Gender differences in relationships between body composition components, their distribution and bone mineral density: an opposite sex twin study.

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Abstract

Background: Numerous studies indicate that bone mineral density (BMD) is closely related to body mass and its components. Most studies have examined these relationships in women with little attention given to how these relationships differ by gender.

Aims: The aims of the present study were to use the opposite sex twin model to determine if there were gender differences in the relationship between body composition and its relation to BMD and how any such differences were influenced by age.

Methods: We measured body composition and bone mass by dual energy x-ray absorptiometry in 93 pairs of opposite sex twins. To examine the effect of age, they were divided into two age groups: under 50 years old (45 pairs) and over 50 years old (48 pairs).

Results: Lean mass (LM) had stronger positive relationships with the most bone variables than fat mass in both genders at all ages. Fat mass (FM) had positive relationships with total body and hip BMD in women under age 50, but not over 50. There was no significant relationship between FM and total or regional BMD in men under age 50, but men over 50 showed positive relationships between FM measures and total and some regional BMD measures. Central adiposity showed a positive relationship with BMD in men over 50 and women under 50.

Conclusion: Fat mass (FM) and lean mass (LM) and their distribution in the body have different relationships with regional BMD in men and women that differ by age.

Key words: Bone mineral density, body composition, fat mass, lean mass
Introduction

Numerous studies have shown an association between bone mineral density (BMD) and body mass. Body mass is made up of fat mass (FM) and lean mass (LM). It is not clear which of the two components of body composition is more closely related to bone mass. In men, lean mass seems to be strongly related to BMD [1-3]. In women, some cross-sectional studies in pre- and postmenopausal subjects [2,4,5] suggest that BMD is related to fat mass while in other studies [1,6-8], both lean and fat mass were related to bone mass. More studies have been conducted on women and only a few studies have directly compared gender differences in the relationship between body composition and BMD [3,9].

A few studies have compared the relationship between body composition and bone mass in pre- and postmenopausal women [10-12], but there are no studies that have compared such relations in males of different age groups.

In most of the studies, total fat mass and total lean mass are used as independent variables in analysing body composition and bone relations even though as part of the body mass, they are highly dependent on body size as well as bone mineral components. Only a few studies have investigated the association of bone mineral measures with body composition components adjusted for body size or their distribution (such as centrality indices) [13,14].

The aims of the present study were to determine (a) if there were gender differences in the relationship between body composition components and bone mineral measures; (b) if there were age related differences in this relationship; (c) if gender differences in the distribution of fat mass
influence bone and (d) if central adiposity has a different relationship with bone in men and women of different age groups?

The unique aspect to our study is the use of the opposite sex twin model which has the advantage of controlling for age, genetic and some early childhood / adolescent influences. In addition, different age groups of men and women are compared in the same study.

**Materials and Methods**

**Subjects**

Study subjects were opposite-sex twin pairs recruited as part of the Northern Sydney Twin Study at Department of Rheumatology of the Royal North Shore Hospital. The hospital’s Human Research Ethics Committee approved the study. After providing written informed consent, each twin was interviewed separately in accordance with a standard questionnaire to collect demographic, lifestyle and medical history data.

**Body Composition and Bone Mineral Density Measurements.**

Baseline characteristics included age, height (m), weight (kg), BMI (Wt/Ht²), smoking history (pack per year) and alcohol consumption (units per week – life average). Whole body, lumbar spine (L1-L4), hip and distal forearm were scanned by dual-energy X-ray absorptiometry (DEXA; QDR 4500W Hologic, Waltham, MA. USA). Bone mineral content (BMC), bone area and areal bone mineral density (BMD) of the lumbar spine (LSBMD), total hip (HIPBMD) and forearm (FORBMD) were obtained from DEXA scans using standard protocols.
Total body bone mineral content (BMCTOT), total fat mass (TOT FM), trunk fat mass (TRUNK FM), total lean mass (TOT LM) were obtained directly from the whole body DEXA body composition analysis outcome. The central or abdominal fat (ABD FM) region was defined by cursor manipulation as extending between the top of the second and the bottom of the fourth lumbar vertebrae and laterally to the inner aspects of the ribcage [15]. Leg fat mass (LEG FM) was calculated as the sum of both leg’s fat mass and appendicular lean mass (APP LM) was measured as the sum of lean tissue mass of extremities [16]. Body fat distribution, “centrality indices” were assessed by trunk-leg fat mass ratio (TR FM / LEG FM), and abdominal-leg fat mass ratio (ABD FM / LEG FM) [7]. Total fat mass to total lean mass ratio (TOT FM / TOT LM) was also calculated from the DEXA output.

