Breast Cancer in the Bahamas in 2009–2011

K. Mungrue, H. Chase, J. Gordon, D. Knowles, K. Lockhart, N. Miller, T. Morley, L. Sealey and B. Turner

Department of Para-Clinical Sciences, Faculty of Medical Sciences, University of the West Indies, St. Augustine, Trinidad.

ABSTRACT

BACKGROUND: Breast cancer is the most common form of cancer affecting women in the Bahamas, which consists of many islands. This is the first attempt to identify which island has the highest occurrence of breast cancer.

OBJECTIVE: The aim of this study was to describe the sociodemographical and spatial features of breast cancer in the Bahamas in 2009–2011.

METHODS: A review of the medical records of all women with a confirmed diagnosis of breast cancer during the period January 1, 2009–December 31, 2011, was undertaken. Data were first obtained from the National Oncology Board of the Bahamas and validated by a review of the medical records. The patient address was geocoded and mapped using ArcGIS 10.0 Environmental Systems Research Institute (ESRI) to satellite images obtained from The Nature Conservancy in the Bahamas.

RESULTS: We recruited 270 patients who satisfied the entry criteria. The cumulative incidences of breast cancer for the years 2009–2011 were 51.4, 45.4, and 51.4, respectively. Breast cancer occurred most often in women of African origin with a mean age at diagnosis of 56.6 ± 13.8 years. Ductal carcinoma was the most common histological type observed with most cancers occurring in Grade II or higher and presenting as late stage (≥ Stage II). Surgery was the preferred method of treatment with modified radical mastectomy being the procedure of choice. Spatial distribution of cases across the Bahamas revealed one cluster, which is present on the island of New Providence. Further analysis of New Providence showed a consistently skewed kernel density in the central and eastern regions, compared with a scattered distribution in the southern and western regions.

CONCLUSION: The island of New Providence had the highest occurrence of breast cancer among all the islands of the Bahamas. The increasing incidence of breast cancer in young women is likely to impose a significant burden on the future of Bahamian health care.

KEYWORDS: breast cancer, spatial epidemiology

CITATION: Mungrue et al. Breast Cancer in the Bahamas in 2009–2011. *Breast Cancer: Basic and Clinical Research* 2016:10 45–52 doi:10.4137/BCBCR.S32792.

TYPE: Original Research

RECEIVED: August 26, 2015. **RESUBMITTED:** October 15, 2015. **ACCEPTED FOR PUBLICATION:** October 19, 2015.

ACADEMIC EDITOR: Goberdhan P. Dimri, Editor in Chief

PEER REVIEW: Four peer reviewers contributed to the peer review report. Reviewers' reports totaled 718 words, excluding any confidential comments to the academic editor.

FUNDING: Authors disclose no external funding sources.

COMPETING INTERESTS: Authors disclose no potential conflicts of interest.

CORRESPONDENCE: kameel.mungrue@sta.uwi.edu

Paper subject to independent expert blind peer review. All editorial decisions made by independent academic editor. Upon submission manuscript was subject to anti-plagiarism scanning. Prior to publication all authors have given signed confirmation of agreement to article publication and compliance with all applicable ethical and legal requirements, including the accuracy of author and contributor information, disclosure of competing interests and funding sources, compliance with ethical requirements relating to human and animal study participants, and compliance with any copyright requirements of third parties. This journal is a member of the Committee on Publication Ethics (COPE).

Provenance: the authors were invited to submit this paper.

Published by Libertas Academica. Learn more about this journal.

Introduction

Cancer is a global problem,[1] and breast cancer is the most common cancer in women worldwide, including the Bahamas,[2–5] an archipelago of 700 islands of which only 28 are inhabited extending >650 miles from the eastern coast of Florida to the southeastern tip of Cuba, in which New Providence is the main island with a population of ~70.4% of the total population.

WHO reports that the incidence of breast cancer in the developing countries is increasing due to increased life expectancy, urbanization, and adoption of western lifestyles.[6] In addition, there is an increase in the number of women with major breast cancer risk factors, including lower age of menarche, late age of first pregnancy, fewer pregnancies, shorter or no periods of breastfeeding, and a later menopause. Other risk factors are the increase in obesity, alcohol consumption, inactivity, and hormone replacement therapy.[7] Since 1999, the breast cancer incidence rate (IR) for females in the Bahamas increased from 32% to 49.5%.[8] Data obtained from the Princess Margaret Hospital Cancer Registry revealed that 48% of the Bahamian patients diagnosed with breast cancer are aged <50 years and 48% are diagnosed with Stage III.[8]

Breast neoplasms have both genetic and environmental risk factors. Mutations in BRCA1, BRCA2, and p53 genes on chromosome 17 have been linked to an increased lifetime risk of breast cancer development. Donenberg et al reported in 2011 that a mutation was identified in 49 (23%) of the 214 Bahamian women with invasive breast cancer who were screened for six mutations of BRAC1.[9] Due to the increasing incidence of breast cancer and the vast array of islands of the Bahamas, it is essential to determine spatial disparities in the occurrence of breast cancer.

Thus, the aim of this study was to describe the sociodemographical and spatial features of breast cancer in the Bahamas in 2009–2011.

Methods

We used a retrospective observational study design. Breast cancer was defined using International Classification of Diseases (ICD-10). The study was approved by the Ethics Committee of The University of the West Indies. Our study included all women with breast cancer who were diagnosed by a physician and confirmed by laboratory test results in the Bahamas during

the period January 2009–December 2011. We restricted the study to this period because it provided the most accurate validated data. Exclusion criteria for this study included males with breast cancer, Bahamians with breast cancer who were not diagnosed in the Bahamas, and persons who were not permanent residents or nationals of the Bahamas.

