pocket or the tooth and gingival margin. 3= The presence of a lot of soft deposits inside the pocket of the gingiva or/ and around the tooth and gingival margin [(10)].

The percentage of bleeding sites (dichotomous yes/no) when stimulated by a standardized periodontal probe manually with a regulated (25g) force inserted 1-2 mm into the gingival sulcus/pocket at six sites on all present teeth was calculated as the bleeding on probing score. Bleeding within 10 seconds was recorded as a positive finding [11].

The loss of clinical attachment was calculated from the CEJ to the base of the gingival sulcus. Six locations on each tooth—the mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, and distolingual—were probed with a gentle force that didn't surpass 25g. From the gingival margin to the base of the gingival sulcus, the pocket's depth was measured. Light force was used to place the probe parallel to the tooth's long axis[9]. Based on the new classification of periodontal disease[12], the diagnosis and case identification of periodontal disease were carried out. The x ray was done for periodontitis cases which represent 30% of the total studied sample to determine the grades.

Statistical analysis

The descriptive analysis was carried out with a complete illustration of all the variables utilized in the study. The continuous variables were expressed as mean ± standard deviation (SD) while the categorical variables were expressed as frequencies and percentages. . To assess the research hypotheses, an inferential analysis was done using various statistical methods. The numerical variables were compared between the comparable groups using the independent samples T-test, and the categorical variables were compared using the Chi-Squared test. Finally, Ordinal Logistic Regression Model was used to answer the hypotheses of this study where the Cumulative Probabilities was used to model ordinal the categorical variables. This model assumes a unique effect β for each logit; this assumption is called the Proportional Odds Assumption. Statistical analysis was done using IBM. SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.

RESULTS

The current study was carried out on sample consists of 384 participants where the male subjects (163) denote 42.4% which is lower than the females (221) who represent 57.6% of participants. Regarding the age, there are 65 (16.9%) patients aged from 18 to 30 years old, 150 (39.1%) aged from 31 to 40 years old, 128 (33.3%) aged from 41 to 50 years old, and only 41 (10.7%) aged from 51 to 60 years old. Regarding the educational level, there were 85 patients (22.1%) were not educated, 81 (21.1%) had elementary education, 51 (13.3%) had middle education, and 167 (43.5%) had higher education. This is illustrated in table 1.

Comparing the demographic data between study groups was done using Chi-Square test. There are significant relationships between BMI and all demographic variables such that, with 99% confidence interval, obesity is more associated with females (56.1%) than males (41.7%) in the study group while male subjects (58.3%) with normal BMI in the control group are more than the female subjects (43.9%) of the same group where there is a statistically significant difference (P=0.005, significant at 0.05) between the 2 groups. About sixty eighty percent (68.3%) of the older patients aged between 50-60 years were obese and showed significant difference (P value = 0.000) compared to those non obese in the control. Obesity is associated with lower educational level where 55 subjects (64.7%) in the study group are not educated with significant difference (P=0.000, significant at 0.01) in comparison to control group. This is shown in table 1.

Comparing the clinical parameters among the study groups was be done by using T-test for BOP (%), PD (mm), CAL (mm) and using Chi-Square test for PI score and diagnosis. It was recorded that either being of normal BMI in the control group or suffering from obesity in the study group doesn't affect the value of each of BOP (%), and PD (mm) with 95% confidence interval (P value= 0.987, 0.306 respectively, significant at 0.01). However, there

TABLE (1) Demographic information between control group and study group

Variable	Group C (Normal group)	Group S (Study group)	Chi-Square (P-Value)
	Frequency (Percentage)	Frequency (Percentage)	
Gender			
Male	95 (58.3%)	68 (41.7%)	7.771** (0.005)
Female	97 (43.9%)	124 (56.1%)	
Age (years)			
18-30	65 (100%)	0	81.919*** (0.000)
30 - 40	68 (45.3%)	82 (54.7%)	
40-50	46 (35.9%)	82 (64.1%)	
50-60	13 (31.7%)	28 (68.3%)	
Educational Level			
No Education	30 (35.3%)	55 (64.7%)	34.643*** (0.000)
Elementary Education	27 (33.3%)	54 (66.7%)	
Middle Education	24 (47.1%)	27 (52.9%)	
Higher Education	111 (66.5%)	56 (33.5%)	

** ***P value is significant at 0.05 level of significance,*** *** P value is significant at 0.01 level of significance***

is a statistically significant difference (P=0.001, significant at 0.01) between mean of CAL (mm) in the study group which has higher record (1.0033±1.34529) compared to that in the control group (0.5223±1.34117) with 99% confidence interval. Obesity is more associated with patients (55.5%) who have poor oral hygiene followed by those (47%) have fair oral hygiene (P=0.004, significant at 0.01) compared to the control group. Obesity is more associated with patients (87.5%) who have periodontitis stage III followed by those have periodontitis stage I (P=0.000, significant at 0.001) in comparison to the control group patients. This is shown in table 2.

