Background: The prevalence of obesity is increasing worldwide with attendant chronic complications. The outcome of HIV/AIDS and its treatment is worse in individuals with coexisting overweight or obesity and its complications. Aim: To determine the prevalence of overweight and obesity among HIV infected patients at enrolment for treatment of HIV/AIDS as well as the associated risk factors. Methods: A cross-sectional descriptive study was conducted in the Special Treatment Clinic (STC), National Hospital, Abuja. A total of 300 adult patients with HIV/AIDS were recruited by purposive sampling. An interviewer-administered questionnaire was used to obtain data on socio-economic and clinical characteristics. The body mass index (BMI) and blood pressure of the respondents were measured. Results: A total of 189 females and 111 males were studied. The mean age was 37.1 years ± 8.6 years. The mean BMI was 25.5kg/m² ± 4.8kg/m². Overweight respondents made up 32.7% of the study population while 15% of them were obese. The mean blood pressure was 117/75 ± 19/11mmHg and 55% of the respondents had normal blood pressure measurements. Amongst those with abnormal blood pressure measurements, 63% were overweight/obese. There was a significant relationship between BMI and sex (p<0.001), marital status (p<0.001), area of residence (p<0.001) alcohol use (p<0.001) and blood pressure (p<0.001). Conclusion: Overweight and obesity occur frequently among patients infected with HIV/AIDS. It is recommended that weight management and other lifestyle modification practices should be integrated into every aspect of their care. Key words: Overweight, Obesity, HIV/AIDS, BMI, CD4 cell count, blood pressure
alarming trend has been attributed to changes in lifestyle and diet as well as migration to urban areas.[8]

There are different definitions and classifications of obesity. The most widely adopted is the definition by the WHO which defines overweight as a body mass index (BMI) of 25kg/m$^2$ to 29.9kg/m$^2$ and obesity as a BMI of 30kg/m$^2$ or more. Normal BMI is between 18.5kg/m$^2$ and 24.9kg/m$^2$ while any BMI of less than 18.5kg/m$^2$ is recorded as underweight.[1] Obesity and overweight have been associated with metabolic abnormalities which result in insulin resistance, diabetes, dyslipidaemia and cardiovascular diseases.[5,6]

Human Immunodeficiency Virus (HIV) is a lentivirus of the retrovirus family that causes Acquired Immunodeficiency Syndrome (AIDS).[7] HIV/AIDS is one of the most prominent public health-care problems especially in Africa where the commoner serotype HIV-I is endemic.[8-11] Nigeria has the second largest number of people living with HIV/AIDS in the world and probable factors responsible for this include such as the subordinate position of women, poor social services, rapid urbanization and modernization, and wars and conflicts.[8]

Patients infected with HIV/AIDS are not exempted from the effects of obesity and overweight. Even though HIV/AIDS was previously termed the ‘Slimming disease’, it has been reported that HIV-infected patients mirror the trends in the general population and are increasingly overweight or obese at diagnosis and during HIV infection.[13] Since the advent of Highly Active Antiretroviral Therapy (HAART), the life expectancy of HIV-infected individuals has steadily increased.[14] As patients live longer, the prevalence of various co-morbid conditions such as obesity which increase cardiovascular risk increase.[15-17] HIV infection on its own is recognised as a cardiovascular risk factor as it leads to increased production of pro-inflammatory cytokines which through several mechanisms, eventually leads to a build-up of plaque in the arteries.[18,19] Several antiretroviral agents have been shown to increase the risk of diabetes, myocardial infarction and hypertension which are responsible for about 7-8% of deaths in these patients.[20] In addition to this, due to the fear of being stigmatized for being infected with HIV/AIDS, many people infected with the virus are not motivated to engage in physical exercise to lose weight.[21] "Thus, the convergence of HIV infection and obesity could compound the risk for non-AIDS-related morbidity and mortality in the ageing HIV-infected population".[22]

Although obesity and HIV infection have been extensively studied, there are just few studies that have evaluated overweight and obesity among HIV-infected population in Nigeria. This study was done to describe the prevalence of obesity and overweight among HIV infected individuals presenting for enrolment for care at a HIV treatment site in North Central Nigeria as well as to identify the associated risk factors.