Data were first collected at the National Oncology Board of the Bahamas. These data were validated from the medical records of patients attending the Princess Margaret Hospital, the largest public healthcare facility in the Bahamas, which is a 400-bed teaching hospital of The University of the West Indies. All relevant data including age, address, race, date of diagnosis, age at diagnosis, primary site of the cancer, laterality, histology/behavior (ICD for Oncology, third edition [ICD-O-3]), tumor size, tumor grade differentiation, collaborative staging (CS) tumor size/extension evaluation, CS lymph nodes, CS lymph node evaluation, treatment, cancer status, and vital status were extracted from the patient's medical records. These variables were statistically analyzed using SPSS version 16. Invasive carcinomas were subdivided according to their growth patterns and degree of differentiation. Cases were histologically graded using the ICD for Oncology, second edition (ICD-O-2) grading system, which was used by the Princess Margaret Hospital Oncology Department. Tumor staging was classified according to the American Joint Committee on Cancer, which follows the TNM classification.

Satellite images of the Bahamas were acquired from The Nature Conservancy, Bahamas. Additionally, settlement-based maps were created and superimposed on the satellite imagery of the corresponding islands. Addresses were geocoded and mapped using ArcGIS (ESRI) 10.0.

Results

A total of 270 patients met the criteria for entry into the study and all were available for analysis. The characteristics of the 270 study participants are listed in Table 1. There was no significant change in the cumulative incidence rate (CIR) during the study period ($P = 0.2$; Table 2). The marginal variations in the IRs reported in Table 2 compared to that of the National Department of Statistics of the Bahamas may be attributed to the more robust data collection of the study.

The majority of patients diagnosed with breast cancer were of African origin. The CIR of breast cancer in people of the African descent was 58.6 per 100,000 (95% confidence interval [CI] 45.6–70.2) in 2009, 48.9 per 100,000 (95% CI 40.2–57.6) in 2010, and 60.5 per 100,000 (95% CI 48.3–72.7) in 2011. The CIR of breast cancer in Caucasian women was 9.12 per 100,000 in 2009, which was the only year available for calculation. This obvious ethnic disparity is reflective of the population of the Bahamas in which 85% are of African origin, 12% of Caucasian origin, and 3% of Asian and Hispanic origin.

From 2009 to 2011, the mean age at diagnosis was 56.6 ± 13.8 years. The highest incidence occurred in women aged 40–59 years (Table 1). The data of breast cancer by age groups were plotted and a least squares regression line was fitted. There was a strong positive linear trend in breast cancer between the age groups 0–29 and 45–49 years ($R^2 = 0.97$). Similarly, there was also a strong negative trend ($R^2 = 0.8$) in breast cancer occurrence in the age groups ≥50 years.

The majority of cases diagnosed with breast cancer had a tumor size of ≤3 cm; however, in 2009, the size of the tumor at diagnosis was larger (3.99 cm). Further analysis revealed that 71.4% of all cases diagnosed with breast cancer had a tumor size ≥2 cm, which is theoretically palpable. When analyzed by age that 7.7% of women in the age group ≤40 years had a tumor size >2 cm when compared with that of the 59.4% of women in the age group >40 years who had a tumor size >2 cm. In fact, there was a positive correlation between age and tumor size.

The predominant tumor histological patterns were ductal carcinoma and infiltrating ductal carcinoma (Table 1). All other tumor histological patterns were minimally represented. Further 57.4% of cases had an unspecified primary tumor site. The most common noted site for the primary tumor at presentation was in the lower quadrant of the breast. Breast cancer was more common in the left breast than the right.

The histological grade/differentiation distribution revealed that most cases were diagnosed as Grade II (2009: 45.74%, 2010: 62.65%, and 2011: 72.34%). The percentage of cases diagnosed as Grade II increased from 2009 to 2011 at a rate of 13.3%. For each year, tumor grades of II and higher accounted for more than half of all diagnosed cases, especially in 2011 where 83% of cases were diagnosed as Grade II or higher (Table 1). Grade I tumors, during the years 2009–2011, had a mean representation of 13.12% ± 4.79.

We collected survival data for all patients until the study ended, a period of up to four years (48 months). Survival rates were calculated for this period using the Kaplan–Meier method. Hence, the four-year survival was 82% (95% CI 78%–96%). There was no significant change in survival between the years 2009 and 2011 (Fig. 1).

The most common stage of breast cancer at the time of diagnosis was Stage II (57%), while early-stage (≤ Stage I) diagnoses accounted for 16.7% of cases.

The approach to the management of breast cancer during the years 2009–2011 was mainly surgical. In 2009, 2010, and 2011, surgery was performed on 45.7%, 51.8%, and 61.7% of patients. Radiation as an option in the treatment for breast cancer was used in only 6.4% of patients; however, no patient received radiotherapy in 2011 (0 of the 94 cases).

We geocoded the address using ArcGIS 10.0 (ESRI) to create maps and show the geographical distribution of breast cancer among all the islands in the Commonwealth of the Bahamas. The majority of cases (>80%) occurred in the Nassau area of the Grand Bahamas Island, which is also the capital city (Table 3 and Figs. 2–4). It was unusual to find that the majority of these cases occurred in the eastern half of the island, as only 5% of cases occurred (CIR: 1.25 per 100,000)

Table 1. Breast cancer characteristics for patients in the Bahamas for the time period 2009–2011.

