Acta Scientific Dental Sciences (ISSN: 2581-4893)

Volume 6 Issue 6 June 2022

Research Article

Bone Density, Body Composition and Periodontitis in Obese Men Candidates for Bariatric Surgery: Preliminary Study

Silvia Helena de Carvalho Sales Peres[1]*, Ana Vírginia Sampaio Castilho[1], Jacira Alves Caracik de Camargo Andrade[1], Ana Carolina da Silva Pinto[1], Eliel Soares Orenha[1] and Sergio Setsuo Maeda[2]

[1]Department of Pediatric Dentistry, Orthodontics and Public Health, Bauru School of Dentistry, University of São Paulo, Bauru, São Paulo, Brazil

[2]Department of Endocrinology, Federal University of São Paulo- UNIFESP, Brazil

***Corresponding Author:** Sílvia Helena de Carvalho Sales-Peres, Department of Pediatric Dentistry, Orthodontics and Public Health, Bauru School of Dentistry, University of São Paulo, Bauru, São Paulo, Brazil.

Received: April 29, 2022

Published: May 23, 2022

Abstract

Objective: This transversal study aimed to evaluate and relate bone mineral density (BMD), body composition and periodontal disease among men.

Study Design: The sample consisted of 22 patients, aged 22 and 48 years, obese with BMI ≥ 40kg/m^2, candidates for bariatric surgery. Evaluations of dual energy X-ray absorptiometry (DXA), anthropometric and oral evaluation, gingivitis and periodontitis were performed. Pearson's correlation index was adopted ($p < 0.05$).

Results: The average weight was 148 kg (122-198); Average BMI of 48.8 kg/m2 (40.5-62.5); BMC (bone mineral content), on average, of 3.31kg (2.7-4.1); Mean total body BMD of 1.3 g/cm2 (1.1-1.5); and an average Z-score of 1.2 (0.0-2.9). The mean total body fat was 43.3% (37.4-52.1), and the percentage of total mas of fat free was 56.6 (47.9-82.3). The average FMI (fat mass index) was 20.6 (14.4-27.0), The A (android)/G (ginoid) ratio of 1.2 (1.0-1.6) and the average trunk weight, 85.8kg (68.3-116.2). 29% of patients had periodontal disease. There was a difference of less than 4.5 kg (1.0 to 7.8) in the weight of DXA compared to the anthropometric weight, which corresponds to an average difference of 3.06% (0.05-5.27). In the correlation analysis of the dental evaluation vs the DXA result, only significant correlation was obtained with gingival bleeding and the FMI ($p = 0.031$, $R = -0.525$).

Conclusion: It can be concluded that with the increase of fat mass there is a decrease in gingivitis, possibly due to the evolution of periodontal disease. Future studies should be conducted to clarify these preliminary findings.

Keywords: Bone Density; Body Composition; Obesity; Periodontal Diseases; DXA Scan

Introduction

Obesity is a chronic inflammatory disease, considered pandemic and one of the greatest public health challenges. Obese patients can present several associated comorbidities, such as arterial hypertension, dyslipidemia, type II diabetes mellitus, obstructive sleep apnea, osteoporosis, among others [1,2]. In addition, obesity is associated with several oral changes, such as periodontal disease, carious lesions, reduced salivary flow and edentulism [3].

Osteoporosis is a disease characterized by low bone mineral density (BMD) and deterioration of bone microarchitecture, causing an increased risk of fractures. The evaluation of BMD by dual energy X-ray absorptiometry (DXA) is one of the methods used for the diagnosis of osteoporosis [4,5].

The ability of DXA to accurately and precisely measure bone mineral density (BMD), fat-free mass (FFM), fat mass (FM) and body composition, in the various body compartments, is well established and is considered, as the gold standard of reference in research and clinical practice [6]. Serial measurements of body composition by DXA could be useful to identify how much FFM and FM patients lose proportionally during the weight loss process [7].

In addition to favoring the appearance of systemic diseases [8], obesity can influence the periodontal condition [9]. Periodontal disease is a disease caused by Gram negative, anaerobic bacteria, which leads to bone resorption, as in osteoporosis, and loss of periodontal structures, causing the loss of ligaments and formation of periodontal pockets. Obesity, osteoporosis and stress can also lead to progression of periodontitis [10]. The association between periodontitis and obesity may have a relevant public health implication, since both are considered important diseases, as risk factors for cardiovascular diseases [11-13]. If left untreated, periodontal disease triggers the progressive loss of gingival tissue, periodontal ligament and alveolar bone, functional and aesthetic problems, generating gingivitis and periodontitis, which can culminate in premature tooth loss [14].

