Correlation between Obesity and Periodontitis in Vietnamese Patients

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Abstract. The objective of this study is to determine the correlation between periodontitis and obesity in patients reporting at the Tradi-tional Medicine Institute in Ho Chi Minh City, Vietnam. This cross-sectional study sample consisted of 679 adult patients aged between 18 and 83 years who visited examination department, the Traditional Medicine Institute, Ho Chi Minh City, Vietnam. All participants completed the questionnaire, had anthropometric (weight, height, waist circumference) and body fat percentage measurements; and periodontal examination (BOP, PI, GI, PD and CAL). The fasting glycemic level and type 2 diabetic status were also determined. Whatever different definitions of obesity used (body mass index, waist-hip ratio and body fat per-centage), the prevalence of periodontitis in the obese group was significantly higher when compared with the non-obese group ($p < 0.05$). In multivariate logistic regression analysis, body mass index, waist-hip ratio and body fat percentage defined obesity were significantly associated with periodontitis, presenting OR of 2.16 (1.35-3.45), 2.09 (1.34-3.26), and 2.71 (1.82-4.05), respectively ($p<0.05$). BOP and CAL were also significantly correlated with periodontitis. Conclusion: Obesity was significantly associated with increased odds of periodontitis ($p<0.05$).

Keywords: obesity, body mass index, waist circumference, body fat percentage, type 2 diabetes, periodontitis

1 Introduction

The prevalence of obesity is rising worryingly not only among adult but also among children in many developed and developing countries [1]. It is defined as excessive fat accumulation that can cause various health disorders [2]. In England, according to The Health Survey for England (HSE) data in 2010, 68% of adults were overweight or obese, this prevalence among American adults was 44.2% in men and 48.3% in women in the same period of time [3, 4]. Data of some studies in Asia showed a lower prevalence of obesity with 10–30 % in South East Asia, 27.2 % in Malaysia, 32.1% for Koreans aged >19 years in the Fourth Korean National Health and Nutrition Examination Survey (KNHANES) [5, 6, 7]. In Vietnam, urban Vietnamese adults suffered also this global epidemic related problem, although underweight still remains a concern [8, 9]. This public health problem is not only an aesthetic trouble, it links to other life-threatening diseases like hypertension, cardiovascular disease, tumor, and others [10, 11]. In addition, obesity was recognised as a potential cause of diabetes [12, 13].

There is substantial evidence for a relationship between overweight/obesity and type 2 diabetes and although this is called "late onset diabetes", we are now seeing increasing prevalence in young people [14]. Adipocytes, or fat cells, is capable of releasing leptin and cytokines, also known adipokines. These proteins, especially interleukin 6 (IL6) and tumor necrosis factor (TNF) have a role in mediating and modulating activ-ity. Excessive adiposity can promote chronic low grade inflammation [15, 16]. Obesity and its related health problems become a burden on the economy of many countries, requiring action across individual and societal levels [1].

Periodontal disease is a multifactorial disease characterised by a progressive destruction of the periodontal ligament and alveolar bone supporting the teeth [1]. Its expression and progression are complications of a complex interaction between a bacterial infection and the host response that can be modified by behavioural factors [17]. Periodontitis is "the sixth complication" of diabetes, and according to Casanova L. et al. (2014), this is a two-way relationship [18, 19]. Regarding the association of periodontitis and obesity, they are among the most common chronic disorders affecting the world's populations and some authors suggest that weight gain and increased waist circumference may be risk factors for development or worsening with regard to periodontal measures [19]. The biological plausibility of the association between obesity and periodontal diseases is hypothesized on the effect of pro-inflammatory cytokines but according to Levine (2013), physiological basis for a causal relationship between obesity and periodontitis remains to be confirmed [15, 16, 1].

As can be seen in such studies, different results obtained may be based on regional and ethnic differ-ences. Therefore, the purpose of this study was to determine the relationship between obesity and periodontitis among patients who visited at examination department, the Traditional Medicine Institute, Ho Chi Minh City, Vietnam. Our hypothesis was that the obese patients were likely to have periodontitis than those in the normal group.

2 Material and Methods

2.1 Subjects

A convenience sample of this cross-sectional study including 679 patients aged between 18 and 83 years who visited Examination Department, Traditional Medicine Institute, Ho Chi Minh City, Vietnam in 2015 from January to June. All subjects were informed about the objective of the study and voluntarily participat-ed the study. Ethical approval was obtained from the Ethical Review Committee of the University of Medi-cine and Pharmacy, Ho Chi Minh City, Vietnam.

2.2 Questionnaire

The subjects completed a self-administered questionnaire. Participants's socio-demographic information including gender, age and years of education were collected. Smoking and dental behaviours such as fre-quency of dental visit, frequency of tooth brushing, flossing and mouthwash use were assessed.

