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**Influence of Relative Adiposity on Static Back Extensor Muscle Endurance in Apparently Healthy Adults**

**Chidozie E. Mbada,1 MSc (PT); Olusola Ayanniyi,2 PhD (PT) FMII; Rufus A. Adedoyin,3 PhD (PT)**

**Abstract:** Few studies have sought to gain insight into the determinants of endurance capacity of the back extensor muscles. This study investigated the influence of body fat on the endurance of the back extensor muscles using different measures of adiposity in apparently healthy Nigerian adults. Three hundred and seventy-six consecutive adults aged 38.9 ± 13.5 years participated in the study. The participants performed the Biering-Sørensen test of static muscular endurance, and their height, weight and percentage body fat (PBF) were measured using standard procedures. Body mass index (BMI), lean body mass and body fat mass were calculated. Descriptive statistics of mean and standard deviation, ANOVA and multiple regression analysis were used. The α level was set at 0.05. A significant difference (p = 0.000) was found in the isometric holding time (IHT) of the underweight (131.04 ± 49.61 seconds), normal (125.52 ± 46.3 seconds), overweight (85.61 ± 37.24 seconds) and obese (73.02 ± 41.67 seconds) categories using the BMI definition. Significant differences (p = 0.000) were found in the IHT among the lean, acceptable, moderately overweight and overweight categories for males and females using the PBF classification. After controlling for age, sex and other anthropometric factors, BMI was significantly associated (p = 0.000) with IHT, accounting for approximately 40% of the variability in back muscle endurance; PBF was significantly associated (p = 0.000) with IHT for males and accounted for approximately 50% of the variability in males and females. Overweight and obesity are important factors in the aetiology of decreased back extensor muscle endurance. Approaches to reduce decreased back muscle endurance and the risk of low back pain may include prevention of overweight and obesity.

**Key words:** adiposity, back extensor muscles, endurance, Nigerian adults, static

**Introduction**

Endurance testing of back extensor muscles examines the localized capability of the extensor muscles of the back to sustain activity [1]. Low levels of static endurance in the back extensor muscles are associated with higher rates of low back pain (LBP) [2,3], decreased proprioceptive awareness [4], poor balance [5], and decreased productivity in the workplace [6]. The assessment of the endurance capability of these muscles is seen to be important in the clinical setting as an outcome tool among healthy and patient populations [7–9].

Ropponen [10] proposed that insight into the underlying determinants for the performance of isometric back extension endurance test will give a better understanding of back endurance testing and allow more accurate interpretation of the back function test in evaluating working capacity, investigation of back disorders, as well as it being useful in preventive medicine and related to maintenance or enhancement of back muscle function. Several anthropometric measures have been considered in relation to back function, such as body mass index (BMI), body weight, height and body fat, and these have led to a wide range of correlation coefficients (r = 0.04–0.68) for the association [11–14].

Increase in body fat level is an important determinant of back health [12,15–17]. The evaluation of fatty mass and definitions of overweight and obesity use a
range of approaches, some of which are complex or invasive, and are inapplicable outside of specialized clinical practice to identify candidates for weight management [18–21]. The BMI as a surrogate measure of the degree of body fat has long been recognized in routine clinical practice and epidemiological studies [22–25]. However, the percentage body fat (PBF), which refers to the fraction of the total body mass that is adipose tissue, has been reported to be a more accurate measure of body fat than BMI, since it directly measures body composition [26]. In addition, body fat mass (BFM), often referred to as fat weight which is another estimate of the weight of the total body fat in absolute terms and expressed as a percentage of total body weight, is also considered as a better proxy of the level of total body fat [27]. Few studies have sought to gain an insight into the relative influence of body fat on the endurance capacity of the back extensor muscles [12,15–17]. The objective of this study was to investigate the influence of body fat on back extensor muscle endurance using different measures of adiposity among apparently healthy Nigerian adults, in order to gain a better understanding of the determinants of test performance.

Methods

Participants

Three hundred and seventy-six apparently healthy consecutive adults with a mean age of 38.9±13.5 years voluntarily participated in this study. The ethical approval for the study protocol was obtained from the Institutional Review Committee of the University of Ibadan/University College Hospital. Participants were fully informed about the purpose of the study and gave signed consent before measurements were taken.

