

# Body Mass Index, Chemotherapy-Related Weight Changes, and Disease-Free Survival in Haitian Women With Nonmetastatic Breast Cancer

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**PURPOSE** Few studies have explored the relationship between body habitus and breast cancer outcomes in Caribbean women of African ancestry. This study evaluates the association between body mass index (BMI) and disease-free survival (DFS) in a retrospective cohort of 224 female Haitian patients with nonmetastatic breast cancer.

**PATIENTS AND METHODS** BMI was obtained from the medical records and categorized as normal weight (< 25 kg/m<sup>2</sup>), overweight (25-29.9 kg/m<sup>2</sup>), and obese (≥ 30 kg/m<sup>2</sup>). DFS was defined as time from surgical resection to disease recurrence, death, or censoring. Kaplan-Meier survival curves were generated, and the association between BMI and DFS was evaluated using Cox proportional hazard models to control for multiple confounders. Exploratory analyses were conducted on weight changes during adjuvant chemotherapy.

**RESULTS** Eighty-three patients (37.1%) were normal weight, 66 (29.5%) were overweight, and 75 (33.5%) were obese. There were no statistical differences in baseline characteristics or treatments received by BMI group. Twenty-six patients died and 73 had disease recurrence. Median DFS was 41.1 months. Kaplan-Meier estimates showed no significant DFS differences by BMI categories. After controlling for confounders, normal weight patients, when compared with overweight and obese patients, had adjusted hazard ratios of 0.85 (95% CI, 0.49 to 1.49) and 0.90 (95% CI, 0.52 to 1.55), respectively. Overall, mean weight loss of 2% of body weight was noted over the course of adjuvant chemotherapy. Patients who were postmenopausal ( $P = .007$ ) and obese ( $P = .05$ ) lost more weight than other groups. However, chemotherapy-related weight changes did not have an impact on DFS.

**CONCLUSION** Baseline BMI and weight changes during adjuvant chemotherapy did not have an impact on DFS in this cohort. Future prospective studies in similar Caribbean breast cancer cohorts are needed to verify study findings.

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## INTRODUCTION

Breast cancer is the most common cancer in Haitian women. In 2018, the estimated number of new breast cancer cases was more than 1,100, with a mortality-to-incidence ratio of more than 60%, one of the highest anywhere in the world.<sup>1,2</sup> Previous population studies of breast cancer in Haiti have demonstrated a preponderance of risk factors such as young age and advanced disease at diagnosis, both of which are associated with shorter survival.<sup>3-5</sup> These studies have also described gaps in breast cancer care delivery, such as delays in diagnosis and treatment initiation, lack of trained oncology specialists, and limited therapeutic options. However, no studies have explored the potential contribution of lifestyle factors to patient survival outcomes after a breast cancer diagnosis.

Observational studies suggest that lifestyle factors may significantly influence the risk of recurrence and death

in patients with nonmetastatic breast cancer. Large meta-analyses have demonstrated that obesity and increased adiposity are associated with higher incidence of postmenopausal breast cancer; conversely, there is a reverse association of these factors with premenopausal breast cancer.<sup>6-9</sup> However, in both pre- and postmenopausal patients with nonmetastatic breast cancer, studies suggest that states with a positive energy balance such as type 2 diabetes,<sup>10-12</sup> obesity,<sup>13-16</sup> weight gain after diagnosis,<sup>17,18</sup> and reduced physical activity,<sup>19-23</sup> are each associated with increased risk of disease recurrence and mortality.

The epidemiologic studies on breast cancer and obesity have been predominantly conducted in White populations and in higher-income countries.<sup>18-23</sup> Except in rare reports, individuals of African descent have been under-represented in these studies.<sup>24,25</sup> There are differences in the epidemiology of obesity in different populations that are correlated with

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## CONTEXT

### Key Objective

This study examines the relationship between body mass index (BMI) and disease-free survival (DFS) in Haitian women with nonmetastatic breast cancer.

### Knowledge Generated

Majority of the patients were overweight or obese at the time of surgery. On average, women lost 2% of their body weight over the course of adjuvant chemotherapy. Baseline BMI and weight changes during adjuvant chemotherapy did not affect DFS in this population.