CHARACTERISTIC	2009	2010	2011
	n (%)	n (%)	n (%)
Age at diagnosis			
0–29	0 (0.00)	1 (1.2)	2 (2.13)
30–34	3 (3.19)	0 (0.0)	3 (3.19)
35–39	6 (6.38)	7 (8.5)	7 (7.45)
40–44	19 (20.21)	8 (9.8)	7 (7.45)
45–49	13 (13.83)	13 (15.9)	17 (18.09)
50–54	11 (11.70)	9 (11.0)	15 (15.96)
55–59	6 (6.38)	14 (15.9)	11 (11.70)
60–64	12 (12.77)	4 (4.9)	6 (6.38)
65–69	8 (8.51)	8 (9.8)	8 (8.51)
70–74	9 (9.57)	4 (4.9)	11 (11.70)
75–79	0 (0.00)	7 (8.5)	5 (5.32)
Over 80	7 (7.45)	8 (9.8)	2 (2.13)
Total	94 (100.00)	83 (100.00)	94 (100.00)
Race			
African descent	91 (96.8)	76 (91.6)	94 (100.0)
Caucasian	2 (2.1)	0 (0.0)	0 (0.0)
Asian	0 (0.0)	1 (1.2)	0 (0.0)
Unknown	1 (1.1)	6 (7.2)	0 (0.0)
Total	94 (100.0)	83 (100.0)	94 (100.0)
Grade			
I	12 (12.8)	15 (18.3)	8 (8.5)
II	43 (45.7)	51 (62.2)	68 (72.3)
III	12 (12.8)	3 (3.7)	10 (10.6)
Not specified	27 (28.7)	13 (15.9)	8 (8.5)
Total	94 (100.0)	82 (100.0)	94 (100.0)
Histology/behavior			
Intraductal carcinoma, non-infiltrating	3 (3.2)	2 (2.4)	2 (2.1)
Ductal carcinoma, NOS	49 (52.1)	38 (46.3)	65 (69.2)
Infiltrating ductal carcinoma	22 (23.4)	31 (37.8)	14 (14.9)
Cystic hypersecretory carcinoma	1 (1.1)	0 (0.0)	0 (0.0)
Inflammatory carcinoma	3 (3.2)	0 (0.0)	0 (0.0)
Carcinoma, NOS	7 (7.5)	0 (0.0)	2 (2.1)
Intraductal papillary carcinoma, NOS	2 (2.1)	1 (1.2)	0 (0.0)
Papillary carcinoma, NOS	2 (2.1)	1 (1.2)	0 (0.0)
Lobular carcinoma, NOS	0 (0.0)	1 (1.2)	3 (3.2)
Papillary carcinoma in situ	1 (1.1)	0 (0.0)	0 (0.0)
Infiltrating papillary adenocarcinoma	1 (1.1)	0 (0.0)	0 (0.0)
Medullary carcinoma, NOS	1 (1.1)	0 (0.0)	0 (0.0)
Mucinous carcinoma	1 (1.1)	0 (0.0)	0 (0.0)
Infiltrating duct and mucinous carcinoma	1 (1.1)	0 (0.0)	0 (0.0)
Adenocarcinoma, NOS	0 (0.0)	1 (1.2)	1 (1.1)
Ductal carcinoma in situ, cribriform type	0 (0.0)	2 (2.4)	1 (1.1)
Ductal carcinoma in situ, comedo type	0 (0.0)	2 (2.4)	1 (1.1)
Ductal carcinoma in situ, micropapillary	0 (0.0)	2 (2.4)	1 (1.1)

(*Continued*)

Table 1. (*Continued*)

CHARACTERISTIC	2009	2010	2011
	n (%)	n (%)	n (%)
Carcinoma in situ, NOS	0 (0.0)	1 (1.2)	3 (3.2)
Infiltrating ductular carcinoma	0 (0.0)	0 (0.0)	1 (1.1)
Total	94 (100.0)	82 (100.0)	94 (100.0)
Stage			
0	3 (3.2)	4 (.9)	4 (4.3)
I	9 (9.6)	15 (18.3)	10 (10.6)
IIA	21 (22.3)	15 (18.3)	16 (17.0)
IIB	15 (16.0)	6 (7.3)	10 (10.6)
IIIA	6 (6.4)	6 (7.3)	8 (8.5)
IIIB	4 (4.3)	6 (7.3)	7 (7.4)
IIIC	9 (9.6)	6 (7.3)	7 (7.4)
IV	7 (7.4)	4 (4.9)	1 (1.1)
Unknown	20 (21.3)	20 (24.4)	31 (33.0)
Total	94 (100.0)	82 (100.0)	94 (100.0)

in the western half of the island. Furthermore, only 7% of breast cancer (CIR: 1.8 per 100,000) occurred in the remainder of all the other islands.

Discussion

There are several important findings of this study. Primarily, we report a CIR of ~50 per 100,000 population between 2009 and 2011. In order to compare this rate with other countries, we used the Human Development Indexes (HDIs).[10] The Bahamas has a HDI of 0.789, and countries in the range of 0.790–0.760 in the year 2014 were selected for comparison. We provide evidence that the occurrence of breast cancer in the Bahamas had the third highest IR per 100,000 among all the countries in this range, which includes Uruguay (HDI: 0.790, IR: 83.1), Romania (HDI: 0.785, IR: 66.2), Russia (HDI: 0.778, IR: 60.7), and Oman (HDI: 0.783, IR: 15.7).10 When CIR was compared to the other larger countries in the Caribbean (Barbados, Jamaica, and Trinidad and Tobago), the breast cancer IR was found to be less than Barbados, whose HDI value (0.776, IR: 78.1) was also less than the Bahamas, but greater than Jamaica (HDI: 0.715, IR: 42) and Trinidad and Tobago (HDI: 0.776, IR: 48) whose HDI values were both less than the Bahamas. Additionally, when the Bahamas breast cancer IR was compared to countries with very high HDI values, such as the United States (0.900) and the UK (0.892), the rate was smaller. This finding lends support to the "westernization effects," which states: in medium and high HDI settings, the observed declines in IRs of cervix and stomach cancer appear to be offset by increasing IRs of female breast, prostate, and colorectal cancers. The "westernization effect" is due to the rapid societal and economic transition, which results in an observed reduction in infection-related cancers, but an increasing burden of cancers associated with reproductive, dietary, and hormonal risk factors.[11] This finding is corroborated by the findings of the geographical distribution of breast cancer in the Bahamas. Based on the results of the spatial analysis (kernel density) of Map Series A, B, and C and

