Anthropometry, CT, and DXA as predictors of GH deficiency in premenopausal women: ROC curve analysis

Miriam A. Bredella¹, Andrea L. Utz², Martin Torriani¹, Bijoy Thomas¹, David A. Schoenfeld³, Karen K. Miller²

¹Department of Radiology, Massachusetts General Hospital, Yawkey 6 E, 55 Fruit Street
Boston, MA 02114

²Neuroendocrine Unit, Massachusetts General Hospital, Bulfinch 457B, 55 Fruit Street
Boston, MA 02114

³Department of Biostatistics, Massachusetts General Hospital, 50 Staniford Street - Suite
560, Boston, MA 02114

Corresponding author:
Miriam A. Bredella
Department of Radiology, Yawkey 6E, 55 Fruit Street
Boston, MA 02114
Phone: 617-726-7717
Fax: 617-726-5282
E-mail: mbredella@partners.org

Running head: Body composition predictors of GH deficiency
Abstract

Visceral adiposity is a strong determinant of GH secretion and states of GH deficiency are associated with increased visceral adiposity, and decreased lean body mass. The purpose of our study was to determine the sensitivity and specificity of different methods of assessing body composition (anthropometry, DXA, and CT) to predict GH deficiency in premenopausal women and threshold values for each technique to predict GH deficiency, using ROC curve analysis. We studied a group of 45 healthy lean, overweight, and obese premenopausal women who underwent anthropometric measurements (BMI, waist and hip circumferences, skin fold thickness), DXA, CT and a GHRH-arginine stimulation test. ROC curve analysis was used to determine cut-off values for each method to identify GH deficiency. Visceral adiposity measured by CT showed the highest sensitivity and specificity for identifying subjects with GH deficiency with a cut-off of >9962 mm² (AUC: 0.95, sensitivity:100%, specificity:77.8%, p=0.0001). Largest waist circumference showed high sensitivity and specificity with a cut-off of >101.7 cm (AUC: 0.89, sensitivity:88.9%, specificity:75%, p=0.0001). When comparing the ROC curves of visceral fat measured by CT and largest waist circumference, the difference between the two methods was not statistically significant (p=0.36). Our study showed that the largest waist circumference predicts the presence of GH deficiency in healthy premenopausal women with high sensitivity and specificity and nearly as well as CT measurement of visceral adiposity. It can be used to identify women in whom GH deficiency is likely and therefore in whom formal GH stimulation testing might be indicated.
Keywords: obesity, body composition, Growth Hormone deficiency, waist circumference, ROC curve analysis
Introduction

Obesity is highly prevalent in the western world, and visceral adiposity is an independent predictor of metabolic complications such as dyslipidemia, type 2 diabetes and cardiovascular disease (25, 35). Prior studies have established that visceral adiposity is a strong determinant of growth hormone (GH) secretion (11, 31, 32), and that GH plays a role in modulating body composition. States of GH deficiency are associated with increased body fat, including visceral adiposity, and decreased lean body mass (10, 14); whereas states of GH excess are associated with decreased body fat and increased lean body mass (4).

The GHRH-arginine stimulation test is a sensitive and specific test for diagnosing GH deficiency, and a cut-off limit of 5 ng/ml has been used to diagnose GH deficiency in adults (6). However, this test is invasive, time-consuming, and expensive. Should GH deficiency be determined to be a treatable condition in young women with visceral adiposity, it would be useful to be able to perform a simple body composition measurement to identify subjects who may be at risk for GH deficiency and for whom formal GH simulation testing may be more likely to yield a positive result. Computed tomography (CT) can quantify visceral and subcutaneous fat depots (7) and is the gold standard for measuring visceral fat. However, it is expensive and involves radiation exposure. Several clinical methods, including anthropometry, and dual energy X-ray absorptiometry (DXA), have been used as surrogates for estimating body fat (8, 15, 19,
20, 27, 28, 34), but these measurements do not allow for the evaluation of visceral fat content. The purpose of our study was to compare sensitivity and specificity of simple less invasive measures of body composition, such as anthropometry to CT and DXA to predict GH deficiency in a group of lean, overweight, and obese premenopausal women. In addition, we wanted to determine threshold values for each technique to predict GH deficiency, using receiver operator characteristic (ROC) curve analysis.
Materials and Methods

The study was approved by the institutional review board of Partners Healthcare Inc. and was Health Insurance Portability and Accountability Act compliant. Written informed consent was obtained from all subjects prior to the study.