### Relevance

The BMI distribution of patients with breast cancer may vary between different populations around the world. More studies are needed to understand the epidemiology of obesity in Caribbean patients with breast cancer, in order to guide context-appropriate survivorship recommendations.

biologic and socioeconomic influences. For example, in the United States, the prevalence of obesity is higher in African American patients with breast cancer than in White patients with breast cancer.<sup>10,26</sup> However, studies in African American cohorts of patients with breast cancer have shown no association between obesity and breast cancer survival outcomes.<sup>27-29</sup>

There is much less data available about the relationship between obesity and breast cancer in patients of African descent in Africa and the Caribbean.<sup>30</sup> Rates of obesity are increasing in Caribbean countries such as Haiti; recent estimates indicate that 55% of Haitian adults are overweight or obese,<sup>31</sup> so we sought to understand the distribution of body mass index (BMI) among a retrospective cohort of Haitian patients with nonmetastatic breast cancer and to explore the association among BMI, chemotherapy-associated weight changes, and clinical outcomes.

## PATIENTS AND METHODS

### Study Setting and Population

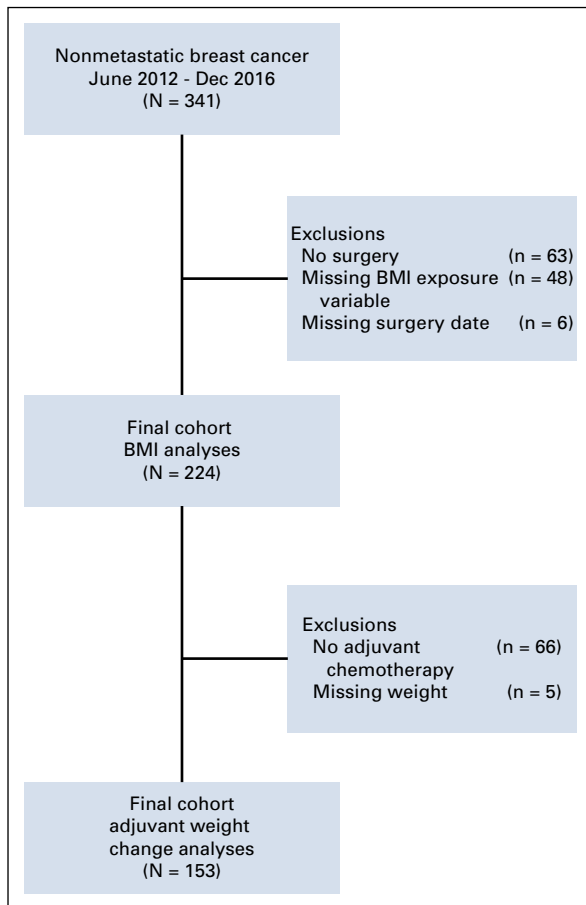
The study sample was ascertained at University Hospital Mirebalais (HUM), a public tertiary 350-bed hospital located in the central plateau region of Haiti.<sup>32</sup> The study population cohort included female patients with confirmed nonmetastatic breast cancer treated at HUM who were newly diagnosed between June 2012 and December 2016. The methods of cohort ascertainment and overall outcome of the primary cohort have been previously described.<sup>3</sup> Briefly, breast cancer diagnosis and stage were confirmed based on review of pathology reports, clinical assessment, physical examination, and imaging documentation in the medical records. Over the ascertainment period, 341 eligible patients with nonmetastatic breast cancer were identified. Of these, 117 patients (34.3%) were excluded: 63 patients who did not undergo curative surgery, six had missing surgery dates, and 48 did not have the data required to compute BMI. The final cohort thus included 224 eligible patients (Fig 1). A subset (n = 153) of these patients was included in

exploratory analyses that evaluated the impact of weight change during adjuvant chemotherapy, excluding patients who did not receive adjuvant chemotherapy (n = 66) and those with missing weight values (n = 5). Research and ethical approvals were obtained from the Institutional Review Boards at Zanmi Lasante in Haiti, which governs local research at HUM, and from the Dana-Farber/Harvard Cancer Center in Boston, Massachusetts.

