Original Article

# PERCENTAGE BODY FAT IN BREAST CANCER PATIENTS AT THE UNIVERSITY COLLEGE HOSPITAL, IBADAN: A CASE-CONTROL STUDY

[1] Abdus-salam Abbas A, [1]Ogunnorin Babatunde Olutoye, [1]Adenipekun Adeniyi A
[2]Olabumuyi Adeniyi Adedayo [3]Olabumuyi Olayide

[1]Radiation Oncology Department University of Ibadan, Ibadan Nigeria.
[2]Radiation Oncology Department, University College Hospital, Ibadan Nigeria
[3]Community Medicine Department, University College Hospital, Ibadan, Nigeria

## ABSTRACT

**BACKGROUND:** Breast cancer is the most important female malignancy in terms of incidence and mortality in Nigeria and globally. This burden of breast cancer requires preventive efforts directed at modifiable risk factors especially within a population at risk. Percentage body fat has previously been found to be higher among breast cancer patients compared to matched controls in global studies.

**OBJECTIVE:** To investigate the association between percentage body fat and breast cancer in the University College Hospital (UCH), Ibadan.

**METHODOLOGY:** The percentage body fat, estimated through two different techniques (bioelectric impedance assay and skin fold thickness), of 70 breast cancer patients and 71 age and gender matched controls were compared.

**RESULTS:** The cases of breast cancer had lower mean percentage body compared to their controls. However, the difference was only significant when estimated by skinfold thickness (SFT). There was an independent association between low percentage body fat (SFT) and breast cancer on multiple logistic regression with an OR of 0.921 (P < 0.005).

**CONCLUSION:** The study indicated an independent significant association between low percentage body fat and breast cancer. This pattern is peculiar to our environment and is due to the advanced stages at which breast cancer patients present to the UCH, Ibadan. As such, there is a need for advocacy to encourage patients to present early. Furthermore, larger longitudinal or cohort studies need to be done in Nigeria to precisely define the relationship between percentage and breast cancer.

**KEYWORDS:** Risk factor, breast cancer, percentage body fat, anthropometry

**RUNNING TITLE:** Percentage body fat in breast cancer at UCH, Ibadan

NigerJmed2019: 237-247


## INTRODUCTION

The global importance of breast cancer cannot be overestimated. It is the commonest female malignancy in the world. Breast cancer accounted for over 600,000 deaths in women in 2018 making it the leading cause of deaths attributable to cancer among women globally.[1] Breast cancer is of similar importance in Nigeria. There were close to 30,000 cases in 2018 resulting in an age standardized incidence rate of 41.7/100000.[1] Close to half of the incidences of breast cancers in Nigeria result in mortalities, as breast cancer is estimated to be responsible for 11564 deaths in 2018 with an age standardized mortality rate of 18.8/100000.[1]

**Correspondence to:** Olabumuyi Adeniyi Adedayo
Radiation Oncology Department
University College Hospital
Ibadan, Nigeria
**Tel:** +234 808 111 3888, +234 806 734 3731
**E-mail address:** niyi.oogaa@gmail.com

Due to the importance of breast cancer both in Nigeria and globally, efforts to reduce its disease burden are imperative. These efforts need to be directed not only to treat and cure the disease in patients diagnosed with breast cancer, but also to prevent breast cancer in Nigerians who do not have it. This can be achieved by screening the at-risk populations and identifying modifiable risk factors.

One related group of modifiable risk factors which are yet to be fully understood include diet rich in red meat, processed meat and fat; low physical activity (sedentary lifestyle) and anthropometric indices such as weight, height, body mass index (BMI), waist circumference, hip circumference and waist-to-hip ratio (WHR). In the Cancer Prevention Study II cohort, it was found that women with a higher BMI had a higher risk of dying from breast cancer.[2] In a pooled analysis of prospective studies, the risk of breast cancer was found to be 30% higher in postmenopausal women with a BMI over 31kg/m2 compared with women with a BMI of 20kg/m2 or less.[3] Conversely, studies show that in premenopausal women elevated BMI and indices of adiposity are associated with a reduced risk of breast cancer.[4-6]

Studies have showed that the relationship between BMI (anthropometry) and breast cancer is complex as, in addition to menopausal status, the association varies by race, age, and possibly hormone receptor status.[7] Anthropometric indices are surrogates for body fatness as such the impact of body fat might not be well characterised.[8] For instance, weight (the numerator in BMI) does not differentiate between lean mass and fat mass.[9] Also waist circumference and waist-hip-ratio (WHR) are indirect measures of central adiposity.[9]

Given these limitations of anthropometry in association with breast cancer, a more accurate assessment of the relationship between adiposity and breast cancer may be to directly measure body fat. Percentage body fat can be derived through skin fold thickness (SFT).[10] Other methods to determine percent body fat include the bioelectric impedance assay (BIA) and dual energy x-ray absorptiometry (DEXA).

