ABSTRACT

Background: The association between body mass index (BMI) and breast cancer risk has been well recognized. The purpose of this study was to determine the association of BMI with breast cancer risks among women of Igbo origin in Imo and Abia states in South Eastern Nigeria.

Methods: The study was conducted at three different locations: Abia State University Teaching Hospital Aba, Abia State; Federal Medical Center, Owerri, Imo State; and the Maranatha Specialist Mission Hospital, Aba, Abia State. This was a prospective hospital-based case control study. Data were collected on sociodemographic characteristics and anthropometric measures using a structured questionnaire. Collected data were imported to SPSS version 23 for analysis. In all, 681 patients participated in the study, of which 345 were women with breast cancer and 336 were control subjects. The t test was used to assess statistical differences of height, weight, and BMI in the studied groups. Logistic regressions were used to calculate the multivariate odds ratio (OR) using a 95% confidence interval (CI) and with significant level set at p<0.05.

Results: Higher BMI was found to be associated with increased risk of breast cancer. There was no significant statistical difference between the height of cases and controls in both pre-and post-menopausal women. The mean value of height was 161.1±7.1 cm among cases compared to controls which was 161.6±6.0 cm (p<0.470). The mean weight among women with breast cancer was 66.3 ± 11.8kg compared to control subjects at 65.4±9.3 kg (p<0.000); The mean BMI for premenopausal and postmenopausal women were 25.6±4.8 kg/m^2 among women with breast cancer compared to control subjects 25.1±4.0 kg/m^2 (p<0.001).

Conclusion and Implications for Translation: Primary prevention measures are important to modestly curtail the increasing burden of obesity and high BMI, which has been found to be associated with and increased risk of developing breast cancer in women. It is most likely that the risk of developing breast cancer in women will be reduced with weight control, dietary adjustments, and moderation in alcohol consumption.

Keywords: Breast Cancer • Imo State • Abia State • South East Nigeria • Body Mass Index • Nigeria
1. Introduction

1.1. Background of the Study

Breast cancer is predominantly a disease that affects women and has a major impact on their health. Globally, breast cancer accounts for 25.1% of all cancers affecting women, and ranking second (11.9%) overall when both sexes are considered together.1

Body Mass Index (BMI) is the weight in kilograms divided by the square of height in meters. BMI is a marker for general adiposity.2 BMI is categorized as underweight (BMI< 18.5kg/m²), normal range (18.5 – 24.9kg/m²), overweight (25 - 30kg/m²), and obese (BMI≥ 30kg/m²) as defined by the World Health Organization (WHO) BMI classification.3 In Nigeria, there are insufficient studies on the association between breast cancer and BMI. The studies by Adebamowo et al.4 and Ogundiran et al.5,6 were done at the South Western part of Nigeria and there are no similar studies conducted in the South Eastern part of Nigeria. The results of the study done by Adebamowo et al.4 show that there is no association between obesity and breast cancer risk.

In other parts of the world, specifically in Europe, USA, and Australia, many epidemiological studies that have been performed have shown that obesity is associated with a significantly elevated breast cancer risk.7,8 High BMI appears to be associated with increased breast cancer risk in post-menopausal women, while it has been shown to have a somewhat protective effect on pre-menopausal women.9,10 Considering that there are limited studies on breast cancer risk and BMI association in Nigeria, and that no studies have been performed among the Igbo women in Abia State and Imo State, this study focused on exploring the association between BMI and breast cancer risk among the Igbo women.

According to the predictions made by Ferlay et al.11 and Bray et al.,1 it is estimated that there will be 52,728 female breast cancer patients in Nigeria by 2035, accounting for about 25% of all female cancers. Among the three population-based cancer registries established in Nigeria, female breast cancer tops the list of cancers at Ibadan (Oyo State), Abuja (Federal Capital Territory), and Calabar (Cross River State). The risk of developing breast cancer is associated with several factors such as aging, family history, exposure to female reproductive hormones (both endogenous and exogenous), dietary factors, benign breast disease, environmental factors, early age at menarche, nulliparity or late age at first delivery, late age at postmenopausal, obesity and postmenopausal hormone therapy.12

1.2. Objectives of the Study

The study was designed to determine the association between BMI and breast cancer risk among the Igbo women living within the Abia and Imo States, Nigeria. We define risk or exposure factors of breast cancer as factors that increase the risk of breast cancer. These include age, family history, medical history, weight, physical activities, diet, smoking, exposure to estrogen, stress, anxiety, alcohol consumption, among others.