Participants were recruited from the University of Ibadan, University College Hospital, Ibadan, and the surrounding metropolis, Ibadan, Nigeria, and were screened via interview to ensure that they satisfied the selection criteria for the study. Eligible participants for this study were not engaged in any systematic exercise programme of the lumbar or hip extensor muscles at the time of the study. Other inclusion criteria included: (1) asymptomatic of LBP for a minimum of 1 year at the time of the study. Other inclusion criteria included: (2) no obvious spinal deformity or neurological disease; (3) no involvement in competitive sport or athletics; or no reported history of cardiovascular diseases contraindicated to exercise.

Procedures

The height of each participant was measured to the nearest 0.1 cm with a height meter (Seca 220; Seca GmbH & Co. KG, Hamburg, Germany) calibrated from 0 to 200 cm. The participant’s heels, back and occiput were touching the scale, with the participant looking straight ahead during the measurement. Weight was measured to the nearest 1.0 kg with a weighing scale (Seca 762; Seca GmbH & Co. KG.) calibrated from 0 to 120 kg, with the participant in light apparel and standing with shoes off. BMI, lean body mass (LBM) and BFM were calculated.

The PBF of all participants was measured using the bioelectric impedance analysis machine (Omron HBF-306-E; Omron Corp., Kyoto, Japan). This method is based on the behaviour of biological structures subjected to a constant low-level alternating current [28]. The participants were instructed to remove all metal objects, e.g. earrings, chains, wrist watches. They were instructed to stand erect with the two feet together and also to hold the machine in both hands such that the palms covered the metal surfaces of the instrument. They were then instructed to hold the arms straight at 90° of shoulder flexion. Dryness of the palms was ensured by using a dry towel for cleaning if the palms were wet, and by also making sure that the participants did not have hyperhidrosis. The height, weight, age and sex of the participants were fed into the micro data processor of the instrument, and the start button was switched on. The participants were then asked to stand still till a new set of data was displayed on the meter. The PBF was then approximated to the nearest one decimal place.

The Biering-Sørensen test of static muscular endurance was used in the assessment of back extensor muscle endurance [29]. As a clinical tool for diagnosis of low back muscular endurance, this test has been reported to be valid, reliable, safe, practical, responsive, easily administered and inexpensive, and there is a substantial quantity of compiled data [7–9]. It measures how long (to a maximum of 240 seconds) the participant can keep the unsupported trunk (from the anterior iliac crests level up) horizontal while lying prone on a plinth with their hands held by their sides. The test procedure was explained and demonstrated to the participants at inclusion. The participant lay on the examination table in the prone position with the upper edge of the iliac crests aligned with the edge of the table. The lower body was fixed to the table by two non-elastic straps located around the pelvis and ankles, with a small pillow/towel used to relieve stress on the ankle joint. With the arms held along the sides touching the body, the participant was asked to isometrically maintain the upper body in a horizontal position. Horizontality was ensured by asking the participant to maintain contact between his/her back and a weighted ball hanging from a Guthrie-Smith frame. Once a loss of contact with the suspended weighted ball for more than 10 seconds was noticed, the participant was encouraged once to immediately maintain contact again. If the position was not immediately corrected, or if the participant claimed he/she could no longer hold the position because of fatigue, discomfort or pain, the test was ended. The total time from the onset of the test to trunk flexion and loss of the static...
neutral position was recorded as the endurance time or the isometric holding time (IHT) (in seconds) with a quartz stopwatch. The test was conducted only once and, thereafter, the participants were discharged [7]. Prior to the test, the participants warmed up using a Sportop bicycle ergometer (B600; Sportop, UK), unloaded for 2 minutes at self-determined speed 5 minutes before the test, as recommended by Alaranta [7].

Computations

The clinical guidelines on the identification, evaluation and treatment of obesity in adults by the National Heart, Lung and Blood Institute [30] was used in the definition of BMI: underweight <18.5 kg/m²; normal ≥18.5–24.9; overweight ≥25–29.9 kg/m²; obesity >30 kg/m². Using the PBF classification for the general population, participants were categorized as follows: lean <12%, acceptable 12–21%, moderately overweight 21–26%, overweight >26% for men; and lean <17%, acceptable 17–28%, moderately overweight >28–33%, and overweight >33% for women [31].

BFM or fat weight was calculated from the bioelectric impedance analysis estimate of the PBF using the formula: BFM = (PBF×total body weight)/100. LBM (kg) was calculated from the PBF estimate of the bioelectric impedance analysis. LBM (kg) was calculated by subtracting BFM (kg) from total body weight (kg).

