Journal of Oral Health & Dentistry
JOHD, 2(3): 151-158
www.scitcentral.com

ISSN: 2638-499X

Review Article: Open Access

Correlation between Body Mass Index and Factors of Mandibular Bone Quality: Literature Review

Bottacin FS[1*] and Watanabe PCA[2]

[*1]*Department of Morphology, Physiology and Basic Pathology, FORP/USP, Brazil*

[2]*Department of Stomatology, Collective Health and Legal Dentistry, FORP/USP, Brazil.*

Received July 02, 2019; Accepted July 11, 2019; Published October 13, 2019

There is a need to simplify the means of identifying people at low risk of developing osteoporosis in order to exclude them from screening to assess bone mineral density, since this procedure is expensive and time consuming for general use in the non-target population selected. Michaelsson et al. [1] determined the relationship between body measurements (weight, height, body mass index, lean tissue mass, fat mass, waist to hip ratio) and mineral bone density in 175 women aged 28-74 years in one Cross-sectional study in a county in central Sweden. A weight over 71 kg was associated with a very low risk of osteopenia compared to women weighing less than 64 kg. In addition, a specific sensitivity analysis revealed that in this population, a woman weighing more than 70 kg is not likely to have osteoporosis. All women who were defined as having total body osteoporosis weighed over 62 kg. These data indicate that weight could be used to exclude women from a screening program for postmenopausal osteoporosis.

Osteoporosis is characterized by a reduction in mineral bone density (MBD). Women more than men are at risk for fractures related to osteoporosis, especially in the wrists, lumbar spine and hips. Numerous factors of diet and lifestyle, including body weight, influence of MBD, and in turn, risk of fracture. The MBD in the whole body, hip, lumbar spine and radius is weak to moderately correlate to body weight, fat mass, and lean body mass in premenopausal, adolescent, and elderly women, possibly as a result of skeletal stress from mechanical loading of body weight alone. In addition, a larger lean body mass may be a cause. Other explanations include increased hormonal circulation in obese women and a greater conversion of adrenal androgens to estrogen linked to a greater mass of adipose tissue. No value currently agrees that weight and height are related to osteoporosis and risk of fracture, but some extra fat mass that yields a body mass index >26-28 confers limited protection, since a thin figure that yields a body mass index <22-24 increases the risk [2].

Klemetti and Kolmakow [3] in their study, in order to determine if the mineral bone density (MBD) of the mandibular cortex is correlated with an ordinal classification of the inferior cortex morphology in panoramic radiographs, concluded that the use of an ordinal classification of the mandibular cortex on panoramic radiographs may be useful for general clinical dentists in assessing the local quality of cortical bone.

Severe residual resorption of the alveolar ridge crest may occur in individuals with high or low bone mineral density in the skeleton. Heavy individuals with heavy skeletons and a large percentage of fat in the body are less predisposed to osteoporosis than small individuals. In addition, the jaws of heavy individuals are probably more massive and dense than the jaws of smaller individuals. This study aimed to examine whether, after a long period of edentulism, the size of the individual is associated with the height of the remaining alveolar ridge and the difficulties in wearing complete dentures. Their conclusions suggest that the size of an individual may play an important role in the fate of residual ridges. Heavy individuals with large jaws have more bone substance to be lost. Larger support tissues in the mandible may also provide better possibilities for the use of complete dentures than the jaws of small individuals. Women with high BMI had high residual resorption in the mandible, often more significant than those with low body mass index (BMI). For the maxilla, however, no significant differences were found. The generally accepted classification for normal BMI is 20 to 25 kg/m^2. In this respect, the range of values 23 and 24 kg/m^2 was used in this study as limits within normal [4].