**METHODOLOGY**

**Study location**
The study was conducted in The Special Treatment Clinic (STC) of National Hospital Abuja. The facility was founded in 1999 to cater for residents of Abuja, other states in the country, and the West African sub-region. It is a tertiary health facility and referral center which provides specialized clinical care in various clinical specialties. It is located in the Federal Capital Territory of Nigeria and thus provides care for a myriad of people from different nationalities and tribes and socioeconomic classes. The STC is the clinic where specialized care is provided for all HIV affected patients in the hospital.

**Study design**
It was a hospital-based cross-sectional descriptive study.

**Study period**
Data was collected within the period November 2012 to January 2013.

**Inclusion criteria**
The study included all HIV seropositive individuals 18 years or older, who presented for enrolment into care for HIV treatment.
**Exclusion criteria**
The patients who required emergency care and those who were pregnant were excluded from the study.

**Sample size estimation**
The Leslie Kish formula\(^2\) for descriptive studies was applied to calculate the sample size using obesity prevalence of 21.3% which was found among HIV positive patients in Owerri, Imo State, Nigeria.\(^3\) The calculated sample size was 300, using a 10% attrition rate.

**Sampling technique**
The sampling method used was purposive sampling. All consecutive HIV positive patients meeting the inclusion criteria that came for enrolment at the STC of the National Hospital, Abuja during the study period were enrolled till the sample size of 300 was reached.

**Study procedure**
Data was collected by the researcher and two trained research assistants using a structured interviewer-administered questionnaire. This questionnaire had been pretested on a small group of patients in the HIV clinic in Maitama District hospital which has a similar structure with the study site. The questionnaire was used to gather information on the respondents' socio-demographic and clinical characteristics. Height was measured to the nearest 0.1 centimeter using the SECA 213 stadiometer with subject facing forwards, without head gear or foot wear. The weight was measured to the nearest 0.1 kg with the patient wearing light clothing without any other accessories. The physician’s SECA 700 digital weighing scale was used and was calibrated before each measurement. The body mass index (BMI) was then calculated using the formula: BMI = Weight (kg)/ Height\(^2\) (m\(^2\)).

The respondents’ blood pressure was determined with the use of an Accoson mercury sphygmomanometer using an appropriate sized cuff. The blood pressure was measured twice at five minute intervals with the patient in a calm seated position with the arm supported at heart level. An average of the two values was recorded.

General nutrition education and lifestyle counselling was provided by a trained counsellor to all the participants in the study.

**Ethical consideration**
The study was approved by the National Hospital Abuja Research and Ethics committee and a written informed consent was obtained from the respondents.

**Statistical analysis**
The data obtained was analyzed using SPSS version 20 software. Frequency tables were generated for socio-demographic characteristics, BMI levels and the factors associated with overweight and obesity. The association between categorical variables was assessed using Chi-square. P-value of significance was set at < 0.05.

**RESULTS**
The females constituted 63% (189) of the study participants. The male to female ratio was 1:1.7. The mean age and standard deviation of the subjects was 37.1 years ± 8.6 (range = 19 –70 years). Those aged less than 40 years constituted the highest population (66.3%) of respondents.

More than half (54.3%) of the study respondents were married. The distribution according to areas of domicile showed that a larger number of the respondents (n=158, 52.7%) lived in rural areas, while the rest, 142 (47.3%), had their domiciles in urban areas. Only 3% of all the respondents had not been exposed to any formal education. Most of the respondents, 225 (74.8%) were employed. At the time of diagnosis and registration for antiretroviral care, 67.7% (203) of the respondents had CD4 counts less than 200 cells/mm\(^3\).

The mean BMI was 25.5 kg/m\(^2\) ± 4.8 kg/m\(^2\). The highest BMI was 42.45 kg/m\(^2\) while the lowest was 14.3 kg/m\(^2\). Overweight respondents constituted 32.7% of the study population while 15% of them were obese. This is seen in figure 1 below.