This study was thus undertaken to investigate the effect of adiposity on breast cancer risk among patients in the University College Hospital Ibadan by measuring percentage body fat through the SFT and BIA techniques.

## MATERIALS AND METHODS

The study was conducted at the University College Hospital (UCH) Ibadan. The case group comprised of 70 patients with newly diagnosed breast cancer recruited at the Radiation Oncology and Surgical Oncology clinics, UCH between August 2016 and January 2017. The control group consisted of 71 age-matched non-breast cancer patients recruited at the Family Medicine Clinic and Chief Tony Anenih Geriatric Centre Outpatient Clinic, UCH between February 2017 and May 2017.

For cases, the inclusion criteria were a histologically diagnosed patient with invasive breast cancer and those who had not had previous cancer treatment (mastectomy, chemotherapy, radiation therapy, hormonal therapy). The exclusion criteria for cases were: Patients with uncontrolled chronic comorbidities such as hypertension and diabetes mellitus, hypo/hyperthyroidism; patients on drugs known to affect lipid metabolism (HMG CoA reductase inhibitors (statins), Bile acid sequestrants, Nicotinic acid, Fibric acids, hormone replacement therapy and other hormonal agents); patients with poor performance status (ECOG ≥ 3); and patients with obvious nutritional impairment (severe mucositis, naso-gastric tube feeding, or parenteral feeding). The inclusion criterion for controls was the patient's gender and age (±1year) matches a case. The exclusion criteria applied to controls were: Patients with breast disease; patients with uncontrolled chronic comorbidities such as hypertension and diabetes mellitus, hypo/hyperthyroidism, patients on drugs known to affect lipid metabolism (HMG CoA reductase inhibitors (statins), Bile acid sequestrants, Nicotinic acid, Fibric acids, hormone replacement therapy and other hormonal agents), patients with poor performance status (ECOG ≥ 3), patients with obvious nutritional impairment (severe mucositis, naso-gastric tube feeding, or parenteral feeding).

The study was (cross-sectional) case-control in design. Height, weight, BMI, estimated percentage body fat estimated from SFT's at four anatomical sites (triceps, biceps, subscapular, and suprailiac regions) according to Durnin and Womersley formula, and percentage body fat by BIA were measured in the cases and controls.

A questionnaire was used to retrieve information including sociodemographic data, clinical data and the above listed measures. Weight was measured to the nearest 0.1Kg and height to the nearest 0.1cm and from these values BMI was derived as weight divided by height squared expressed as $Kg/m^2$. Skinfold thickness was measured at 4 anatomical sites: the biceps, triceps, subscapular and suprailiac skinfold thicknesses using a calliper (Lange Skinfold Calliper). For each skin fold thickness, the average value of three readings was used. An indirect estimate of the percentage body fat calculated from the sum of the four skinfold thicknesses was derived using the formula proposed by Durnin and Womersley. The percentage body fat was also estimated through the Bioelectrical impedance assay method (BIA) using the Omron Fat Loss Monitor (HBF-306, Omron Corporation). The study was approved by the joint ethical review committee of the University of Ibadan/University College Hospital, Ibadan (approval number: UI/EC/15/0460).

Statistical analysis

The IBM SPSS v21 was used to analyse the data. Descriptive statistics (means and standard deviation for quantitative variables and frequencies and percentages for qualitative) were presented and appropriate tables and charts were used. The t-test was used to compare the mean levels of the quantitative outcomes between cases and controls.

Multiple logistic regression analysis was done on the significant variables to further adjust for confounding variables in the comparison of outcomes between cases and controls. Level of significance was set at 5%.

## RESULTS

All the cases were women, their ages ranged from 23 to 82 years with a mean age of 52.1±12.0 years. While the age rage and mean age of the age-matched apparently healthy controls was 24 to 83 years and 52.5±12.6 years respectively. There was no significant difference between the cases and controls with regards to ethnicity, marital status, religion, education and occupation. However, over 83% of the controls were employed as opposed to 68.6% of cases, this difference was statistically significant (P = 0.047) (table 1).