Statistical Analysis

Mean values for the measured variables were compared between the male and female co-twins, using paired T-tests. Uni- and multivariate regression analyses were performed to evaluate the strength of relationship between body composition / bone mineral variables. In the regression models bone measures were used as dependent variables. Body composition parameters were independent factors while multivariate regression models also included body size (height) and lifestyle factors (smoking and alcohol history), previously reported as being associated with bone [17-21]. The results of multiple regressions are expressed in standardized regression coefficients ($\beta$ betas) because this measure allows direct comparisons of the strengths of the association between different determinants with different measure units. A 95% confidence interval was used to describe the strength of association; P<0.05 was considered significant. All of the statistical analysis was done using the statistical package SPSS.
Results

Ninety-three pairs of opposite sex twins were recruited in the study. To study the effect of age, the cohort was divided into two age groups: under 50 years old (45 pairs) and over 50 years old (48 pairs). We chose to stratify groups by age rather than menopausal status of women in twin pairs, for easier comparison men and women of different age groups. In the < 50 age group women were pre- or peri- menopausal. In the ≥ 50 age group, all women were postmenopausal.

The demographic, body composition and bone mineral measures are shown for the two age groups by gender in Table 1. As expected, men were taller, heavier and had higher BMI. TOT FM was greater in women than men, but this difference was not significant in the younger group. Women also had higher LEG FM. There was no significant difference between men and women in TRUNK FM in both age groups. Indeed, men had slightly more trunk fat than women in the < 50 age group. ABD FM was higher in men for both age groups. Total and regional LM were also significantly higher in males. Consequently, TOT FM / TOT LM ratio was higher in females. Men had greater values for BMCTOT and all areal BMDs in all age groups.

Figure 1 shows the relationship between total body BMC and body composition measures in males and females. In males, the association between TOT FM and BMCTOT was significant in the ≥ 50 age group (explaining 13.6% of the variance), but was not significant in the < 50 age group. In females on the other hand, there was a significant association between TOT FM and BMCTOT in the younger group, but not the older group. The pattern of the association between TRUNK FM and total body BMC was similar. The only significant association
between TRUNK FM / LEG FM ratio and BMCTOT was in men < 50 ($R^2=0.124$). There was a significant association between TOT LM and BMCTOT in both men and women in the two age groups. ($R^2=0.33$ and 0.59 respectively).

The relationship between LSBMD and body composition measures is shown in Figure 2. LSBMD had weaker associations with body composition measures, than other bone mineral variables. It might be due to a greater measurement error caused by different body thickness [22]. In males LSBMD was associated only with TR FM / LEG FM ratio in the < 50 age group and TOT LM in the ≥ 50 age group ($R^2=0.091$ and 0.171 respectively). There was no significant association between LSBMD and any of the body composition measures in women of any of the stratified age groups.

**Figure 3** shows the relationship between HIPBMD and body composition measures. TOT FM did not show an association with HIPBMD in males, however in females it accounted for 29.8% of the variance in the < 50 group. TRUNK FM explained 32.9% of the variance of HIPBMD in females < 50. There was a significant relationship between TOT LM and HIPBMD in males, accounting for 24% of the variance in the < 50 age group, 15.9% - in ≥ 50. The association between TOT LM and HIPBMD in females was weaker in the ≥ 50 group and not present in the younger females. Similar results were present for FNBMD (data not shown).

