Is there a Relationship between HDL Cholesterol and Muscle Mass in Post-Menopausal Women?

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Abstract:

Menopause coincides with undesirable changes in body composition including increased fat mass and loss of muscle mass (1). One contributing factor to muscle loss is sarcopenia, a low muscle for weight medical condition. These changes are closely linked with enhanced risk for cardiovascular diseases, the top killer of postmenopausal women in the United States. High-density lipoprotein cholesterol (HDL-C), often called the “good cholesterol”, predicts for protection against cardiovascular disease in women. Mouse studies have shown that higher HDL-C levels are positively correlated with higher lean body mass (2). The relationship of HDL-C levels and muscle mass in overweight, Type 2 diabetic, postmenopausal women at risk for cardiovascular diseases was examined. The results indicated that higher levels of total body fat correlate strongly with increasing trunk fat, however, higher HDL-C levels did not correlate with greater lean body mass.

Introduction:

HDL-C, commonly known as 'good cholesterol' scavenges the body to collect cholesterol and carry it back to the liver to be broken down. Recently it has been reported that high-density lipoprotein cholesterol (HDL-C) may target skeletal muscle to promote fatty acid utilization for energy metabolism and increased muscle mass and strength in mice (2). This suggests HDL-C could play an important role in maintaining muscle mass, which is often lost during the menopausal transition in women (1). Age related loss of skeletal muscle mass is known as sarcopenia, and is seen frequently in post-menopausal women (4). When measured, muscle mass is often grouped with total lean body mass (LBM) which consists of any body mass, such as skin, bones, muscles, and organs, not consisting of fat.

Hypothesis:

My study hypothesis is that as HDL-C levels increase so will LBM. In order to investigate this hypothesis, I will examine possible relationships of LBM and fat mass and establish the correlation between HDL-C and LBM in study participants.

Methods:

Data for this study was collected from participants at baseline in two studies previously conducted in the Department of Human Sciences. The first study used was the Women's Diabetes Study (WDS), a 2009 study that examined the role of CLA (Conjugated Linoleic Acid) in improving glucose tolerance, fasting plasma glucose, and insulin in subjects with type 2 diabetes (T2DM). The second study used was the Dietary Fatty Acids as Complementary Therapy in T2DM (FACT), a 2011 study that sought to determine the ability of CLA to reduce body weight and fat mass in subjects with T2DM.

Inclusion criteria for the WDS and FACT studies included: overweight or obese (BMI $\geq$ 25 kg/m^2 and $\leq$ 45 kg/m^2), 18-70 years of age, and have a diagnosis of Type 2 Diabetes. Exclusion criteria for these studies included that the participant not have liver malfunction, gastrointestinal disorders, or use hormone replacement therapy. Participants from the two studies used for this analysis were female and had baseline data of total body and trunk composition and HDL-C (n=58).

Participants' LBM and adipose tissue measurements were collected and quantified using a dual x-ray absorptiometry scan. A dual x-ray absorptiometry (DEXA) scan measures the differing densities of lean body mass (muscle, organs, etc.) and non-lean mass, adipose tissue using weak x-ray beams. Serum HDL-C was measured from blood samples collected in a fasted state.

Variables considered in the data set analysis include total body mass, fat mass, lean body mass, age, BMI, height, and HDL-C levels. Data were analyzed using Microsoft Excel.

Results:

The Relationship of adipose to LBM

From the WDS and FACT study a total of 58 participants were used in this analysis. The relationship between total body fat and trunk body fat was examined controlling for height. Participants demonstrated higher trunk fat mass when total body fat mass increased [Figure 1]. This relationship between trunk fat and total body fat was strong [Pearson – R= 0.9046, $P<0.05$]. Additionally, as trunk lean body mass (LBM) increased, so did total body fat, but this correlation was much less dramatic [Pearson – R= 0.3600, $P<0.10$] than seen with trunk fat and total body fat.

Effect of higher HDL cholesterol

The relationship between HDL-C and LBM was examined in participants, taking into account height, weight, and adequacy of HDL-C level. There was no correlation between HDL-C levels and total LBM. When subjects with adequate HDL-C levels ($\geq$50 mg/dL) were analyzed separately from those with low HDL-C levels to determine if HDL-C status affected the relationship to LBM, there was still no significant relationship found between HDL-C and LBM, regardless of HDL-C status [Figure 2].