**Table 1:Cross tabulation of Demographic parameters with disease status of study population**

| Variable | Disease Status | | | | P Value |
|---|---|---|---|---|---|
| | Case | | Control | | |
| | N | %` | N | % | |
| Marital status (N) | 70 | | 71 | | 0.126 |
| Not currently married | 25 | 35.7 | 17 | 23.9 | |
| Currently married | 45 | 64.3 | 54 | 76.1 | |
| Religion (N) | 70 | | 71 | | 0.670 |
| Christianity | 49 | 70.0 | 52 | 73.2 | |
| Islam | 21 | 30.0 | 19 | 26.8 | |
| Level of Education (N) | 69 | | 71 | | 0.204 |
| < Secondary | 22 | 31.9 | 30 | 42.3 | |
| = Secondary | 47 | 68.1 | 41 | 57.7 | |
| Occupation (N) | 70 | | 66 | | 0.676 |
| Professional/Civil servant | 21 | 30.0 | 22 | 33.3 | |
| Artisan/Trader/Others** | 49 | 70.0 | 44 | 66.7 | |
| Employment status (N) | 70 | | 71 | | 0.047^ |
| Employed | 48 | 68.6 | 59 | 83.1 | |
| Unemployed | 15 | 21.4 | 5 | 7.0 | |
| Retired | 7 | 10.0 | 7 | 9.9 | |
| Ethnicity (N) | 70 | | 71 | | 0.786 |
| Yoruba | 59 | 84.3 | 61 | 85.9 | |
| Others* | 11 | 15.7 | 10 | 14.1 | |

^ statistically significant at 0.05

** Others include: Peace Corps officer, Librarian, Farmer and House-wife

* Other includes: Igbo, Hausa, Urhobo, Igala and Mandingo

There were more cases who attained menarche at an early age and menopause and a later age. But these differences were not statistically significant. In addition, a non-significant higher proportion of cases breastfed for a shorter duration compared to controls (table 2).

**Table 2: Reproductive factors associated with the disease status of study population**

| Variable | Disease status | | | | P Value |
|---|---|---|---|---|---|
| | Case | | Control | | |
| | N | % | N | % | |
| Menarche (N) | 70 | | 71 | | 0.795 |
| =13y | 13 | 18.6 | 12 | 16.9 | |
| >13y | 57 | 81.4 | 59 | 83.1 | |
| Age at 1st confinement (N) | 60 | | 62 | | 0.817 |
| =30y | 54 | 90.0 | 55 | 88.7 | |
| >30y | 6 | 10.0 | 7 | 11.3 | |
| Duration of Breastfeeding (N) | 62 | | 58 | | 0.186 |
| =1y | 23 | 37.1 | 15 | 25.9 | |
| >1y | 39 | 62.9 | 43 | 74.1 | |
| Menopause (N) | 42 | | 34 | | 1.000* |
| =55y | 38 | 90.5 | 31 | 91.2 | |
| >55y | 4 | 9.5 | 3 | 8.8 | |
| Parity (N) | 70 | | 69 | | 0.713 |
| 0-2 | 19 | 27.2 | 16 | 23.2 | |
| 3-5 | 36 | 51.4 | 40 | 58.0 | |
| Greater or Equals 6 | 15 | 21.4 | 13 | 18.8 | |

* Fisher's exact value reported

The difference between the cases and controls with regards to family history of breast cancer and presence or absence of comorbidities was not statistically significant. The proportion of cases that were either currently taking alcohol or had taken in the past (14.5%) was higher than that of the controls (5.6%). However, this difference was not statistically significant. None of the cases nor controls had a history of smoking. The cases had significantly higher systolic and diastolic blood pressures compared to the controls (table 3).

**Table3: Medical and social factors associated with disease status of the study population**

| Variable | Disease status | | P Value |
|---|---|---|---|
| | Case (%) | Control (%) | |
| Family History (N) | 70 | 71 | 0.275* |
| No | 92.9 | 97.2 | |
| Yes | 7.1 | 2.8 | |
| Comorbidities (N) | 70 | 71 | 0.178 |
| Present | 18.6 | 28.2 | |
| Absent | 81.4 | 71.8 | |
| Systolic BP (mmHg)* | 137.1±25.0 | 129.7±16.4 | 0.044^ |
| Diastolic BP (mmHg)* | 85.4±13.0 | 79.1±10.6 | 0.002^ |
| Alcohol history (N) | 62 | 71 | 0.141* |
| Never used | 85.5 | 94.4 | |
| Current/Past users Users | 14.5 | 5.6 | |
| Tobacco history (N) | 70 | 71 | NA |
| No | 100.0 | 100.0 | |
| Yes | 0.0 | 0.0 | |

* Fisher's exact value reported
^ statistically significant at 0.05
NA Not applicable

The cases had statistically significantly lower weights than the controls (P = 0.002). This was also the relationship among the postmenopausal women among whom the mean weight was 66.7Kg compared to 77.1Kg in the controls (P = 0.003). The premenopausal cases also had a lower mean weight compared to the controls. However, the difference was not statistically significant (P = 0.160) (table 4). The average height in the two groups was the same. Therefore, the cases had a lower mean BMI compared to controls (P = 0.001). There was no significant difference in the BMI among the premenopausal women, even though the premenopausal cases had lower BMIs compared to the controls. The postmenopausal cases also had lower mean BMIs (25.0Kg/m$^2$) compared to postmenopausal controls (29.5Kg/m$^2$), this difference was statistically significant (P = 0.05) (table 4). The cases had significantly lower triceps SFTs among all the participants and among the postmenopausal women. Similarly, the cases had significantly lower biceps SFTs this was reflected in all the participants and in both the postmenopausal and premenopausal subdivisions. The cases also had significantly lower subscapular SFTs but this was only seen when all the participants were compared. However, the difference in suprailiac SFTs between the cases and controls was not statistically significant. The estimated percentage body fat by SFTs was significantly lower in the cases when comparing all participants and in the postmenopausal women. The percentage body fat by BIA was lower in the cases among all participants and both the postmenopausal and premenopausal subdivisions. However, the differences were not statistically significant.