**Figure 4** shows the relationship between FORBMD and body composition measures. Similar to LSBMD, FORBMD showed weaker associations with body composition than BMCTOT or HIPBMD.
In Table 2, the results of the multivariate regression analyses of the associations between bone mineral and body composition variables are shown. The models were fitted for body size (height) and lifestyle factors. In males, the only significant body composition predictors of BMCTOT were TOT LM and APP LM and in younger subjects, centrality indices. In contrast in younger females, the association between BMCTOT and all of the body composition variables was significant, while in older females this was only so for TOT LM. For LSBMD, there were no statistically significant associations between LS BMD and any of the body composition measures in females. In males, centrality indices were associated with LSBMD in the < 50 age group. In the older males, TOT LM and APP LM were associated with LSBMD.

For HIPBMD, adjustment for height and lifestyle factors in males did not alter the associations seen in the univariate analysis (significant for TOT LM and APP LM). In females, most body composition measures were associated with HIPBMD in the younger group. In the older female group only TRUNK FM and ABD FM and lean mass measures were associated with HIPBMD. Adjusting for height and lifestyle factors in the multivariate analysis did not alter the association between FORBMD and body composition measures.

TOT FM / TOT LM ratio was only associated with BMCTOT and HIPBMD in women under 50 age group.

Discussion

This study examined relationships between body composition components, such as fat body mass and lean body mass and bone mineral measures in healthy adult male and females of opposite sex twin pairs. In addition the influences of body composition distribution (centrality
indices) and age on these relationships were investigated. The benefits of comparing opposite sex twins is that they are completely matched for age and partly for genes and environmental effects. In agreement with other reports, our results show different associations between body composition and bone mineral variables in the men and women [4,23,24]. Generally lean mass had stronger relationships with bone variables in both genders at all ages than fat mass, except the associations of hip BMD with total and trunk fat mass were stronger with those with lean mass in females under 50. There was no significant relationship between fat mass and total or regional BMD in men under age 50, but in men over 50 there were a positive relationships between fat mass measures and total and some regional BMD measures.

The results of the previous studies do not agree on whether fat mass or lean mass is the major determinant of bone mineral mass. Some cross-sectional studies suggest that bone mineral is related to fat mass [4,5], others show that both lean and fat mass are related to bone mass [1,6,25]. Reid [26] has reviewed those studies investigating the relationship between body mass, its components and bone and concluded that whilst both fat and lean mass are related to bone measures, the effect of fat mass becomes more important in postmenopausal women and that the relationship between lean mass and bone density was substantially accounted for by body size. The importance of adjusting bone mineral variables for body size has been well recognized, with surrogate volumetric BMD; apparent BMD (spine BMAD=BMC/A^{3/2}, forearm and hip BMAD=BMC/A2, and total body BMAD=BMC/(A^{2}/Ht); BMD/Ht, BMD/Ht^2 all being used to avoid this problem [3-5,27,28].

Khosla et al. [27] examined bone density throughout the skeleton in premenopausal women, postmenopausal women taking estrogen, and postmenopausal women not taking estrogen. They assessed the relative impact of fat and lean mass on bone according to the bone parameter chosen and found that when BMC was assessed, lean mass was the principal
determinant. With progressive adjustment for size, first with BMD and then with surrogates for volumetric density (BMAD and BMD/height), the effect of lean mass declined and that of fat mass increased. However an effect of lean mass persisted in some groups at some sites, even with the measures of volumetric density, suggesting that both soft tissue components have some impact on bone. Reid et al. [4] have shown that even after the adjustment for height, the association between soft tissue and bone was still present. In our study the results of using vBMD or BMD/height were similar to those derived from multiple regression fitted for height (data not shown).

Pluijm et al.[9] reported a predominant effect of fat mass on bone density in older women, and suggested that soft tissue is less important in men. Similarly, in the Health ABC Study, both fat and lean mass correlated with BMD in black and white women, but the effect of lean mass was lost when BMAD was assessed [29]. In men in the Health ABC study, lean mass was related to BMD, but not to BMAD, consistent with the data of Reid et al [4]. In peripubertal girls, Young et al [30] observed a relationships between gain in bone and gain in soft tissue, and concluded that lean mass has an important effect during linear growth, but that fat mass is predominant thereafter.