Corresponding author: Fabio Santos Bottacin, Department of Morphology, Physiology and Basic Pathology, School of Dentistry, University of São Paulo, 0 Café AVE, Ribeirão Preto City, São Paulo State, Brazil, Tel: 55 16 996140757; E-mail: fabio.santos.b@hotmail.com

Citation: Bottacin FS & Watanabe PCA. (2019) Correlation between Body Mass Index and Factors of Mandibular Bone Quality: Literature Review. J Oral Health Dent, 2(3): 151-158.

The relationship between bone mineral density and tooth loss was assessed in elderly women by Taguchi et al. [5]. The authors concluded that the loss of posterior teeth is related not only to the decrease of alveolar bone but also to its mineral bone density.

During adulthood, the amount and quality of muscle and bone minerals decrease, as fat increases. Men have larger mean amounts of muscle and bone and a higher mean bone density than women. In women, the normal decrease in body mass and bone quality is accentuated by menopause. On average, blacks have a greater number of muscles and higher bone density than whites. Ethyl life, diet and exercise are important for maintaining a healthy body and good bone quality. Physically active people have increased levels of muscle and bone density. Age, sex, race and lifestyle affect level and changes in body mass and bone mineral density [6].

Low weight (low percentage of body fat, low body mass index or low body weight) was evaluated by Ravn et al. [7] in their study as a risk factor for low bone mineral density (MBD) or increased bone loss in a randomized trial with "alendronate" for the prevention of osteoporosis in postmenopausal women with normal bone mass. The percentage of body fat, BMI and body weight was correlated with the mean MBD. They concluded that a small increase in bone loss was an important risk factor for low weight and that there was no association between the parameters.

According to Coin et al. [8] underweight individuals are associated with malnutrition and osteoporosis. Other factors correlated to malnutrition such as protein shortage may be involved in the relationship between low weight and osteoporosis.

Dietary calcium intake and physical activity are considered to be practical measures for the prevention of osteoporosis. However, its associations with mineral bone density (MBD) in elderly people are unclear. The study by Nguyen et al. [9] examined the association between osteoporosis and these two factors in relation to body mass index (BMI) cross-sectional, epidemiological study involving 1075 women and 690 men, from 69 to +/- 6, 7 years old (mean +/- SD). Among individuals with lower BMI (< or = 23 kg/m^2 for females and < or = 24 kg/m^2 for males), quadriceps strength (< or = 15 kg for females and < or = 28 kg for men) and dietary intake of calcium (< or = 465 mg/day), 64% and 40% of women and men, respectively, were classified as having osteoporosis (based on a reduction of 2.5-SD men The prevalence was only 12% in women and 1.5% in men among those in the highest values of the three factors. Adequate dietary intake of calcium and maintenance of a physically active lifestyle in past decades of life could potentially translate into a reduction in the risk of osteoporosis and consequently improve the quality and perhaps the quantity of life in the elderly population.

Low pre-menopausal mineral bone density (MBD), a decrease in MBD and an increase in bone fragility that occur as a result of aging and menopause, are major determinants of the risk following osteoporosis fracture. In addition, low body mass index (BMI), low calcium intake, low physical activity and smoking may affect MBD [10].

Prospective studies have shown that the incidence of osteoporotic fractures is inversely related to bone mass. Peak bone mass is considered a major determinant of mineral bone density (MBD) in adulthood; thus maximizing peak bone mass is important for the prevention of osteoporosis. It has generally been accepted that the highest peak of bone mass throughout the skeleton is reached during the 35 years in both sexes, but in the lumbar spine and femoral neck, bone mass accumulation is virtually complete by late adolescence and early adulthood. Thus, failure to gain sufficient bone mass during skeletal growth and the period of bone consolidation may predispose to the development of senile osteoporosis. Some years ago and until recently it has been suggested that senile osteoporosis is a pediatric disease. Consequently, assessment of bone mineral status during childhood and adolescence may be a useful tool in identifying individuals with reduced bone mass who might be exposed to an increased risk of osteoporosis in adulthood [11].