**Table 4: Comparing mean values of anthropometric indices in cases and controls**

| Variable | Menopausal status | Case | | Control | | P |
|---|---|---|---|---|---|---|
| | | N | $\bar{X}$±SD | N | $\bar{X}$±SD | |
| Weight (Kg) | Premenopausal | 28 | 68.2±17.0 | 37 | 74.9±20.0 | 0.160 |
| | Postmenopausal | 42 | 66.7±14.8 | 34 | 77.1±13.9 | 0.003^ |
| | Both | 70 | 67.3±15.6 | 71 | 76.0±17.3 | 0.002^ |
| Height (m) | Premenopausal | 28 | 1.6±0.1 | 37 | 1.6±0.1 | 0.309 |
| | Postmenopausal | 42 | 1.6±0.1 | 34 | 1.6±0.1 | 0.376 |
| | Both | 70 | 1.6±0.1 | 71 | 1.6±0.1 | 0.218 |
| BMI (Kg/m$^2$) | Premenopausal | 28 | 25.3±6.2 | 37 | 28.0±6.5 | 0.102 |
| | Postmenopausal | 42 | 25.0±5.2 | 34 | 29.5±6.2 | 0.001^ |
| | Both | 70 | 25.1±5.6 | 71 | 28.7±6.4 | 0.001^ |
| Triceps SFT (mm) | Premenopausal | 28 | 18.9±8.9 | 37 | 24.0±11.4 | 0.056 |
| | Postmenopausal | 42 | 20.3±8.7 | 34 | 29.0±9.9 | <0.001^ |
| | Both | 70 | 19.8±8.7 | 71 | 26.4±10.9 | <0.001^ |
| Biceps SFT (mm) | Premenopausal | 28 | 13.2±7.8 | 37 | 19.4±9.5 | 0.006^ |
| | Postmenopausal | 42 | 14.4±8.2 | 34 | 19.8±8.8 | 0.008^ |
| | Both | 70 | 13.9±8.0 | 71 | 19.6±9.1 | <0.001^ |
| Subscapular SFT (mm) | Premenopausal | 28 | 19.3±8.0 | 37 | 24.1±11.1 | 0.057 |
| | Postmenopausal | 42 | 19.0±9.4 | 34 | 21.6±11.8 | 0.300 |
| | Both | 70 | 19.2±8.8 | 71 | 22.9±11.4 | 0.031^ |
| Suprailiac SFT (mm) | Premenopausal | 28 | 14.6±6.7 | 37 | 13.7±7.0 | 0.608 |
| | Postmenopausal | 42 | 13.2±5.5 | 34 | 15.5±6.1 | 0.081 |
| | Both | 70 | 13.7±6.0 | 71 | 14.6±6.6 | 0.433 |
| % body fat (SFT) | Premenopausal | 28 | 32.5±7.0 | 37 | 35.3±7.8 | 0.140 |
| | Postmenopausal | 42 | 35.5±6.2 | 34 | 39.5±5.2 | 0.003^ |
| | Both | 70 | 34.3±6.6 | 71 | 37.3±7.0 | 0.010^ |
| % body fat (BIA) | Premenopausal | 28 | 28.7±8.9 | 37 | 29.8±9.5 | 0.612 |
| | Postmenopausal | 42 | 34.5±9.2 | 34 | 35.8±8.4 | 0.526 |
| | Both | 70 | 32.1±9.4 | 71 | 32.7±9.4 | 0.706 |