From the study, 44% of the males were overweight while 30% of them were obese. Among the females, 25.9% were overweight.
while 17% were obese. The association between BMI and socio-demographic characteristics was assessed and showed a statistically significant relationship between BMI and sex (p<0.001), marital status (p<0.001), and area of residence (p<0.001). This is shown in table 1 below.

The mean blood pressure was 117/75 ± 19/11 mmHg. The maximum blood pressure was 210/112 mmHg while the lowest was 88/52 mmHg. Fifty-five percent (55%) of the respondents had normal blood pressure measurements. Amongst those with abnormal blood pressure measurements, 63% were overweight/obese. Among those patients who were obese, only 31.1% had normal blood pressure values, while 44.9% of those who were overweight had normal blood pressures. All the underweight patients had normal blood pressures. There was a significant relationship between BMI and Blood pressure classification (p<0.001). This is shown in Table 3 below.

The mean CD4 cell count was noted to be 424.69 cells/m³. There was a significant relationship between baseline CD4 and BMI as is shown in the figure 2 below (p<0.001).

**DISCUSSION**

The prevalence of cardiovascular risk factors like overweight and obesity is rising in both HIV infected and non-HIV infected individuals worldwide. However, HIV-infected patients have a higher risk of cardiovascular diseases due to complex interactions between the traditional risk factors and HIV infection itself.[25] Thus, HIV infected individuals who are overweight or obese are additionally prone to metabolic syndrome, type 2 diabetes, heart disease, osteoarthritis, sleep apnoea, colon cancer as well as low self-esteem and depression.[9]

In this study, the prevalence of overweight amongst these patients was 32.7% while 15% of them were obese. This was similar to findings from Eastern Nigeria[24] but lower than findings from the United States of America (USA).[26] From this study, 25.9% of the females were overweight while 18% were obese. For the male gender, 44% of them were overweight and 9.9% were obese. This was similar to reports from other studies done in both developed and developing countries.[27] but contrary to findings from Australia.[28] There may be several reasons why women may be more prone to overweight and obesity than men. All other things being equal, such as age and exercise levels, women require fewer calories per kilogram of body weight daily than men and thus conserve more body fat.[29] Also, pregnancy and female hormones make it easier for women to gain weight. Again, women more often do the cooking in the households and so are likely to do a lot of eating while cooking. Finally, in fat-prone women, hormonal contraceptives cause the body to generate increased amounts of fat and water.[27]
Table 1: Association between BMI and socio-demographic variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total (N=300)</th>
<th>Underweight (n=10, 3.3%)</th>
<th>Normal (n=147, 49%)</th>
<th>Overweight (n=98, 32.7%)</th>
<th>Obesity (n=45, 15%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;40 years</td>
<td>199 (66.3)</td>
<td>9 (90.0)</td>
<td>98 (66.6)</td>
<td>65 (66.0)</td>
<td>27 (60.0)</td>
<td>0.467</td>
</tr>
<tr>
<td>&gt;40 years</td>
<td>101 (33.6)</td>
<td>1 (10.0)</td>
<td>49 (33.3)</td>
<td>33 (34.0)</td>
<td>18 (40.0)</td>
<td></td>
</tr>
<tr>
<td>SEX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>189 (63.0)</td>
<td>7 (70.0)</td>
<td>99 (67.3)</td>
<td>49 (50.0)</td>
<td>34 (75.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Male</td>
<td>111 (37.0)</td>
<td>3 (30.0)</td>
<td>48 (32.7)</td>
<td>49 (50.0)</td>
<td>11 (24.4)</td>
<td></td>
</tr>
<tr>
<td>MARITAL STATUS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>163 (54.3)</td>
<td>3 (30.0)</td>
<td>74 (50.3)</td>
<td>59 (60.8)</td>
<td>27 (60.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Unmarried</td>
<td>137 (45.6)</td>
<td>7 (70.0)</td>
<td>73 (49.7)</td>
<td>39 (39.8)</td>
<td>18 (40.0)</td>
<td></td>
</tr>
<tr>
<td>RESIDENCE</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Rural</td>
<td>158 (52.7)</td>
<td>6 (60.0)</td>
<td>74 (50.3)</td>
<td>54 (55.1)</td>
<td>24 (53.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Urban</td>
<td>92 (47.3)</td>
<td>4 (40.0)</td>
<td>73 (49.7)</td>
<td>44 (44.9)</td>
<td>21 (46.7)</td>
<td></td>
</tr>
<tr>
<td>EMPLOYMENT STATUS</td>
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<td></td>
<td></td>
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<tr>
<td>Unemployed</td>
<td>77 (25.7)</td>
<td>4 (40.0)</td>
<td>46 (31.3)</td>
<td>20 (20.4)</td>
<td>7 (15.6)</td>
<td>0.084</td>
</tr>
<tr>
<td>Employed</td>
<td>223 (74.3)</td>
<td>6 (60.0)</td>
<td>101 (68.7)</td>
<td>78 (79.6)</td>
<td>38 (84.4)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Relationship between BMI and alcohol use