Ordinal Logit Regression Model was used to answer the research question through selecting the significant independent variables from list of independent variables according to their significance. It was concluded that the model is significant as the chi-square value with 7 degrees of freedom = 57.631 and the associated p-value =0.0000 which is not more than 0.05.

It is revealed that BMI has significant impact on diagnosis, such that the cumulative odds ratios for each rank of diagnosis for normal BMI is less than for it's for obese by 33.9% holding all other variables constant with 95% confident. The cumulative odds ratios for each rank of diagnosis for patients who aged less than 40 years old is less than for those who aged more than 40 years old by 52.1% holding all other variables constant with 95% confident. The cumulative odds ratios for each rank of diagnosis for patients who are still students is 3 times for those who are either unemployed or retired holding all other variables constant with 95% confident. All other variables have no significant impact on diagnosis with 95% confident. This is shown in Table 3. Periodontally healthy is the estimated cut-point on the latent variable used to differentiate periodontally healthy from localized gingivitis, generalized gingivitis, Level (1), Level (2), Level (3) and Level (4) when values of the predictor variables are evaluated at zero. Localized gingivitis is the estimated cut-point on the latent variable used to differentiate localized gingivitis from Generalized

Gingivitis, Level (1), Level (2), Level (3) and Level (4) when values of the predictor variables are evaluated at zero. Generalized gingivitis is the estimated cut-point on the latent variable used to differentiate generalized gingivitis from Level (1), Level (2), Level (3) and Level (4) when values of the predictor variables are evaluated at zero. Level (1) is the estimated cut-point on the latent variable used to differentiate Level (1) Level (2), Level (3) and Level (4) when values of the predictor variables are evaluated at zero. Level (2) is the estimated cut-point on the latent variable used to differentiate Level (2) from Level (3) and Level (4) when values of the predictor variables are evaluated at zero.

TABLE (2) Comparison of clinical parameters between study groups.

Numerical Variable	**Group C (Normal group)**	**Group S (Study group)**	**T-Test (P-Value)**
	Mean ± Standard Deviation		
BOP (%)	36.4919±23.35939	36.5245±16.04048	-0.016 (0.987)
PD (mm)	2.8104±12.22633	1.9067±0.20688	1.024 (0.306)
CAL (mm)	0.5223±1.34117	1.0033±1.34529	-3.508*** (0.001)
Categorical Variable	Frequency (Percentage)	Frequency (Percentage)	**Chi-Square (P-Value)**
PI Score			
Good Oral Hygiene	30 (71.4%)	12 (28.6)	10.894*** (0.004)
Fair Oral Hygiene	61 (53%)	54 (47%)	
Poor Oral Hygiene	101 (44.5%)	126 (55.5%)	
Diagnosis			
Periodontally Healthy	18 (100%)	0	
Localized Gingivitis	64 (61.5%)	40 (38.5%)	
Generalized Gingivitis	78 (53.4%)	68 (46.6%)	
Periodontitis Stage I	13 (18.8%)	56 (81.2%)	66.380*** (0.000)
Periodontitis Stage II	11 (44%)	14 (56%)	
Periodontitis Stage III	2 (12.5%)	14 (87.5%)	
Periodontitis Stage IV	6 (100%)	0	

BOP; Bleeding on probing, PD; probing depth, CAL; clinical attachment loss, PI; plaque index.
****** P value is significant at 0.01 level of significance.***

TABLE (3) Ordinal logistic regression and parameter estimates

	Estimate	Odds	Std. Error	Wald	df	Sig.
Periodontally Healthy	-4.677	0.009307	0.763	37.533	1	0.000
Localized Gingivitis	-2.292	0.101064	0.724	10.023	1	0.002
Generalized Gingivitis	0.478	0.620022	0.713	0.449	1	0.503
Level (1)	0.769	2.157608	0.719	1.143	1	0.285
Level (2)	1.626	5.0835	0.735	4.892	1	0.027
Level (3)	2.968	19.45297	0.815	13.261	1	0.000
[Gender = Male]	-0.047	0.954087	0.298	0.024	1	0.876
[BMI = Normal]	-1.079	0.339935	0.225	22.976	1	0.000
[MS = Single]	-1.313	0.269012	0.761	2.975	1	0.085
[MS = Married]	-0.736	0.479026	0.701	1.101	1	0.294
[Age = less than 40]	-0.736	0.479026	0.221	11.112	1	0.001
[Occupation = Student]	1.341	3.822864	0.420	10.208	1	0.001
[Occupation = Employed]	0.413	1.511345	0.323	1.633	1	0.201

DISCUSSION

It's crucial to comprehend how obesity and periodontal disease are related because it not only raises the morbidity of diabetes mellitus type 2 and coronary heart disease but also may direct the existing preventive and therapeutic approaches. In clinical research, measuring BMI according to Martinez-Herrera et al., is simple method for weight determination[3]. In light of this, the current study was carried out using a case-control design to estimate the effect of obesity on the periodontal health of a sample of Egyptian patients.