### Study Variables and Covariates

Comprehensive data on patient characteristics were collected at presentation, including diagnostic information, weight and height at the time of surgery, treatments administered, and outcomes, including disease recurrence and death. Study covariate data were obtained through review and abstraction of HUM medical records. The primary independent variable was BMI, calculated as weight in kilograms divided by the square of height in meters. BMI was computed using the first post-surgery weight and height measurement obtained at the start of adjuvant treatment. Post-surgery weight was missing in 31 patients (13.8%), so we used the most recent recorded weight before surgery. This decision was justified by evaluating the difference in post-surgery weight and last recorded presurgery weight in 61 patients who had both data points available. The mean difference was 0.34 kg (standard deviation, 4.37 kg), and median was -0.20 kg (interquartile range, -1.0 to 1.1 kg); there were no statistically significant differences between the two weight measures (*t* test *P* = .54). Weight change over the course of adjuvant chemotherapy treatment was also examined.

There were other covariates of interest in the following categories: patient demographics, clinical disease characteristics, geographical information, previous medical history, and treatment details. Stage at presentation was modified from the Union for International Cancer Control TNM staging (7th edition) classification<sup>33</sup>: stage I and stage II were classified as early and stage III as locally advanced.



**FIG 1.** Cohort derivation. BMI, body mass index.

Menopausal status was determined from records of loss of periods for at least 12 months before presentation. For individuals with missing menopausal status, patients older than age 50 years were assumed to be postmenopausal based on menopausal age estimates in the Caribbean region.<sup>34</sup> Urban and rural residence classification was determined by the patient's recorded home residence location. This residence location was linked to a World Bank database that classifies residence locations as urban or rural based on population density estimates.<sup>35</sup> Pathologic type and grade were obtained from pathology reports based on World Health Organization classifications.<sup>36</sup> Estrogen receptor (ER) status was determined by using guidelines from the College of American Pathologists; samples were deemed positive for 1% cell positivity or greater as documented in pathology reports.<sup>37</sup> Progesterone receptor status and the presence of human epidermal growth factor receptor 2 amplification are not routinely obtained in Haiti, so they were not included in the pathologic classification. Time to definitive treatment was defined as date of presentation at HUM to start of earliest treatment, either definitive surgery or initiation of neoadjuvant therapy. Delayed treatment initiation was defined as greater than 12 weeks based on results from previous observational studies.<sup>38-40</sup>

## Study End Points

The primary end point was disease-free survival (DFS), defined as date of surgery to date of tumor recurrence, death from any cause, or censoring at the latest date of follow-up if neither of these events occurred. Disease recurrence was ascertained by review of medical records, as determined from clinical examination, imaging, or pathologic confirmation. Death information was obtained from the medical records and from the HUM hospital death registry.

## Statistical Analysis

For baseline patient characteristics, proportions were estimated within each covariate category by BMI subgroups. Groups were compared using  $\chi^2$  test for categorical variables and analysis of variance for continuous variables. The percentage of weight change during adjuvant chemotherapy was estimated within relevant covariate categories and groups were compared by using *t* tests. Kaplan-Meier analysis was used to generate survival curves for the cohort. Log-rank tests were used to compare survival curves between groups.<sup>41</sup> Cox proportional hazards regression analysis was used to determine the association of BMI with DFS, adjusted for the effect of relevant covariates.<sup>42</sup> Our adjusted model considered potential confounders, including disease stage (early *v* locally advanced), menopausal status (premenopausal *v* postmenopausal), ER status (positive *v* negative), time to definitive treatment (dichotomized as treatment within 12 weeks of presentation *v* treatment after 12 weeks), and home residence classification (urban *v* rural). The selection of covariates for the final model was based on clinical significance. Except as otherwise noted, covariates with missing variables were coded as a separate unknown category. We performed exploratory analyses on weight changes over the course of adjuvant chemotherapy and similarly explored the association between weight changes and DFS.

All analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC). Reported *P* values are two-sided, and a threshold level of significance of *P* < .05 was considered statistically significant. There was no adjustment of significance threshold for multiple comparisons. All data used for this analysis were abstracted between May 2018 and December 2018 and stored securely in a Research Electronic Data Capture (REDCap) database.