Bone mass can be affected by frequent risk factors in the occurrence of periodontitis and osteoporosis. This disease leads to alveolar bone loss, which can occur in both the mandible and the maxilla. However, changes resulting from osteoporosis potentially worsen periodontal conditions and systemic bone loss potentiates periodontal disease, since cytokines and inflammatory mediators increase [15,16].

Bone loss and the risk of fractures in men are clearly associated with decreased levels of bioavailable estrogens [17] Male osteoporosis is still underestimated and undertreated, which has significant clinical and social consequences, considering that the aging of the male population is growing exponentially [18].

It is not clear how osteoporosis and periodontal disease interact, especially in males. Osteoporosis is less prevalent in males and there are few studies on the risk of fractures in men who have undergone bariatric surgery.

For this reason, further studies are needed that consider the occurrence of osteoporosis and periodontal disease in morbidly obese men who are candidates for bariatric surgery, since there are still no reports in the literature. Thus, the objective of the present study was to know BMD, body composition and periodontal conditions and to relate them to each other, in men, with morbid obesity (grade III), candidates for bariatric surgery at.

Materials and Methods

This was a cross-sectional study, which was only carried out after evaluation and approval by the Human Research Ethics Committee of, located in the municipality with approval nº 1,134,198. The guidelines were followed according to the Declaration of Helsinki. Only the patients who participated in the study, who, after reading the Free and Informed Consent Term, accepted and signed the term.

The study sample consisted of 22 male patients, morbidly obese candidates for bariatric surgery who did not have comorbidities that could cause osteoporosis by itself or by treatment. The average age was 34 years old (22 to 48), with an average BMI of 48.8 kg/m^2 (40.5 to 62.5kg/m^2). Women were excluded from this study, so that hormonal factors could not be a source of bias. Patients were excluded if they had chronic illnesses, mental, cognitive or neurological illnesses, and those with less than two teeth per sextant.

The sample was calculated based on the retrospective analysis of male patients who were waiting for bariatric surgery from June 2013 to April 2015. The formula for calculating sample sizes was used to describe qualitative variables in a sample. finite population (< 10000), with a 95% confidence level and 80% test power, which resulted in 40 patients.

Study Design

The study was developed in the following stages

Choice of previously trained examiners to perform the exams

Examiner training and calibration was carried out before starting clinical examinations and conducted by an experienced examiner.

Anamnesis, anthropometric assessment and physical examination were performed in all participants, during routine consultations. Nutritional assessment of individuals was performed by measuring anthropometric measurements of weight and height. The patients were weighed on an anthropometric scale, brand Welmy (Santa Bárbara d'Oeste, São Paulo, Brazil), serial number 0294, model 104, year of manufacture 2007, (maximum: 300kg, minimum 2kg, decimal scale: 100g), INMETRO verification No. 2,738.101-8, and were measured on the same anthropometric scale that has a 2m vertical stem, 1cm decimal scale according to the techniques recommended by WHO [19]. and, based on these values, calculated the body mass index (BMI) formula: Weight (kg)/height [2] (m). For the classification of nutritional status, the cutoff points defined by WHO [19] were used, as described in table 1.

BMI- kg/m^2	
Underweight	<18.5
Normal	18.5 a 24.9
Overweight	25.0 a 29.9
Grade I obesity	30.0 a 34.9
Grade II obesity	35.0 a 39.9
Grade III obesity	≥40

Table 1: Classification of nutritional status using BMI [20].

The dental evaluation

Periodontal examinations were performed by post-graduate dental surgeons in the area of public health at. Some of the exams were carried out in the dental office at, by the same dental surgeons on the team, all with standardized training to perform the oral exam.

In order to evaluate the periodontal condition, six sites per tooth were probed (distobuccal, center of the buccal face, mesiobuccal, distolingual, center of the lingual and mesiolingual face), in all the teeth present in the mouth, using the periodontal probe for this purpose. North Carolina type.