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total (N=300)</th>
<th>Underweight (n=10, 3.3%)</th>
<th>Normal (n=147, 49%)</th>
<th>Overweight (n=98, 32.7%)</th>
<th>Obesity (n=45, 15%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALCOHOL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>272 (90.7)</td>
<td>10 (100)</td>
<td>140 (95.2)</td>
<td>88 (89.2)</td>
<td>34 (75.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>28 (9.3)</td>
<td>0 (0.0)</td>
<td>7 (4.8)</td>
<td>10 (10.8)</td>
<td>11 (24.4)</td>
<td></td>
</tr>
</tbody>
</table>
The prevalence of overweight and obesity was noted to be higher in respondents who were more than 40 years of age. This was similar to a large prospective study in the USA. This finding may be due to the fact that there is usually a decrease in energy expenditure as individuals are getting older. Also, BMI values may be affected by the loss of height caused by kyphosis (posterior convex angulation of the spine) which occurs commonly as individuals grow older.

Overweight and obesity were found to be more common in married respondents than their unmarried counterparts. This may be due to the increased socioeconomic burden that comes with being married, which could lead to increased stress levels and unhealthy lifestyle choices.

The prevalence of overweight and obesity was significantly higher in respondents who had a lower baseline CD4 cell count. This finding is consistent with previous research that has shown a negative correlation between CD4 cell count and BMI. This may be due to the fact that as the immune system becomes weaker, the body may be less able to regulate energy intake and expenditure, leading to weight gain.

### Table 3: Relationship between BMI and blood pressure classification

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total (N=300)</th>
<th>Underweight (n=10, 3.3%)</th>
<th>Normal (n=147, 49%)</th>
<th>Overweight (n=98, 32.7%)</th>
<th>Obesity (n=45, 15%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP Classification</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>165 (55.0)</td>
<td>10 (100.0)</td>
<td>97 (66.0)</td>
<td>44 (44.9)</td>
<td>14 (31.1)</td>
<td></td>
</tr>
<tr>
<td>Pre-HTN</td>
<td>89 (29.7)</td>
<td>0 (0.0)</td>
<td>37 (25.1)</td>
<td>34 (34.7)</td>
<td>18 (40.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Stage 1 HTN</td>
<td>30 (10.0)</td>
<td>0 (0.0)</td>
<td>12 (8.2)</td>
<td>12 (12.2)</td>
<td>6 (13.3)</td>
<td></td>
</tr>
<tr>
<td>Stage 2 HTN</td>
<td>16 (5.3)</td>
<td>0 (0.0)</td>
<td>1 (0.7)</td>
<td>8 (8.2)</td>
<td>7 (15.6)</td>
<td></td>
</tr>
</tbody>
</table>

### Figure 2: Relationship between baseline CD4 cell count and BMI

The figure shows a clear negative correlation between baseline CD4 cell count and BMI. This is evident from the slopes of the lines, which indicate a decrease in CD4 cell count as BMI increases. The p-value of <0.001 further supports the significance of this finding.
unmarried counterparts. This may be because there may be more resources available from both partners to purchase food. Also a married person is more likely to eat regularly since he has a confidant with whom to eat.\textsuperscript{31}

Individuals living in rural dwellings were discovered to be more overweight than their counterparts who lived in urban areas. This was similar to findings in a large study in Malaysia\textsuperscript{32} and may be due to consumption of cultural diets rich in fat as well as mechanization of previously physically laborious jobs.

