BODY COMPOSITION AND CARDIOVASCULAR STATUS OF WOMEN: IMPLICATIONS FOR HEALTHY LIVING

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Abstract
The state of the human circulatory system and fat cells are important in determining how well and how long people would live. These organs are constantly affected by factors such as age, race, environmental exposure, heredity, sex, lifestyle, nutrition and level of physical activity. Current statistics released by the World Health Organisation shows that many people are dying from diseases related to cardiovascular organs and obesity. It is against this background that this study seeks to determine the body fat per cent and cardiovascular parameters of women. The participants for this study were drawn from the University of Lagos, Akoka and Lagos State University, Ojo. They comprised 83 non-academic female staff who volunteered and gave their consent to participate in the study. Physical characteristics of age, height, weight, waist and hip circumferences were measured. This was followed by measurement of selected cardiovascular parameters such as heart rate, resting systolic and diastolic blood pressure and electrocardiographic parameters PR interval, QRS duration, QT interval and mean left ventricular voltages. Mean, standard deviation, and percentages were used in the analysis of data. Electrocardiogram (ECG) findings revealed that some participants had tachycardia and bradycardia. Body composition results showed that the women had body mass index mean value of 28.24kg/m^2, waist/hip ratio of 0.86, while baseline clinical parameters indicated pulse rate of 78.7bpm, systolic blood pressure of 128.39mmHg, and diastolic blood pressure of 78.24mmHg. These results show that participants were found to be overweight, obese and at high risk waist/hip ratio. Participants were thus advised to change their lifestyle; reduce intake of saturated fat, consume adequate diet and get involved in regular physical activity.

Keywords: Cardiovascular, Electrocardiogram, Fat, Nutrition, Exercise.
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Introduction
The cardiovascular system which includes the heart; blood vessels and blood, function by transporting oxygen and nutrients to the cells of the body, regulates body temperature, pH levels, fluid balance and protection of the body from blood loss and infection. When these organs are affected negatively, it leads to a group of diseases of the heart and blood vessels.

Most important Cardiovascular Diseases (CVDs), are those related to atherosclerosis, cardiomyopathies, hypertension and cerebro-vascular disorders (Plowman and Smith, 2003). Worldwide CVDs prevalence could be attributed to behavioural and physiological risk factors such as inactive lifestyle and inadequate diet.

According to the World Health Organisation (WHO, 2006), cardiovascular diseases, overweight and obesity related diseases remain the leading cause of death in some developed countries with higher death rate in females than in males. In 1999, cardiovascular disease contributed to a third of global death. Low and middle income countries also contributed to 78% of cardiovascular deaths.

Approximately 62 million Americans have one or more forms of the disease. The burden of CVD is increasing rapidly in Africa and it is now a public health problem throughout the African Region. According to WHO (2006), CVD has a major socio-economic impact on individual, families and societies in terms of health care cost, absenteeism from work and national productivity.

In Nigeria, prevalence may be low at present but social changes are taking place, and this may lead to massive increase in CVDs morbidity within the next two decades (Amoo, 2007). Furthermore, the change in diet from fibres to fast foods like pastries appears to result in excess fat storage in the human body. Overweight and obesity are currently recognised as important risk factors for atherosclerotic CVD and premature mortality.

Researchers have classified obesity into central and general (Ascaso et al., 2003; Brunner et al., 2007; Gutin et al., 2007; Willis et al., 2007; Okura et al., 2003). The most widely used measures of total or general and abdominal obesity or adiposity are the Body Mass Index (BMI) and waist circumference respectively. While abdominal obesity is recognised as a major risk factor for coronary heart diseases (CHD), waist circumference and WHR are more strongly associated with metabolic risk factors, occurrence of CVD and deaths (Fouad et al., 2006; Heitmann et al., 2004).

Metabolic Syndrome (MS) is also a cluster of health threatening and lifestyle related conditions. According to Bakker, Gansevoort and deXeeuw (2007), the criteria used to define MS are, increased waist circumference, increased triglycerides, decreased HDL-cholesterol, increased blood pressure and increased plasma glucose. Anyone who has three or more of these criteria is diagnosed as having MS.

Death is no longer from mono-causal infectious diseases but multi-causal, chronic non-communicable diseases, not limited to CVDs but includes diabetes and other degenerative diseases, Otinwa (2007). Therefore, the assessment of cardiovascular parameters and body composition has become an important means of determining the level of risk and susceptibility to cardiovascular and excess body fat related diseases.