## RESULTS

### Baseline Characteristics

Baseline demographic and clinical characteristics for the cohort by BMI categories are provided in Table 1. The population distribution by BMI categories showed 83 patients (37.1%) had normal weight, 66 (29.5%) were overweight, and 75 (33.5%) were obese. Overall, there were no statistically significant differences in baseline characteristics among the BMI categories. The mean age

**TABLE 1.** Patient Characteristics by BMI Categories

Characteristic	BMI						P <sup>a</sup>
	< 25 kg/m <sup>2</sup> (n = 83)		25-29.9 kg/m <sup>2</sup> (n = 66)		≥ 30 kg/m <sup>2</sup> (n = 75)		
	No.	%	No.	%	No.	%	
Mean age, years (SD)	48.9 (11.9)		47.6 (9.6)		50.9 (9.9)		.19 <sup>b</sup>
Postmenopausal	32	38.5	20	30.3	30	40.0	.44
Regional home location							.31
Central	18	21.7	14	21.2	8	10.7	
South	7	8.4	4	6.1	3	4.0	
North	2	2.4	4	6.1	3	4.0	
West	56	67.5	44	66.7	61	81.3	
Urban residence	48	57.8	48	72.3	49	65.3	.17
Presenting symptoms <sup>c</sup>							
Breast mass	77	92.8	57	86.4	70	93.3	.28
Breast pain	28	33.7	23	34.8	22	29.3	.75
Primary T stage							.65
1-2	21	25.3	17	25.8	16	21.3	
3-4	48	57.8	32	48.5	43	57.3	
Unknown	14	16.9	17	25.8	16	21.3	
Regional N stage							.69
0-1	64	77.1	47	71.2	54	72.0	
2-3	9	10.8	7	10.6	6	8.0	
Unknown	10	12.1	12	18.2	15	20.0	
Final TNM stage							.77
Early	24	28.9	18	27.3	18	24.0	
Locally advanced	50	60.2	37	56.1	44	58.7	
Unclear	9	10.8	11	16.7	13	17.3	
ER status							.98
Positive	43	51.8	35	53.0	37	49.3	
Negative	27	32.5	20	30.3	24	32.0	
Unknown	13	15.7	11	16.7	14	18.7	
Biopsy histologic type							.41
Invasive ductal	56	67.5	51	77.3	50	66.7	
Invasive lobular	1	1.2	2	3.0	3	4.0	
Other	16	19.3	5	7.6	10	13.3	
Unknown	10	12.0	8	12.1	12	16.0	
Biopsy pathologic grade							.62
Well or moderately differentiated	15	18.1	16	24.2	16	21.3	
Poorly differentiated	37	44.6	21	31.8	29	38.7	
Unknown	31	37.4	29	43.9	30	40.0	

Abbreviations: BMI, body mass index; ER, estrogen receptor; SD, standard deviation.

<sup>a</sup>Estimated by  $\chi^2$  test unless otherwise noted.

<sup>b</sup>Estimated by analysis of variance test.

<sup>c</sup>Nonmutually exclusive.

**TABLE 2.** Treatment Details by BMI Categories

Treatment Elements	BMI						P <sup>a</sup>
	< 25 kg/m <sup>2</sup> (n = 83)		25-29.9 kg/m <sup>2</sup> (n = 66)		> 30 kg/m <sup>2</sup> (n = 75)		
	No.	%	No.	%	No.	%	
Timeliness of treatment							.13
Within 12 weeks	38	45.8	41	62.1	42	56.0	
More than 12 weeks	45	54.2	25	37.9	33	44.0	
Modified radical mastectomy	82	98.8	62	93.9	70	93.3	.19
Neoadjuvant therapy <sup>b</sup>							
Total	43	51.8	28	42.4	30	40.0	.29
Hormonal	6	7.2	8	12.1	5	6.7	.45
Chemotherapy	40	48.2	23	34.8	25	33.3	.11
Both	3	3.6	3	4.6	0	0.0	.20
Adjuvant therapy <sup>b</sup>							
Total	68	81.9	52	78.8	65	86.7	.46
Hormonal	45	54.2	37	56.1	47	62.7	.54
Chemotherapy	56	67.5	45	68.2	57	76.0	.44
Both	33	39.8	30	45.4	39	52.0	.30

Abbreviation: BMI, body mass index.