Overweight and obesity were also discovered to be more common in those respondents who were employed. This was similar to a study in Turkey\textsuperscript{33} but contrary to reports from Australia.\textsuperscript{28} This may be explained by the fact that most executives working in the study area may be involved in sedentary jobs and may be too busy to engage in physical activity.

In this study, alcohol use was significantly associated with overweight and obesity. One gram of alcohol provides an energy level of 29kJ or 7.1kcal, thus it can contribute to weight gain.\textsuperscript{34} Alcoholic drinks are usually said to contain an excessive amount of empty calories with no real nutritional value. If people consume a few alcoholic drinks per week as well as their regular diet, it can quickly put them on the path to becoming overweight or obese. One problem is that these calories don not satisfy hunger and may in fact stimulate hunger.\textsuperscript{35} Different types and quantities of alcohol may have different effects on weight gain. However, this study did not assess the types of alcohol taken by the respondents.

The significant relationship between blood pressure and BMI discovered in this study has been corroborated by several large epidemiological studies.\textsuperscript{36, 57} Findings from the Framingham study have reported high blood pressure,\textsuperscript{38} and overweight and obesity\textsuperscript{39} as independent risk factors for cardiovascular disease. It has been reported that even a modest weight reduction is beneficial to the blood pressure levels. Therefore, the obese hypertensive HIV-infected patient should be encouraged to modify their lifestyles in order to lose weight.

In the pre HAART era, it was reported that an increased weight caused less reduction over time in the CD4 count levels. It appeared that it was beneficial for a patient to have a higher weight because the additional nutritional stores served as some extra protection from the adverse consequences of opportunistic infections. However, in this post HAART era, it has been discovered that excessive weight is no longer needed, and actually has negative effects on the immunity as reflected in the CD4 counts.\textsuperscript{26,40} In this study, Crum-Ciaflone \textit{et al.} reported that over time, obese HIV infected patients were more likely to have lower CD4 counts than their counterparts who had normal BMIs. Furthermore, the obese patients in their study also had lower CD4 counts than the overweight patients.\textsuperscript{40} A possible mechanism for the association between obesity and less robust CD4 counts may be that obesity is associated with elevated levels of inflammatory markers (eg C-reactive protein and interleukin-6) and adipokines which may have negative immune effects.\textsuperscript{41} They also reported that underweight patients had lower CD4 counts too, suggesting the need to maintain a healthy weight.

The implication of the increasing prevalence of obesity in patients with HIV is that the standard antiretroviral drug dosages may not be sufficient for the overweight and obese individuals and may lead to drug resistance. Also, obesity has been associated with multiple morbidities whose drug treatments may involve complex interactions with antiretroviral drugs. It is thus recommended that weight control programs which involve discussions on healthy diet and regular physical activity be included in the treatment plan of all patients receiving care at HIV clinics.

The present study has some limitations. We did not evaluate the dietary habits and physical activities of the respondents. Also, being a cross-sectional study, the findings may be not easily generalized to other environments.

\textbf{CONCLUSION}

The health challenges associated with overweight and obesity are well described in the general population. In this study, a significant
The number of HIV-infected patients were discovered to be overweight or obese at the time of enrolment for care. It is thus recommended that during the enrolment of HIV/AIDS patients for care, they should be screened for overweight and obesity. Targeted weight management programs should commence at an early stage of their treatment in order to help those who are already overweight to attain a healthy weight and also to help those who already have a healthy weight to maintain it.

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Okeke et al.: Prevalence of overweight and obesity among HIV infected patients

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Professor Sofola A. Olusoga,
Department of Physiology,
University of Lagos,
Nigeria.
Tel: +234(0) 7093848134
Email: enquiry@michaeljoanna.com
www.michaeljoanna.com