2.3 Diagnosis of obesity and type 2 diabetes

All participants wearing light clothing, underwent anthropometric measurements, by professional nutri-tionist, included weight, height, hip (HC) and waist circumferences (WC). Height was measured using measuring rod and body weight was measured using mechanical flat scale. WC was measured using circum-ference measuring tape which was kept parallel to the floor and not to be pulled tight. WC was measured at the approximate midpoint between the lower

margin of the last palpable rib and the top of the iliac crest [20]. The HC measurement was taken around the widest portion of the buttocks [27]. The body fat percentage was measured using the Omron body fat monitor (HPF375, Omron Healthcare Co. Ltd., Kunotsubo, Terado-cho, Muko, Kyoto, Japan). Patients were asked to stand with their knees and back straight, step both feet on foot electrodes, extend their arms straight at a 90˚ angle to their body, hold the grip electrodes. After setting age, gender, and height, body fat percentage was displayed. Waist-hip ratio (WHR) was calculated as the ratio of WC to HC. Body mass index (BMI) was calculated as the ratio of weight (kilograms) to the square of height (metes). According to WHO guidelines, overweight/ obesity was defined as BMI ⩾25 kg/m^2 and non-obesity was defined as BMI between 18.5 and 24.9 kg/m^2. Obesity, based on WC, was defined as WC ⩾ 90cm in men and ⩾80 cm in women. Obesity, based on WHR, was defined as a WHR ⩾0.90 for men and ⩾0.85 for women. Obesity, based on body fat percentage (BF%), was defined as >25% in men and >35% in women [20]. All participants also had blood test and type 2 diabetes was diagnosed if fasting plasma glucose concentration ⩾ 7.0 mmol/l after fasting for 8 hours [21].

2.4 Clinical examination

All participants underwent a clinical periodontal examination that was carried out by a professional dental hygienist. The periodontal status of all teeth, excluding third molars, were assessed using plaque index (PI), gingival index (GI), probing pocket depth (PD), bleeding of probing (BOP) and clinical attachment loss (CAL) [22, 23]. Periodontitis was diagnosed basing on the standard of Centers for Disease Control and Prevention (CDC) and American Academy Periodontology (AAP), 2007: Slight periodontitis, at least 1 point has PPD from 5mm or over; or CAL from 3 or over and PPD from 4mm or over at 2 points not on the same tooth; Moderate periodontitis, at least 2 approached points (not on the same tooth) has CAL's value over 4mm or PPD over 5mm; and Severe periodontitis, at least 2 approached points (not on the same tooth) has CAL over 6mm and at least 1 point has PPD over or equal 5mm [24].

2.5 Statistical analysis

For data processing and data analysis, we used SPSS software (Version 20.0; IBM Japan, Inc., Tokyo, Japan). Characteristics of subjects' variables were described using frequency distribution for categorical vari-ables; mean and standard deviation for continuous variables. Chi-square test was used to assess the associa-tion between categorical variables and t-test was used to evaluate the differences between the means values. The multivariate analysis of the association between obesity indicators and periodontal parameters was con-ducted using regression analysis and analysis of variance for multiple dependent variables, adjusting for the effects of the covariables. Odds ratios (ORs) and their 95% CI were calculated. A p value of <0.05 was con-sidered statistically significant.

3 Results

3.1 Characteristics of the study subjects

This study included a total of 679 participants (182 males and 497 females) aged between 18 and 83 years old with a mean (standard deviation) of 47.9 (16.7). The number of obese subjects according to BMI, WHR and BF% were 462 – 68.0%, 467 – 68.8%, 345 – 50.8%, respectively.

3.2 Prevalence of periodontitis and periodontal status

There were 219 patients (32.3%) who had periodontitis. Obese subjects determined on BMI, WHR and BF% had the prevalence of periodontitis 37.0%, 36.4% and 42.6%, respectively; while those of non-obese group were respectively 22.1%, 23.1% and 21.6%. Whatever different definitions of obesity used, the preva-lence of periodontitis in the obese group was significantly higher when compared with the non-obese group ($p<0.05$). Table 1 shows the periodontal condition of the obese and non-obese groups. The means of PPD, CAL in obese subjects were significantly higher than those in non-obese subjects when obesity was defined by BMI, WHR and BF% ($p<0.01$). Regarding BOP, just BF% defined obese subjects showed significantly higher frequencies of bleeding on probing.