^ statistically significant at 0.05

**Table 5: Showing correlation between the statistically significant variables**

| | | Employment status | Systolic BP | Diastolic BP | BMI | % body fat SFT | % body fat BIA |
|---|---|---|---|---|---|---|---|
| Employment status | Pearson Correlation | 1 | .246** | .203* | .056 | .105 | .184* |
| | P Value | | .004 | .018 | .512 | .217 | .030 |
| | N | 141 | 136 | 136 | 141 | 141 | 139 |
| Systolic BP | Pearson Correlation | .246** | 1 | .739** | .120 | .198* | .290** |
| | P Value | .004 | | .000 | .166 | .021 | .001 |
| | N | 136 | 136 | 136 | 136 | 136 | 134 |
| Diastolic BP | Pearson Correlation | .203* | .739** | 1 | .052 | .136 | .186* |
| | P Value | .018 | .000 | | .545 | .114 | .032 |
| | N | 136 | 136 | 136 | 136 | 136 | 134 |
| BMI | Pearson Correlation | .056 | .120 | .052 | 1 | .751** | .717** |
| | P Value | .512 | .166 | .545 | | .000 | .000 |
| | N | 141 | 136 | 136 | 141 | 141 | 139 |
| % body fat SFT | Pearson Correlation | .105 | .198* | .136 | .751** | 1 | .651** |
| | P Value | .217 | .021 | .114 | .000 | | .000 |
| | N | 141 | 136 | 136 | 141 | 141 | 139 |
| % body fat BIA | Pearson Correlation | .184* | .290** | .186* | .717** | .651** | 1 |
| | P Value | .030 | .001 | .032 | .000 | .000 | |
| | N | 139 | 134 | 134 | 139 | 139 | 139 |

** Correlation is significant at the 0.01 level
* Correlation is significant at the 0.05 level

Table 5 shows the results of Pearson correlation analysis of the statistically significant variables on bivariate analysis (employment status, systolic BP, diastolic BP, BMI, percentage body fat by SFT), though percentage body fat by BIA was not statistically significant on t test, we also included it in the correlation analysis. Employment status was not moderately or strongly correlated with any of the above factors. Systolic BP was not moderately or strongly correlated to any of the factors in the analysis except diastolic BP, this was the same picture in diastolic BP. BMI was strongly correlated to percentage body fat measured both by SFT and BIA, with Pearson correlation values of 0.751 and 0.717 respectively (P value < 0.001). However, percentage body fat by SFT was only moderately correlated to percentage body fat by BIA, with a Pearson correlation value of 0.651 (P value < 0.001).

**Table 6:Logistic Regression of employment status, systolic BP, and percentage body fat by SFT**

| Variable | Model 1 | | | | Model 2 | | | | Model 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | P Value | OR | Confidence level of OR | | P Value | OR | Confidence level of OR | | P Value | OR | Confidence level of OR | |
| | | | Lower | Higher | | | Lower | Higher | | | Lower | Higher |
| Employment status (N) | | | | | | | | | | | | |
| Employed | | 1.000 | | | | 1.000 | | | | 1.000 | | |
| Unemployed | 0.021^ | 3.609 | 1.210 | 10.764 | 0.037^ | 3.238 | 1.070 | 9.793 | 0.052 | 3.089 | 0.990 | 9.635 |
| Retired | 0.656 | 1.289 | 0.422 | 3.941 | 0.963 | 1.027 | 0.323 | 3.271 | 0.762 | 1.203 | 0.363 | 3.985 |
| Systolic BP | | | | | 0.086 | 1.015 | 0.998 | 1.033 | 0.028^ | 1.021 | 1.002 | 1.041 |
| % body fat SFT | | | | | | | | | 0.005^ | 0.921 | 0.870 | 0.975 |
| Model ? $^2$ | 5.966, df 2, 0.051 | | | | 9.010, df 3, 0.029 | | | | 17.874, df 4, 0.001 | | | |
| Nagelkerke $R^2$ | 0.057 | | | | 0.085 | | | | 0.164 | | | |

^ statistically significant at 0.05

Table 6 shows stepwise logistic regression models used to analyse the risk/association of non-correlating variables which were hitherto significant on bivariate analysis (employment status, systolic blood pressure, and percent body fat SFT). This was to confirm the independence of the association between percentage body fat and breast cancer. Though diastolic blood pressure was statistically significant with t test, we did not include it in the logistic regression models as it strongly correlated with systolic blood pressure in the correlation analysis (table 5). Percentage body fat by BIA was not statistically significant on t test, it was thus not used in the logistic regression model, rather we used percentage body fat by SFT. In addition, since percentage body fat and BMI were strongly correlated, we did not include BMI in the logistic regression models. Model 3 indicates that elevated systolic blood pressure was an independent associated factor for breast cancer (P = 0.028). With an odds ratio (OR) of 1.021, every 1mmHg increase in systolic blood pressure, increases the likelihood of breast cancer by 2.1%. Low percentage body fat SFT was independently associated with breast cancer (P = 0.005). The OR of 0.921 indicates every 1% increase in percentage body fat, as measured by skin fold thickness, reduced the likelihood of breast cancer by 7.9%. The model also hinted at the fact that the association between unemployment and breast cancer was confounded by low percentage body fat SFT, as it lost its statistical significance in the model.

## DISCUSSION

This study was embarked on to observe the correlation of adiposity with breast cancer. The mean age (52.1±12.0 years) of the study sample indicates breast cancer continues to be a disease of the middle aged and elderly. The study also illustrated the negative impact a diagnosis of cancer has on one's capacity to get employed and or to remain employed. A study by Park et al noted that cancer patients in Korea were more likely to lose their jobs and less likely to get re-employed compared to those who are not afflicted with the disease.[11] However, it is needful to investigate the true picture of the association between breast cancer and unemployment. As further analysis in our study showed unemployment did not remain an independent risk factor upon logistic regression indicating that there are other factors that may be relevant confounders.

