Association of Osteoporosis and Metabolic Syndrome in Older African American, Mexican American, and Non-Hispanic Caucasian Women: A Comparison

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Bio:

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Abstract:

Both osteoporosis and metabolic syndrome affect millions of women. Non-Hispanic Caucasian women are more likely to suffer from osteoporosis when compared to their African American and Mexican American counterparts. However, they have lower incidence levels of metabolic syndrome. Conversely, African American women are at greater risk of metabolic syndrome (obesity, type II diabetes, cardiovascular disease) and are less likely to suffer from osteoporosis than Mexican American and non-Hispanic Caucasian women. Data from women aged 50 years or older from these three racial/ethnic groups in the National Health and Nutrition Examination Survey (NHANES), a nationally representative data set from 2003–2004, were analyzed. Data from self-reports were used as variables for osteoporosis. Cardiovascular fitness, body composition, lipid factors, and diabetes profiles will be used as variables for metabolic syndrome. The data were related by correlating the overall measures for all three racial/ethnic groups combined and then for each racial/ethnic group separately, and by comparing the levels between each racial/ethnic group using Oneway ANOVAS. There is not much research literature on the possible association between these two illnesses in different racial/ethnic backgrounds. This study examined how physiology and race/ethnicity of older women affect the linkage between osteoporosis and metabolic syndrome. The most noteworthy findings are the association between weight measures and wrist fractures, where those with this type of fracture had significantly lower weight ($t = -2.79$, $\sigma = 0.005$); the association between lipid factors and spinal fractures, where those with spinal fractures had significantly lower total cholesterol ($t = -2.047$, $\sigma = 0.041$); and racial/ethnic differences in osteoporosis and metabolic syndrome components with African American women having greater weight components, lower incidence of osteoporotic fractures, and significant incidence of metabolic syndrome components.

Introduction

In the United States, it is estimated that one out of every four women aged 65 or older, and every second woman aged 85 or older, has had an osteoporotic fracture (Angbratt et al., 2007). Along a different line of study, over 47 million Americans suffer from metabolic syndrome (NHANES, 2004). These two different disorders are likely to increase by 2040, as it is expected that 77 million people will be age 65 or older (Stone, 1999). Some of these individuals will potentially suffer from both osteoporosis and metabolic syndrome. The purpose of this study is to examine the levels of osteoporosis and metabolic syndrome in postmenopausal African American, Mexican American, and non-Hispanic Caucasian women to determine if a negative association exists between the two illnesses overall and in each of these three racial/ethnic groups.

Literature Review

Osteoporosis

Once women reach menopause, bone density begins to decline and bones become more porous and brittle. This results in a greater risk of osteopenia and osteoporosis in postmenopausal women. The main factors in the decrease of bone density include significant age-related decreases in circulating estrogen, genetic disposition, prior fragility fracture, advanced age, and the use of certain medications (Delaney, 2006).

These predictive data on osteoporosis are broad and general, with significant variation based on genetic differences, behavior, and diet. Generally, peak bone mass is achieved by age 30. After 30, degenerative processes go into effect. Women naturally undergo rapid bone loss 2 to 3 years before menopause, and that generally continues for up to 5 years postmenopause (Delaney, 2006). The National Osteoporosis Foundation (NOF, 2007) recommends that the

following women undergo bone mineral density testing: all women aged 65 years or older, regardless of other risk factors for osteoporosis; postmenopausal women younger than 65 with one or more risk factors for osteoporosis (other than being non-Hispanic Caucasian, postmenopausal, and female); and all postmenopausal women who have had a fragility fracture. These risk factors were originally the most significant indicators of potential osteoporosis; however, an imaging technique known as dual-energy x-ray absorptiometry (DEXA) has made it possible to identify decreased bone mineral density by scanning patients. Such DEXA scan data are still a long way from becoming part of a woman's annual physical due to its cost.