In the most of the previous reports total fat mass and total lean mass was used as independent variables in analysing body composition and bone relations, even though as part of the body mass they are highly dependent on body size as well as bone mineral components. Only a few studies have investigated the association of bone mineral measures with body composition components adjusted for body size or their distribution (such as centrality indices) with [13,14,31,32]. Furthermore the results of the present study show that total composite measures such as 'total fat mass' are not always the best choice of independent
variables when associations between body composition and bone are studied. It may be better to use regional composition measures (trunk fat mass) or ratios such as centrality indices.

Some of the previous studies reported that total fat mass was not related to bone mineral measures in men [4,14,23]; others have shown positive associations between total fat mass and hip BMD [9,24]. The wide age range in many previous studies might have influenced these results. Our study has shown that trunk fat mass and abdominal fat mass had a strong positive association with total Body BMC and hip BMD in men over 50 and women under 50. We have also found that body fat distribution (centrality indices) were associated with BMCTOT and LSBMD in males under 50 and hip BMD and forearm BMD in males over 50. Kirchengast et al. [13] have reported that FDI (fat distribution index, similar to the measure TR FM/LEG FM we used in our study) had positive associations with femoral BMD in both sexes, although not statistically significant. However their study cohort was 60 to 92 years old. In our study, the association between TR FM/LEG FM and hip BMD was significant only in men and women < 50 years of age. Appendicular lean mass, which represents 75% of the body muscle mass, had similar relationships with bone mineral measures to those with total lean mass.

Our study has also revealed that a total body BMC and regional areal BMD have different relations with body composition. Thus total body BMC and hip BMD have stronger relationship with body composition, its components and their ratios than lumbar BMD, and forearm BMD.
Consistent with our results, it has been reported that adult men of all ages have lower body fat mass, but the fat they have is predominantly located on the abdomen, as opposed to women [33]. In fact our results show, that abdominal fat mass was higher in males.

Some of the previous studies reported differences in body composition bone mineral relationships between premenopausal and postmenopausal women [10-12]. MacInnis et al [12] in a co-twin study on 30 to 65 year old women have shown the importance of the separation of the study subjects into two groups according to menopausal status. Their findings suggested that the profile and the strength of bone density determinants differed in the two groups. The results of multivariate analysis suggested that fat mass has a strong influence on hip BMD postmenopausally, but not premenopausally. In contrast, the association of the hip BMD with lean mass was strong premenopausally and not significant postmenopausally. The discrepancies between the results of our study and the above mentioned may be related to statistical power attributable for sample size or the difference in age in groups studied. We have not found any reports on comparison of body composition bone mineral relations between younger and older age groups in males.

Several mechanisms have been proposed for the associations between fat mass and lean mass with BMD. Both fat mass and lean mass may contribute to an increase in BMD by causing increased mechanical loading [34]. Another explanation is that fat mass may have a protective effect on BMD in women because of the conversion of androgens to estrogens [35,36]. Recently, other endocrine regulators have been suggested. Insulin resistance in obese people causes high serum insulin concentrations, which have an anabolic effect on osteoblasts and thus increase bone formation and BMD [37]. Moreover, insulin also reduces the synthesis of SHBG, thereby regulating the free levels of estrogens and androgens. Other possible
regulating factors include leptin [38-42]. Walton et al [33,43] have shown that body fat distribution (expressed as the ratio between the mass of fat tissue in the android (central) and gynoid (hip and thigh) regions, rather than overall adiposity, influences serum lipids and lipoproteins in healthy men independently of age. Thomas et al. have shown that fat mass, lean mass and insulin are the strongest predictors of serum leptin level [30, 33]. They have shown there is a sexual dimorphism in the relationship of fat mass and leptin to BMD, with both being positively associated with BMD in women, but not in men [30]. In women, leptin may also mediate at least part of the protective effect of fat mass on the skeleton [38]. Thomas and Burguera [41] suggested that the sex-dependent specificity of the relationship between leptin and BMD in human studies could be, at least in part, caused by serum leptin levels that are two- to threefold higher in women than in men, independent of adiposity.

It has also been shown that body fat distribution (centrality indices) is more correlated with cardiovascular dysmetabolic factors (total cholesterol, HDL cholesterol, triglyceride, blood pressure) than total fat [33].

