USING ULTRASOUND TO DETERMINE CARDIOVASCULAR DISEASE RISK.

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Abstract

Cardiovascular (CV) disease remains the leading cause of death in the world despite being largely preventable. Risk factors include high levels of visceral fat. Ultrasound has made it possible to measure subcutaneous adipose tissue (SCAT) and visceral adipose tissue (VAT) separately. PURPOSE: To determine the relationship between the Framingham CV risk profile, SCAT, VAT, and physical activity (PA) levels in adults. METHODS: CV risk factors were evaluated in 46 participants. To determine the Framingham Score, BMI, total cholesterol, and high-density lipoprotein levels were measured and combined. Amounts of SCAT and VAT were determined from the ultrasound scan. Minutes of moderate to vigorous PA were reported from a questionnaire. Pearson Correlations determined the relationships between variables tested at an alpha level of $p \leq 0.05$. RESULTS: There were significant, moderate correlations between VAT amounts and the Framingham profile ($r=0.445$, $p=0.002$). There was significant negative moderate correlations between the number of minutes of moderate to vigorous PA reported and the Framingham profile ($r= -0.440$, $p=0.002$), the amount of VAT measured ($r= -0.315$, $p=0.035$), and the amount of SCAT measured ($r= -0.301$, $p=0.045$). CONCLUSIONS: Results suggest VAT may be a viable predictor of future CV disease. Further research is needed to strengthen the use of the VAT measurement in the assessment of CV disease.

Introduction

Cardiovascular disease (CVD) is the number one cause of death in world. Prevention is the key to reducing the likelihood of developing CVD; this can be assessed regularly by monitoring risk factors. The risk factors need to be assessed together to provide a "big picture" of the patient's overall cardiovascular risk.

One of the major risk factors of CVD is obesity. In the context of this study, we focused on abdominal adiposity, which can be divided into two categories: subcutaneous adipose tissue (SCAT), which is fat tissue stored between the skin and the muscle (McArdle et al., 2010) and visceral adipose tissue (VAT), which is fat stored deep to the muscle, skin, and SCAT (Chuang et al., 2012; Liu et al., 2003). Ultrasound is becoming a commonly-used technique to generate an image of this tissue, as is it more accessible than other imaging machines such as MRI and CT scans.

In order to assess overall cardiovascular risk, a 30-year cardiovascular risk profile was used, one of the components of the Framingham Heart Study (Pencina et al., 2009). The profile takes into account risk factors that have all been linked individually to CVD. Using all these risk factors, the Framingham Risk Profile creates a score that provides a more complete analysis of the patient's overall cardiovascular risk.

The purpose of this study was to determine the relationship between the Framingham CV risk profile, SCAT, VAT, and physical activity (PA) levels in adults.

Figure 1: Data collection using the BodyMetrix ultrasound machine.

Methods

CV risk factors were evaluated in 46 participants ranging in age from 18-65. Participants were recruited through advertisements to Linfield College and the surrounding community of McMinnville. We recorded anthropometric data including body fat percentage using an ultrasound machine, as well as skin-folds and BIA. To determine the Framingham CV Risk Score, BP, BMI, total cholesterol, and high-density lipoprotein levels were measured and combined into a score. Participants were asked to fast for at least 8 hours and the Cholestech machine, which required only a finger stick, was used to measure the clinical data. Participants filled out a pen and paper PAQ. From the questionnaire, we selected the number of minutes of moderate to vigorous physical activity reported by participants to correlate with other risk factors. Pearson Correlations were conducted to determine the relationships between all variables tested at an alpha level of $p \leq 0.05$.

Using the new technology of the portable ultrasound machine, BodyMetrix, a scan of the waist was conducted The wand was placed 1 cm to the right of the umbilicus. A 10-cm scan was completed by drawing the wand from the umbilicus toward the right hip. The amounts of SCAT and VAT were determined from the scan when two researchers agreed upon the measurement.