An estimated 10 million people have osteoporosis in the United States (Chapman-Novakofski et al., 2006). Of these 10 million Americans, women represent 80% of those affected by osteoporosis (Gold, 2006). Noting prevalence, an estimated 35% of postmenopausal non-Hispanic Caucasian women have osteoporosis of the hip, spine, or forearm (Chapman-Novakofski et al., 2006). Additionally, the National Osteoporosis Foundation reports that approximately 5% of African American women and 10% of Hispanic women over age 50 have osteoporosis.

The role ethnicity plays in the incidence of osteoporosis is connected to genetics as well as other risk factors, including diet and physical activity. Differences in urinary calcium excretion are possible contributors to racial/ethnic dissimilarities in bone mineral density, with African American women excreting less calcium than do all their racial/ethnic counterparts. In effect, this increases the amount of calcium taken up by the bones (Chapman-Novakofski et al., 2006). Furthermore, African American women have a slower bone turnover rate and undergo bone loss slower during early menopause (Chapman-Novakofski et al., 2006). This supports the

view that bone mass density has a strong genetic determination, with heritability over 50% (Deng, 2003).

The National Institutes of Health (NIH) recommend calcium intake of 1,000 mg/day in adults and 1,500 mg/day in individuals over age 65 (NIH, 2001). Analysis of data from the Hispanic Health and Nutrition Examination Survey (HHANES) and the second National Health and Nutrition Examination Survey (NHANES) showed that the calcium intake of Hispanic American women is similar to that of non-Hispanic Caucasian women and significantly more than that of African American women (Chapman-Novakofski et al., 2006). Average calcium intakes of all age-groups were approximately 70% of the recommended intake in all women except African Americans, in whom intakes were 50% (Chapman-Novakofski et al., 2006). This information reveals that although non-Hispanic Caucasian women take in more calcium on average than African American women, they still have a higher prevalence of bone fragility. The racial difference in calcium intake and absorption are factors of critical interest in this study, which attempts to relate the occurrence of osteoporosis and metabolic syndrome together for different racial/ethnic groups of older women.

Metabolic Syndrome

Metabolic syndrome is another disease increasing at an alarming rate in the United States. Metabolic syndrome refers to a specific clustering of cardiovascular risk factors, including abdominal obesity, atherogenic dyslipidemia, elevated blood pressure, insulin resistance, a prothrombotic state, and a pro-inflammatory state (Smith et al., 2003). Like its components, metabolic syndrome occurs predominantly during middle age and affects minority populations at a higher rate. It is a complex, underlying mechanism that stimulates the progression of metabolic abnormalities and is composed of multiple individual components (O'Neill, 2006). Metabolic

abnormalities stem from the hypothalamus, located in the brain. Arousal of the hypothalamus causes the sympathetic nervous system (SNS) to kick into gear, and symptoms of the disorder include visceral obesity, higher cholesterol levels, and increased blood pressure, among other things (Bjorntorp, Holm, & Rosmond, 1996).

Over 47 million Americans have metabolic syndrome (NHANES, 2004). Of these individuals, an alarming 22.9% of non-Hispanic Caucasian women, 20.9% of African American women, and 27.2% of Hispanic American women suffer from this disease (NHANES, 2003). These startling proportions are aggravated by the current upward trend of increased obesity (BMI > 30 kg/m^2) in the U.S. population. Specifically, African Americans are at a higher risk for hypertension-related cardiovascular morbidity and mortality than their Caucasian counterparts "due to concomitant risk factors such as diabetes, obesity, low socioeconomic status, and possible increased hereditary predisposition" (Smith et al., 2003, p. e136). According to the American Heart Association (2008), adult blood pressure should normally be less than 120/80 mmHg. Blood pressure within the range of 120/80 to 139/89 mmHg is considered prehypertension, and hypertensive blood pressure remains above 140/90 mmHg on average. Table 1 provides more numbers for cardiovascular fitness.

Regarding diabetes measures, the American Diabetes Association (ADA) reports that a person with a fasting blood glucose level of 126 mg/dl or greater has diabetes. Prediabetes measures include fasting blood glucose levels between 100 and 125 mg/dl. Also, individuals without high blood sugar have glycohemoglobin (hemoglobin A1C) levels below 6%.