Data analysis

The descriptive statistics of means, confidence interval and standard deviation were used to summarize the data collected. One-way ANOVA was used to compare between the various categories of the participants. Multiple regression analysis was used to identify the association between adiposity and IHT. The α level was set at 0.05. Data analysis was carried out using SPSS version 13.0 (SPSS Inc., Chicago, IL, USA).

Results

The means with 95% confidence interval of the physical characteristics of the participants and the measures of adiposity are presented in Table 1. Using the clinical guidelines on the identification, evaluation and treatment of obesity in adults [30] for the BMI definition, all the participants were classified into the underweight, normal, overweight or obese category. A summary of the one-way ANOVA and LSD post hoc multiple comparison among the underweight, normal, overweight and obesity categories are presented in Table 2. The ANOVA and LSD post hoc test showed a significant difference (F = 27.82; p = 0.000) among the endurance time of the underweight (131.04 ± 49.61) seconds, normal (125.52 ± 46.3 seconds), overweight (85.61 ± 37.24 seconds) and obese (73.02 ± 41.67 seconds) categories. Shorter endurance time was found in the overweight and obese categories.

With respect to PBF level, all participants were categorized into the lean, acceptable, moderately overweight or overweight category according to the New York Obesity

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Table 1. Physical characteristics and the measures of adiposity of all the participants

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>38.9 (37.5–40.3)</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.65 (1.57–1.73)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>63.8 (62.6–65.0)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.5 (23.1–23.9)</td>
</tr>
<tr>
<td>PBF (%)</td>
<td>26.5 (25.5–26.5)</td>
</tr>
<tr>
<td>LBM (kg)</td>
<td>46.2 (45.4–47.0)</td>
</tr>
<tr>
<td>BFM (kg)</td>
<td>17.4 (16.5–18.3)</td>
</tr>
</tbody>
</table>

CI = confidence interval; BMI = body mass index; PBF = percentage body fat; LBM = lean body mass; BFM = body fat mass (fat weight).

Table 2. Summary of the one-way ANOVA and LSD post hoc multiple comparison among the underweight, normal, overweight and obese categories using the body mass index (BMI) classification for all participants

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>Underweight (n = 26)</th>
<th>Normal (n = 238)</th>
<th>Overweight (n = 70)</th>
<th>Obese (n = 42)</th>
<th>F ratio</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>36.77 ± 12.71†</td>
<td>36.48 ± 13.81†</td>
<td>44.27 ± 11.51†</td>
<td>44.81 ± 11.43†</td>
<td>9.72</td>
<td>0.000</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.64 ± 0.07</td>
<td>1.66 ± 0.08†</td>
<td>1.62 ± 0.07†</td>
<td>1.63 ± 0.07†</td>
<td>5.97</td>
<td>0.001</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>47.65 ± 55.5†</td>
<td>59.99 ± 7.62†</td>
<td>69.77 ± 7.79‡</td>
<td>85.10 ± 9.77‖</td>
<td>174.02</td>
<td>0.000</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>17.57 ± 0.89†</td>
<td>21.58 ± 1.82‡</td>
<td>26.94 ± 1.50‖</td>
<td>32.43 ± 2.00‖</td>
<td>656.64</td>
<td>0.000</td>
</tr>
<tr>
<td>PBF (%)</td>
<td>18.83 ± 6.48†</td>
<td>22.92 ± 7.13‡</td>
<td>32.85 ± 6.81‖</td>
<td>40.86 ± 4.87‖</td>
<td>115.17</td>
<td>0.000</td>
</tr>
<tr>
<td>LBM (kg)</td>
<td>38.45 ± 6.79‖</td>
<td>46.13 ± 7.11‖</td>
<td>46.90 ± 7.43‖</td>
<td>50.36 ± 7.40‖</td>
<td>14.96</td>
<td>0.000</td>
</tr>
<tr>
<td>BFM (kg)</td>
<td>8.86 ± 2.88‖</td>
<td>13.80 ± 4.84§</td>
<td>22.88 ± 5.53‖</td>
<td>34.74 ± 5.62‖</td>
<td>266.39</td>
<td>0.000</td>
</tr>
<tr>
<td>IHT (s)</td>
<td>131.04 ± 49.61†</td>
<td>125.52 ± 46.3†</td>
<td>85.61 ± 37.24‖</td>
<td>73.02 ± 41.67‖</td>
<td>27.82</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*Data are presented as mean ± standard deviation; †, ‡, §, ‖ for a particular variable, mode means with different superscripts are significantly different (p < 0.05) while mode means with the same superscripts are not significantly different (p > 0.05). When only one contrast is significant, one of the cell means has no superscript. The pair of cell means that is significant has different superscripts. PBF = percentage body fat; LBM = lean body mass; BFM = body fat mass (fat weight); IHT = isometric holding time.
Research Center [31] for males and females. A summary of the one-way ANOVA and LSD post hoc multiple comparison among the lean, acceptable, moderately overweight and overweight categories for males and females are presented in Tables 3 and 4, respectively. The ANOVA and LSD post hoc test showed a significant difference \( (F = 24.57; p = 0.000) \) in the endurance time among the lean (137.29 ± 56.91 seconds), acceptable (139.13 ± 42.33 seconds), moderately overweight (101.20 ± 39.42 seconds) and overweight (75.93 ± 38.70 seconds) for the male categories (Table 3). Table 4 shows a significant difference \( (F = 19.51; p = 0.000) \) in the endurance time among the lean (151.25 ± 58.31 seconds), acceptable (135.28 ± 47.45 seconds), moderately overweight (116.55 ± 38.31 seconds) and overweight (83.24 ± 38.88 seconds) for the male categories. Among the male and female categories, shorter endurance time was found among the overweight categories.