Table 2. CIR of breast cancer in the Bahamas per 100,000 women with a 95% CI.

YEAR	RATE PER 100,000 (95% CI)
2009	51.4 (41.0–61.8)
2010	45.4 (35.7–55.2)
2011	51.4 (41.0–61.8)

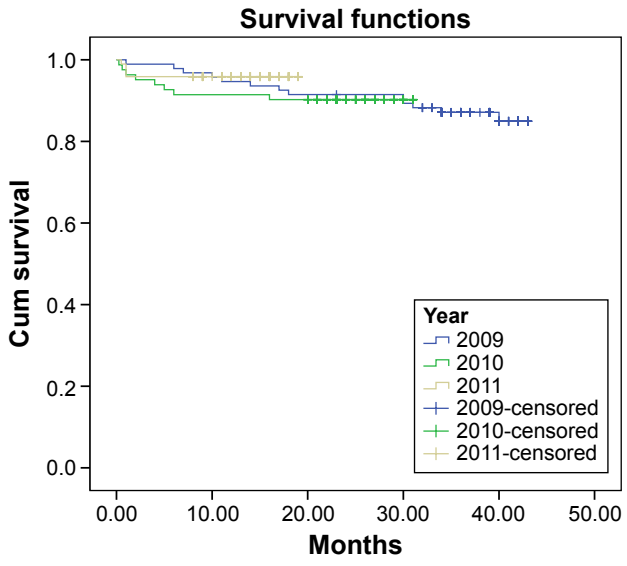

Figure 1. Kaplan–Meier survival analysis of breast cancer patients in the Bahamas in 2009–2011.

Table 3. The geographical distribution of breast cancer cases for the years 2009, 2010, and 2011.

ISLAND	2009	2010	2011
	n (%)	n (%)	n (%)
Nassau	79 (85%)	83 (98.8%)	76 (80.8%)
Grand Bahama	5 (5%)	0 (0%)	9 (9.5%)
Abaco	3 (3%)	1 (1%)	3 (3%)
Other islands	7 (7%)	0 (0%)	6 (6.7%)
Total	94 (100%)	84 (100%)	94 (100%)

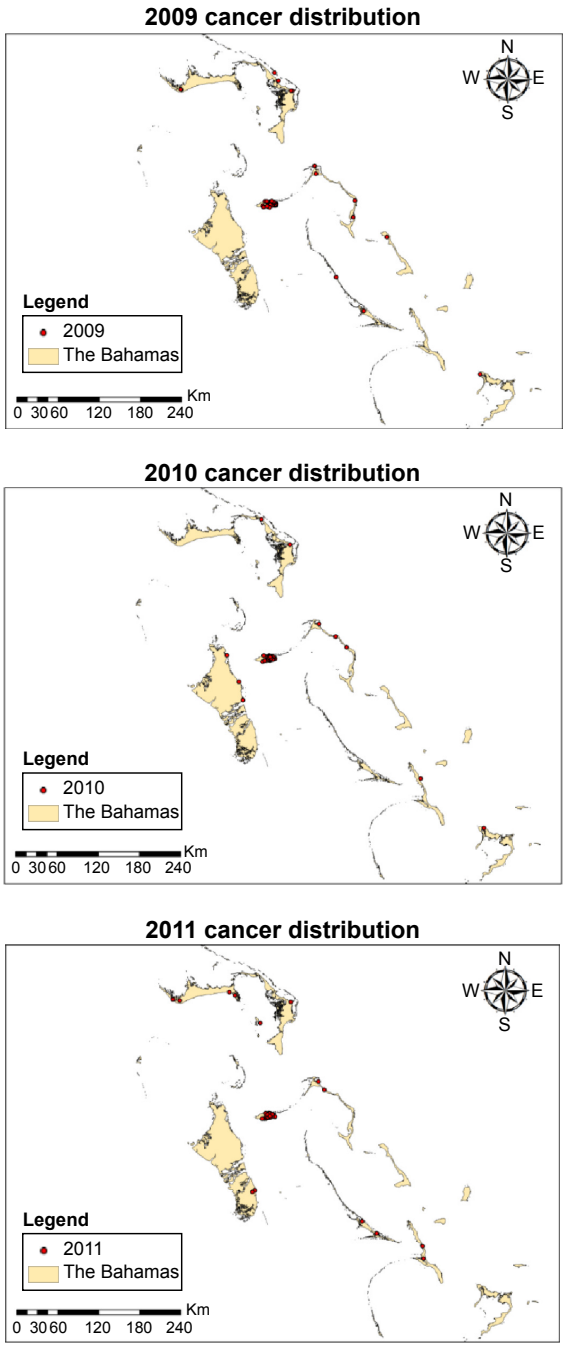

Figure 2. Map Series A: the geographic distribution of breast cancer incidence of all the islands of the Bahamas for the years 2009–2011.