Blum et al. [12] in their study to assess the association of body size during adolescence with subsequent bone mass in the adult led a continuation of a cohort study in a base community of girls who participated in growth and sexual maturity in a study 30 years ago. They concluded that low body weight and low BMI at menarche appear to be significant predictors of reduced bone mass in healthy premenopausal women aged 40-45 years old.

Yahata et al. [13] in their study investigated the influence of modifiable risk factors (body weight and lifestyle) for bone loss in mineral bone density (MBD). Specific age changes in the metacarpal and their associations with body mass index and lifestyle among 532 post-menopausal Japanese women's housing communities were examined. The MBD of the metacarpal decreased significantly with increasing age. A simple correlation analysis indicated that the metacarpal MBD correlated significantly with BMI and physical activity index. Multiple regression analysis showed that an increase in age was associated with MBD in the decreased metacarpal and a larger BMI increased the MBD in the metacarpal.

Human bones decrease in density and increase in porosity beginning approximately in the third decade of life. Zlataric et al. [14] in order to determine if mineral bone density of the mandible (MBD) and some linear radiomorphometric measurements in the panoramic dental radiograph (PDR) are correlated with different categories of body mass index (BMI) in elderly individuals. Patients with BMIs of 20 to 25 kg/m^2 were classified as category 1 (generally accepted scale of normal BMI), and patients with BMIs greater than 25

were classified as category 2 (individuals with a skeletal heavy and a lot of body fat). The results revealed statistically significant differences in all indices measured between the different categories of BMI. The differences found were also statistically significant in MBD values among different BMI categories; the differences were more pronounced in women. Patients with category 3 BMI had significantly lower MBD values compared to BMI category 2. They concluded that heavy people have larger MBD and larger values in linear radiomorphometric measurements than lighter people.

In the study, patients with generalized osteoporosis were older (mean age: 72.2 vs. 54.7 years, $p<0.001$), lower (height 153.1 vs. 161.7 cm, $p<0.001$) and had an index lower body mass (BMI) (23.7 vs. 28.5 kg/m^2; $p<0.001$) compared to patients with normal BMD.

In their study, Knoke and Barrett-Connor [15] evaluated the sex-specific effect of weight change on the change in total bone mineral density of the hip during 4 years (1992-1996) in 1,214 adults in a community dwelling whose average of age was 71 years. In the analyzes controlled by age, average weight and lifestyle, weight loss was the strongest independent predictor of bone loss. In analysis of invariable logistic regression, hip bone loss of at least 1 percent per year increased with age in both men and women. Similarly, in the simple linear regression analysis, measured continuously, bone loss in the hip increased with age in both men and women. A lower mean body mass index was significant in both men and women, but only in linear regression analysis. The results of multivariate analyzes of logistic and linear regression, including age and all other significant remaining risk factors for $p=0.05$, weight loss was the most significant risk factor, and a lower mean body mass index was also independently associated with bone loss in both sexes.

In 2003, Watanabe [16] related three bone quality indicators: the fractal dimension, the percentage of trabeculation and the bone connectivity, correlating them with the mineral bone density and concluded that, it is possible to refer patients to search for a low bone mineral mass, by the analyzes lower cortical mandible and trabecular morphological pattern.

Blain et al. [17], studying risk factors for the change in mineral bone density in older women, show that maintenance of body weight throughout the postmenopausal period and body fat mass have protective roles against bone loss in the proximal femur in women aged 75 years old or older and suggest the value in including weight change assessment throughout postmenopausal and percentage body fat mass in screening programs for elderly women who are at a higher risk of accelerated loss of bone.

Barrera et al. [18] analyzed the possible protective effect of obesity on the development of osteoporosis, confirming that a high body mass index (BMI) is a protective factor of osteoporosis in the mineral bone density of the femoral neck among the elderly. The risk for osteoporosis among men and women with a BMI above 30 kg/m2 was approximately 33% compared to a normal BMI of obesity in the development of osteoporosis.