Results

Demographics	Average	Range
Age (yr)	35.6 ± 16.9	18 - 68
Height (in)	67.3 ± 4.1	59.3 - 75
Weight (lbs)	168.4 ± 44.7	101.8 - 325.8
BMI (k/m^2)	26.1 ± 6.2	18.1 – 46.3
Total Cholesterol (mg/dL)	173.4 ± 32.7	116 - 264
HDL Levels (mg/dL)	58.1 ± 16.6	33 - 93
Systolic BP (mm Hg)	117.9 ± 9.9	90 - 140
VAT (mm)	20.3 ± 8.9	1.5 - 45.2
SCAT (mm)	11.1 ± 5.8	1.4 - 31.1

Table 1: Demographics of participants in the study.

	Framingham	VAT	SCAT	PAQ
Framingham	1.000	0.445**	0.050	-0.440**
VAT	0.445**	1.000	0.509**	-0.315*
SCAT	0.050	0.509**	1.000	-0.301*
PAQ	-0.440**	-0.315*	-0.301*	1.000

Table 2: Correlation data from the four variables studied.
VAT – Visceral adipose tissue * = $p < 0.05$
SCAT – Subcutaneous adipose tissue ** = $p < 0.01$
PAQ – Physical activity questionnaire

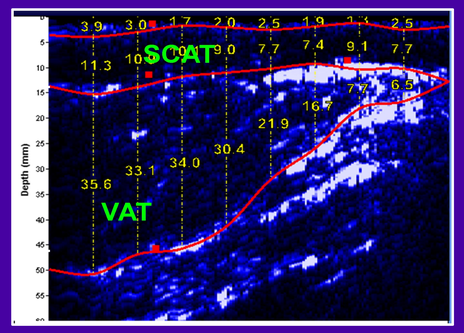

Figure 2: Abdominal ultrasound scan displaying subcutaneous (SCAT) and visceral (VAT) adipose tissue.

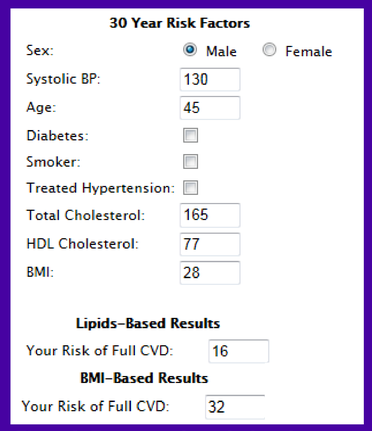

Figure 3: Factors used to calculate the Framingham risk profile.

Discussion

The moderate correlations between VAT and the Framingham Risk Profile indicate that increased visceral fat leads to an increase in the likelihood of developing cardiovascular disease. This finding is consistent with findings in other literature, which suggest that visceral fat has higher metabolic consequences than does subcutaneous fat findings (Liu et al., 2003; Stolk et al., 2003) . This is also supported by the fact that a strong correlation was not found between SCAT and the Framingham Risk Profile data.

Negative moderate correlations were found between the number of minutes of moderate to vigorous physical activity reported and SCAT, VAT, and the Framingham Risk profile. This suggests, as is consistent with other research, that higher levels of body fat and increased risk of cardiovascular disease may be related to a more sedentary lifestyle (Held et al., 2011).

We conclude that measuring VAT is an important component of assessing overall CVD risk and based on the moderate correlations we found, portable ultrasound seems to be a potentially viable method to measure visceral and subcutaneous fat and evaluate cardiovascular risk. However, we recommend that future studies are conducted to provide more data on the portable ultrasound equipment and techniques.

Study Limitations

Limitations included the reduced variability in our population. There were many college students and faculty members included in the study, limiting the variety of individuals. We also had different technicians, ranging in experience level, using the ultrasound machine and quantifying the VAT and SCAT, which may have altered our results. Finally, participant responses to PAQ have some margin of error. The particular PAQ used in this study has been tested for reliability, finding that it correlated fairly highly with 7-day self-reported diaries, but the results have not yet been published.

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