Race/Ethnicity and the Relationship between Osteoporosis and Metabolic Syndrome

Studies have shown that women in their menopausal stage with metabolic disorders (i.e., obesity, hypertension, diabetes, and so on) may have protection against osteoporosis because

their medications for these illnesses increase glucose and insulin metabolism, which keeps hormone levels from dwindling (Agardh et al., 2002). In addition, there have also been studies that show that women of different racial/ethnic backgrounds have other types of protection against osteoporosis. The prevalence of obesity is greater in African American women than in non-Hispanic Caucasian women. This additional adipose tissue may serve as protection from osteoporosis due to "increased skeletal loading during ambulation" (Cauley et al., 1994, p. 1035). Excess fatty tissue may also serve as an estrogen source in postmenopausal women (Cauley et al., 1994).

Unlike their non-Hispanic Caucasian counterparts, African American women consume less dietary calcium, yet still have equally massive or more massive skeletons (Heaney, 2006). This may be explained by the parathyroid hormone (PTH). The PTH causes less urinary calcium loss and, in some cases, enhances intestinal absorption of calcium. In a study of Caucasian and African American women of equal weight, "African American women had a lower excretion of bone resorption biomarkers despite a parathyroid hormone level that was as high as or higher than those of the Caucasian women" (Heaney, 2006, p. 1096). Similarly, with the same injected dose of parathyroid hormone, African American women had a smaller rise in resorption biomarkers than did Caucasian women. This observed relative resistance forces higher PTH secretion and leads to greater utilization of dietary calcium in African American women (Heaney, 2006).

The parathyroid adaptation evaluated by Heaney is efficient toward bone health in African Americans. However, it may also contribute to an increased susceptibility of metabolic syndrome, stroke, obesity, and hypertension among African American women (Heaney, 2006). According to Heaney, the underlying 'cure' to the situation would be for African Americans to

consume more calcium, which would exert less work on the PTH and reduce the incidence of the metabolic diseases (Heaney, 2006).

Summary

At this point in time, there are known relationships between osteoporotic and metabolic syndrome differences among different groups of women, particularly on the basis of racial/ethnic groups. In comparison, although some data exists, relatively little work has been performed to look at the simultaneous relationship of osteoporosis and metabolic syndrome, especially in conjunction with some of the previously noted racial/ethnic differences.

Hypotheses

This study observes the relationship of self-reported occurrences of osteoporotic fractures (hip, wrist, and spine) and all the different indicators of metabolic syndrome in two ways. The two measures available in NHANES include both categorical and continuous measures. The assessment of categorical measures include questionnaire self-reports of race/ethnicity, education, annual household income, marital status, language of interview, self-report of physician-diagnosed high blood pressure, self-report of physician-diagnosed diabetes, and self-reported use of insulin. The measures of continuous measures include lab and examination component measures of weight, body mass, waist circumference, systolic blood pressure, diastolic blood pressure, total cholesterol, HDL and LDL cholesterol levels, triglyceride levels, glucose levels, and glycohemoglobin percentages. In this study, chi-square statistics are used for the categorical factors and *t*-tests are used for continuous factors.

Overall, the hypothesis predicts a negative relationship between osteoporosis and the components of metabolic syndrome. In addition, it was expected that African American women would have a higher rate of metabolic syndrome and a lower rate of osteoporosis. After first

examining descriptive statistics and relationships, the previous predictions were tested. Finally, a logistic regression was attempted to formulate an overall predictive model of fractures.