The mean systolic and diastolic blood pressure values were found to be statistically significantly higher among the cases than the controls. This may be due to the anxieties associated with a new diagnosis of breast cancer. However, these mean blood pressure values, though higher than the mean value of the controls, were still within the normal limits.

Studies showed a higher incidence of breast cancer among those with a daily consumption of four or more alcoholic drinks per day.[12] In this study, quantity of alcohol consumed daily was not recorded as the values are difficult to estimate with certainty in this cohort of patients. However, cases had more proportions of women who had taken alcohol in the past or current alcohol users, though the association was not significant.

The mean height among the cases and controls in this study sample was similar in both postmenopausal and premenopausal women. However, previous studies by Adebamowo et al and Ogundiran et al revealed taller women were at increased risk for breast cancer.[13,14] It is not clear why our study did not follow this trend.

This study revealed a statistically significant higher weight in controls compared to cases. Factoring in the constant mean height in the entire study population, one would expect the significantly higher BMI of the controls in this study. This pattern is particularly significant among the postmenopausal women in this study (P value = 0.001). Among the premenopausal women, there was also a higher mean BMI in the controls compared to the cases of breast cancer. However, this was not significant (P value = 0.102). Cases with low BMI compared to controls is not in keeping with findings in global literature, except in premenopausal breast cancer. This is due to anovulatory menstrual cycles associated with premenopausal obesity which result in low serum oestrogen levels.[15,16] However, previous studies in our environment, particularly the studies done in our centre differ from global findings. The study by Adebamowo et al showed no significant association,[13] while the study by Ogundiran et al revealed an inverse association between BMI and breast cancer indicating low BMI to be associated with breast cancer (P-trend 0.009).[14] This was similar to the finding in this study.

The anovulatory menstrual cycle effect noted in the global association between low BMI and premenopausal breast cancer can not explain the results this study noted. For one, the inverse association between BMI and breast cancer among the premenopausal women in this study was not significant. Furthermore, this inverse association between BMI and breast cancer persisted significantly among postmenopausal women in our study. If it were the anovulatory theory that was responsible for the premenopausal inverse risk, the association in the postmenopausal women should have flipped into a direct risk as seen among postmenopausal women in global studies.

This study noted a lower mean percentage body fat among the breast cancer cases compared to the controls in spite of the method of assessment. However, the difference was only significant using the skin fold thickness (SFT) method. This same pattern was seen in the postmenopausal women. However, in the premenopausal women, percentage body fat was lower in the cases by both techniques but none was significant. This study, contrary to previous studies inversely associates percentage body fat with breast cancer with an OR 0.921 (95% CI 0.870-0.975). A study conducted in Brazil by Martins et al also utilised skin fold thickness and bioelectric impedance assay (BIA) to compare percentage body fat between cases of breast cancer and controls. That study noted percentage body fat was higher in cases than controls, though only significantly higher with the BIA technique.[17]

Similarly another case-control study in Uruguay noted a significantly higher percentage body fat by SFT in the cases of breast cancer.[18] However, in a similar case control study done among African Americans, there was no statistically significant difference between the women with breast cancer and the controls.[19] The trends noted by these comparative cross sectional case control studies (excluding the one done among African Americans) were corroborated by longitudinal and prospective cohort studies. For instance, the longitudinal study utilizing data from the Women's Health Initiative (WHI). On follow up, incident cases of breast cancer were recorded and they were found more in women with higher percentage body fat. The hazard ratio of highest quintile to lowest quintile was 1.5; CI 1.33-1.99 (Ptrend = 0.007).[9] The Swedish population based prospective cohort study by Borgquist et al reported an increased risk of breast cancer in women with the highest quintile of percentage body fat compared to the lowest RR 1.65 (95% CI 1.12-2.43) Ptrend < 0.01.8 Another population based cohort by Krebs et al in the US with a follow up period of just over 11 years had similar findings. The women who later had breast cancer had higher mean percentage body fat compared to the women who did not develop breast cancer during the follow up period.[20]

Considering the fact that the study conducted among African Americans showed no significant relationship between percentage body fat and breast cancer; ethnicity may explain the reason why this study showed a relationship which is in contrast to many previous findings. However, ethnicity is unlikely to be the sole reason for the findings in this study. This is because the OR's in the African American study were only <1 (similar to this study) among premenopausal women. In postmenopausal women the OR's were >1 indicating percentage body fat was a risk for breast cancer, though, as their 95% confidence intervals included the null value, they were also not significant.[19]