Ensrud et al. [19] in their study tested the hypothesis that weight loss in elderly men is associated with careless increase in rates of hip bone loss, adiposity and intention to lose weight. They measured body weight, body composition, hip bone mineral density and intention to lose weight in a cohort study of 1342 elderly men enrolled in a study called "Osteoporotic Fractures in Men (MrOS)" and followed them prospectively in a mean of 1.8 years for changes in weight and MBD. Higher rates of bone loss in the hip were observed in men with careless weight loss from the category of body mass index, body composition or intent to lose weight. Even among obese (body mass index, >30 kg/m^2), men attempting to lose weight, those with documented voluntary weight loss, experienced an increase in hip bone loss. Elderly men with experience of weight loss had increased hip bone loss rates, equally among overweight and obese men who undergo voluntary weight reduction.

A strong positive association between body mass index and mineral bone density is well defined in postmenopausal osteoporosis but not in men. Toth et al. [20] investigating this association in men, concluded that bone density at femoral neck sites is lower in normal weight males than in obese individuals, consequently the risk factors for proximal femoral osteoporosis are higher in these men cases.

Cobayashi et al. [21], in their study: "Bone Mineral Density in overweight and obese adolescents", concluded that overweight and obese adolescents in the final stages of sexual maturity had higher bone mineral density in relation to normal weight; however, cohort studies were necessary to evaluate the influence of such a characteristic on bone strength in adulthood and, consequently, on the incidence of osteopenia and osteoporosis at more advanced ages.

Although obesity is associated with an increased risk of many chronic diseases including cardiovascular disease, diabetes, hypertension and cancer, there is little evidence to suggest that obesity increases the risk of osteoporosis. In fact, both weight and body mass index (BMI) is positive predictors of bone mass in adults, suggesting that those who are overweight or obese may be at a lower risk for osteoporosis. However, recent evidence suggests that in children and adolescents, obesity may be associated with lower bone mass better than larger bone mass [22].

Obesity is associated with increased bone mineral density and a decrease in osteoporosis and hip fracture in older men and women. Both fat mass and fat mass free (FMF) are directly correlated with MBD; the relationship between fat mass and MBD is stronger in women than in men. In addition, elevated body mass index (BMI) values are associated with a slower rate of bone loss induced by

postmenopausal estrogen deficiency, presumably because of the increased conversion of adrenal precursors to estrogen in adipose tissue. Although increased MBD in obese individuals has been attributed to mechanical loading, protective effects have also been observed in non-weight bearing bones. Consequently, hormonal factors that are elevated in obese people, such as circulating estrogen, insulin and leptin, may contribute to the beneficial effects of obesity on MBD, stimulating bone growth and inhibiting bone remodeling. Both the increase in MBD and the extra cushioning around the femur's outer prominence can provide protection against hip fracture during a fall in obese elderly people. Data from a prospective cohort study found that a 1-SD decrease in fat mass was associated with a 30% increase in the risk of hip fracture. In addition, weight loss, loss of body fat and decrease in BMI are associated with an increased risk of hip fracture. Weight loss can have adverse effects on bone status. Data from many studies conducted on pre-and post-menopausal obese women between the ages of 37 and 72 found that diet-induced weight loss caused significant clinical decreases in total MBD. In addition, bone loss may be proportional to the amount of weight loss. Weight loss changes the plasma concentration of hormones involved in bone metabolism and increases markers of bone turnover. Although involuntary 10% weight loss in a community of elderly men and women is associated with an increased risk of hip fracture, it is not known whether bone loss associated with intentional weight loss increases the risk of fractures osteoporosis in obese people [23].

Low body mass index (BMI) is a well-documented risk factor for future fracture. De Laet et al. [24] in their study, aimed to quantify this effect and to explore the association of fracture-related BMI with age, gender, and mineral bone density from an international perspective using world-wide data. They concluded that a low BMI confers a risk of substantial importance for all fractures which is mostly independent of age and sex, but dependent on the MBD. The significance of BMI as a risk factor varies according to the level of BMI.