Test of homogeneity of variance was carried out because of a large difference in sample size between the four groups of participants either in the BMI or PBF classifications. IHT was significantly different across the BMI categories (Levene statistics 5.320; \( p = 0.001 \)). While using the PBF classification, IHT was significantly different across the groups among males (Levene statistics 6.042; \( p = 0.001 \)) but not among the females (Levene statistics 1.603; \( p = 0.190 \)). Owing to the significant group differences found in age and anthropometric variables in the ANOVA analysis either in the BMI or PBF classifications, multiple regression analysis was used to identify whether adiposity is independently associated with IHT after controlling for age, sex and the anthropometric variables. BMI was significantly associated \( (F = 27.888; \ p = 0.000) \) with IHT, independently of age, sex and other anthropometric variable, accounting for approximately 40% of the variability in back muscle endurance. PBF was

### Table 3. Summary of the one-way ANOVA and LSD post hoc multiple comparison among the lean, acceptable, moderately overweight and overweight categories using percentage body fat classification for males

<table>
<thead>
<tr>
<th>Variables</th>
<th>Lean &lt; 12%( (n=17) )</th>
<th>Acceptable 12–21%( (n=100) )</th>
<th>Moderately overweight &gt; 21–26%( (n=35) )</th>
<th>Overweight &gt; 26%( (n=41) )</th>
<th>F ratio</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>24.29 ± 3.79( ^\ddagger )</td>
<td>33.85 ± 12.27( ^\dagger )</td>
<td>47.57 ± 12.20( ^\ddagger )</td>
<td>49.63 ± 9.30( ^\ddagger )</td>
<td>36.05</td>
<td>0.000</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.67 ± 0.08 ( ^\dagger )</td>
<td>1.70 ± 0.07 ( ^\dagger )</td>
<td>1.66 ± 0.07 ( ^\dagger )</td>
<td>1.66 ± 0.08 ( ^\dagger )</td>
<td>4.59</td>
<td>0.004</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>54.23 ± 6.78 ( ^\dagger )</td>
<td>61.02 ± 8.47 ( ^\dagger )</td>
<td>63.31 ± 7.01 ( ^\dagger )</td>
<td>74.73 ± 13.28 ( ^\dagger )</td>
<td>27.54</td>
<td>0.000</td>
</tr>
<tr>
<td>BMI (kg/m(^2))</td>
<td>19.07 ± 0.85 ( ^\dagger )</td>
<td>21.07 ± 2.08 ( ^\dagger )</td>
<td>23.12 ± 2.10 ( ^\dagger )</td>
<td>27.25 ± 4.52 ( ^\dagger )</td>
<td>60.09</td>
<td>0.000</td>
</tr>
<tr>
<td>PBF (%)</td>
<td>10.60 ± 1.16 ( ^\dagger )</td>
<td>16.87 ± 2.62 ( ^\dagger )</td>
<td>23.29 ± 1.55 ( ^\dagger )</td>
<td>31.22 ± 4.00 ( ^\dagger )</td>
<td>352.56</td>
<td>0.000</td>
</tr>
<tr>
<td>LBM (kg)</td>
<td>48.52 ± 6.26 ( ^\dagger )</td>
<td>50.63 ± 6.91 ( ^\dagger )</td>
<td>48.52 ± 5.16 ( ^\dagger )</td>
<td>51.10 ± 7.72 ( ^\dagger )</td>
<td>1.45</td>
<td>0.231</td>
</tr>
<tr>
<td>BFM (kg)</td>
<td>5.7176 ± 0.84 ( ^\dagger )</td>
<td>10.39 ± 2.45 ( ^\dagger )</td>
<td>14.80 ± 2.13 ( ^\dagger )</td>
<td>23.63 ± 6.58 ( ^\dagger )</td>
<td>158.26</td>
<td>0.000</td>
</tr>
<tr>
<td>IHT (s)</td>
<td>137.29 ± 56.91 ( ^\dagger )</td>
<td>139.13 ± 42.3 ( ^\dagger )</td>
<td>101.20 ± 39.42 ( ^\dagger )</td>
<td>75.93 ± 38.70 ( ^\dagger )</td>
<td>24.57</td>
<td>0.000</td>
</tr>
</tbody>
</table>