Subjects

The study group comprised 45 healthy premenopausal women who were recruited from the community through advertisements. Exclusion criteria included hypothalamic or pituitary disorders, diabetes mellitus or other chronic illnesses, estrogen or glucocorticoid use and weight greater than 280 pounds (due to the limitations of the DXA and CT scanners). Participants were admitted to the General Clinical Research Center at the Massachusetts General Hospital, where testing was performed. Each participant underwent anthropometric measurements, DXA, and CT, as detailed below, and a GHRH-arginine stimulation test. For the GHRH-arginine stimulation test, GHRH 1 mcg/kg plus arginine 0.5 g/kg (maximum 30 gm) IV were administered and GH levels drawn at baseline and every 30 minutes for two hours (6). GH deficiency was based on standard criteria used to diagnose adults with hypopituitarism (peak GH after stimulation with GHRH and arginine <5ng/ml) (6). Clinical characteristics, peak GH after GHRH-arginine stimulation, and fat mass, measured by DXA, have been previously published (29, 30).

Biochemical Analyses
Serum samples were collected and stored at -80˚ C. Serum GH was measured using an immunoradiometric assay (IRMA) kit, with a minimum detection limit of 0.01 ng/ml, an intra-assay coefficient of variation (cv) of 3.1-5.4% and an inter-assay cv of 5.9-11.5%.

**Anthropometry**

Body weight was measured at a standard balance beam scale to the nearest 0.1 kg in triplicate and averaged. Height was measured barefoot to the nearest 0.1cm in triplicate and averaged. Body mass index (BMI) was calculated as weight divided by height squared (kg/m²).

Skin fold thickness of the triceps, biceps, subscapular and suprailiac areas was measured using metal calipers in triplicate and averaged. Skin fold measurements were used to estimate % body fat.

Body circumferences were measured at the waist at the smallest circumference between the lowest rib and iliac crest, at the level of the umbilicus, the midpoint between the lowest rib and iliac crest, the iliac crest, and at the hip using a metal tape to the nearest 0.1 cm in triplicate and averaged. The largest circumference represents the largest value obtained from the above measures. Iliac waist-to-hip and largest hip-to-waist ratios were determined from the circumferential measurements of the waist at the level of the umbilicus and the hips at the level of the iliac crest taken with the patient in a standing position.
All measurements were performed by research bionutritionists who had been previously trained and certified to perform these procedures.

**Dual X-ray Absorptiometry**

DXA measurements of body composition were performed using a Hologic QDR 4500 scanner (Hologic Inc., Waltham, MA). The following parameters were obtained: % fat of the right and left upper and lower extremities, % trunk fat, and total % body fat. In addition, the amount of fat (in g) of the upper and lower extremities, trunk, and total body was obtained. Coefficients of variation of DXA have been reported as 3% for body fat mass (21).

**Computed Tomography (CT)**

Each subject underwent cross-sectional CT scan of the abdomen at the level of L4. Assessment of visceral and subcutaneous abdominal fat compartments by single-slice CT image of the abdomen was performed. Patients were placed supine, feet first in the scanner and with flexion of the knees to minimize lumbar lordosis. A lateral scout image was obtained to identify the level of L4, which served as the landmark for the single slice image. Scan parameters for each image were standardized (144 table height, 80kV, 70 mA, 2 seconds, 1 cm slice thickness, 48 FOV). Fat attenuation coefficients were set at -50 to -250 HU as described by Borkan et al. (7). Total abdominal cross-sectional area was computed by outlining the outer contour of the abdomen. A second outline of the back and abdominal wall musculature (inner contour) was used to define the subcutaneous fat area. Visceral abdominal fat was defined as the area within the inner
contour comprising all pixels with attenuation coefficients between -50 and -250 HU. The total fat area was calculated as the sum of subcutaneous fat and visceral abdominal fat. These values were used to calculate area of subcutaneous adipose tissue, visceral adipose tissue and total adipose tissue.

**Statistical analysis**

JMP Statistical Discoveries (version 4.0.2, SAS Institute, Inc., Cary, NC) and MedCalc (version 9.2.1.0, MedCalc, Mariakerke, Belgium) were used for statistical analysis. The means and standard deviations (SD) were calculated and groups were compared using the Student’s t-test. ROC curve analysis of different methods of body composition measurements was performed to determine sensitivity and specificity, area under the ROC curve, confidence intervals (CI) as well as cut-off values for each method to detect GH deficiency.

Since this was an exploratory study we did not perform a validation study. However, we performed a cross validated error estimate to determine the error estimate for each measure.