The estrogen receptor alpha (ER-alpha) plays an important role in mediating estrogen signaling. Studies in Caucasian populations have shown that it is involved in endocrine-related diseases, such as osteoporosis and obesity. In the current study, Jian et al. [25] first used a quantitative transmission imbalance (QTI) test to examine the relationship between this gene and both osteoporosis-related phenotype bone mineral density and obesity-related phenotype body mass index (BMI), in 384 Chinese nuclear families. The study did not support any association of the ER-alpha gene with MBD and BMI in the Chinese population.

Ozeraitiene and Butenaite [26] in their study aimed to examine the relationship between bone mineral density and nutritional status, age and anthropometric data in elderly women and had as results that the anthropometric parameters (height, weight, body mass index, thickness measured from the fold of the skin) in elderly women with osteoporosis were the lowest. They determined that the more fats and proteins stored in the body, the greater the bone mineral density. Nutritional status and age had a significant influence on bone mineral density. Women with osteoporosis were older and heavier, had smaller height and body weight. Their BMI values, skin fold thickness and percentage of body fat were lower. This study showed that bone mineral density was related to body mass index and triceps, waist and thigh skin fold thickness. Individuals with BMI=25.1-30 kg/m^2 were considered overweight and those with BMI>30.1 kg/m^2 were considered obese. The national research study evaluating the risk of osteoporosis in the US has indicated that the possibility of developing osteoporosis is lower when body mass index is higher. Obesity and overweight in postmenopausal women can protect them from osteoporosis. It has been reported that a high body mass index and bone mineral density are preventive factors.

Yasar and Akgu¨nlu [27] evaluated postmenopausal women and considered aspects such as mineral bone density and number of teeth in the mandible. The menopausal status, age and weight were recorded in a questionnaire. There was a statistically significant relationship between individuals with osteoporosis and without osteoporosis only for the age factor. Patients with osteoporosis have more morphological changes in the lower cortex and age is a risk factor for osteoporosis.

Deng et al. [28] evaluated the importance of genetic determination, mineral bone density, and body mass index of the spine and hip and explored the genetic, environmental and phenotypic correlations between the above phenotypes in the Chinese Han ethnic group. A significant genetic, environmental and phenotypic correlation was observed. When MBD in the spine and hip has significant genetic determination, BMI is more likely to be affected by environmental factors than MBD. In addition, MBD in the spine and hip shares more genetic effect than BMI and MBD do in the Chinese Han ethnic group, although the effects are significant for both. Important is the significant genetic correlation between BMI and MBD found in the current study provides meanings to appropriately adjust the effect of BMI on MBD when performing linkage analysis and/or BMD association. BMI was shown to be a significantly positive determinant of MBD.

Low body mass index is associated with a high risk of osteoporosis and fractures, but its impact on functional recovery after fractures is unknown. When investigating the association between BMI and both, functional recovery and rehabilitation period in women with hip fractures. Di Monaco et al. [29] concluded that BMI can affect function after hip fracture, regardless of fracture risk: individuals with a higher BMI and low risk of hip fracture may have a poorer

functional recovery in fracture of the hip, despite prolonged rehabilitation. Conversely, individuals with lower BMI and high risk of hip fracture may have better functional recovery in cases of hip fracture.

White et al. [30] in their cohort study examined a baseline population for risk factors for hip, wrist and spine fractures in men and women and concluded that high body mass index was protective at all 3 fracture sites in women, but those who used vitamin A supplements had increased rates of hip and wrist fracture.

The influence of weight loss on continued growth in children and on bone mass and quality is not known. Although there appears to be agreement that bone loss occurs with weight loss in older women and possibly older men, it is unclear whether there is any detriment to bone health in young individuals or in children with weight reduction. The risk for bone loss may depend on initial body weight, age, gender, physical activity and dietary conditions such as the extent of energy restriction or specific levels of nutrients ingested.