Specific Goals and Hypotheses

Specific Goals:

Our specific goals were to determine the following for the Igbo women within the Abia and Imo States, Nigeria:

1) Determine the association between BMI and premenopausal breast cancer risks;
2) Determine the association between BMI and postmenopausal breast cancer risks;
3) Determine the association between height and breast cancer risks; and
4) Determine the association between weight and breast cancer risks for pre- and postmenopausal women.

Research Hypotheses:

We posed the following research hypotheses associated with the Igbo women within the Abia and Imo States, Nigeria:

1) There is no significant association between BMI and breast cancer risk among premenopausal women;
2) There is no significant association between BMI and breast cancer risk among postmenopausal women;
3) There is no significant association between height and breast cancer risk among women;
4) There is no significant association between weight and breast cancer risk among women in the study.
2. Methods

The study was a prospective, hospital-based case control study conducted between October 2014 and August 2016. Data on exposure factors were collected from all the confirmed and suspected cases of breast cancer during the period; cases confirmed microscopically to have malignancy were included in the study. Frequency match was used for age and BMI. The data were collected for two years. Pre-designed case and control registration forms were used to collect the information. Anthropometry measurements were also performed, and control was collated at the same hospitals.

2.1. Study Population

The study population was premenopausal and postmenopausal Igbo women attending the Abia State University Teaching Hospital (in Abia State), the Maranatha Specialist Hospital (in Abia State), and the Federal Medical Center Owerri (in Imo State). As of 2012, the five-year prevalence of all cancers within Nigeria is 225,000 (53.1%). A total of 681 women were enrolled into the study, of which 345 women were diagnosed with breast cancer and 336 women were control subjects. Purposive sampling method was used to select tertiary health institutions and a referral center for breast cancer in the Imo and Abia States. All statistical analysis were performed using Statistical Package for Social Sciences (SPSS) version 23 software package, Armonk, NY; IBM Corp. Quantitative data were expressed as numbers and percentages while qualitative standards were expressed as Mean± Standard Deviation (SD). The Independent t test was used to assess statistical differences in height, weight and BMI in the population studied. Based on their BMI, women were grouped into four categories as per the WHO classifications: Underweight (BMI < 18.5 kg/m²), Normal (18.5 – 24.9 kg/m²), Overweight (25 - 30 kg/m²), and Obese (BMI ≥ 30 kg/m²). The second BMI category was used as a reference category. The odds ratio was calculated by finding the risk estimation between the group of BMI in both pre- and postmenopausal women separately. Multiple logistic regression analyses were conducted to estimate the odds ratio for developing breast cancer, using a 95% confidence interval for variables.

2.3. Ethical Approval

The study received ethical approval from the Department of Public Health, Federal University of Technology Owerri, Abia State University Teaching Hospital (Abia State), the Maranatha Specialist Hospital (Abia State), and the Federal Medical Center Owerri (Imo State). Written informed consent was sought and obtained from each subject. Participation was voluntary and the study did not involve invasive procedures or the alteration of standard clinical care.

3. Results

Table 1 shows the frequency distribution for BMI for the total population and for pre- and post-menopausal women. Of the 681 (100%) subjects studied, 345 (50.7%) were breast cancer cases and 336 (49.3%) were controls. The overall mean height and weight difference were 161.39 ± 6.6 cm and 65.9 ± 10.6 kg, respectively. The subjects’ BMI for underweight, normal, overweight and obese for cases were 17 (5.0%), 162 (46.9%), 99 (28.7%) and 67 (19.4%), respectively. The subjects’ BMI for underweight, normal, overweight and obese for controls were 16 (4.8%), 152 (45.2%), 131 (39.0%), 37 (11.0%), respectively.

3.1. Difference in Height, Weight and BMI

Table 2 presents the differences in height, weight and BMI between cases and controls for premenopausal and postmenopausal women. The premenopausal mean height for cases was 159.9± 8.0 cm compared to controls 161.7±5.6 cm (p<0.009); weight was 65.6±13.0 kg compared to controls 65.7±9.1 kg (p<0.0001); and BMI was 25.7±5.3 kg/m² compared to controls 25.2± 3.8 kg/m² (p<0.0001). When the mean height difference between cases and control subjects was evaluated, it was observed that the mean height was significantly higher for premenopausal controls compared to premenopausal breast cancer cases, while the mean height was found to be lower for postmenopausal controls compared to postmenopausal breast cancer cases (p<0.009).