The results of the current study recorded that in respect to periodontal diagnosis, the highest percentage of the studied population sample is for generalized gingivitis followed by localized gingivitis, periodontitis stage I grade A, stage II grade A and periodontally healthy having the same percent, followed by stage II grade B and finally stage III, IV together represents the least percentage. This is not in agreement with the results of the Abbass et al., study done on Egyptian population which found that higher prevalence of periodontitis compared to gingivitis or periodontally healthy[13]. This may be due to different recruitment where their study recruited patients from multi-center with different descriptive data (three private dental clinics in addition to Faculty of Dentistry, Cairo University). Meanwhile the current study recruited patients only from one center (Faculty of Dentistry, Cairo University). The highest percent of the participants had poor oral hygiene followed by the fair one while the lowest percent had good oral hygiene were recorded in the current study finding and coincide with that of Abbass et al., research[13].

In addition, this study result's shows that obesity is more associated with females than males which is similar to results recorded by the research done by Amin, 2010 [14]. The current study revealed that, the older participants are more obese than younger participants. Obesity is associated with lower educational level. Married subjects are highly suffered from obesity than single patients. Unemployed and retired patients had obesity more than others. The current research found that obese subjects had more CAL than normal subjects with significant difference between the two groups this agrees with the findings by an Egyptian study[14] and other studies[8,15,16]. Meanwhile there is no statistical difference regarding the BOP and PD in the existing study which was in agreement with two studies which reported that obesity was not related to PD[17,18]. This study revealed that patients of the study group had more significant poor oral hygiene in comparison to those of the control group that coincides with the results of these studies [15, 18]. This finding may be due to psychological aspects that have a detrimental impact on the attitudes of obese people towards oral hygiene practices, such as low self-esteem or low perceptions of one's own value [19].

The present study reported that the obesity is more associated with periodontitis stage III followed by periodontitis stage I. This in line with the results of a research[15] where it found obese participants had severe periodontitis. However, this disagrees with the results of recent study carried out on Egyptian population which identified insignificant statistical difference between different subgroups of BMI[13]. This can be explained by different study design between them where this study was a cross-sectional study compared to case control pattern of the existing study.

According to the current study findings, obesity could have significant effect on the periodontal health where the total number of periodontally involved obese patients are more than the subjects with normal BMI. This is similar to the results of these studies [14-16] but disagree with the finding of these studies[13,18,20] where they reported no association between periodontitis and obesity. This can be attributed to difference in study setting regards research [13] where in included three private dental offices besides the Faculty of Dentistry, Cairo University. Also the difference of age range and type of participants in study [18] which involved

undergraduate dental students aged (18-40) years compared to dental patients aged (18-60) years. The explanation in case of study [20] is due to different measurement of obesity where it used waist circumference and PD for periodontitis diagnosis method compared to the current study which used BMI and new classification of periodontal disease. Also, this study reported that periodontal health is affected by age and occupation where patients more than 40 years old and student ones had periodontitis in comparison to others, where this in agreement with the finding showed by recent study [16].

Relationship between periodontitis and a number of obesity indices has been shown [21, 22]. Second only to smoking, obesity has been recognized as a major risk cause for inflammatory periodontal tissue damage [23]. In order to do so, obesity activates the immune system through cytokines synthesis like tumor necrosis factor (TNF-α), IL-6, and IL-1, which start an acute phase of immune response, further raise the likelihood of triggering inflammatory reactions that cause periodontal disease to advance [24]. This could then lead to immune cells infiltrating the body and becoming activated, resulting in a pro-inflammatory status. According to the information that is currently available, obesity has been linked to higher levels of oral periodontal pathogens including Tannerella forsythia and Selenomonas noxia [25].

CONCLUSIONS

The current study emphasized the significant association between obesity and periodontitis in adult dental patients in Egypt. In addition, a positive relationship between poor oral hygiene and CAL in obese patients. Age was found to be a strong predictor for periodontal disease. It is advised that physicians inform their obese patients about the dangers of periodontal disease and emphasize the importance of regular visits to dentists and the value of good oral hygiene practice. Therefore, dental practitioners can use the findings of this research to further encourage Egyptian population to keep a healthy regime and a normal body weight.

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