The Pearson correlation analysis done showed that BMI was strongly correlated to percentage body fat by SFTs and percentage body fat by BIA. In addition, the same correlational analysis revealed percentage body fat by SFT and percentage body fat BIA were only moderately correlated. This study then proves BMI to be as good a surrogate for adiposity as percentage body fat by SFT which is the acceptable technique for epidemiological studies on percentage body fat.[21,22] The reading of percentage body fat measured by the BIA technique are highly dependent on the hydration status of the participant and when the participant took a meal.[23,24]

As such for adequate and consistent readings, strict protocols regarding the time of the day the measurement is taken and the amount of water and meals taken before the procedure are followed. Such strict protocols were not followed in this study, as it would be difficult to do so among the patients we recruited at their respective outpatient clinics. This could be the reason why percentage body fat BIA was not statistically significant and why it was only moderately correlated to percentage body fat SFT.

As such, the same explanation for the inverse association of BMI with breast cancer could also pertain to the inverse association between percentage body fat SFT and breast cancer. This implies, the advanced presentation, lower socioeconomic status (unemployment) and possibly poorer nutrition in the cases of breast cancer recruited might be an additional reason for the pattern seen.

The key to this inverse association would be an explanation peculiar to our environment. Adding up the sociodemographic and clinicopathologic presentations indicate the cases of breast cancer were more likely to be unemployed, and would more likely present in advanced stages with higher grades of differentiation. Hence, in our environment, breast cancer patients present at stages in which the wasting effect of breast cancer has set in or is already in play. Additionally, the socioeconomic status of patients with breast cancer is relatively lower, as they are usually unemployed. In Nigeria, the ratio of oncological centres with radiotherapy machines to citizen is abysmally low, (9 centres to 203,452,505 citizen[25]). Patients thus need to travel from distant regions of the country to seek oncological care. The living conditions of most of the patients that travel from distant regions are usually suboptimal. Hence, the nutritional status of cases of breast cancer compared to population controls or apparently healthy hospital controls, who usually reside within the city where the studies are done, would be unfavourable.

## CONCLUSION

The study indicated newly diagnosed patients with breast cancer in UCH, Ibadan have significantly higher blood pressures, and were likely to be unemployed compared to age matched apparently healthy controls.

The study also showed the breast cancer patients had lower weights, BMI and percentage body fat as measured by skin fold thicknesses compared to the controls and these differences were satistically significant. On logistic regression, low percentage body fat was proven to be an independent associated factor with breast cancer.

## LIMITATIONS

This study was cross-sectional by design. The findings noted were those seen in the participants of the study on the day they were recruited. The relationship between the factors studied are thus limited to associations and not cause-effect or risk factors.

The controls used were apparently healthy patients of the family medicine department and Chief Tony Anenih Geriatric Centre clinics. It was ascertained that the controls recruited had no clinical evidence of breast cancer or complaints of any other breast pathology. However, mammography studies were not done in them. This implies a remote possibility of a control having a yet to be discovered early breast cancer.

## RECOMMENDATIONS

The inverse relationship between adiposity (BMI and percentage body fat) and breast cancer in our environment needs to be further investigated. This requires larger, better funded and more carefully conducted studies. This would be helpful to analyse by categories such as group staging, T-stage and other cut-off points such as those for percentage body fat proposed by Gallagher et al.[26]

BMI was strongly correlated to percentage body fat by SFT and it is more easily determined by measuring weight and height compared to measuring skinfold thicknesses at varying anatomical sites. We thus recommend its continued use epidemiologically and for personal purposes at community level to measure and track adiposity. We do not recommend the use of percentage body fat by BIA for research purposes except if strict protocols regarding hydration and meals of the participants are followed.[23,24] On the other hand, this study adds more credence to the fact that measuring percentage body fat by the skin fold thickness technique is adequate for epidemiological intent.[21] The DEXA technique is the gold standard.[22] It is however expensive and capital intensive. Also, it is not feasible to frequently track adiposity over a period of time. It is not advisable to expose a person to x-rays weekly or monthly.

## REFERENCES

1. Cancer today, http://gco.iarc .fr/today/home( accessed 25 November 2018).
2. Calle EE, Rodriguez C, Walker-Thurmond K, et al. Overweight, obesity, and mortality from cancer in a prospectively studied cohort of US adults. New England Journal of Medicine 2003; 348: 1625–1638.