3.3 Correlation between obesity and periodontitis

The multivariate logistic regression model presented was carried out to assess the association between the occurrence of periodontitis and age, BOP, CAL, type 2 diabetes and obesity with the adjustment of gender, level of education, smoking and dental check-up behaviours; frequency of tooth brushing; dental floss and mouth rinse use; PI, GI and PPD. It is observed that BMI, WHR and BF% defined obesity were significant-ly associated with periodontitis, presenting OR of 2.16 (1.35-3.45), 2.09 (1.34-3.26), and 2.71 (1.82-4.05), respectively. Obese patients based on BMI, WHR or BF% who had mean of BOP>7.6 were more likely to have periodontitis (OR: 2.31, 2.38 and 2.40, respectively). Similar results appeared for CAL, OR were 2.64, 2.74 and 3.14 if patients had mean CAL>2.5 mm. In addition, age (18-83 years), type 2 diabetes remained significantly associated with periodontitis (Table 2).

4 Discussions

The overall results of this present study indicated a relationship between obesity and perio-dontitis. This association was also showed in recent studies [7, 25-28]. Most of authors used BMI to define obesity [29-31], while some studies incorporated multiple measures of body composition simultaneously which were BMI, WC, WHR and BF% [25, 26, 32, 33]. Accord-ing to WHO, there were variations in body fat distribution by ethnicity, in which, compared to Caucasian, a higher percentage of body fat was observed at lower BMI in Asians. In addition, measures of abdominal obesity (e.g WC or WHR) were better than BMI as predictors of car-dio-vascular diseases [20]. In our study, in order to obtain more consistency with our sample, we chose BMI, WHR and BF% to evaluate the relation obesity-periodontitis in order to obtain more consistency with our sample.

The prevalence of periodontitis in overweight/ obese subjects according to BMI, WHR and BF% in our study were 37.0%, 36.4%, 42.6% respectively. Using the same criteria to evaluate periodontitis, Khan et al. (2015) reported the prevalence of chronic periodontitis among the obese participants (based on BMI) which was 73.9 %28. In the study of Khader et al. (2009), according to BMI, the prevalence of periodontitis in overweight and obese subject were 29.6% and 51.9%, while according to WHR, this were 38.2% [26]. The dif-ferences may come from the sample size and different thresholds of grouped BMI. In our study, if BMI >25kg/m^2, this patient was considered overweigh/obesity. Meanwhile, Malaysian authors based on BMI >27.5kg/m^2 to define obesity , and study's participants in Jordan were divided to overweigh and obesity groups separately, although they used same BMI criteria with our study [26, 28].

To determine the cross-sectional relationship between obesity and periodontitis, multivariate logistic re-gression models were chosen for this study. The correlation between periodontitis and obesity (based on BMI, WHR and BF%) remained significant with increased ORs when adjustment was made for gender, level of education, smoking and dental check-up behaviours; frequency of tooth brushing; dental floss and mouth wash use. Compared with Khader et al. (2009), periodontitis was significantly associated with WC and BF% defined obesity, but not with WHR defined obesity26. Likewise, after adjusting for important variables, da Silva et al. (2009) showed that BMI defined obesity (OR=2.7), high WC (OR=2.5) and high BF% (OR=2.6) significantly associated with increased odds of periodontitis [32].

Also in logistic regression, according to BMI, WHR, and BF%, patients who were more than 45 years old were likely to have more periodontitis, with OR=2.17, 2.12 and 2.15, respectively. This finding was consistent with what was showed in previous studies in Vietnam, Thailand, and Brazil [34-36]. Age factor may affect the occurrence of periodontitis because of the contact with microbes of periodontal tissue for a long time [37].

BOP did not reflect severity of periodontitis but it may indicated risk for CAL [38]. In this study, BOP of BF% defined obese group was higher than BOP of the normal group. Moreover, BOP associated significantly with periodontitis with increased OR. Kongstad et al. (2009) also found a slightly positive as-sociation between BMI and BOP, either in males of females group [39].

In our study, the average PD was significantly higher in obese subjects when compared with that among normal participants ($p<0.01$). Pocket depth reflected current disease status but it was not as reliable as CAL. Saito et al. (2005) showed the association between the highest quartile of BMI and the highest quintile of mean PD with significantly higher OR25. Likewise, CAL was significantly higher in obese participants when compared with that in normal weight participants, and furthermore, after adjusting variables, CAL was significantly associated with periodontitis ($p<0.05$). This finding may be explained by that attachment loss may correlate more with periodontal disease and was more precise measure of alveolar bone loss when com-pared with PD. In addition, this result was not dissimilar to that of Wood et al. (2003) and Khader et al. (2009), they reported also that CAL were correlated with increased BMI [26, 40].

The mechanisms for the association of obesity with periodontitis were not well understood. According to many studies, cytokines derived from adipose tissues may play a important role. These adipocytokines, especially IL-6 and TNF-α, appeared to have ability to modulate inflammatory activity [15, 16]. Besides, plasminogen-activator inhibitor 1 was responsible for gingival inflammation40. On the other hand, Maciel et al. (2016), reported that obese patients had a higher count and proportion of periodontal pathogens than controlled group [41].