Power calculation: The t-test power was used to approximate the power of the ROC curve test. With a proposed sample size of 9 for the GH deficient and 36 for the GH sufficient group, the study will have a power of 82.3% to yield a statistically significant result, that the area under the ROC curve is greater than 0.5. This computation assumes that the mean difference is 1.1 (corresponding to means of 1.1 versus 0.0) and the common within-group standard deviation is 1.0.
Results

Clinical Characteristics of Study Subjects

Subject characteristics are shown in Table 1. Study participants ranged from 19-45 years, mean 33±8.3 years (SD). Study participants ranged in BMI from 19.2 to 43.6 kg/m², mean 30.9±6.5 kg/m² (SD) and were categorized as lean (n=10) if BMI < 25 kg/m², overweight (n=12) if BMI ≥ 25 kg/m² and < 30 kg/m², and obese (n=23) if BMI ≥30 kg/m², based on WHO definitions (1). Nine patients had GH deficiency as determined by the GHRH-arginine stimulation test, and 36 subjects were GH sufficient. Subjects with GH deficiency were slightly older and had higher weight, BMI, total, subcutaneous and visceral fat, as determined by CT, compared to the GH sufficient subjects. Clinical characteristics of the two groups are shown in Table 2.

Body composition determinants of GH deficiency

Results of ROC curve analyses are summarized in Table 3. On the basis of ROC curves, visceral adiposity measured by CT showed the highest sensitivity and specificity for identifying subjects with GH deficiency. The area under the curve (AUC) was 0.95 and with a cut-off value of >9962 mm², sensitivity was 100% and specificity was 77.8% (p=0.0001). Sensitivity and specificity of the cross validated error estimate were 89% and 75%, respectively. The largest waist circumference was the umbilical waist circumference in 75% of patients. Largest waist circumference showed high sensitivity and specificity when a cut-off value of >101.7 cm was used (AUC: 0.89, sensitivity 88.9%, specificity 75%, p=0.0001). Sensitivity and specificity of the cross validated error
estimate were 67% and 72%, respectively. Using a cut-off value of >80cm for largest waist circumference as used to diagnose metabolic syndrome by the International Diabetes Federation (3), sensitivity was 100% but specificity was only 9%. Using a cut-off value of >88cm for the largest waist circumference as proposed by Lean et al (18) to determine visceral adiposity, sensitivity was 100% but specificity dropped to 25%. When comparing the ROC curves of visceral fat measured by CT and largest waist circumference (cut-off value of >101.7cm), the difference between the two methods was not statistically significant (p=0.36) (Figure 1).

Determination of total and trunk fat content as measured by DXA showed an AUC of 0.87 and 0.88 with sensitivity of 100% and specificity of 69.4% and 66.7%, respectively, when using a cut-off value of >16246g and >31677g, respectively (p=0.0001). Sensitivity and specificity of the cross validated error estimate were 67% and 64%, respectively for total fat and 67% and 67%, respectively, for trunk fat. Comparing ROC curves of visceral fat measured by CT and trunk fat (g) measured by DXA, the difference between the two methods was not statistically significant (p=0.36). The largest waist-to-hip ratio demonstrated an AUC of 0.85 and sensitivity was 100% and specificity was 66.6% when a cut-off value of >0.85 was used (p= 0.0001). Sensitivity and specificity of the cross validated error estimate were 67% and 57%, respectively. Comparing the ROC curves of visceral fat as measured by CT and largest hip to waist ratio, the difference between the two methods was not statistically significant (p=0.3).
Discussion

Our study showed that the largest waist circumference can predict GH deficiency in premenopausal women and that this measurement is almost as sensitive and specific for predicting GH deficiency as visceral fat measured by abdominal CT. These data may be of importance if further research confirms the association of GH deficiency with increased cardiovascular risk.

An increased prevalence of visceral adiposity and cardiovascular events has been established in women with GH deficiency due to hypopituitarism. Studies have shown that decreased GH secretion is an independent risk factor for visceral obesity and cardiovascular disease in this patient population. Higher cardiovascular mortality in female GH deficient patients than in males has been found (9, 24). This may reflect a relatively more severe state of GH deficiency in women compared with men, as GH secretion is nearly twice as high in young, healthy women as in men (11). Therefore, we focused our study on healthy overweight and obese women and the relationship between visceral adiposity and GH deficiency in this patient population.