3. Van den Brandt PA, Spiegelman D, Yaun S-S, et al. Pooled analysis of prospective cohort studies on height, weight, and breast cancer risk. American journal of epidemiology 2000; 152: 514–527.
4. Baer HJ, Tworoger SS, Hankinson SE, et al. Body fatness at young ages and risk of breast cancer throughout life. American journal of epidemiology 2010; 171: 1183–1194.
5. Feigelson HS, Jonas CR, Teras LR, et al. Weight gain, body mass index, hormone replacement therapy, and postmenopausal breast cancer in a large prospective study. Cancer Epidemiology Biomarkers & Prevention 2004; 13: 220–224.
6. Amadou A, Hainaut P, Romieu I. Role of Obesity in the Risk of Breast Cancer: Lessons from Anthropometry. Journal of Oncology 2013; 2013: 1–19.
7. Chandran U, Hirshfield KM, Bandera EV. The role of anthropometric and nutritional factors on breast cancer risk in African-American women. Public health nutrition 2012; 15: 738–748.
8. Borgquist S, Jirström K, Anagnostaki L, et al. Anthropometric factors in relation to different tumor biological subgroups of postmenopausal breast cancer. International Journal of Cancer 2009; 124: 402–411.
9. Rohan TE, Heo M, Choi L, et al. Body fat and breast cancer risk in postmenopausal women: a longitudinal study. Journal of cancer epidemiology; 2013, http:// www.hindawi.com/ journals/jce/2013 /754815/abs/ (2013, accessed 9 October 2015).
10. Durnin JV, Womersley J. Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16 to 72 years. Br J Nutr 1974; 32: 77–97.
11. Park J-H, Park J-H, Kim S-G. Effect of cancer diagnosis on patient employment status: a nationwide longitudinal study in Korea. Psychooncology 2009; 18: 691–699.
12. Halperin EC, Brady LW, Wazer DE, et al. Perez & Brady's Principles and Practice of Radiation Oncology. Lippincott Williams & Wilkins, https://books.google.com/books?hl=en&lr=&id=GEwlAgAAQBAJ&oi=fnd&pg=PA1036&dq=perez+and+brady&ots=0hzgDrhyd0&sig=tTyP71uIoewF5yNSbNX5_cXMdnU (2013, accessed 17 March 2015).
13. Adebamowo CA, Ogundiran TO, Adenipekun AA, et al. Obesity and height in urban Nigerian women with breast cancer. Annals of epidemiology 2003; 13: 455–461.
14. Ogundiran TO, Huo D, Adenipekun A, et al. Case-control study of body size and breast cancer risk in Nigerian women. American journal of epidemiology 2010; 172: 682–690.
15. Renehan AG, Tyson M, Egger M, et al. Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371: 569–578.
16. Van den Brandt PA, Spiegelman D, Yaun S-S, et al. Pooled analysis of prospective cohort studies on height, weight, and breast cancer risk. American journal of epidemiology 2000; 152: 514–527.
17. Martins KA, Freitas-Junior R, Monego ET, et al. Anthropometry and lipid profile in women with breast cancer: a case-control study. Revista do Colégio Brasileiro de Cirurgiões 2012; 39: 358–363.
18. Ronco AL, Boeing H, De Stefani E, et al. A case-control study on fat-to-muscle ratio and risk of breast cancer. Nutrition and cancer 2009; 61: 466–474.
19. Bandera EV, Chandran U, Zirpoli G, et al. Body fatness and breast cancer risk in women of African ancestry. BMC cancer 2013; 13: 475.
20. Krebs EE, Taylor BC, Cauley JA, et al. Measures of adiposity and risk of breast cancer in older postmenopausal women. Journal of the American Geriatrics Society 2006; 54: 63–69.
21. Determining body composition in adults - UpToDate, https://www.uptodate .com/ contents /determining-body-composition-in-adults?search= percentage% 20body%20fat &source=search_result&selectedTitle=1~150&usage_type= default &display_rank=1 (accessed 10 February 2019).
22. Nutritional Status Assessment in Adults Technique: History and Physical Examination, Anthropometric Measures, Nutrition Screening, https://emedicine.medscape.com/article/2141861-technique (accessed 10 February 2019).
23. Validation of tetrapolar bioelectrical impedance method to assess human body composition. - PubMed - NCBI, https://www.ncbi.nlm. nih.gov/ pubmed/3700310 (accessed 10 February 2019).
24. Bioelectrical impedance: effect of 3 identical meals on diurnal impedance variation and calculation of body composition | The American Journal of Clinical Nutrition | Oxford Academic, https://academic. oup.com/ajcn/article /74/4/ 474/ 4737410 (accessed 10 February 2019).
25. Africa: Nigeria — The World Factbook - Central Intelligence Agency, https://www.cia. gov/ library /publications/resources/the-world-factbook/ geos/ni.html (accessed 10 February 2019).
26. Gallagher D, Heymsfield SB, Heo M, et al. Healthy percentage body fat ranges: an approach for developing guidelines based on body mass index, http://ajcn.nutrition.org (accessed 21 October 2017).
27. What are the guidelines for percentage of body fat loss? ACE Fit | Fitness Information, http://www.acefitness.org/acefit/healthy-living-article/60/112/what-are-the-guidelines-for-percentage-of/ (accessed 12 May 2015).