<sup>a</sup>Estimated by  $\chi^2$  test.

<sup>b</sup>Nonmutually exclusive.

was 49.1 years. Eighty-one patients (36.2%) were postmenopausal. The majority of the patients (58.5%) had locally advanced disease. For the patients with documented ER status, 61.8% were ER-positive.

### Treatment

There were no statistically significant differences in treatment between the BMI categories (Table 2). Many patients had delays in treatment initiation: more than 12 weeks elapsed from initial presentation to definitive treatment initiation for 46.0% of patients. In all, 101 patients (45.1%) received neoadjuvant therapy, and 185 (82.6%) received adjuvant therapy.

### Weight Changes With Adjuvant Chemotherapy

Weight changes over the course of adjuvant chemotherapy, grouped by patient characteristics, are reported in Table 3. During the course of chemotherapy, 93 patients (60.8%) lost weight with a mean weight change measured as percentage of total body weight of 2.0% weight loss. On average, there was weight loss across every grouping of the patient characteristics explored. However, there were statistically significant differential magnitudes of weight loss by menopausal status and baseline BMI. Postmenopausal women lost a larger percentage of their weight (4.1%) compared with premenopausal women (0.9%;  $P = .007$ ). There was a trend suggesting that patients with higher initial BMI lost larger percentages of weight: obese patients lost 3.4% ( $P = .05$ ) and overweight patients lost 2.0% ( $P = .47$ )

compared with normal-weight individuals who lost 0.4%. There were no significant differences in weight loss across group categories by disease stage, hormone receptor status, or home residence classification.

### Body Mass Index, Weight Changes, and Survival

During the follow-up period, 73 patients had disease recurrence, and 26 patients died. Seven of those who died did not have documented disease recurrence. The median follow-up time was 21.7 months, and the median DFS was 41.1 months (95% CI, 37.6 to 49.4 months). No significant DFS difference by BMI categories was observed in Kaplan-Meier analysis (log-rank test  $P = .84$ ; Fig 2). Similarly, the survival analyses by weight gain/weight loss categories showed no difference in DFS (log-rank test  $P = .75$ ; Fig 3). We also analyzed survival comparing stable weight (within 3% of baseline), weight loss (> 3%), and weight gain (> 3%) and observed no difference in DFS (log-rank test  $P = .13$ ; Fig 4). After controlling for confounders (clinical stage, menopausal status, ER status, time to treatment, and home residence classification), there was no association between BMI categories and DFS. Compared with patients with normal weight, overweight and obese patients had adjusted hazard ratios (HRs) of 0.87 (95% CI, 0.50 to 1.52), and 0.85 (95% CI, 0.50 to 1.45), respectively. For analyses that were limited to patients who received adjuvant chemotherapy, in addition to listed confounders, we further controlled for weight change during adjuvant treatment. Compared with normal-weight patients, overweight and

**TABLE 3.** Weight Change During Adjuvant Chemotherapy

Category	No. of Patients	Mean Percent Weight Change (SD)	P <sup>a</sup>
Total No. of patients	153	-2.0	
BMI, kg/m <sup>2</sup>			
< 25	52	-0.4 (7.3)	Ref
25-29.9	43	-2.0 (5.9)	.47
≥ 30	58	-3.4 (7.4)	.05
Menopausal status			.007
Postmenopausal	53	-4.1 (8.3)	
Premenopausal	100	-0.9 (6.0)	
Home residence classification			.94
Rural	54	-2.0 (4.7)	
Urban	99	-2.1 (8.1)	
Disease stage			.68
Early	50	-2.7 (7.7)	
Locally advanced	77	-1.7 (7.4)	
ER status			.9992
Positive	85	-2.3 (7.1)	
Negative	45	-2.3 (7.1)	

Abbreviations: BMI, body mass index; ER, estrogen receptor; SD, standard deviation.