Osteoporosis and obesity are two common disorders that affect a large number of elderly in the general population. Approximately 30% of women and 12% of men are affected by osteoporosis or low bone mass at some point during life. In addition, approximately 31% of elderly men and 35% of elderly women are classified as having obesity in the US Several lines of epidemiological evidence suggest that the two disorders may be inversely associated with obese individuals who have high bone mineral density and reduced risk of fracture than non-obese individuals. Indeed, it has been well known that the variation between 23% and 47% of MBD in the general population can be "explained" by variation in body mass index (BMI), making BMI one of the strongest and most consistent predictors of DOM. Both body weight (BMI) and MBD are partly genetically determined. In the same way, between 43 and 70% of the BMI variation is attributed to genetic factors [31].

Low body weight is associated with an increased risk for osteoporosis and fractures, but the contribution of other lifestyle factors has not been previously studied within lean elderly women. Korpelainen et al. [32] evaluating the association between lifelong lifestyle factors and bone density, falls and postmenopausal fractures in elderly women with low body mass index, concluded that poor functional ability and symptoms of depression were associated with the recent drop. In elderly women with low BMI, lifelong physical activity may protect against fractures, when low bone mass of the heel and solitary life appear to be associated with an increased risk for fractures. Poor functional ability and the presence of depression may be associated with a risk of falling. Type 2 diabetes can modify the risk of low bone mass and post-menopausal low trauma fractures. Several studies have shown that low body weight and low body mass index are associated with low MBD and fractures.

Body weight is considered a strong predictor of mineral bone density regardless of age and gender. It is not clear whether the influence of body weight on MBD is dependent on the balance between expenditure and energy input. Body weight can be height-related by calculating body mass index (BMI, kg/m^2), which serves to distinguish overweight from normal body weight and between normal body weight and energy deficiency, i.e., BMI<18.7. It has been suggested that the optimal BMI scale for women between 18.7 and 23.8 years old and a bone scan is recommended if BMI<19. Despite body weight, women tend to refer to their weight, which influence eating habits, dieting and physical activity. The body weight of young women may be associated with a variety of underlying lifestyle behaviors, such as eating habits, physical activity and dieting and may be potential predictors of significant variation of MBD depending on body weight and balance energy. In addition, the significance of potential predictors, such as lifestyle behaviors and psychological factors in the MBD of above, normal, and underweight young women need to be considered in order to form a knowledge base for prevention and coping strategies, health promotion. Elgan and Fridlund [33] with the aim of identifying important predictors between lifestyle behaviors and psychological factors of bone mineral density in relation to body mass index among young women over a 2 year period, that in the BMI<19 category, women had a lower level of Deoxypyridinoline (DPD) (p=0.017), a lower level of MBD (p=0.001), lower fat intake reported by them (p=0.011) and a lower hormone age (p=0.015) on average than those in the BMI category >24. Women in the category with a BMI between 19 and 24 consumed less alcohol/month (p=00017) and had a lower MBD (p=0.002) than women with a BMI>24.

Alfaro-Acha et al. [34] examining the interactive effect of cognition and body weight with hip fracture, concluded that low cognitive function increased the conditional association between body mass index and hip fracture in elderly Mexican Americans. The relationship between BMI and cognition is potentially important in identifying people at risk for hip fracture and supports the need to include cognitive and anthropometric measures in the assessment of hip fracture risk in osteoporosis screening programs. The body mass index was computed by dividing the weight in kilograms by height in square meters. BMI was used as a continuous variable and as a variable category, based on previously established criteria. Four categories of BMI were created: low weight (<22.0 kg/m^2), normal (22.0-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), and obese (30 kg/m^2). Low-weight individuals (BMI<22) were at greater risk for hip fracture and this risk was higher in people with the lower "Mini-Mental State Examination" (MSE) scores. For people in the higher and lower MSE groups, a larger BMI was associated with a lower risk of hip fracture. For those categorized as obese (BMI > or = 30), the risk of hip fracture was approximately equal in the higher and lower MSE