Figure 1

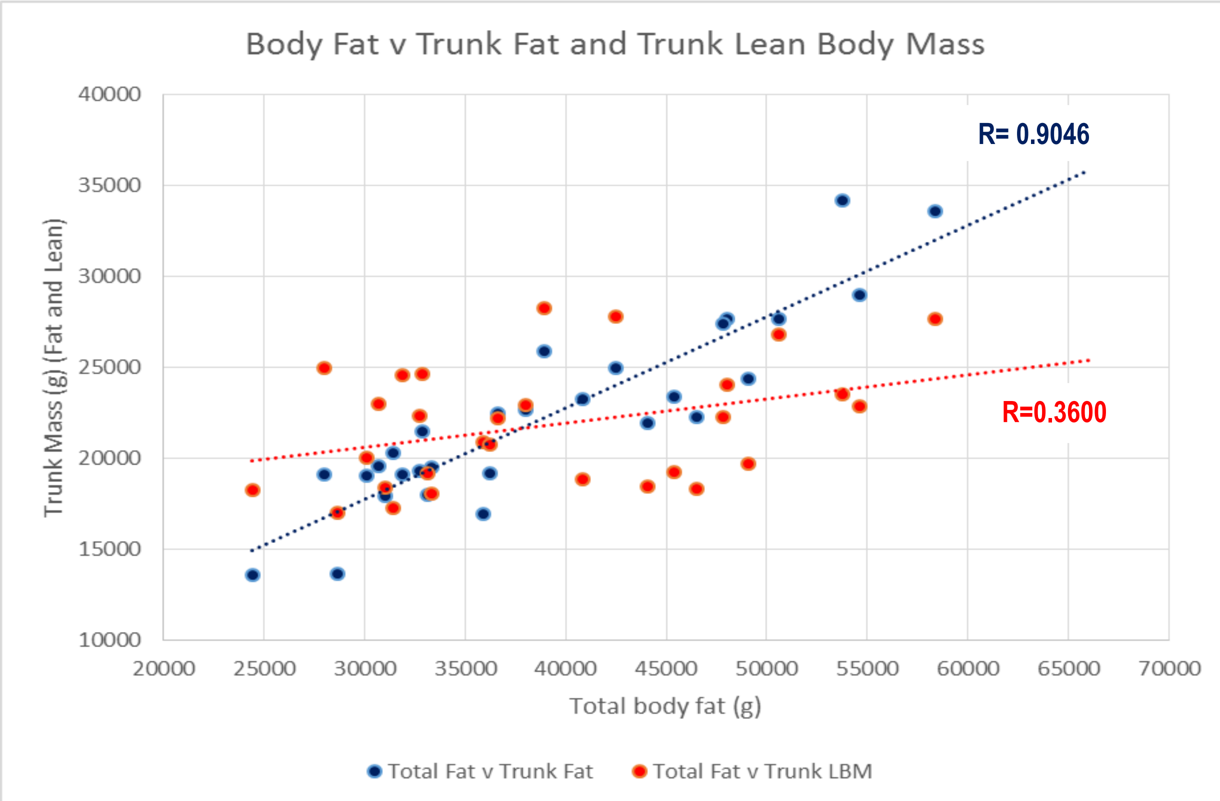
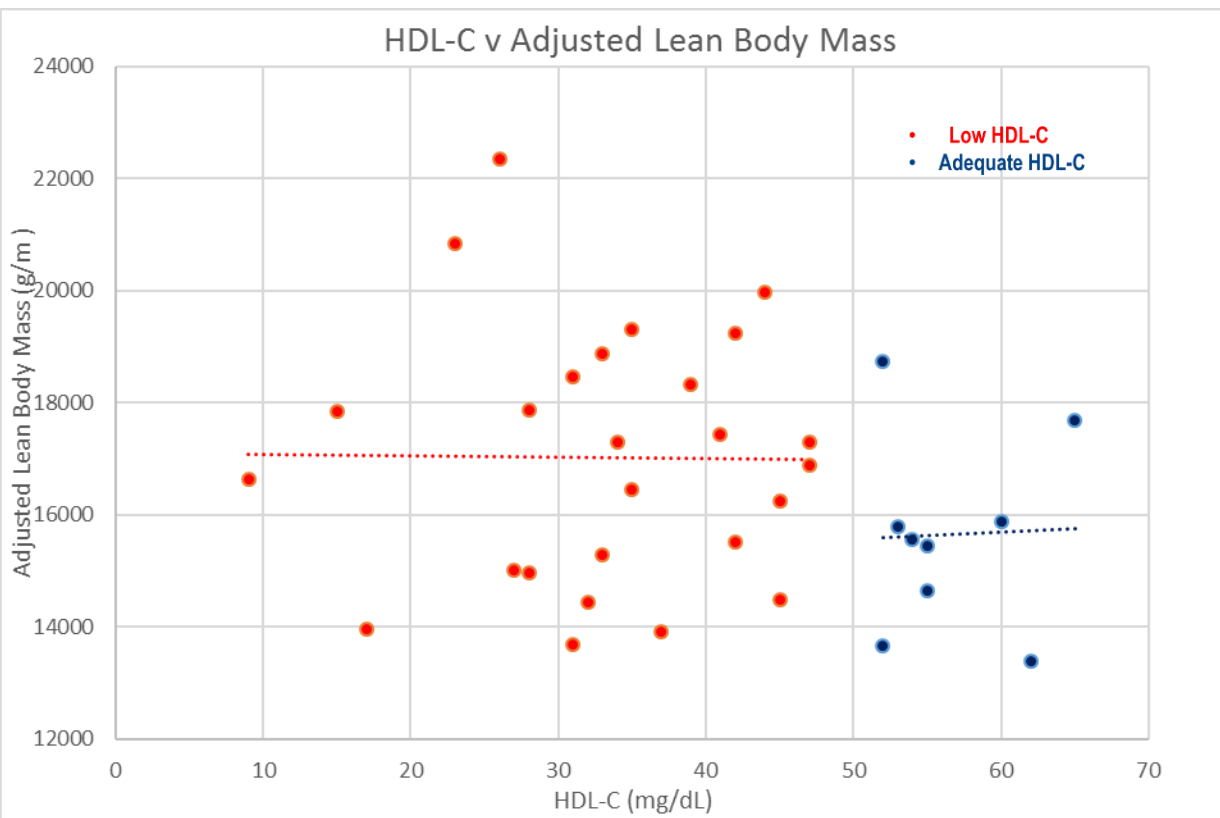