Multiple studies have demonstrated decreases in visceral adiposity, without a change in overall weight or BMI in GH deficient patients during physiologic GH administration (5, 15). Although not FDA approved for clinical use, GH replacement has been studied in subjects with visceral adiposity without pituitary or hypothalamic disease, and may improve insulin sensitivity over time, potentially due to adipose reduction. In a study by
Johannsson et al. (17), administration of low-dose GH to obese men resulted in decreased visceral fat mass, suggesting a possible therapeutic role for GH in patients with visceral obesity. In a study evaluating GH administration in obese postmenopausal women (12), 12 months of GH administration reduced the amount of visceral fat and increased thigh muscle mass, whereas no change in subcutaneous adipose tissue was observed. Therefore, if further research confirms these effects, it might be useful to develop diagnostic tools in order to identify subjects with visceral adiposity who might be at risk for being GH deficient and in whom formal GH stimulation testing should be performed.

Sophisticated imaging modalities such as CT or MRI are able to distinguish visceral from subcutaneous fat with a high level of precision, but these methods are expensive, time consuming, and CT involves radiation exposure (2, 26). Simple anthropometric variables such as waist circumference and waist-to-hip ratio have been used to estimate visceral adipose tissue. Several studies have indicated that the waist circumference is strongly related to health risks associated with obesity and that it correlates with visceral fat measured by CT (13, 16). Our study showed that the largest waist circumference is an easy and reliable method that can predict GH deficiency in premenopausal women. Waist circumferences can be measured at several locations. In our study, the waist circumference measured at the umbilicus corresponded in 75% of study participants to the largest waist circumference. Visceral adiposity measured with CT showed a higher sensitivity and specificity in detecting GH deficiency than largest waist circumference. However, the difference between the two methods was not statistically significant. On the basis of ROC curves, the most sensitive and specific cut-off was >102 cm in women for
largest waist circumference. Current guidelines suggest a cut-off of >88 cm in women on
the basis of detecting many metabolic risk factors (16). In our study, the specificity of
detecting GH deficiency dropped from 75% to 25% when using 88 cm as a cut-off. The
International Diabetes Federation suggests a cut-off value for largest waist circumference
of >80 cm to diagnose metabolic syndrome. Using this cut-off value, the specificity in
our study dropped to 9%. In a study by Wahrenberg et al (33) a cut-off of >100 cm was
sensitive and specific for predicting insulin resistance in men and women. Based on our
data, a waist circumference of >102 cm in premenopausal women provides a useful
reference value to identify obese women who may be at risk for GH deficiency and who
should undergo formal GH stimulation testing.

In our study, BMI and iliac waist-to-hip ratio measurements showed low sensitivity and
specificity in predicting GH deficiency. Trunk and total fat as determined by DXA
showed high sensitivity and specificity in detecting GH deficiency. However, sensitivity
and specificity were higher for the largest waist circumference. In addition, DXA requires
radiation exposure. As expected, skin fold measurements did not predict GH deficiency
in our population. We performed skin fold thickness measurements of the triceps, biceps,
subscapular, and suprailiac areas to present the complete spectrum of anthropometric
measurements.

Our study had several limitations. First is the relatively small number of subjects who
were GH deficient (n=9) compared to the GH sufficient subjects (n=36). Second, we only
studied premenopausal women. There are sex- and age-related differences in the relation
of waist measurement to accumulation of visceral adipose tissue (22, 23). Thus, it is
likely that different cut-off values for waist circumference as predictors of GH deficiency would be found in pre and postmenopausal women and in men. We also did not perform a validation study to test the proposed cut-off values derived in our study in a different population. However, we performed a cross validated error estimate which confirmed our cut-off values. Without a larger sample size and without appropriate cross validation data our cut-off values for waist circumference should be viewed with caution until results of larger studies have become available. Since there were only 9 cases in our sample, estimates of sensitivity would have a standard error of 13% (calculated at 80% sensitivity). A measured sensitivity of 100% would have a 95% lower confidence bound of 72%. For many clinical applications this is not adequate and further validation studies in larger patient populations should be performed.