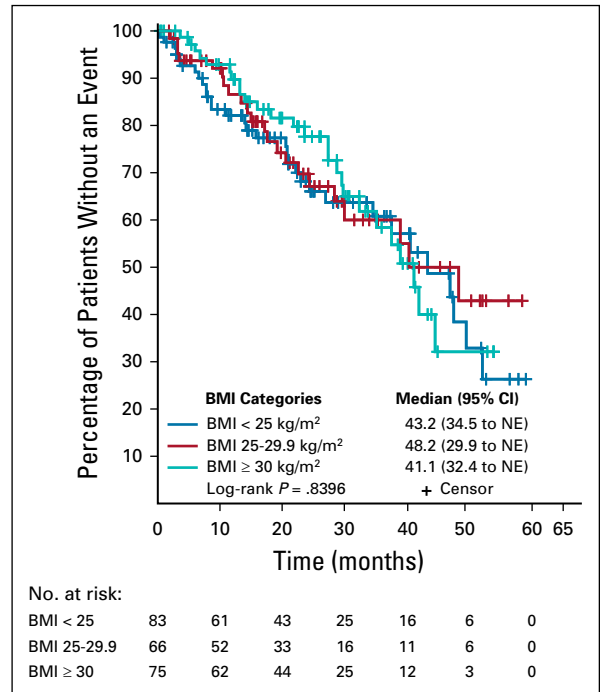
<sup>a</sup>Estimated by *t* test.

obese patients had adjusted HRs of 1.29 (95% CI, 0.55 to 3.08) and 1.61 (95% CI, 0.76 to 3.42), respectively (Table 4).

**DISCUSSION**

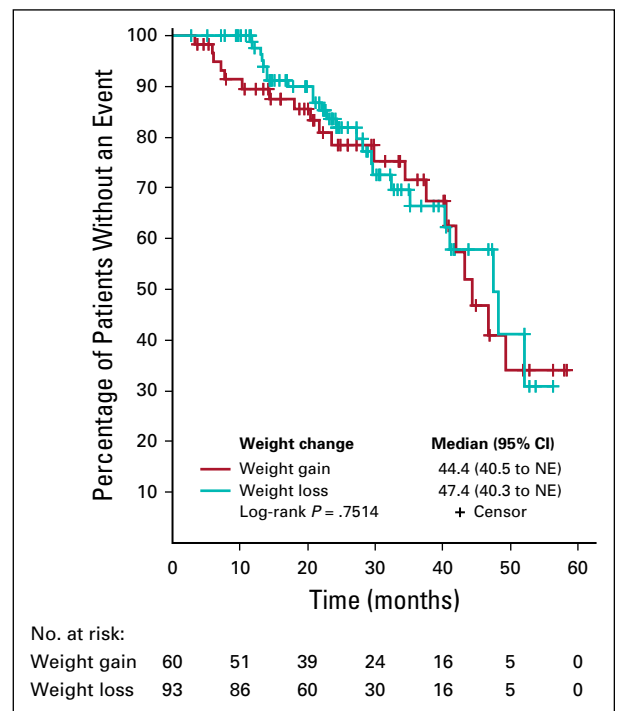
In this retrospective cohort of female patients with non-metastatic breast cancer in Haiti, 63% were either overweight or obese. Being overweight or obese was not associated with different disease characteristics at diagnosis or with types of treatments received. In addition, in survival analyses that controlled for multiple confounders, there was no association between increased BMI and breast cancer DFS. Our study also showed that most patients lost weight over the course of adjuvant chemotherapy; patients who were postmenopausal or obese were more likely to have chemotherapy-associated weight loss. Overall, chemotherapy-associated weight changes were modest and did not have an impact on breast cancer survival outcomes.