This research seeks to determine whether the cardiovascular and body composition status of middle aged female administrative staff in the university workplace will be within normal range.

Method

Participants
A total of 83 apparently healthy female staff of the University of Lagos and Lagos State University, Ojo, Lagos, Nigeria participated in the study. The participants were recruited through advertisements placed in the local University publication and contacts made by the researchers and assistants.

All testing was performed at the University of Lagos and Lagos State University board rooms. The University of Lagos Central Research Committee approved all protocols before any testing was done and a written informed consent was obtained from all participants before testing.

Test Procedures
Participants’ age were recorded while their height and weight were measured in light clothing (without shoes) with a stadiometer and calibrated bathroom weighing scale. The waist and hip circumferences were measured according to the procedure of Norton and Olds (1996). While the waist circumference was taken at the level of the narrowest point between the lower coastal border and the iliac crest after expiration, the hip circumference was taken at the level of the greatest posterior protuberance of the buttocks. Measurements were taken in centimetres to one decimal place.

The international classification of overweight and obesity according to BMI, (CDC-NHANES, 2007; Tuncelli et al., 2006; WHO, 2006) was adopted: Normal range: 18.5 – 24.99 (Kg/m²), Overweight: 25 – 29.99 (Kg/m²), Obese ≥ 30 (Kg/m²).

Participants’ blood pressures were obtained after 10 minutes of rest using an Accuson ® mercury sphygmomanometer. Electrocardiographic parameters were measured by a Cardiologist from Lagos University Teaching Hospital, Lagos, Nigeria.

A resting twelve lead electrocardiogram was done using an automated three channel machine at a paper speed of 25mm/second and leads were placed according to the
American Heart Association guidelines. The heart rate, PR interval, QRS duration, QT interval were calculated and Sokolow and Lyon’s and Cornell’s criteria were used to determine the presence of left ventricular hypertrophy.

**Results**

Results are given as mean, standard deviation and percentages reflecting participants’ risk level and susceptibility to CVDs, overweight and obesity related diseases.

**Table 1: Physiological Parameters of Participants**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Age (Yrs)</th>
<th>Body mass Index (Kg/m²)</th>
<th>Waist Conferences (cm)</th>
<th>Waist/ hip ratio</th>
<th>Systolic blood pressure (mmHg)</th>
<th>Diastolic blood pressure (mmHg)</th>
<th>Pulse rate (bpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean/SD</td>
<td>41.88±7.7</td>
<td>28.24±7.47</td>
<td>34.51±4.17</td>
<td>0.86±0.08</td>
<td>128.39±17.47</td>
<td>78.24±10.43</td>
<td>78.66±10.83</td>
</tr>
</tbody>
</table>

The mean values of the physical-physiological parameters evaluated are as shown in Table 1. The mean age of the study population was 41.88±7.47 years which shows that the female participants are in their middle age.

The body mass index and resting systolic blood pressure were slightly above the normal range.

**Table 2: Mean Values of some Electrocardiogram**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Heart Rate (bpm)</th>
<th>PR interval in m/sec</th>
<th>QRS interval in m/sec</th>
<th>QT interval in m/sec</th>
<th>SV1 + RV5 in mm</th>
<th>SV3 + RaVL in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± Sd</td>
<td>73.39±11.46</td>
<td>17.25±2.25</td>
<td>17.25±2.25</td>
<td>17.25±2.25</td>
<td>17.25±2.25</td>
<td>17.25±2.25</td>
</tr>
</tbody>
</table>

Legend: SV1 + RV5 = sum of the amplitude of the S-wave in lead V1 and the R - wave in lead V5 in millimeters: SV3 + RaVL in mm = sum of the amplitude of the S- wave in lead V3 and R-wave in lead aVL in millimeters.