Method

Participants and Procedures

Secondary data analysis from the 2003–2004 NHANES from the Centers for Disease Control and Prevention (CDC) was used. This current data analysis is covered under a previous determination of exemption from Institutional Review Board status. A major resource used for information about the NHANES was the doctoral dissertation of Amy E. O'Neill (2006). In this dissertation, the NHANES is described as the following:

> The NHANES was designed to obtain information on the health and nutritional status of the United States population. Given the focus on the U.S. population age-groups from birth (youngest) to 85 (oldest) were included. The NHANES data sets use complex, multistage, stratified, clustered samples of non-institutionalized, civilian populations.
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> One of the main goals of the NHANES is to estimate the national prevalence of selected health conditions and risk factors. The survey over-sampled for Mexican Americans, non-Hispanic Blacks and older adults to ensure reliable estimates for these groups. Each participant was given a home interview, along with a detailed clinical interview, a full medical evaluation, and laboratory workup, which were conducted in the NHANES Mobile Examination Center (MEC). (p. 26–27)

The current study selected from the 2002–2003 NHANES for women ages 50 to 84. In this sample, there was an average age of 66.2 years (SD = 9.7 yrs). The sample was further limited to the three largest ethnic/racial groups in the NHANES dataset. This resulted in a breakdown of 17.8% African American women (*n* = 194), 20.0% Mexican American women (*n* = 218), and 62.1% non-Hispanic Caucasian women (*n* = 676), totaling 1,088 women. On an education scale where 1 = less than high school, 2 = high school diploma or GED equivalent, and 3 = more than high school, these women reported an average education of 2.06 (SD = 0.94), meaning that most had a high school education. On an 11-point income scale, where 1 = $0–$4,999/year, 5 = $20,000–$24,999, 6 = $25,000–$34,999, 7 = $35,000–$44,999, and 11 ≥ $75,000, these women reported an average income of 6.6 (SD = 6.6). Concerning marital status, 48.4% of the women were married (*n* = 527), 28.5% were widowed (*n* = 310), 13.7% were divorced (*n* = 149), 5.6% were never married (*n* = 61), 2.2% were separated (*n* = 24), and 1.6% were partnered (*n* = 17). Finally, concerning the language of the interview, 8.3% of the women received their interviews in Spanish (*n* = 90). All except 1 of these 90 women requesting a Spanish-language interview reported their race/ethnicity as Mexican American.

Measures

Osteoporosis. For the self-report, osteoporotic measures assessing fractures were specifically selected because risk is an important indicator of osteoporosis. The DEXA scan is not yet part of the NHANES, and without it, these self-reported risk factors were evaluated through the use of questionnaires. These self-reports assessed broken or fractured hips, wrists, and spines. Examples included the following: “Has a doctor ever told you that you had broken or

fractured your hip?" "Has a doctor ever told you that you had broken or fractured your wrist?" "Has a doctor ever told you that you had broken or fractured your spine?"

Metabolic Syndrome. Several examination variables were used to assess the components of metabolic syndrome including obesity, lipid factors, cardiac health, and diabetes.

Obesity. The examined components of obesity in this study included weight, body mass index (BMI), and waist circumference.

Lipid Factors. Lipid factors assessed included, total cholesterol, HDL and LDL levels, and triglyceride measures.

Diabetes. Various examination variables and self-reports were evaluated to assess diabetic health measures including serum glucose levels, glycohemoglobin levels, and self-reports of diabetes diagnosed by a physician. Examples include the following: "Other than during pregnancy, have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?" Self-reported use of insulin is measured using the question, "Are you now taking insulin?"

Cardiac Health. Cardiac health measures included self-reported diagnosis of hypertension by a physician, as follows: "Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure?" They were also asked about their average systolic blood pressure and average diastolic blood pressure.

Results

Descriptive Statistics and Groups Differences

Women reported on prior fractures of the hip, spine, and wrist. In this self-report, 9.3% reported breaking their wrists (n = 101), but less than 2% reported breaking or fracturing their hips (n = 19; 1.7%) or spines (n = 20; 1.8%). In comparing multiple fractures, a significant

finding included a higher than expected proportion of women fracturing both their hip and spine ($n = 3$; 1.6%) ($\chi^2 = 22.6$; $p = 0.004$). Additionally, in making comparisons among the racial/ethnic groups, African American women had a much smaller ($n = 5$; 2.6%) than expected ($n = 18$) count of broken or fractured wrists ($\chi^2 = 14.0$; $p = 0.001$). In comparison, both the Mexican American ($n = 19$; 8.7%) and non-Hispanic Caucasian ($n = 77$; 11.4%) women showed about the same proportion of broken wrists. There were no statistically significant racial/ethnic differences on either hip or spinal fractures.