- **Probing depth (PD):** distance from the gingival margin to the most apical point of the bottom of the groove/pocket.
- **Gingival bleeding index (GBI):** presence or absence of bleeding after probing the gingival sulcus. GBI is considered positive when bleeding occurs within 10 seconds after polling. The number of positive findings is expressed as a percentage of the number of teeth present.
- **Gingival recession:** distance, in millimeters, from the cementoenamel junction to the height of the gingival margin at the six sites corresponding to the probe.
- The level of clinical attachment loss was assessed by adopting the distance in millimeters from the cementoenamel junction to the bottom of the gingival sulcus or periodontal pocket, at the 6 sites corresponding to the probe.
- Number of teeth present and absent, so that total or partial edentulism could be identified.
- **Presence of calculus:** the ball point probe was used to traverse the extension of the dental surface without forcing, as slightly as possible.

To assess the prevalence of periodontal disease, the criteria defined and suggested by the Centers for Disease Control (CDC) and the American Academy of Periodontics (AAP) for epidemiological investigation [20] were used, considering CAL values and PD

- **Severe:** presence of two or more points with CAL ≥ 6mm on different teeth and one or more points with PD ≥ 5mm on different teeth
- **Moderate:** presence of two or more points with CAL ≥ 4mm on different teeth or two or more points with PD ≥ 5mm on different teeth.
- **Mild:** presence of two or more points with CAL ≥ 3mm on different teeth or two or more points with PD ≥ 4, or one point with PD ≥ 5mm (on different teeth).

Thus, the parameters of periodontal pocket and loss of clinical insertion were expressed in percentages, in relation to the total number of points evaluated.

Performing BMD of the total skeleton and body composition by DXA

All tests were performed by the same operator. In this study, it was adopted, for the evaluation of bone mineral density of total body (BMD) and body composition, the performance of dual energy X-ray absorptiometry (DXA), in the Discovery W scanner device (Hologic, Inc., Waltham, MA), with capacity for patients up to 205kg.

Calibration of the device was performed daily, prior to service, following the rules of the equipment manual itself, with an average duration of 6 to 10 minutes.

Patients received the following previous recommendations: fast for 2 hours, including water, empty the bladder before the exam, have not performed physical exercises, to avoid dehydration and alteration in the results, be in light clothing, without thick metals or plastics and without having performed imaging tests using barium or iodine. They were previously advised that they should remain in the supine position for a maximum of 20 minutes (duration of the exam).

All data were tabulated: bone compartment with Total Bone Mineral Content (in kg), BMD (in g/cm2) and, in the case of the Z-Score, a patient with bone density of the total body, within or below expected for chronological age. The lean compartment, referring to the muscle and bone compartment, was presented as the value of total free fat mass and appendicular mass (in kg) and the appendicular fat free mass index (kg/m2), being the reference for men ≥ 7.26kg/m2, and the patient has an appendicular mass below or within the expected for the gender. The adipose compartment had the values of total body fat presented in kg, total body fat in% and the fat mass index (FMI) in kg/m2, having as reference values 3-6kg/m2 for men. The A (android)/G (ginoid) ratio with Android > 1 as the reference value; Ginoid ≤ 1. At the end, with fat mass inside, below or above the expected for males with a predominance of gynoid and android.1

Statistical analysis

Qualitative variables were calculated using absolute and relative frequencies. The analysis of the quantitative variables was carried out by observing the minimum and maximum values and calculating means and medians. Regarding the linear correlation analyzes, they were analyzed by the Pearson correlation index and the results represented by the Scatterplot graphs. The confidence interval considered was 95%. The level of significance used for the tests was 5% ($p < 0.05$). For data analysis, the program SPSS v.22 was used.

Results

The study included 22 subjects, with an average age of 34 years (22-48), an average weight of 148kg (122-198), an average BMI of 48.8 (40.5-62.5) and an average overweight of 71kg (45-106).

The difference in the average weights obtained by means of anthropometric measurements averaging 148 kg (122-198) and by DXA averaging 144 kg (119-191) draws attention. This difference had an average percentage change of 3.6% (0.05-5.27%).

Regarding dental evaluation, 29% of patients had severe periodontal disease, 41% moderate periodontal disease, 18% mild periodontal disease and 12% did not have periodontal disease. Regarding the percentage of GBI the average was 61.8% (0-100%).