\*Data are presented as mean ± standard deviation; \( ^\dagger,^\ddagger,^\ddagger,^\|$ for a particular variable, mode means with different superscripts are significantly different \( (p < 0.05) \) while mode means with the same superscripts are not significantly different \( (p > 0.05) \). When only one contrast is significant, one of the cell means has no superscript. The pair of cell means that is significant has different superscripts. BMI = body mass index; PBF = percentage body fat; LBM = lean body mass; BFM = body fat mass (fat weight); IHT = isometric holding time.

### Table 4. Summary of the one-way ANOVA and post hoc LSD multiple comparison among the lean, acceptable, moderately overweight and overweight categories using percentage body fat classification for females

<table>
<thead>
<tr>
<th>Variables</th>
<th>Lean &lt; 17%( (n=4) )</th>
<th>Acceptable 17–28%( (n=50) )</th>
<th>Moderately overweight &gt; 28–33%( (n=40) )</th>
<th>Overweight &gt; 33%( (n=89) )</th>
<th>F ratio</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>34.25 ± 13.12</td>
<td>28.70 ± 9.53( ^\ddagger )</td>
<td>38.35 ± 12.59( ^\dagger )</td>
<td>45.12 ± 11.59( ^\ddagger )</td>
<td>22.88</td>
<td>0.000</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.62 ± 0.05</td>
<td>1.62 ± 0.07</td>
<td>1.62 ± 0.08</td>
<td>1.62 ± 0.08</td>
<td>0.04</td>
<td>0.990</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>52.00 ± 14.30( ^\ddagger )</td>
<td>53.64 ± 6.3( ^\dagger )</td>
<td>58.15 ± 6.93( ^\dagger )</td>
<td>72.53 ± 11.87( ^\dagger )</td>
<td>48.79</td>
<td>0.000</td>
</tr>
<tr>
<td>BMI (kg/m(^2))</td>
<td>19.95 ± 4.45( ^\dagger )</td>
<td>20.36 ± 1.94( ^\dagger )</td>
<td>22.35 ± 2.14( ^\ddagger )</td>
<td>28.00 ± 3.94( ^\ddagger )</td>
<td>73.93</td>
<td>0.000</td>
</tr>
<tr>
<td>PBF (%)</td>
<td>14.70 ± 0.96 ( ^\dagger )</td>
<td>25.01 ± 2.57 ( ^\dagger )</td>
<td>30.65 ± 1.45 ( ^\dagger )</td>
<td>38.91 ± 4.29 ( ^\dagger )</td>
<td>230.66</td>
<td>0.000</td>
</tr>
<tr>
<td>LBM (kg)</td>
<td>44.30 ± 1.97</td>
<td>40.00 ± 5.33</td>
<td>40.08 ± 5.42</td>
<td>44.00 ± 5.71</td>
<td>7.38</td>
<td>0.000</td>
</tr>
<tr>
<td>BFM (kg)</td>
<td>7.70 ± 2.39 ( ^\dagger )</td>
<td>13.36 ± 2.21 ( ^\dagger )</td>
<td>17.85 ± 2.51 ( ^\dagger )</td>
<td>28.54 ± 7.21 ( ^\ddagger )</td>
<td>105.85</td>
<td>0.000</td>
</tr>
<tr>
<td>IHT (s)</td>
<td>151.25 ± 58.31 ( ^\dagger )</td>
<td>135.28 ± 47.45 ( ^\dagger )</td>
<td>116.55 ± 38.31 ( ^\dagger )</td>
<td>83.24 ± 38.88 ( ^\dagger )</td>
<td>19.51</td>
<td>0.000</td>
</tr>
</tbody>
</table>