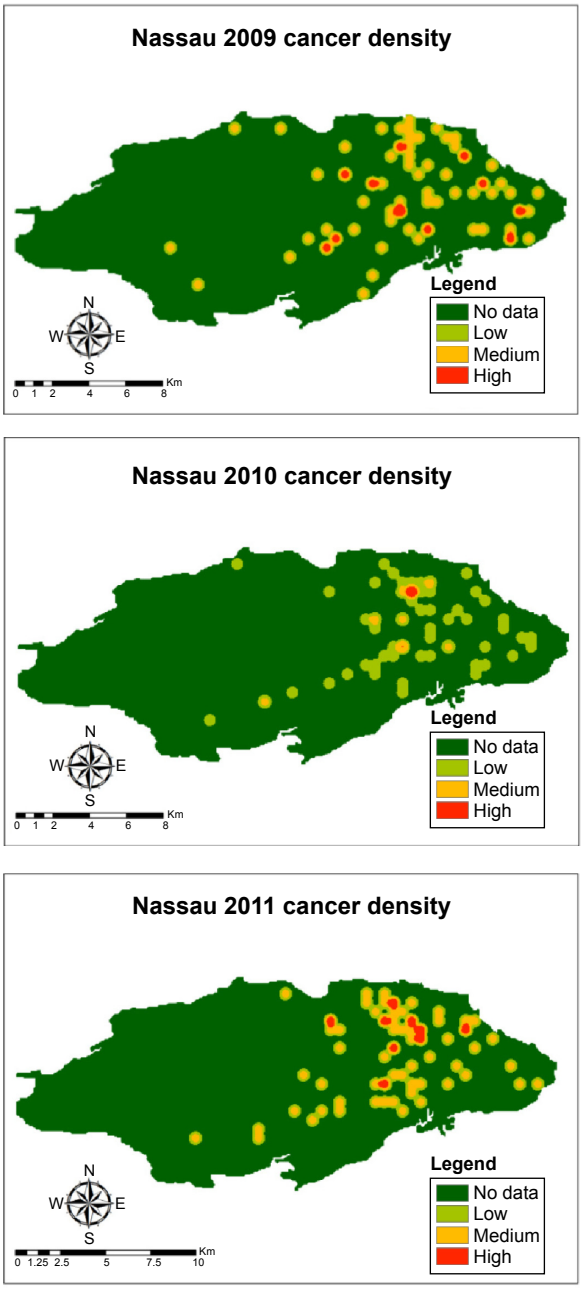

Figure 3. Map Series B: kernel density of breast cancer cases for Nassau, New Providence from 2009 to 2011, each circle represents age-specific groups.

Table 3, for the years 2009–2011, the highest density of breast cancer patients (85% in 2009, 98.8% in 2010, and 80.8% in 2011) occurred in Nassau, an urban area, representing 70.4% of the population. Using the United States Office of Management and Budget definition of a metropolitan statistical area (MSA) as a Core-Based Statistical Area having at least one urban cluster of at least 50,000 population, Nassau qualifies as a MSA. Therefore, we provide further evidence that breast cancer in the Bahamas is higher in MSA.[12] On the other hand, Donenberg et al showed that in the Bahamas, there is a high prevalence of mutations in BRCA 1.[9] This high frequency may be due to a founder effect together with the evidence that

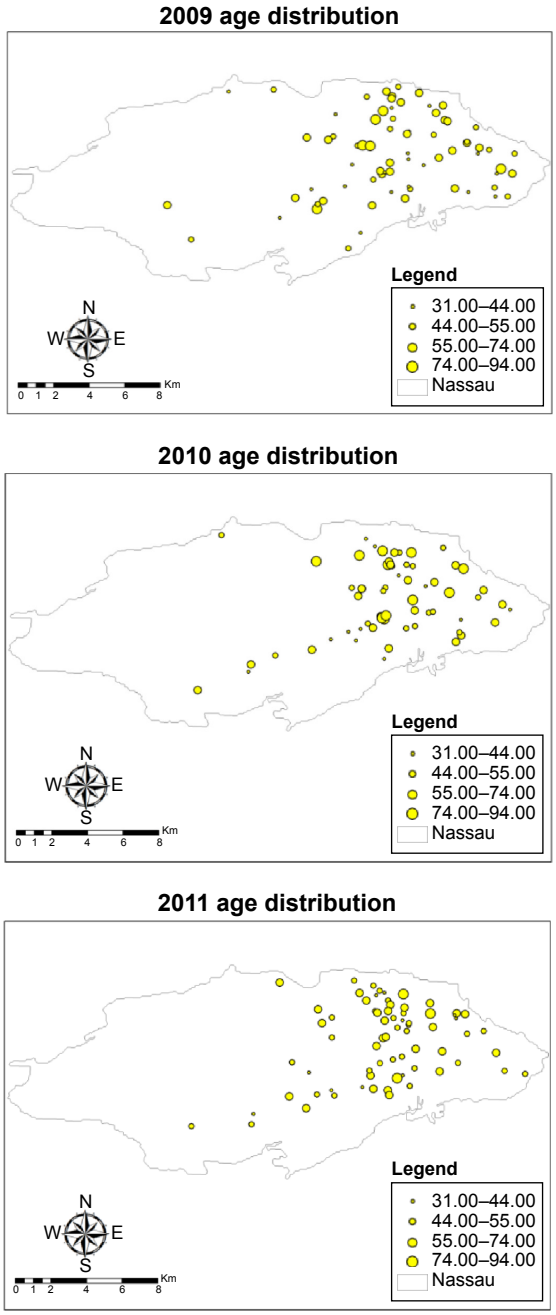

Figure 4. Map Series C: distribution of breast cancer cases for Nassau, New Providence by age at diagnosis from 2009 to 2011, each circle represents age-specific groups.