**Table 3: Proportion of Participants with Abnormal Physical-physiological Parameters**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Overweight (%)</th>
<th>Obese (%)</th>
<th>Abnormal Waist conference (%)</th>
<th>Systolic Hypertension (%)</th>
<th>Diastolic Hypertension (%)</th>
<th>Tachycardia (%)</th>
<th>Bradycardia (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>29</td>
<td>32</td>
<td>31</td>
<td>19</td>
<td>10</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>(34.9)</td>
<td>(39.6)</td>
<td>(36.3)</td>
<td>(22.9)</td>
<td>(12)</td>
<td>(2.4)</td>
<td>(1.2)</td>
</tr>
</tbody>
</table>

Table 3 shows the proportion of participants in the whole group who had abnormalities in clinical parameters evaluated. About 71% (61) of the subjects had abnormal body mass index; this accounted for more than a third of the population.

39% (32) were obese. The same trend was seen in other measures of obesity. 36% (31) had abnormal waist conference and 47% (39) had abnormal waist hip ratio. Elevated systolic blood pressure was noted in 22.9% (19) of the subjects, while 12% (10) had elevated diastolic blood pressure.
Table 4: Abnormalities in Evaluated Electrocardiographic Parameters Evaluated

<table>
<thead>
<tr>
<th>ECG Parameters</th>
<th>N</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tachycardia</td>
<td>5</td>
<td>5.9</td>
</tr>
<tr>
<td>Bradycardia</td>
<td>2</td>
<td>2.4</td>
</tr>
<tr>
<td>Lest Axis Deviation</td>
<td>5</td>
<td>5.9</td>
</tr>
<tr>
<td>Right Axis Deviation</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>Indeterminate Axis</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>1st Degree Heart Block</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>Prolonged QT</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>P Mitrale</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>Abnormal Q-waves</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>ST Segment Depression</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>T-wave Inversion</td>
<td>6</td>
<td>7.2</td>
</tr>
<tr>
<td>Atrial Premature Complexes</td>
<td>2</td>
<td>2.4</td>
</tr>
<tr>
<td>Ventricular premature complexes</td>
<td>2</td>
<td>2.4</td>
</tr>
<tr>
<td>LVH by Sokolow Lyons Criteria</td>
<td>12</td>
<td>14.1</td>
</tr>
<tr>
<td>LVH by Cornell’s Criteria</td>
<td>5</td>
<td>5.9</td>
</tr>
<tr>
<td>RVH</td>
<td>1</td>
<td>1.2</td>
</tr>
</tbody>
</table>

**Legend:** LVH = Left Ventricular Hypertrophy RVH = Right Ventricular Hypertrophy

Table 4 shows the abnormalities in the ECG parameters evaluated. Most of the patients were in sinus rhythm. Only 7 (8.3%) patients had an abnormality in their rate while 4 (4.8%) had abnormalities in their rhythm (atrial premature complexes), 2 (2.4%) and ventricular premature complexes 2 (2.4%).

About 8% of the subjects had abnormal axis and the dominant abnormalities was left-axis deviation in 5.9% of the subjects. ECG left ventricular hypertrophy was noted in 14.1% of the subjects using the Sokolow and Lyon’s criteria and in 5.9% of the subjects using the Cornell criteria.

**Discussion**

The abnormal body composition which resulted in overweight, obesity and high risk body fat per cent is associated with diabetes and heart related diseases such as high blood pressure, hyperlipemia and arteriosclerosis (Otiniwa, 2008). Obesity may not be a primary risk factor for CVDs but its role as a secondary and contributing factor in heart disease cannot be denied.

The result of this study corroborated the submission of King, Aubert and Herman (1998), that diabetes is one of the fastest growing public health problems in both developing and developed countries due to increasing prevalence of obesity and sedentary behaviours as observed in this study. In a similar study, Clyde et al. (2005), acknowledged that obesity has become epidemic in the US with a disproportionate higher burden in African American women who were > 40 years.

The presence of metabolic syndrome among participants has two major underlying risk factors which are obesity and insulin resistance. Exacerbating factors are: physical inactivity, advancing age, endocrine and genetic factors (Scott and Grundy, 2006). According to Hu, Qiao, Tuomilehto (2004); Malik, Wong, Franklin et al. (2004),
metabolic syndrome is associated with an increased risk for cardiovascular mortality. It is a predictor of cardiovascular mortality in both men and women.

Sedentary lifestyle is currently recognised as another of the major risk factors for atherosclerotic CVD (Pate, Pratt, Blair et al., 1995; Thompson, Buhner, Pina et al., 2003).

The role of physical inactivity in the causation of CVDs is related to the increased obesity creating a disposition to a raised blood pressure and elevated serum cholesterol as well as a greater risk of diabetes mellitus. All current guidelines on the management of the individual components of the metabolic syndrome emphasise that lifestyle modification such as weight loss and physical activity is first-line therapy.