3.2. Association between Breast Cancer Risks and BMI

Table 3 shows the association between breast cancer risk and BMI. It was found that there was a positive association between BMI and
breast cancer risk, with the risk being higher for postmenopausal subjects when compared to the control subjects, the odds of developing breast cancer for women in the premenopausal category were 1.74, 1.50, and 2.21 higher for underweight, overweight and obese, respectively. The odds of developing breast cancer for women in the postmenopausal category were 1.66 and 2.72 higher for underweight and obese women compared to controls (Figure 1).
3.3. BMI categories in pre- and postmenopausal breast cancer risk among women

There was a total of 345 breast cancer cases and 336 controls overall, including both pre- and postmenopausal women. Breast cancer risk increased with increasing BMI, with the risk level more pronounced among postmenopausal women, and for women with BMI more than 30 kg/m². The results of multiple logistic regressions show that a high BMI (more than 30 kg/m²) was positively correlated with the risk of breast cancer development in both pre- and postmenopausal Igbo women within the Abia and Imo States, Nigeria.

4. Discussion

There was a slight difference between the heights of patients with breast cancer for all women collectively with controls, which shows that breast cancer risk is not associated with increased height. This is in contrast with the findings of other studies in Europe and Africa in which breast cancer risk was associated with increasing height in both pre- and postmenopausal women. The increase in breast cancer risk seem to be associated with increase in height as expressed by Zhang et al. which showed that adult height is a risk factor for breast cancer in women and 10 cm increase in height was associated with a 17% elevated risk of breast cancer. The association between height and breast cancer risk

<table>
<thead>
<tr>
<th>Measurement</th>
<th>N (%)</th>
<th>Breast Cancer Cases (%)</th>
<th>Control (%)</th>
<th>Odds ratio</th>
<th>p-value</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premenopausal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>114 (46.0)</td>
<td>61 (46.9)</td>
<td>53 (44.9)</td>
<td>1-ref</td>
<td>0.034</td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>14 (5.6)</td>
<td>8 (6.2)</td>
<td>6 (5.1)</td>
<td>1.740</td>
<td>0.143</td>
<td>0.829-3.641</td>
</tr>
<tr>
<td>Overweight</td>
<td>78 (31.5)</td>
<td>33 (25.4)</td>
<td>45 (38.1)</td>
<td>1.500</td>
<td>0.521</td>
<td>0.435-5.172</td>
</tr>
<tr>
<td>Obese</td>
<td>42 (16.9)</td>
<td>28 (21.5)</td>
<td>14 (11.9)</td>
<td>2.210</td>
<td>0.120</td>
<td>1.246-5.970</td>
</tr>
<tr>
<td>Total</td>
<td>248 (100)</td>
<td>130 (100)</td>
<td>118 (100)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postmenopausal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>200 (46.2)</td>
<td>101 (47.0)</td>
<td>99 (45.4)</td>
<td>1-ref</td>
<td>0.045</td>
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</tr>
<tr>
<td>Underweight</td>
<td>19 (4.4)</td>
<td>9 (4.2)</td>
<td>10 (4.6)</td>
<td>1.660</td>
<td>0.089</td>
<td>0.930-2.980</td>
</tr>
<tr>
<td>Overweight</td>
<td>152 (35.1)</td>
<td>66 (30.7)</td>
<td>86 (39.4)</td>
<td>1.880</td>
<td>0.231</td>
<td>0.668-5.317</td>
</tr>
<tr>
<td>Obese</td>
<td>62 (14.3)</td>
<td>39 (18.1)</td>
<td>23 (10.6)</td>
<td>2.720</td>
<td>0.010</td>
<td>1.204-4.054</td>
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<tr>
<td>Total</td>
<td>433 (100)</td>
<td>215 (100)</td>
<td>218 (100)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Normal</td>
<td>314 (46.1)</td>
<td>162 (46.9)</td>
<td>152 (45.2)</td>
<td>1-ref</td>
<td>0.004</td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>33 (4.8)</td>
<td>17 (5.0)</td>
<td>16 (4.8)</td>
<td>1.700</td>
<td>0.023</td>
<td>1.070-2.690</td>
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<tr>
<td>Overweight</td>
<td>230 (33.8)</td>
<td>99 (28.7)</td>
<td>131 (39.0)</td>
<td>1.700</td>
<td>0.187</td>
<td>0.772-3.763</td>
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<tr>
<td>Obese</td>
<td>104 (15.3)</td>
<td>67 (19.4)</td>
<td>37 (11.0)</td>
<td>2.396</td>
<td>0.000</td>
<td>1.480-3.868</td>
</tr>
<tr>
<td>Total</td>
<td>681 (100)</td>
<td>345 (100)</td>
<td>336 (100)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1: Distribution of Odds Ratios and BMI categories in pre- and postmenopausal breast cancer risk among women
may likely be due to a more complex interaction between genetic and environmental factors.4,15