\*Data are presented as mean ± standard deviation; \( ^\dagger,^\ddagger,^\ddagger,^\|$ for a particular variable, mode means with different superscripts are significantly different \( (p < 0.05) \) while mode means with the same superscripts are not significantly different \( (p > 0.05) \). When only one contrast is significant, one of the cell means has no superscript. The pair of cell means that is significant has different superscripts. BMI = body mass index; PBF = percentage body fat; LBM = lean body mass; BFM = body fat mass (fat weight); IHT = isometric holding time.
significantly associated with IHT for males ($F = 24.402; p = 0.000$) and ($F = 19.179; p = 0.000$) for females, independently of age, sex and other anthropometric variables, accounting for approximately 50% of the variability in back muscle endurance for males and females.

**Discussion**

This study examined the influence of adiposity on the isometric endurance of the low back extensor muscles in apparently healthy Nigerian adults using the Biering-Sørensen test of static muscular endurance. This study found a significant association between adiposity (assessed by BMI and PBF) and low back extensor muscle endurance. Specifically, shorter endurance time was found among the overweight and obese categories. This finding is consistent with those studies that implicated increase in body fat level in the aetiology of decrease endurance of the back muscles [12,15–17]. However, there was no significant difference in the endurance time of the overweight and normal weight subjects using the BMI definition. Likewise, no significant difference was found among the subjects of both sexes with low PBF level classified as lean and acceptable. From this study, we can imply that as the measures of adiposity increase, endurance time of the back extensor muscles decreases, and it agrees with reports that healthy subjects of both sexes with a high percentage of body fat demonstrated shorter isometric back extension holding time [12,15].

In this study, age and the different anthropometric variables were significantly different across the different adiposity classifications. It is possible that the significant age and anthropometric difference between the different categories of participants could be co-factors contributing to the significant disparity in endurance capacity among them. This is because previous studies have reported age [32,33] and anthropometric factors, such as BMI, body weight, height, body fat and LBM [11–14], to significantly influence endurance test results [11,12], but it remains debated in some other studies [34–38]. However, further analysis with multiple regression showed that adiposity was significantly associated with low back endurance after controlling for the effect of age, sex and other anthropometric factors.

Some studies have implicated overweight and obesity in the aetiology of LBP and musculoskeletal morbidity [39–45]. Obesity is considered a purported risk factor and may be more a matter of general health, yet may influence certain back pain outcomes [41,42]. Central obesity and loss of muscle mass in the trunk and lower extremities have recently been identified as causative factors in the development of chronic LBP in studies among women [46,47]. Weight reduction has been reported to unload the spine and offer other musculoskeletal benefits [45].

Toda et al [48], in their study of women whose LBP was non-sciatic, opined that weight loss/reduction and muscle strengthening exercises might be of benefit in the treatment of patients with chronic LBP. However, in a prospective population-based cohort study of Jones et al [49], it was reported that neither BMI nor its variations were associated with an increase in the risk of future LBP. The prevalence of obesity in the community has been reported to be of concern, first because obesity is an independent predictor of back pain, but more importantly as it has a global health impact [44]. The prevalence of overweight and obesity has been reported to be increasing in developing countries [50,51], with a consequent upsurge in potential morbidity, mortality and negative economic impact [52]. It is believed that the prevalence of obesity within a population is often seen prior to a rise in the occurrence of chronic non-communicable diseases such as hypertension and diabetes [53]. Nonetheless, data on the toll of overweight and obesity on musculoskeletal health appear scant.

**Conclusion**

From the outcome of this study, overweight and obesity are important factors in the aetiology of decreased back extensor muscle endurance. As the measures of adiposity increase, endurance time of the back extensor muscles decreases. Lack of back extensor muscle endurance has frequently been cited as a suspected factor in the aetiology of LBP [54], and it has also been associated with prolonged or recurrent back pain [55]. Approaches to reduce decreased endurance of the back extensor muscles and the risk of LBP may include prevention of overweight and obesity.

This study is limited in its external validity because of the lack of randomization of the study sample. Therefore, the results of this study can serve as reference data for determinants of back extensor muscle endurance testing among apparently healthy Nigerian adults. However, our ANOVA results on PBF among female participants should be interpreted with caution because of the non-significant result of the homogeneity of variance test. We recommend that further research be carried out in an attempt to explain the mechanisms responsible for the influence of body fat on isometric endurance of back extensor muscles.

**References**


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