To our knowledge, this study is the first to explore the relationship between BMI and breast cancer outcomes in a Caribbean population. Most previous reports of breast cancer outcomes in Caribbean populations have not assessed weight and adiposity measures.<sup>43-45</sup> One report from a Haiti retrospective breast cancer cohort showed a 69.9% prevalence of overweight or obesity, but did not assess the impact of obesity on cancer outcomes.<sup>5</sup> The

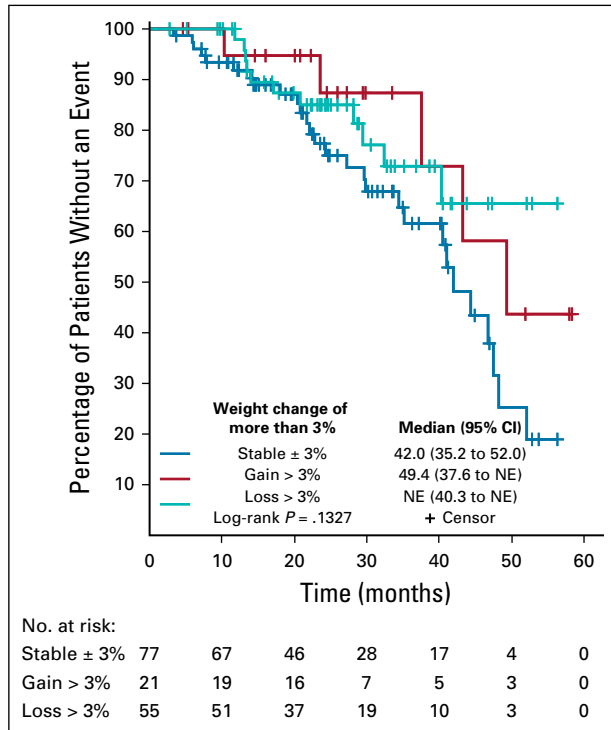


**FIG 2.** Kaplan-Meier curve for disease-free survival by body mass index (BMI) categories. NE, not reached and unable to estimate.

proportion of Haitian patients with breast cancer who are overweight or obese in our report is on par with rates of 60% to 70% reported among African Americans and higher than rates (< 45%) in Whites from the same cohorts.<sup>28,29</sup>



**FIG 3.** Kaplan-Meier curve for disease-free survival by weight loss or gain. NE, not reached and unable to estimate.



**FIG 4.** Kaplan-Meier curve for disease-free survival by weight change categories. NE, not reached and unable to estimate.

Recognizing the rising worldwide rates of obesity, its prevalence is now routinely assessed in recent breast cancer cohorts in populations of African descent.<sup>46-48</sup>

In large international systematic meta-analyses, overweight and obesity are associated with higher disease recurrence, higher overall mortality, and higher breast cancer–specific mortality.<sup>14,15</sup> Nonetheless, the impact of increased weight on breast cancer outcomes remains understudied in populations of African descent, because they were markedly under-represented in previous studies. The only detailed reports in this unique population were studies in African American patients, where there have been no clear associations between increased BMI and any breast survival outcome measures.<sup>27-29,49</sup> Differences in association

trends in distinct ethnic populations may be a result of complicated interplay between biologic factors, socio-demographic mediators, and confounders of the relationship between weight and breast cancer outcomes.<sup>30,50</sup> The results in African-American populations may provide some insights into the contribution of genetic biologic mechanisms but may not address the contributions from socio-demographic variation that exists within the worldwide diversity of populations of African descent in Africa and the Caribbean.

Despite limitations with cross-study comparisons because of differences in methodology, the lack of association between BMI and DFS in this Haitian study cohort is consistent with findings from African American cohorts.<sup>28,49</sup> However, there are no directly comparable studies in the literature from similar cohorts in Africa or other populations of African descent in the Caribbean.

In addition to absolute weights, weight changes after a breast cancer diagnosis may have an impact on survival outcomes. A recent systematic meta-analysis of 25 studies indicated that, on average, patients gain weight over the course of adjuvant chemotherapy; the aggregated mean increase in weight was 2.7 kg.<sup>51</sup> The reasons for weight gain are not completely understood, although some hypotheses include reduced physical activity, changes in diet during cancer therapy, chemotherapy-induced metabolic changes, and use of steroids that accompanies chemotherapy regimens. In our Haitian patient cohort, patients lost 1.7 kg or 2% of their body weight on average; these findings are in contrast to the results of previous studies.<sup>51</sup> We hypothesize that the contrasting results in this Haitian cohort are likely explained by the differences in the unique study population compared with the populations included in the aggregate studies. An unexplained underlying biologic mechanism is possible, because there was a paucity of individuals of African descent in the studies included in the meta-analysis. The study findings may also be partly explained by differences in the cultural and social experience of having breast cancer in Haiti compared with other settings represented in the meta-analysis.