Postmenopausal women obesity has been deemed as a risk factor for developing breast cancer in previous studies.16,17 As reported previously,8,14,16,17 this study found that there was a statistically significant difference between the weight of controls [65.4±9.3, <0.01, CI=95%] and weight of women with breast cancer: [66.3±11.8 <0.01 CI= 95%]. This study also showed statistically significant differences in BMI between case subjects [25.6±4.8, p<0.001] and control [25.1±4.0, p<0.001]. The result is consistent with the results of studies by Dukyoo, et al.18 and Zhu et al.19

In this study, BMI was categorized into four (4) categories according to the WHO classification: underweight (BMI< 18.5kg/m²); normal range (18.5 – 24.9kg/m²); overweight (25- 30kg/m²); and obese (BMI≥ 30kg/m²). The likelihood of developing breast cancer was 2.72 higher for postmenopausal obese women compared to obese women (OR=2.39), when pre- and postmenopausal women were combined (Figure 1).

Findings from this study show that as BMI increases, the risk of breast cancer in postmenopausal women increases. Our results are consistent with work done by Iwasaki et al.,14 Dukyoo et al.,18 Rosilene. et al.,20 and Cold et al.9 After menopause, obesity increases breast cancer risk. Women who were overweight or obese after menopause were found to have a 30-60% higher risk of developing breast cancer than women who were leaner.16-17,21 Some studies have shown that fat tissue contains an enzyme called aromatase which converts androgens to estrogen, making women with higher BMI to have higher blood estrogen levels, ultimately increasing their chances of developing breast cancer when compared to leaner women with lower estrogen levels.22

The high risk of developing breast cancer associated with high BMI in postmenopausal women in this study, may also be attributed to high levels of insulin in their body. Women with high BMI tend to have higher levels of insulin compared to leaner women.23 Some studies24-26 have reported an association with an increased risk of breast cancer among postmenopausal women with high levels of insulin.

4.1. Limitations

The study examined the breast cancer risk in relation to BMI for premenopausal and postmenopausal Igbo women in two South East Nigeria states. Our results cannot be generalized to all women in Nigeria. The relationship between breast cancer and obesity was most likely related to high estrogen levels in postmenopausal women; however, our study did not explore staging of breast cancer, or treatment modality in breast cancer, as this was beyond the scope of the study. This study did not measure the possible effect of hormone replacement therapy (HRT) on the risk of developing breast cancer in women. HRT has been shown to increase the risk of breast cancer, and it is possible that some of the menopausal women in the study were on HRT.

4.2. Recommendations

Primary prevention measures such as increasing physical activity is important to modestly curtail the increased risk of developing breast cancer associated with higher BMI. Other primary prevention methods include the avoidance of weight gain, specially during postmenopause, through diet and lifestyle changes such as limiting the consumption of alcohol. More research on HRT is recommended given that HRT increases the risk of breast cancer and there might be a possibility that menopausal women were on HRT.

5. Conclusion and Implications for Translation

Among the population, weight, and body mass index were associated with increased breast cancer risk. There was a positive association between BMI and breast cancer risk for both pre- and postmenopausal women, but the association was stronger among postmenopausal women.

Compliance with Ethical Standards

Conflicts of Interest: The authors declare that they have no conflict of interest. Financial Disclosure: There are no financial conflicts of interest to disclose. Funding/Support: There are no funding/support resources to disclose. Ethics Approval: Ethical clearance was obtained from the Ethical Committee at Abia State University Teaching Hospital, the Maranatha
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Key Messages

► According to the study’s findings, postmenopausal women are more at risk of developing breast cancer as their BMI increases.
► To reduce the risk of getting breast cancer it is recommended that women should increase their physical activity, observe proper diet and pursue a healthy lifestyle.

References