Using the opposite sex twins and looking at gender differences in body composition, particularly central adiposity and bone mineral relations in different age groups, is a novel approach. Although we have only presented results based on areal BMD, we have also analysed the data as volumetric BMD, using methods previously reported [44,45], but this made no difference to the results (data not shown). It could be argued that by examining associations between multiple bone and body composition measures across two age and gender groups, some adjustment for multiple comparisons should have been applied.

In summary, we found that body composition components such as fat mass, lean mass and their regional distribution have different relationships with bone mineral measures in men and
women that varies with different ages. These findings suggest studies of mechanisms of body composition to bone mineral relationships should take into account age by gender interactions as well as regional effects on body composition and bone mass.

References


29. Taaffe DR, Cauley JA, Danielson M, Nevitt MC, Lang TF, Bauer DC, Harris TB. Race and sex effects on the association between muscle strength, soft tissue, and bone


39. Ruhl CE, Everhart JE. Relationship of serum leptin concentration with bone mineral

40. Douchi T, Iwamoto I, Yoshimitsu N, Kosha S, Nagata Y. Leptin production in pre- and

41. Thomas T, Burguera B. Is leptin the link between fat and bone mass? J Bone Miner Res
2002;17:1563-1569.

42. Kontogianni MD, Dafni UG, Routsias JG, Skopouli FN. Blood leptin and adiponectin
as possible mediators of the relation between fat mass and BMD in perimenopausal

43. Walton C, Lees B, Crook D, Worthington M, Godsland IF, Stevenson JC. Body fat
distribution, rather than overall adiposity, influences serum lipids and lipoproteins in

44. Faulkner RA, McCulloch RG, Fyke SL, De Coteau WE, Mckay HA, Bailey DA,
Houston CS, Wilkinson AA. Comparison of areal and estimated volumetric bone

45. Naganathan V, Sambrook P. Gender differences in volumetric bone density: a study of
FIGURE 1. Relationship between Total Body BMC and Body composition
FIGURE 2. Relationship between Lumbar Spine (L1-L4) BMD and Body composition
FIGURE 3. Relationship between Total Hip BMD and Body composition
FIGURE 3. Relationship between Total Forearm BMD and Body composition
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<tr>
<td></td>
<td>Male n=45</td>
<td>Female n=45</td>
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<tr>
<td></td>
<td>Male n=48</td>
<td>Female n=48</td>
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<tr>
<td>AGE (years)</td>
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<td>1.63± 0.07</td>
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<tr>
<td>WEIGHT (kg)</td>
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<tr>
<td>BMI (kg/m²)</td>
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<td>25.47±5.65</td>
</tr>
<tr>
<td>TOT FM (kg)</td>
<td>19.77±11.07</td>
<td>22.41±11.60</td>
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<tr>
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<td>10.42±6.55</td>
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<tr>
<td>LEG FM (kg)</td>
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<tr>
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<td>APP LM (kg)</td>
<td>27.85±3.84</td>
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<td>BMCTOT (kg)</td>
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<td>LSBMD (g/cm²)</td>
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<td>HIPBMD (g/cm²)</td>
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<td>FORBMD (g/cm²)</td>
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Table 2. Results of multivariate Regressions analysis of Bone Mineral Measurements on Body composition components

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<td>HIBPMD (standardized β)</td>
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<td>TOT LM</td>
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<td>0.129</td>
<td><strong>0.556</strong></td>
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<td>APP LM</td>
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<td>0.168</td>
<td><strong>0.638</strong>*</td>
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Male  N=45

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<td>HIBPMD (standardized β)</td>
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<td>0.269</td>
<td><strong>0.579</strong>*</td>
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<tr>
<td>ABD FM</td>
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<td>0.231</td>
<td><strong>0.543</strong>*</td>
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<td>0.1435</td>
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<td>0.352</td>
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<tr>
<td>TOT FM / TOT LM</td>
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<td>0.254</td>
<td><strong>0.558</strong>*</td>
<td>0.301</td>
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Female  N=45

*p < 0.05;  ** p < 0.01;  *** P < 0.001. Significant associations are printed in bold.

Covariates: Height, Smoking and Alcohol History.