According to this data, African American women were on average heavier (mean = 84.4 kg; SD = 20.4) than both their Mexican American (mean = 72.8 kg; SD = 15.3) and non-Hispanic Caucasian (mean = 73.3 kg; SD = 17.2) counterparts ($F = 30.2$; $p < 0.001$). For BMI, non-Hispanic Caucasian women (mean = 28.2 kg; SD = 6.2) had on average lower values than both Mexican American (mean = 30.2 kg; SD = 5.9) and African American (mean = 31.9 kg; SD = 7.1) women ($F = 25.4$; $p < 0.001$). For waist circumference, non-Hispanic Caucasian women (mean = 96.9 cm; SD = 13.9) also had lower average values than both Mexican American (mean = 100.4 cm; SD = 12.7) and African American (mean = 102.5 cm; SD = 15.1) women ($F = 12.2$; $p < 0.001$). Observing data concerning cardiovascular health, non-Hispanic Caucasian women (mean = 133.83 mmHg; SD = 21.4) had the lowest average systolic blood pressure when compared to African American (mean = 139.7 mmHg; SD = 26) and Mexican American (mean = 141.7 mm Hg; SD = 24.7) women ($F = 10.6$; $p < 0.001$). However, all groups had high average systolic blood pressure (> 130 mm Hg). Mexican American women were on average hypertensive (> 140 mm Hg). The average diastolic blood pressures were higher among African American women (mean = 71.9 mm Hg; SD = 13.2) when compared to Mexican American (mean = 68.4 mm Hg; SD = 15.5) and non-Hispanic Caucasian (mean = 67.1 mm Hg; SD =

15.4) women ($F = 6.6$; $p = 0.001$). Each of these average diastolic blood pressures among the three different racial/ethnic groups was ideal (< 80 mm Hg). Of the women who reported having ever been told by a doctor whether they have high blood pressure or not, 72.2% of African American women ($n = 140$), 53.7% of Mexican American women ($n = 117$) and 53.3% of non-Hispanic Caucasian women ($n = 357$) said they had been told they had high blood pressure. This equated to 56.7% of the women in this study having been told that they were hypertensive ($\chi^2 = 22.9$; $p < 0.001$).

In relation to lipid factors, there were no racial/ethnic differences for total cholesterol levels. However, on average each racial/ethnic group had borderline (200 to 239 mg/dl) total cholesterol levels. Comparing HDL levels, average HDL measures were greatest among African American women (mean = 64.8 mg/dl; SD = 18), followed by non-Hispanic Caucasian (mean = 61.2 mg/dl; SD = 17.5) and Mexican American (mean = 56.4 mg/dl; SD = 14.2) women ($F = 11.5$; $p < 0.001$). Interestingly, non-Hispanic Caucasian and African American women on average had HDL levels greater than 60 mg/dl, at which point it becomes a negative risk factor for heart disease. Concerning triglyceride levels, Mexican American women (mean = 195 mg/dl; SD = 109.5) had alarming and significantly greater levels than their non-Hispanic Caucasian (mean = 154.7 mg/dl; SD = 81.8) and African American (mean = 122.6 mg/dl; SD = 83.3) counterparts ($F = 16.3$; $p < 0.001$). Finally, when analyzing LDL levels, non-Hispanic Caucasian (mean = 127.1 mg/dl; SD = 38.8) women had greater average LDL cholesterol levels than African American (mean = 119 mg/dl; SD = 39.7) and Mexican American (mean = 118.7 mg/dl; SD = 38.1) women.