The correlation analysis of the dental evaluation (average pocket depth, average recession index, number of missing teeth, % of teeth with calculations and% GBI) vs DXA result (% of total fat, % of total fat-free mass, BMD, BMC and FMI), there was a significant correlation between the gingival bleeding index and the FMI ($p = 0.031$, $R = -0.525$).

Discussion

The present study was designed to assess the possible association between BMD, body composition and periodontal conditions in men with morbid obesity.

The body composition, BMD and BMC of the total body of patients treated at HAC were investigated with the possibility that later longitudinal studies use this research as a basis. The increase in BMD in patients with obesity could represent a physiological adjustment to the increase in body weight, but it would not necessarily lead to an improvement in bone strength [21]. In a study with obese individuals, it was found that obesity affects the alveolar bone pattern and may present a high risk of progression of alveolar bone loss and periodontal conditions [22].

The recommendations for the use of DXA by the International Society for Clinical Densitometry (ISCD) [7] indicate the use of DXA for follow-up of people who will undergo some treatment that can lead to a reduction of ≥ 10% of their weight (degree of evidence C). Such losses after bariatric surgery could cause the undesirable decrease in fat-free mass (10 to 15%), in addition to the desirable fat reduction (30-35%), during the first postoperative year [23], as well as the decrease in BMD of the total body [24]. The maximum weight limit found was 200kg, since the most modern machines for performing DXA support up to 205kg. Another factor that hinders the use of DXA would be the individual's biotype that may exceed the area to be scanned. Excessive skin on the arms, common after heavy weight loss, can also cause a reading error [25]. These factors should be considered sparingly, given some limitations in the use of this device.

According to the literature, DXA is very suitable for detecting changes in peripheral fat, but it has limitations in differentiating visceral from subcutaneous fat and even from the infiltrated fat in the tissues, as occurs in the muscles [26]. Ponti., *et al*. Presented data on obese patients and reported that DXA could provide a comprehensive assessment of body compartments, identifying a significant redistribution of lean and fat mass [27]. When comparing the weight values found in the anthropometric analysis with those of the DXA, we found an average difference of 4.5 kg more than in the anthropometric values, indicating a difference of 3.06%.

Another aim of this work was to compare the conditions of body composition and BMD to the periodontal conditions. Igniasak and colleagues assessed whether the number of teeth and the marginal periodontal status were associated with body composition and BMD in a sample of elderly women and concluded that body composition and BMD were not significantly correlated with the number of teeth present and gum bleeding [28]. Gorman and colleagues conducted a survey of obese and normal-weight men and found that overweight men had more events of periodontal disease than in men of normal weight [29].

In this work, in the analysis of the correlation between dental variables with body composition and BMD, a significant correlation was obtained between the index of gingival bleeding and the FMI, with most patients having moderate and severe periodontal disease. Similar results were found in other studies carried out with obese patients [22,30].

The strengths of this study are based on the findings regarding the adopted gender, the male, which often makes it difficult to include them in the sample. Thus, these findings allow to warn about the care to be taken with morbidly obese men, demonstrating the health situation that this group is exposed to. The health care of class III obese patients should be better studied, so that this group has comprehensive and multidisciplinary care.

Variables	Average	Median	(Minimum - Maximum)
Age (years)	34	34	(22 - 48)
Weight(kg)	148	143	(122 - 198)
BMI	48.8	47.8	(40.5 - 62.5)
Overweight (kg)	71	69	(45 - 106)

Table 2: Characteristics of individuals who participated in the study.

Variables (n = 22)	Average	Median	(Minimum - Maximum)
Weight(kg)	148	143	(122-198)
Weight DXA (kg)	144	139	(119-191)
Difference Weight DXA vs weight (kg)	4.5	4.8	(1.0-7.8)
Difference Weight DXA vs weigh (%)	3.06	3.27	(0.05-5.27)
BMI (kg/m^2)	48.8	47.8	(40.5-62.5)
Bone Mineral Content (kg)	3.31	3.25	(2.7-4.1)
BMD (g/cm^2)	1.3	1.3	(1.1-1.5)
Z-Score	1.2	1.2	(0.0-2.9)
Total body fat (kg)	62.8	58.6	(44.9-99.5)
Fat-free mass (kg)	80.8	81.2	(68.8-93.8)
Total body fat (%)	43.3	43.5	(37.4-52.1)
Total body fat (%)	56.6	56.4	(47.9-62.2)
FMI (kg/m^2)	20.6	19.7	(14.4-27.0)
A/G ratio	1.2	1.19	(1.0-1.6)
IFFM (kg/m^2)	26.6	26.4	(22.6-33.0)
Appendicular fat-free mass index (kg/m2)	9.9	9.9	(8.4-11.9)
Total appendicular mass (kg)	52.3	51.3	(39.5-68.0)
Arms mass (kg)	15.3	14.9	(12.5-20.0)
Leg mass (kg)	37.0	35.2	(27.0-48.0)
Trunk weight (kg)	85.8	83.1	(68.3-116.2)