groups. Previous studies have reported an inverse relationship between body weight and hip fracture risk. It was found that a 10% loss in weight significantly increased the risk of hip fracture in people 65 years of age or older. In a study of elderly, white, non-Hispanic women, it was found that a higher BMI significantly reduced the risk of hip fracture. However, these studies did not examine whether cognition modulates the risk of hip fracture in low-weight, elderly adults. Several mechanisms have been proposed to explain the association between BMI and hip fracture. One hypothesis suggests that low weight may be a marker of underlying clinical circumstances, including decline in healthy physical status, weakness, subclinical disease or chronic inflammation that may increase the risk of falls and fractures. Another hypothesis suggests that low weight is associated with loss of MBD, which increases the risk of hip fracture. Numerous studies have found a higher MBD in heavier individuals and, conversely, a lower MBD in those who are underweight. The results of the current study confirm that low BMI is a marker for hip fracture in older Mexican- American adults, although it may be necessary to consider BMI in combination with other potential risk factors, including cognitive ability, when the incidence of fracture of the hip, especially in older adults, is high.

Some researchers in their study, state that body mass index is often used to predict DOM. This may fail. Large epidemiological studies with BMI and MBD data were analyzed. Weight alone is a better predictor of MBD than BMI. While others evaluated the relationship between quality of life and bone status, including bone metabolism, in Japanese postmenopausal women in the community. Although chance is not clear, in addition to low BMI, the role of limitations due to poor emotional status and low physical function are related to the low mineral bone index in Japanese postmenopausal women in the community.

It is well established that a minority of celiac patients present with “classical” symptoms due to mal-absorption. However, few studies have focused on the distribution of BMI in celiac populations and their relationship to clinical characteristics, or their response to treatment. Dickey and Kearney [35] reviewed measures of BMI and other clinical and pathological features of a database of 371 celiac patients diagnosed over a 10 years period and seen by a single gastroenterologist. To assess the response to gluten exclusion, they compared BMI at diagnosis and after a 2-year treatment in patients with serologic support for dietary compliance. There was an impressive relationship between BMI and measures of bone density. Only 6% of overweight patients had osteoporosis in the lumbar spine or neck of the femur compared to 48% of patients with BMI<20.

According to Asomaning et al. [36], individuals with BMI<18.5, those overweight with those with BMI > or = 25 and obese, individuals with BMI > or = 30 are considered as underweight.

Thus, in order to estimate if the prevalence of excess weight is likely to reduce osteoporosis among elderly women, concluded that the increasing prevalence of excess weight of weight among older women in the US seems unlikely to be accompanied by a significant reduction in osteoporosis.

Osteoporosis affects 4-6 million (13%-8%) of postmenopausal white women in the United States of America. Most studies point to risk factors for osteoporosis and have considered body mass index (BMI) only as a possible contributory factor. In their study, Asomaning et al. [36] evaluated the direct relationship between BMI and osteoporosis. BMI was inversely associated with the MBD status. They concluded that women with low BMI are at increased risk for osteoporosis. The change in risk associated with a change of drive in BMI (approximately 5-8 pounds) is of greater magnitude than most other modifiable risk factors. To help reduce the risk of osteoporosis, patients should be advised to maintain a normal weight.

Several studies have shown that low BMI is associated with low MBD and low fracture rates. However, the results that have been published are from studies in which reproductive factors and mineral bone density are extremely controversial, with some showing a beneficial effect, while others show a detrimental impact of these factors on bone mass [37].

Still in 2006, Watanabe [16] analyzed the trabecular bone pattern in macerated mandibles and concluded that the trabecular bone seen in panoramic radiographs refers mainly to the trabeculae inserted into the buccal and lingual cortices.

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