Concerning the diabetes measures, Mexican American women ($n = 62$; 29%) self-reported a greater physician diagnosis of diabetes than their African American ($n = 52$; 27.8%)

and non-Hispanic Caucasian (n = 90; 13.7%) counterparts (χ^2 = 34.7; $p < 0.001$). Additionally, a number of women with a self-reported doctor diagnosis of high blood sugar also reported the use of insulin. Of those that reported physician-diagnosed diabetes, more African American (n = 18; 34.6%) women used insulin to treat their diabetes than non-Hispanic Caucasian (n = 21; 23.3%) and Mexican American (n = 14; 22.6%) women. Moreover, there were statistically significant racial/ethnic differences on serum glucose levels and glycohemoglobin percentages. Analyzing serum glucose concentrations, Mexican American (mean = 117.1 mg/dl; SD = 54.8) and African American (mean = 109.2 mg/dl; SD = 41.8) women had higher serum glucose levels than non-Hispanic Caucasian (mean = 98.3 mg/dl; SD = 29.3) women (F = 19.7; $p < 0.001$). Concerning glycohemoglobin levels, Mexican American (mean = 6.2%; SD = 1.4) and African American (mean = 6.1%; SD = 1.1) women also had greater percentages than their non-Hispanic Caucasian (mean = 5.7%; SD = 0.7) counterparts (F = 29.5; $p < 0.001$).

Relationship of Osteoporosis and Metabolic Syndrome

This study evaluated the relationship of the three self-reported incidences of osteoporotic fractures with all the different indicators of metabolic syndrome in two ways.

Wrist fractures. It was first observed that weight measures related to the presence or absence of a wrist fracture. In these comparisons, the number of participants may vary because of missing data. In comparing the body weight of those with wrist fractures (70.3 kg; n = 95; SD = 16.0) and without wrist fractures (75.5 kg; n = 897; SD =18.1), those with this type of fracture had significantly lower weight (t = −2.79; σ = 0.005). Concerning BMI, when those with (27.7 kg; n = 94; SD = 6.1) and without (29.8 kg; n = 892; SD = 6.5) wrist fractures were compared, those with this type of fracture had significantly lower BMI (t = −2.489; σ = 0.013). Finally, when the waist circumference of those with (95.9 cm; n = 87; SD = 13.2) and without (98.9 cm;

n = 853; SD = 14.1) wrist fractures were compared, those with wrist fractures had marginally lower waist circumferences than those without ($t = -1.872$, $\sigma = 0.061$). No differences were found on the weight measures for either spinal or hip fractures.

When related to wrist fractures, LDL cholesterol showed an unaccepted trend ($F = 3.622$; $p = 0.058$) and was marginally significant. All the lipid measures (total cholesterol, HDL and LDL levels, and triglyceride levels) showed no difference on the presence or absence of wrist fractures. There were no differences on any of the cardiovascular measures (average systolic and average diastolic blood pressure) for those with or without wrist fractures. Finally, there were no differences on any of the diabetes measures (serum glucose levels and glycohemoglobin levels) for those with or without the presence of a wrist fracture.

Spinal Fractures. In this study, lipid factors related to the presence or absence of a spinal fracture. When those with (194.8 mg/dl; *n* = 18; SD = 33.4) and without (215.3 mg/dl; *n* = 937; SD = 42.3) spinal fractures were compared to total cholesterol, those with this type of fracture had significantly lower total cholesterol ($t = -2.047$; $\sigma = 0.041$). Comparing LDL cholesterol to those with (93.3 mg/dl; *n* = 9; SD = 31.3) and without (124.3 mg/dl; *n* = 446; SD = 38.9) spinal fractures, the women with spinal fractures also had significantly lower LDL levels ($t = -2.371$; $\sigma = 0.018$). There were no lipid measures relating to hip or wrist fractures. In addition, some factors were not significantly related to spinal fractures. There were no differences on any of the weight measures (weight, BMI, and waist circumference) for those with or without this type of fracture. There were no differences on any of the cardiovascular measures (average systolic and average diastolic blood pressure) for those with or without spinal fractures. There were no differences on any of the diabetes measures (serum glucose levels and glycohemoglobin levels) for those with or without the presence of a spinal fracture. Finally, logistic regression models

were attempted to predict each of the three fracture types. These models did not contribute any findings beyond the results already noted.