Figure 2



Discussion:

The overall hypothesis was that higher HDL-C levels would correlate with higher measures of LBM, however the results did not support this hypothesis. There was no correlation between HDL-C levels and LBM measurements. Even when HDL-C levels were separated into adequate (n= 9) and low (n= 26) sections, no correlation with LBM measures was found. There was a strong correlation between total body fat and trunk fat. This was expected because when body fat is gained, it is distributed all over the body, not in an isolated area. Additionally, it was expected that participants would show an increase in trunk LBM when total fat mass was greater due to the body's need to carry and compensate for additional weight. This weak correlation between trunk LBM and total fat mass suggests the presence of sarcopenia, age related decrease in lean body mass and reduced muscle strength. These findings may be due to the small pool of subjects and/or confounding variables that may alter muscle mass in people with type 2 diabetes or low HDL-C.

Limitations for this study include the small, homogeneous study population. Data for this study were collected from women who were overweight or obese; no 'normal' body weight participants were examined. Trends in HDL and LBM relationships would have likely been more exaggerated if a more diversified pool were analyzed. Additionally, because all subjects analyzed were in a postmenopausal state, they may have experienced an inherently higher risk for having sarcopenia (4, 5) and therefore it is possible that all LBM measurements are low for the relative body mass measurements. Furthermore, only 9 participants had healthy HDL-C levels. This is not a large enough sample pool to determine reliable correlations or trends.

Future research could examine whether strategies which elevated HDL-C could aid in retaining muscle in women during menopause. Additionally, research could investigate whether HDL-C levels can be manipulated by consuming foods high in monounsaturated and polyunsaturated fats. Previous studies indicate that consuming foods with these healthy fats can increase HDL-C levels (6).

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