Our study indicated that type 2 diabetes had an impact on periodontitis. The presence of diabetes in our multivariate model for the occurrence of periodontitis resulted in an OR of 1.94, 1.95 and 2.07 ($p<0.01$). In obesity studies, it is well established that diabetes is associated with both obesity and periodontitis. Diabetes could be considered a confounder of this association beside smoking, oral hygiene and gender [37]. Levin (2013) stated that there was a three-sided relationship of morbidity linking diabetes, obesity, and periodontal diseases [1]. Moreover, analysis of USA national sample suggested that insulin resistance mediated the relationship between obesity and periodontal disease [16]. Saito et al. (2005) also suggested a direct link not de-pendent on diabetic of periodontitis in assessing glucose test tolerance [25].

Like most of studies involving the association between obesity and periodontitis, although having the largest sample size compared to other research in Vietnam which had same topic, our cross-sectional design study cannot make any definite conclusion about causality. Another limitation of our study involved study population. The sample was taken in a hospital thus it could not represent for the entire population.

In conclusion, despite these limitations, the present study in a group of Vietnamese patients contributed to close the gap between dentistry and medicine in recognising that obesity was associated with periodontitis and greatly improved treatment of periodontal infection would also ameliorate some systemic illnesses, and vice versa.

Table. 1 The prevalence of periodontitis and periodontal parameters of subjects according to obesity

	BMI			WHR			BF%		
	Non-obese (n=217)	**Obese (n=462)**	**p**	**Non-obese**	**Obese (n=467)**	**p**			**p**
Periodontics n, (%)	48 (22.1%)	171 (37.0%)	<0.05	49 (23.1%)	170 (36.4%)	<0.05	72 (21.6%)	147 (42.6%)	<0.05
BOP (Mean±SD)	6.75±6.35	7.82±6.78	>0.05	7.18±6.45	7.61±6.75	>0.05	6.92±5.77	8.02±7.38	<0.05
PI(Mean±SD)	1.22±0.25	1.25±0.29	>0.05	1.22±0.26	1.25±0.29	>0.05	1.23±0.27	1.25±0.29	>0.05
GI (Mean±SD)	1.076±0.09	1.081±0.09	>0.05	1.07±0.09	1.08±0.10	>0.05	1.08±0.09	1.07±0.09	>0.05
PD (Mean±SD)	2.32±0.82	2.61±0.53	<0.01	2.39±0.82	2.58±0.55	<0.01	2.36±0.64	2.67±0.63	<0.01
CAL (Mean±SD)	2.34±0.78	2.60±0.54	<0.01	2.41±0.78	2.57±0.55	<0.01	2.41±0.64	2.63±0.61	<0.01

Chi-square test[1]; Independent t test[2]; Significant difference at p<0.05

Table. 2 Multivariate logistic regression model for the periodontitis

Variables	OR (95%CI)	p
Obesity (BMI)		
No	1	0.001
Yes	2.16 (1.35-3.45)	
Age		
≤45 years	1	<0.001
>45 years	2.17 (1.41-3.32)	
BOP		
Mean≤7.6	1	<0.001
Mean>7.6	2.31 (1.57-3.38)	
CAL		
Mean≤2.5	1	0.033
Mean>2.5	2.64 (1.08-6.45)	
Type 2 Diabetes		
No	1	0.001
Yes	1.94 (1.30-2.90)	
Variables	**OR (95%CI)**	**p**
Obesity (WHR)		
No	1	0.001
Yes	2.09 (1.34-3.26)	
Age		
≤45 years	1	<0.001
>45 years	2.12 (1.39-3.35)	
BOP		
Mean≤7.6	1	<0.001

Variables	OR (95%CI)	p
Mean>7.6	2.38 (1.62-3.49)	
CAL		
Mean≤2.5	1	0.028
Mean>2.5	2.74 (1.11-6.74)	
Type 2 Diabetes		
No	1	0.001
Yes	1.95 (1.30-2.93)	
Variables	**OR (95%CI)**	**p**
Obesity (BMI)		
No	1	0.001
Yes	2.71 (1.82-4.05)	
Age		
≤45 years	1	<0.001
>45 years	2.15 (1.40-3.30)	
BOP		
Mean≤7.6	1	<0.001
Mean>7.6	2.40 (1.63-3.55)	
CAL		
Mean≤2.5	1	<0.05
Mean>2.5	3.14 (1.28-7.71)	
Type 2 Diabetes		
No	1	<0.05
Yes	2.07 (1.38-3.11)	

*Adjusted by gender, level of education, smoking and dental check-up behaviours; number of tooth brushing; dental floss use, mouthrinse use, GI and PD; OR: odds ratio; CI: confidence interval; Significant difference at $p<0.05$

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