**TABLE 4.** DFS Outcomes by BMI Categories and Weight Change

	No. of Events/No. of Patients at Risk	%	Median DFS (months)	95% CI	Log-Rank Test P
Total BMI cohort	80/224	35.7	41.1	37.6 to 49.4	
BMI categories, kg/m <sup>2</sup>					.84
< 25	32/83	38.6	43.2	34.5 to NR	
25-29.9	22/66	33.3	48.2	29.9 to NR	
≥ 30	26/75	34.7	41.1	32.4 to NR	
Total weight change cohort	44/153	28.8	46.8	41.1 to NR	.75
Weight change categories					
Weight loss	24/93	25.8	47.4	40.3 to NR	
Weight gain	20/60	33.3	44.4	40.5 to NR	

Abbreviations: BMI, body mass index; DFS, disease-free survival; NR, not reached.

Furthermore, in exploratory analyses, adjuvant chemotherapy-associated weight change was not associated with DFS. However, controlling for weight changes led to increases in the DFS HR point estimates for overweight and obese individuals compared with normal-weight individuals: 0.87 to 1.29 for overweight individuals and 0.85 to 1.61 for obese individuals. These HRs did not reach statistical significance because the exploratory analyses may not have been sufficiently powered to detect small effect sizes observed in this study.

There are some limitations to our study. The median follow-up time of 21.7 months in our study was short, which limits the assessment of overall survival and long-term outcomes. There were also limitations with death ascertainment and determination of cause of death because of the lack of a reliable national death registry. Subsequent analyses from this cohort after longer follow-up or a larger cohort may allow for more accurate overall survival analyses. In addition, there are limitations with use of BMI, which is an imperfect measure of adiposity.<sup>52</sup> BMI does not capture muscle mass or relative fat amount and distribution, all of which are important measures of adiposity and body composition. Because of the retrospective nature of the study, anthropomorphic measures such as waist circumference or waste-to-hip ratios, and radiographic adiposity measures were not readily available. Future studies are needed in this study population to validate the use of BMI and compare BMI with other measures of adiposity measures.

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## EQUAL CONTRIBUTION

L.N.S. and T.R.R. contributed equally to this study.

## PRIOR PRESENTATION

Presented as an oral presentation at 12th International Conference of the African Organisation for Research and Training in Cancer, Maputo, Mozambique, November 5-8, 2019.

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Furthermore, the retrospective nature of the study limited the ability to robustly assess and control for socioeconomic, behavioral, and lifestyle factors. In many low-income countries, obesity is associated with relatively higher socioeconomic status, which is the converse of the relationship in countries like the United States.<sup>53</sup> Uncontrolled confounders may potentially be obscuring the true associations between weight and DFS outcomes. There is a possibility of systematic bias in our analyses. The primary study population included individuals who obtained curative-intent surgery and who had BMI measures; there may be systematic differences between the cohort population and individuals who were excluded from the study. Thus, the findings from these analyses may not be generalizable to other cohorts in Haiti or the Caribbean.

In conclusion, this Haitian breast cancer cohort highlights the high prevalence of overweight and obesity in patients with nonmetastatic breast cancer. There was no association between DFS and being overweight or obese, which is similar to findings in African American breast cancer cohorts. Despite the limitations of this study, our findings contribute to the growing body of evidence showing differential effects of obesity on breast cancer outcomes in different populations. The study findings are hypothesis generating; they lay the groundwork for more detailed prospective analyses to confirm these findings, and to better assess mediators and confounders of the relationship between baseline weight, weight changes, and breast cancer outcomes of patients in Haiti and other parts of the Caribbean.

## AUTHOR CONTRIBUTIONS

**Conception and design:** Temidayo Fadelu, Ruth Damuse, Elizabeth Pecan, Timothy R. Rebbeck

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**Manuscript writing:** All authors

**Final approval of manuscript:** All authors

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## AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

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