Physical activity can help to decrease the risk of cardiovascular disease mortality in general, and coronary heart disease mortality in particular. Prospective epidemiological studies have consistently shown that regular physical activity and cardiorespiratory fitness prevent CVD and premature cardiovascular mortality in women (Hu, Willett, Li, Stampfer, Colditz and Manson, 2004).

Active people are at lower risk of CVD and they develop less CVD at later age, and tend to have less severe forms of CVD compared to those who are inactive. Moderate-intensity aerobic exercise such as walking may be effective, as more vigorous exercise in the prevention of cardiovascular diseases. However, some studies suggest that vigorous exercise confers further protection against heart diseases (Wannamethee, Shaper and Walker, 1998; Oguma and Shinoda-Tagawa, 2004; Manson, Hu, Rich-Edwards et al, 1999; Lee, Rexrode, Cook, manson and Buring, 2001; Manson, Greenland, laCroix et al., 2002; Tanasescu, Leitzmann, Rimam, Willett, Stampfer, Hu, 2002).

Corroborating the above findings; Norwegian researchers found out that high intensity interval training maximally improves every conceivable measure of heart function and heart strength. It also helps to prevent both the pre-diabetic metabolic syndrome and the heart damage it causes (Ulrik, Oyvind and Ole, 2009).

There is more evidence that older people who compete in vigorous sports, such as biking and running; live longer and suffer less disease than people who exercise at a more casual pace. The most intense exercise includes interval training: running or cycling very fast to the extent of becoming severely short of breath, then resting and repeating these almost maximum efforts several times in the same workout.

The protective effect of physical activity is strong as most physically active individuals usually have about half the cardiovascular mortality compared with that in the least active people, (Paffenbarger, Hyde, Wing and Steinmetz, 1984).

Age is a factor in the accumulation of fat. Advancement in age is associated with developmental and functional changes. The capacity of most body systems diminishes with age (Enmiola, 2008). As a person grows older, basal metabolic rate slows down thus increasing the rate at which excess fat is stored. Graham (2008) accurately put the decline rate after age 30 to be at 10%, while pumping efficiency is reduced by about 20%. The prevalence of metabolic syndrome increases with age. The highest prevalence is observed
in older persons, although frequency rises rapidly in middle age and parallels (Clyde, 2005).

Inadequate diet information is a major factor in weight gain. It could be high consumption of fats especially those found in dairy products, poultry and meats, which contain a lot of cholesterol that are injurious to cardiovascular health. High intake of salt (sodium) has been linked to high blood pressure. Healthy foods such as dietary fibre, fruits, vegetables, fish and nuts have been widely associated with good health and protective effect against CVD (Igbanugo, 2007).

Health and quality of life can be preserved and improved through participation in physical activity and good nutrition. It is well established that exercise and diet modification is the best method for weight loss (Ross, and Janssen, 1999). The benefits of participating in physical activities for females of all ages are remarkable; including a reduced risk of developing coronary heart disease, hypertension, colon cancer and diabetes among many other benefits (Murray, 2002 and Otinwa, 2008).

**Conclusion**

a. The incidence of diabetes and heart related diseases such as high blood pressure have been reported as higher killers in Nigeria.

b. The presence of metabolic syndrome in this study is associated with higher risk for cardiovascular disease and diabetes.

c. The presence of the syndrome is a progressive condition that seems to worsen with advancing age and increasing obesity.

d. The most important means of reducing the incidence and prevalence of cardiovascular diseases and weight related health problems in the study population is lifestyle modifications.

e. Weight reduction is recommended against the early predisposition to CVD and diabetes.

f. University campuses should provide the settings for health promotion. As workplaces, they should provide ideal environments in order to identify preferences for and barriers to participation in physical activity among staff population.

g. The university administration must encourage sedentary female study population to become active.

h. Nutrition education should be embarked upon in order to ensure that adequate knowledge is provided on what individuals should eat and how it affects body functioning.

i. Gymnasium for exercise and adequate time for such should be provided during working hours. The frequency of 3 days of exercise per week should be observed in order to have positive change in body composition.
References


Vanguard, Tuesday September 30 (2003). *Obesity Shows in the Mind*.