Table 3: Analysis of the results obtained by DXA in patients who are candidates for bariatric surgery.

DXA Result/ Dental Variable	Bone Mineral Content (kg)	BMD (g/cm²)	% Total body fat	% total fat free mass	FMI (kg/m²)
Probing Depth	R = -0.387 p = 0.125	R = -0.449 p = 0.070	R = -0.171 p = 0.511	R = 0.171 p = 0.511	R = -0.302 p = 0.239
Average recession	R = -0.237 p = 0.360	R = 0.078 p = 0.766	R = -0.415 p = 0.097	R = 0.415 p = 0.097	R = -0.338 p = 0.184
Missing teeth number	R = -0.425 p = 0.069	R = -0.189 p = 0.467	R = 0.027 p = 0.917	R = -0.026 p = 0.921	R = -0.015 p = 0.955
% Teeth with calculus	R = 0.110 p = 0.674	R = 0.201 p = 0.438	R = -0.293 p = 0.254	R = 0.294 p = 0.252	R = -0.409 p = 0.103
% GBI	R = -0.369 p = 0.145	R = -0.312 p = 0.223	R = -0.308 p = 0.229	R = 0.309 p = 0.227	R = -0.525 p = 0.031*

Table 4: Analysis of the correlation of the dental evaluation vs DXA results.

*. The correlation is significant at the level 0.05 (2 ends).

R = Pearson's correlation index.

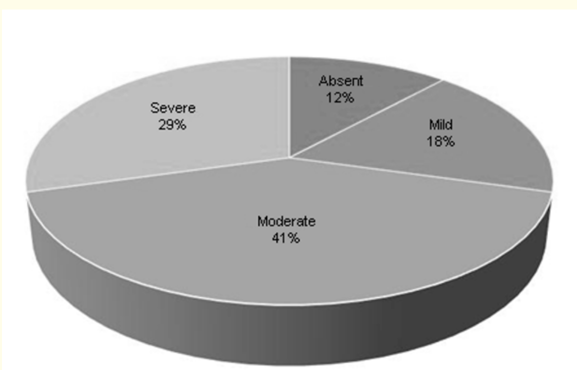

Figure 1: Classification of patients according to the severity of periodontal disease.

Conclusion

In conclusion, as there is an increase in fat mass, the involvement of periodontal tissue increases, ceasing to be a disease restricted to periodontal soft tissue, leading to the impairment of bone structure, and the increase in fat mass is related to the worsening of periodontitis.

Declaration of Interests

The authors declare no conflicts of interest.

Acknowledgement

The work was supported by CNPq (483010/2013-8) and the Coordination for the Improvement of Higher Education Personnel - Brazil (CAPES - Finance Code 001).

Bibliography

1. Sales-Peres SHC and Sales-Peres M. "Obesidade e saúde bucal riscos e desafios" 1 (2016): 11-20.
2. Sales-Peres SHC., *et al*. "Periodontal Status in Morbidly Obese Patients with and without Obstructive Sleep Apnea Syndrome Risk: A Cross-Sectional Study". *Journal of Periodontology*87.7 (2016): 772-782.
3. Moura-Grec PG., *et al*. "Impact of bariatric surgery on oral health conditions: 6-months cohort study". *International Journal of Dentistry* 64.3 (2014): 144-149.
4. Rocha-Braz MG and Ferraz-de Souza B. "Genetics of osteoporosis: searching for candidate genes for bone fragility". *Archives of Endocrinology and Metabolism* 60.4 (2016): 391-401.

5. Gluer CC. "30years of DXA technology innovations". *Bone* 104 (2017): 7-12.

6. Balsiger BM., *et al*. "Bariatric surgery. Surgery for weight control in patients with morbid obesity". *Medical Clinics of North America* 84.2 (2000): 477-489.