carriers have an 80%–90% lifetime risk of developing breast cancer.[13,14]

Further analysis of the geographical data revealed that there was a sharp contrast in the occurrence of breast cancer in the northwestern half of the island in which there were only a few scattered cases compared with the eastern half of the island.[15] This varying geographical distribution of breast cancer incidence may be partly due to the historical development of Nassau, the capital city. The population of the city grew because it provided a deepwater harbor and port for trade and tourism. Over time it expanded initially to the south and then east, mainly populated by the working class. On the other hand, the northwestern coastal area has been devoted to the hotel and tourism industry as well as high-priced residential communities attracting people of higher socioeconomic status (SES). This finding raises important issues as it deviates from the findings of other studies. Breast cancer incidence is associated with SES as measured at both the individual and community levels. At the individual level, breast cancer incidence in the United States is higher among women with more education and income,[16,17] and is also greater in communities with higher average levels of income and education,[18–25] as well as in urban communities.[20,24] Our findings suggest that breast cancer incidence is higher in urban areas populated by people of lower SES compared with people of higher SES living in nonurban settings. Therefore, is breast cancer incidence greater in lower SES communities and urban communities simply because there are more lower SES women residing there? Alternatively, is there something else about residing in lower SES and urban communities that confers a greater risk of breast cancer to all residents, regardless of their own SES? These questions are difficult to answer in this study because it is difficult to find breast cancer incidence data that are linked with socioeconomic information at both the individual and community levels.[26,27] The first step is to determine whether the associations are likely to be compositional, contextual, or both.[28–30] Individual SES is associated with a number of risk factors that put higher SES women at greater risk of developing breast cancer, including reproductive and lifestyle factors such as lower parity, later age at first full-term pregnancy, greater body weight, higher alcohol consumption, lower lactation, and exogenous hormone use.[17] High individual SES is also associated with a greater use of mammography screening,[31,32] and therefore with early detection of breast cancer that may increase IRs among high SES women.[33–35] If these are true, then there should be no remaining association between breast cancer incidence and either community SES or urbanicity after controlling for individual risk factors. On the other hand, contextual effects of community imply that something about the community context of lower SES and residing in an urban community confers the risk of breast cancer to residents, regardless of their own SES. Factors such as environmental exposures, lifestyle behaviors, or choices such as higher alcohol consumption and lower physical activity are possible factors.

The age range of 40–59 years had the highest proportion of cases. The mean age at diagnosis was five years earlier in Bahamian women than in women from the United States for the same time period.[36] The proportion of women diagnosed under the age of 55 years was also higher in Bahamian women than in the US.[37] Compared with the UK, more Bahamian women were diagnosed with breast cancer by the age of 60 years than women in the UK.[38] However, the mean age at diagnosis was only 1.9 years younger in Bahamian women than in Jamaican women.[39] These findings suggest that breast cancer is occurring in younger women in the Caribbean. In addition, 71.7% of women presented at the time of diagnosis

with a tumor size ≥2 cm, suggesting that screening should begin at an earlier age.

Ductal carcinoma was the predominant histological pattern. In contrast, the most common type of cancer within the US is infiltrating ductal carcinoma, accounting for 80% of all diagnosed invasive cancers.[38] However, the most common form of noninvasive cancer identified was ductal carcinoma accounting for 15% of all new cancer cases.[40] Overall cancer occurrence was higher in the left breast than the right. Several European studies have reported higher rates for left-sided breast cancers in the range of 1.05–1.2 times than the incidence on the right.[41]

Importantly, 70% of patients presented with late-stage (≥ Stage II) breast cancer, particularly in women ≤40 years (95.5%). This finding is consistent with the literature, which suggests that younger women are more likely to present with more advanced and aggressive forms of cancer than the older women.[42,43] Anders et al concluded that breast cancers in younger women present with a shared altered genetic pattern, which differs from breast cancers in older women.[44] The genetic variation in young women combined with decreased hormone sensitivity and higher human epidermal growth factor receptor (HER)-2/epidermal growth factor receptor (EGFR) found in the study accounts for the difference in cancer progression and aggression at diagnosis.[45,46] In a separate study, Klauber-Demore showed that young women of African origin are more likely to present with a more aggressive basal type of breast cancer than are young Caucasian women when controlled for tumor site, age, and individual socioeconomic factors.[47]

Surgery remains the primary treatment for breast cancer in the Bahamas. It was surprising to find that radiotherapy was not commonly used as current evidence has indicated that it is both clinically effective and cost-effective in the adjuvant and palliative settings.[48] The long-term safety and efficacy of hypofractionated radiotherapy after breast-conserving surgery and mastectomy for operable breast cancer has recently been confirmed.[49] The Standardisation of Breast Radiotherapy (START) trials have suggested generalizability to all subgroups of patients.[50,51] Notwithstanding, we report a three-year survival rate of 82%, which compares favorable with the recent findings of an average five-year survival rate of 85% reported in the. We restricted the study to this period because it provided the most accurate validated data.

A major limitation of the study was incomplete handwritten medical records. This was especially the case for patient address and treatment type. Many Bahamians often migrate domestically from other islands to New Providence and vice versa. Without collection of previous addresses and duration of stay, the effects of migration on the study were unable to be addressed. For those patients who died out of hospital, we were unable to validate the cause of death, as death certification was unavailable.

In conclusion, we provide evidence for the first time on the spatial distribution of breast cancer in the Bahamas.