In conclusion, the largest waist circumference predicts the presence of GH deficiency in premenopausal women without hypothalamic or pituitary disease with high sensitivity and specificity and nearly as well as CT measurement of visceral adiposity. This provides further evidence of the importance of visceral fat mass as a predictor and possible mechanism for GH deficiency in young healthy women. GH replacement has not been established to be a safe and effective treatment for young overweight or obese women and is not FDA approved. However, should GH deficiency be established to have important cardiovascular risk or metabolic consequences in the future, we raise the possibility that a simple test that can be performed in any office with a tape measure might be able to identify women in whom GH deficiency is likely and therefore in whom formal GH stimulation testing might be indicated.
Grants

This work was supported in part by the following grants: HL077674, MO1 RR01066, and K23RR23090
References


Figure legends

Figure 1: ROC curve of visceral fat measured by CT (solid line) and largest waist circumference (dotted line) to detect GH deficiency. Although the AUC is larger for the CT measurement, the difference is not significant (AUC CT: 0.95, AUC largest waist circumference: 0.89, p=0.36).
Table legends

Table 1: Clinical characteristics of all subjects.

Table 2: Clinical characteristics of GH deficient and GH sufficient subjects.

Table 3: ROC curve analysis of different body composition methods
Table 1
Clinical characteristics of all subjects.

<table>
<thead>
<tr>
<th>Variable</th>
<th>All subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n= 45)</td>
<td>(n= 45)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>33±8.3</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>82±18.3</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>30.9±6.5</td>
</tr>
<tr>
<td>GH stimulation peak (ng/mL)</td>
<td>14.8±11</td>
</tr>
</tbody>
</table>
Table 2
Clinical characteristics of GH deficient and GH sufficient subjects.