Discussion

This study used a sample of African American, non-Hispanic Caucasian, and Mexican American women ages 50 to 84. These three national samples of women were used because they are the three largest ethnic/racial groups in the United States. Additionally, Mexican Americans made up the bulk of the Hispanic population. Of noteworthy interest, 40.8% (n = 89) of Mexican American women wanted a Spanish-language interview. Only one other individual, who self-identified as African American, requested a Spanish-language interview.

Turning attention now to results, the relationship between weight measures and fractures suggests a possible association between body mass and the likelihood of fracturing a wrist. Although the NHANES does not currently have DEXA scan data or PTH measures, according to Majumdar et al. a wrist fracture is a critical event in the natural history of osteoporosis because it predicts an increased risk for hip and spinal fractures (Majumdar et al., 2004). Additionally, fractures of the wrist are the most common symptomatic fractures related to osteoporosis (Majumdar et al., 2004).

Furthermore, concerning weight/BMI and fractures, according to Asomaning et al., "individuals with low BMI typically have low stores of body fat and lower circulating estrogen levels, which help prevent loss of bone tissue. Because body fat also acts as a cushion, low BMI may increase the risk of fracture as a result of a fall" (Asomaning et al., 2006, p. 1029). This same protective factor for fractures also exists for BMI, as BMI and weight are directly associated.

The previous results relating lipid factors and spinal fractures suggest that lower LDL cholesterol levels may increase women's susceptibility to spinal fractures. Other research (Tankó et al., 2003) had different findings in that increased cholesterol contributes to vertebral bone loss in postmenopausal women.

Another interesting observation included high triglyceride levels among Mexican American women in this study. On average, Mexican American women were 5 units from being in the high triglyceride level range. These levels may be contributed to genetic disposition. In a study by Duggirala et al., "We found strong evidence for linkage of ln TG levels to a genetic location on chromosome 15q in the Mexican American population, which is prone to disease conditions such as type II diabetes and the insulin resistance syndrome that are associated with hypertriglyceridemia" (Duggirala et al., 2000, p. 1237). This supports the idea that the high triglyceride levels found in the current study can be attributed to genetics.

Analyzing HDL level data, African American and non-Hispanic Caucasian women on average had higher HDL levels in this study. HDL levels greater than 60 mg/dl are considered protective against heart disease.

Finally, serum glucose and hemoglobin A1C levels in African American and Mexican American women were on average in the prediabetic range (100 to 125 mg/dl). Dr. Candib discusses her opinions concerning low-income and minority individuals and the prevalence of diabetes climbing to epidemic proportions, "underlying the problem are complex factors—genetic, physiological, familial, social, economic, and political" (Candib, 2007, p. 547). There are several potential causes of this rise; however, it is difficult to pinpoint the particular reason behind high blood sugar levels among vulnerable populations.

Overall, there is an association between weight measures and wrist fractures, where those with this type of fracture had significantly lower weight. There is also an association between lipid factors and spinal fractures, where those with spinal fractures had significantly lower total cholesterol. Finally, there were several racial/ethnic differences in osteoporosis and metabolic syndrome components, with African American women having greater weight components, lower incidence of osteoporotic fractures, and significant incidence of metabolic syndrome components. Mexican American women had lower weight components than African American women and lower incidence of osteoporotic fractures than non-Hispanic Caucasian women, but greater incidence of metabolic syndrome components than African American and non-Hispanic Caucasian women. Non-Hispanic Caucasian women had lower weight components and fewer incidences of metabolic syndrome components than Mexican American and African American women; however, they had greater incidences of osteoporotic fractures.

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Table 1. Blood Lipid Parameters

Blood Lipid	Desirable	Borderline	High
Total Cholesterol	< 200 mg/dl	200–239 mg/dl	≥ 240 mg/dl
Low-Density Lipoproteins (LDL)	< 130 mg/dl	130–159 mg/dl	≥ 160 mg/dl
High-Density Lipoproteins (HDL)	> 35 mg/dl (values > 60 mg/dl are considered a negative risk factor)		
Triglycerides	< 200 mg/dl		

Source: From http://www.healthchecksystems.com/chol.htm.