Author Contributions

Conceived and designed the experiments: KM. Analyzed the data: HC, JG, DK, KL, NM, TM, LS, and BT. Wrote the first draft of the manuscript: HC, JG, DK, KL, NM, TM, LS, and BT. Contributed to the writing of the manuscript: KM, HC, JG, DK, KL, NM, TM, LS, and BT. Agree with manuscript results and conclusions: KM, HC, JG, DK, KL, NM, TM, LS, and BT. Jointly developed the structure and arguments for the paper:km, HC, JG, DK, KL, NM, TM, LS, and BT. Made critical revisions and approved final version: KM. All authors reviewed and approved of the final manuscript.

REFERENCES

1. Boyle P. The globalisation of cancer. *Lancet*. 2006;368:629–630.
2. Boyle P, Levin B, eds. *World Cancer Report 2008*. Lyon: IARC; 2008.
3. Ferlay J, Bray F, Pisani P, Parkin DM. GLOBOCAN 2000: Cancer Incidence, Mortality and Prevalence Worldwide. IARC Cancer Base No. 5. [1.0]. Lyon, France: IARC; 2001.
4. Parkin DM, Whelan SL, Ferlay J, Raymond L, Young J. *Cancer Incidence in Five Continents*. Vol VIII. Lyon: IARC Press; 1997.
5. Jemal A, Bray F, Melissa M, Ferlay J, Ward E, Forman D. Global cancer statistics. *CA Cancer J Clin*. 2011;61(2):69–90.
6. World Health Organization. *Breast Cancer Prevention and Control*. Geneva: World Health Organization; 2012. Available from: http://www.who.int/cancer/detection/breastcancer/en/index.html
7. Colditz GA, Bohlke K. Priorities for the primary prevention of breast cancer. *CA Cancer J Clin*. 2014;64:186–194.
8. The Bahamas. Princess Margaret Hospital Cancer Registry, Public Hospitals Authority. Number and Incidence Rates (Per 100,000 Population) of Selected Cancers, Bahamas 1998–2009. Health Information and Research Unit, Nassau; 2010.
9. Donenberg T, Lunn J, Curlinf D, et al. A high prevalence of BRAC 1 mutations among breast cancer patients from the Bahamas. *Breast Cancer Res Treat*. 2011; 125(2):591–596.
10. Human Development Report 2014. *Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience*. HDRO (Human Development Report Office) United Nations Development Programme; 2014. Retrieved July 25, 2014.
11. Banquet CR, Mishra SI, Commiskey P, Ellison GL, DeShields M. Breast cancer epidemiology in blacks and whites: disparities in incidence, mortality, survival rates and histology. *J Natl Med Assoc*. 2008;100(5):480–488.
12. Russell EF, Kramer MR, Cooper HLF. Metropolitan area racial residential segregation, neighborhood racial composition, and breast cancer mortality. *Cancer Causes Control*. 2012;23(9):1519; Warner ET, Gomez SL. Impact of neighborhood racial composition and metropolitan residential segregation on disparities in breast cancer stage at diagnosis and survival between black and white women in California. *J Community Health*. 2010;35(4):398–408.
13. Neuhausen S, Gilewski T, Norton L, et al. Recurrent BRCA2 6174delT mutations in Ashkenazi Jewish women affected by breast cancer. *Nat Genet*. 1996;13:126–128.
14. Struewing JP, Abeliovich D, Peretz T, et al. The carrier frequency of the BRCA1 185delAG mutation is approximately 1 percent in Ashkenazi Jewish individuals. *Nat Genet*. 1995;11:198–200.
15. Ferlay J, Soerjomataram I, Ervik M, et al. *GLOBOCAN 2012 v1.1, Cancer Incidence and Mortality Worldwide: IARC CancerBase No. 11 [Internet]*. Lyon, France: International Agency for Research on Cancer; 2014. Available from: http://globocan.iarc.fr. Accessed January 16, 2015.
16. Heck KE, Pamuk ER. Explaining the relation between education and postmenopausal breast cancer. *Am J Epidemiol*. 1997;145:366–372.
17. Kelsey JL, Bernstein L. Epidemiology and prevention of breast cancer. *Annu Rev Public Health*. 1996;17:47–67.
18. Gorey KM, Holowaty EJ, Laukkanen E, Fehringer G, Richter NL. Association between socioeconomic status and cancer incidence in Toronto, Ontario: possible confounding of cancer mortality by incidence and survival. *Cancer Prev Control*. 1998;2:236–241.
19. Mackillop WJ, Zhang-Salomons J, Groome PA. Associations between community income and cancer incidence in Canada and the United States. *Cancer*. 2000;89:901–912.
20. Prehn AW, West DW. Evaluating local differences in breast cancer incidence rates: a census-based methodology. *Cancer Causes Control*. 1998;9:511–517.
21. Liu L, Deapen D, Bernstein L. Socioeconomic status and cancers of the female breast and reproductive organs: a comparison across racial/ethnic populations in Los Angeles County, California (United States). *Cancer Causes Control*. 1998; 9:369–380.