7. Kendler DL., *et al*. "The Official Positions of the International Society for Clinical Densitometry: Indications of Use and Reporting of DXA for Body Composition". *Journal of Clinical Densitometry* 16.4 (2007): 496-507.

8. Saini R., *et al*. "Periodontal diseases: A risk factor to cardiovascular disease". Ann Card Anaesth 13 (2010): 159-161.

9. Saito T., *et al*. "Obesity and periodontitis". *The New England Journal of Medicine* 339.7 (1998): 482-483.

10. Cochran DL. Inflammation and bone loss in periodontal disease". *Journal of Periodontology* 79.8 (2008): 1569-1576.

11. Buchwald H., *et al*. "Bariatric surgery: a systematic review and meta-analysis". *JAMA* 14 (2004): 1724-1737.

12. Trevisan M and Dorn J. "The relationship between periodontal disease (pd) and cardiovascular disease (cvd)". *Mediterranean Journal of Hematology and Infectious Diseases* 2.3 (2010): e2010030.

13. Moura-Grec PG., *et al*. "Impact of bariatric surgery on oral health conditions: 6-months cohort study". *International Journal of Dentistry* 64 (2014): 144-149.

14. Pihlstrom BL., *et al*. "Periodontal diseases". *Lancet* 366.9499 (2005): 1809-1820.

15. Penoni DC., *et al*. "Association of osteoporosis and bone medication with the periodontal condition in elderly women". *Osteoporosis International* 27.5 (2016): 1887-1896.

16. Martinez-Maestre MA., *et al*. "Periodontite e osteoporose: uma revisão sistemática". *Climacteric* 13.6 (2010): 523-529.

17. Herrera A., *et al*. "Male osteoporosis: A review". *World Journal of Orthopedics* 3.12 (2012): 223-234.

18. Willson T., *et al*. "The clinical epidemiology of male osteoporosis: a review of the recent literature". *Clinical Epidemiology* 9.7 (2015): 65-76.

19. World Health Organization WHO. "Obesity: preventing and managing the global epidemic. Report of a World Health Organization Consultation". Geneva: World Health Organization. WHO Obesity Technical Report Series (2000): 284.

20. Eke PI., *et al*. "Advances in surveillance of periodontitis: the Centers for Disease Control and Prevention periodontal disease surveillance project". *Journal of Periodontology* 83.11 (2012): 1337-1342.

21. Henry MJ., *et al*. "Fracture Risk (FRISK) Score: Geelong Osteoporosis Study". *Radiology* 241.1 (2006): 190-196.

22. Sales-Peres SHC., *et al*. "Alveolar bone pattern and salivary leptin levels among premenopausal obese women". *Arquivos Brasileiros de Cirurgia Digestiva* 32.1 (2019): e1422.

23. Chaston TB., *et al*. "Changes in fat-free mass during significant weight loss: a systematic review". *International Journal of Obesity* 31.5 (2007): 743-750.

24. Coates PS., *et al*. "Gastric bypass surgery for morbid obesity leads to an increase in bone turnover and a decrease in bone mass". *The Journal of Clinical Endocrinology and Metabolism* 89.3 (2004): 1061-1065.

25. Knapp KM., *et al*. "Obesity increases precision errors in dual-energy X-ray absorptiometry measurements". *Journal of Clinical Densitometry* 15.3 (2012): 315-319.

26. Woodrow G. "Body composition analysis techniques in the aged adult: indications and limitations". *Current Opinion in Clinical Nutrition and Metabolic Care* 12.1 (2009): 8-14.

27. Ponti F., *et al*. "Body composition, dual-energy X-ray absorptiometry and obesity: the paradigm of fat (re)distribution". *BJR Case Reports* 5.3 (2019).

28. Ignasiak Z., *et al*. "Analysis of the relationships between edentulism, periodontal health, body composition, and bone mineral density in elderly women". *Clinical Interventions in Aging* 23.11 (2016): 351-356.

29. Gorman U., *et al*. "Alterações no peso corporal e adiposidade predizem a progressão da periodontite nos homens". *Journal of Dental Research* 91.10 (2012): 921-926.

30. Marsicano J., *et al*. "Avaliação do estado de saúde bucal e da taxa de fluxo salivar em pacientes obesos após cirurgia bariátrica". *European Journal of Dentistry* 6.2 (2012): 191-197.