<table>
<thead>
<tr>
<th>Variable</th>
<th>GH peak , 5 ng/ml (n=9)</th>
<th>GH peak ≥ 5ng/ml (n=36)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>38.4±6.2</td>
<td>31.7±8.2</td>
<td>0.03</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>101.3±17.3</td>
<td>78.1±15.6</td>
<td>0.0003</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>37±5.2</td>
<td>29.4±6</td>
<td>0.001</td>
</tr>
<tr>
<td>Total abdominal fat (mm²)</td>
<td>82078±21911</td>
<td>48026±22625</td>
<td>0.0002</td>
</tr>
<tr>
<td>Subcutaneous fat (mm²)</td>
<td>51895±16320</td>
<td>33693±14474</td>
<td>0.002</td>
</tr>
<tr>
<td>Visceral fat (mm²)</td>
<td>16852±5349</td>
<td>7127±3868</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>GH stimulation peak (ng/mL)</td>
<td>3.4±1.2</td>
<td>17.7±10.5</td>
<td>0.0002</td>
</tr>
</tbody>
</table>
### Table 3. ROC curve analysis of different body composition methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Threshold</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>ROC-AUC</th>
<th>95% Confidence Interval</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI (kg/m(^2))</td>
<td>&gt;36.4</td>
<td>66.7</td>
<td>88.9</td>
<td>0.83</td>
<td>0.69-0.92</td>
<td>0.0002</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>&gt;79.8</td>
<td>100</td>
<td>63.9</td>
<td>0.85</td>
<td>0.71-0.94</td>
<td>0.0001</td>
</tr>
<tr>
<td>Waist circumference-largest (cm)</td>
<td>&gt;101.7</td>
<td>88.9</td>
<td>75</td>
<td>0.89</td>
<td>0.76-0.96</td>
<td>0.0001</td>
</tr>
<tr>
<td>Waist circumference-umbilicus (cm)</td>
<td>&gt;101.7</td>
<td>88.9</td>
<td>74.3</td>
<td>0.89</td>
<td>0.75-0.96</td>
<td>0.0001</td>
</tr>
<tr>
<td>Waist circumference-iliac (cm)</td>
<td>&gt;99</td>
<td>100</td>
<td>66.7</td>
<td>0.84</td>
<td>0.7-0.93</td>
<td>0.0001</td>
</tr>
<tr>
<td>Waist circumference-mid (cm)</td>
<td>&gt;98.7</td>
<td>88.9</td>
<td>73.5</td>
<td>0.85</td>
<td>0.71-0.94</td>
<td>0.0001</td>
</tr>
<tr>
<td>Waist circumference-smallest (cm)</td>
<td>&gt;88.7</td>
<td>100</td>
<td>60</td>
<td>0.86</td>
<td>0.72-0.94</td>
<td>0.0001</td>
</tr>
<tr>
<td>Hip circumference (cm)</td>
<td>&gt;109</td>
<td>100</td>
<td>50</td>
<td>0.8</td>
<td>0.66-0.91</td>
<td>0.0009</td>
</tr>
<tr>
<td>Iliac Waist-Hip Ratio</td>
<td>&gt;0.85</td>
<td>77.8</td>
<td>58.3</td>
<td>0.7</td>
<td>0.54-0.82</td>
<td>0.057</td>
</tr>
<tr>
<td>Largest waist-hip ratio</td>
<td>&gt;0.87</td>
<td>100</td>
<td>66.6</td>
<td>0.85</td>
<td>0.72-0.94</td>
<td>0.0001</td>
</tr>
<tr>
<td>Skin % body fat</td>
<td>&gt;36.4</td>
<td>88.9</td>
<td>68.6</td>
<td>0.79</td>
<td>0.64-0.89</td>
<td>0.002</td>
</tr>
<tr>
<td>Skin biceps (mm)</td>
<td>&gt;10.7</td>
<td>100</td>
<td>52.8</td>
<td>0.73</td>
<td>0.57-0.85</td>
<td>0.025</td>
</tr>
<tr>
<td>Skin subscapular (mm)</td>
<td>&gt;18.5</td>
<td>100</td>
<td>33.3</td>
<td>0.64</td>
<td>0.48-0.78</td>
<td>0.18</td>
</tr>
<tr>
<td>Skin suprailiac (mm)</td>
<td>&gt;22.3</td>
<td>100</td>
<td>47.2</td>
<td>0.71</td>
<td>0.55-0.83</td>
<td>0.043</td>
</tr>
<tr>
<td>Skin triceps (mm)</td>
<td>&gt;22.7</td>
<td>100</td>
<td>52.8</td>
<td>0.76</td>
<td>0.61-0.87</td>
<td>0.008</td>
</tr>
<tr>
<td>Abd. CT total area (mm2)</td>
<td>&gt;66800</td>
<td>88.9</td>
<td>80.6</td>
<td>0.85</td>
<td>0.71-0.94</td>
<td>0.0001</td>
</tr>
<tr>
<td>Abd. CT SQ fat (mm2)</td>
<td>&gt;54700</td>
<td>66.7</td>
<td>91.7</td>
<td>0.8</td>
<td>0.66-0.91</td>
<td>0.0009</td>
</tr>
<tr>
<td>Abd. CT visceral fat (mm2)</td>
<td>&gt;9962</td>
<td>100</td>
<td>77.8</td>
<td>0.95</td>
<td>0.84-0.99</td>
<td>0.0001</td>
</tr>
<tr>
<td>DXA % fat left arm</td>
<td>&gt;43.8</td>
<td>100</td>
<td>61.1</td>
<td>0.8</td>
<td>0.65-0.9</td>
<td>0.0012</td>
</tr>
<tr>
<td>DXA % fat right arm</td>
<td>&gt;42.1</td>
<td>100</td>
<td>63.9</td>
<td>0.83</td>
<td>0.69-0.92</td>
<td>0.0002</td>
</tr>
<tr>
<td>DXA % fat left leg</td>
<td>&gt;45</td>
<td>77.8</td>
<td>75</td>
<td>0.77</td>
<td>0.62-0.88</td>
<td>0.0043</td>
</tr>
<tr>
<td>DXA % fat right leg</td>
<td>&gt;44.6</td>
<td>77.8</td>
<td>77.8</td>
<td>0.76</td>
<td>0.61-0.87</td>
<td>0.0078</td>
</tr>
<tr>
<td>DXA % fat trunk</td>
<td>&gt;39.9</td>
<td>100</td>
<td>66.7</td>
<td>0.85</td>
<td>0.71-0.94</td>
<td>0.0001</td>
</tr>
<tr>
<td>DXA % fat total</td>
<td>&gt;39.1</td>
<td>100</td>
<td>63.9</td>
<td>0.83</td>
<td>0.69-0.93</td>
<td>0.0001</td>
</tr>
<tr>
<td>DXA fat trunk (g)</td>
<td>&gt;16246</td>
<td>100</td>
<td>69.4</td>
<td>0.87</td>
<td>0.74-0.95</td>
<td>0.0001</td>
</tr>
<tr>
<td>DXA fat total (g)</td>
<td>&gt;31677</td>
<td>100</td>
<td>66.7</td>
<td>0.88</td>
<td>0.74-0.95</td>
<td>0.0001</td>
</tr>
<tr>
<td>DXA lean total (g)</td>
<td>&gt;45637</td>
<td>100</td>
<td>36.1</td>
<td>0.7</td>
<td>0.55-0.83</td>
<td>0.05</td>
</tr>
<tr>
<td>DXA lean trunk (g)</td>
<td>&gt;23323</td>
<td>100</td>
<td>61.1</td>
<td>0.77</td>
<td>0.62-0.88</td>
<td>0.004</td>
</tr>
</tbody>
</table>