22. Devesa SS, Diamond EL. Association of breast cancer and cervical cancer incidence with income and education among whites and blacks. *J Natl Cancer Inst*. 1980;65:515–528.
23. Krieger N. Social class and the black/white crossover in the age-specific incidence of breast cancer: a study linking census-derived data to population-based registry records. *Am J Epidemiol*. 1990;131:804–814.
24. Yabroff KR. Does Community Socioeconomic Status Have an Effect on Breast Cancer Mortality in White and Black Women? Dissertation in the School of Hygiene and Public Health. Baltimore: The Johns Hopkins University; 2000.
25. Yost K, Perkins C, Cohen R, Morris C, Wright W. Socioeconomic status and breast cancer incidence in California for different race/ethnic groups. *Cancer Causes Control*. 2001;12:703–711.
26. Krieger N, Chen JT, Ebel G. Can we monitor socioeconomic inequalities in health? A survey of US health departments' data collection and reporting practices. *Public Health Rep*. 1997;112:481–491.
27. Krieger N, Williams D, Moss N. Measuring social class in US public health research: concepts, methodologies and guidelines. *Annu Rev Public Health*. 1997;18:341–378.
28. Macintyre S, Ellaway A, Cummins S. Place effects on health: how can we conceptualise, operationalise and measure them? *Soc Sci Med*. 2002;55:125–139.
29. Diez Roux AV. Investigating neighborhood and area effects on health. *Am J Public Health*. 2001;91:1783–1789.
30. Duncan C, Jones K, Moon G. Context, composition, and heterogeneity: using multilevel models in health research. *Soc Sci Med*. 1998;46:97–117.
31. Katz SJ, Zemencuk JK, Hofer TP. Breast cancer screening in the United States and Canada, 1994: socioeconomic gradients persist. *Am J Public Health*. 2000;90: 799–803.
32. Calle EE, Flanders WJ, Thun MJ. Demographic predictors of mammography and Pap smear screening in US women. *Am J Public Health*. 1993;83: 53–60.
33. Menck HR, Mills PK. The influence of urbanization, age, ethnicity, and income on the early diagnosis of breast carcinoma: opportunity for screening improvement. *Cancer*. 2001;92:1299–1304.
34. Schootman M, Fuortes LJ. Breast and cervical carcinoma: the correlation of activity limitations and rurality with screening, disease incidence, and mortality. *Cancer*. 1999;86:1087–1094.
35. Lantz PM, Remington PL, Newcomb PA. Mammography screening and increased incidence of breast cancer in Wisconsin. *J Natl Cancer Inst*. 1991;83:1540–1546.
36. David N, Danforth DN Jr. Disparities in breast cancer outcomes between Caucasian and African American women: a model for describing the relationship of biological and nonbiological factors. *Breast Cancer Res*. 2013;15(3):208.
37. Surveillance Epidemiology and End Results. *Cancer of the Breast*. National Cancer Institute. Available from: http://seer.cancer.gov/statfacts/html/breast.html. Updated, 2012; Cited October 16, 2012.
38. Cancer Research UK. *Breast Cancer Incidence Statistics*. Cancer Research UK. Available from: http://www.cancerresearchuk.org/cancer-info/cancerstats/types/breast/incidence/uk-breast-cancer-incidence-statistics#age. Updated May 10, 2012; Cited October 16, 2010.
39. Shirley SE, Sinclair PA, Stennett MA, Codrington G, Bhatt R, Escoffery CT. The pathology of breast cancer in Jamaica: the national public health laboratory study. *West Indian Med J*. 2010;59(2):177–181.
40. Maggard M, O'Connell J, Lane K, Liu J, Etzioni D, Ko C. Do young breast cancer patients have worse outcomes? *J Surg Res*. 2003;113(1):109–113.
41. Fredholm H, Eaker S, Frisell J, Holmberg L, Fredriksson I, Lindman H. Breast cancer in young women: poor survival despite intensive treatment. *PLoS One*. 2009;4(11):e7695.
42. iSource National Breast Cancer Centre. *Clinical Practice Guidelines for the Management of Early Breast Cancer*. 2nd ed. Canberra: National Health and Medical Research Council; 2001. Available from: http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/cp74.pdf. Cited October 16, 2014.
43. Lantz P, Mujahid M, Schwartz K, et al. The influence of race, ethnicity, and individual socioeconomic factors on breast cancer stage at diagnosis. *Am J Public Health*. 2006;96(12):2173–2178.
44. Anders C, Hsu D, Broadwater G, et al. Young age at diagnosis correlates with worse prognosis and defines a subset of breast cancers with shared patterns of gene expression. *J Clin Oncol*. 2008;26(20):3324–3330.
45. World Health Organization. *Guidelines for Management of Breast Cancer*. Cairo: World Health Organization, Regional Office for the Eastern Mediterranean; 2006. Available from: http://applications.emro.who.int/dsaf/dsa697.pdf. Cited October 16, 2012.
46. Davies C, Godwin J, Gray R, et al. Early breast cancer trialists' collaborative G: relevance of breast cancer hormone receptors and other factors to the efficacy of adjuvant tamoxifen: patient-level meta-analysis of randomised trials. *Lancet*. 2011;378:771–784.
47. Klauber-Demore N. Tumour biology of breast cancer in young women. *Breast Dis*. 2005–2006;23:9–15.
48. Whelan TJ, Pignol JP, Levine MN, et al. Long-term results of hypofractionated radiation therapy for breast cancer. *N Engl J Med*. 2010;362:513–520.
49. Group ST, Bentzen SM, Agrawal RK, et al. The UK standardisation of breast radiotherapy (START) trial A of radiotherapy hypofractionation for treatment of early breast cancer: a randomised trial. *Lancet Oncol*. 2008;9:331–341.
50. Group ST, Bentzen SM, Agrawal RK, et al. The UK standardisation of breast radiotherapy (START) trial B of radiotherapy hypofractionation for treatment of early breast cancer: a randomised trial. *Lancet*. 2008;371:1098–1107.
51. Allemani C, Weir HK, Carreira H, et al. Global surveillance of cancer survival 1995–2009: analysis of individual data for 25 676 887 patients from 279 population-based registries in 67 countries (CONCORD-2). *Lancet*. 2015;385(9972):977–1010.