Clinical research

Stroke and breast cancer in the United States during 2007–2017

Irene Rethemiotaki[1], Andrew Rethemiotakis[2]

[1]Department of Production Engineering and Management, Technical University of Crete, Chania, Greece
[2]Department of Agriculture, Technological Educational Institute of Crete, Irakllon, Greece

Corresponding author:
Irene Rethemiotaki
Department of Production Engineering and Management
Technical University of Crete
Chania, Greece
E-mail: eirinireth@yahoo.gr

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Abstract

Introduction: The main purpose of this work is to study the malignant neoplasms of the breast and the incidence of strokes in the United States and to find not only statistically significant predictors for cancer, but also a possible association between breast cancer and stroke.
Material and methods: The statistical methods used to derive the results of this work are χ^2 and one-way analysis of variance (ANOVA) tests, in order to check the statistical significance of breast cancer in relation to socio-economic factors of patients. In addition, a multivariate logistic regression analysis was used with the odds ratio (OR) to find statistically significant prognostic factors for breast cancer. The Pearson correlation coefficient was used to find the relationship between breast cancer and stroke.
Results: According to multiple logistic regression analysis, widowed women have 11 times higher risk developing breast cancer, while white women who are unemployed but have worked previously have two times higher risk for the occurrence of this type of cancer. In addition, a statistically significant relationship was found between the number of cases of breast cancer and stroke.
Conclusions: Our results describe for the first time the importance of deprivation (of work and partner) as a primary prognostic risk factor for cancer. Moreover, we found a link between breast cancer diagnosis and stroke.

Key words: malignant neoplasms of the breast, prognostic factors, breast cancer, socio-economic factors, stroke.

Introduction

Breast cancer is the most common malignancy worldwide, accounting for 14% of all new cancer cases in the world in 2016 [1]. The incidence of breast cancer is mainly observed in women over 40–49 years of age [2]. The main risk factors are age [3], positive family history of cancer [4], early menarche [5] and late childbearing [4, 5], woman's age at menopause [6], and race [7], while in 75–80% of women no risk factor is found [8]. Regarding the socio-economic factors, increased incidence of breast cancer was found for women with higher education [9–12], highest income [10], and creative core occupation [10, 11]. A recent study suggests an association between socio-economic factors and breast cancer and, more specifically, proves that breast cancer tends to be higher across

richer countries. Women from richer countries are prone to higher demand for treatments represented by oral contraceptives (OCs) and hormone therapy (HT), factors which increase the risk of breast cancer [13].

Prior studies have found increased risk of stroke in patients with breast cancer, who were given radiotherapy (RT). More specifically, it has been found that RT to the supraclavicular lymph nodes gives a significant dose of radiation to the proximal carotid artery, which increases the risk of carotid stenosis and ischaemic stroke [14]. Moreover, cancer is not a well-established independent risk factor for arterial thromboembolism, and cancer patients do not systematically receive treatments to prevent myocardial infarction and stroke, resulting in an increased risk for such cases in cancer patients [15–17].

This work studies breast cancer and stroke in the United States in the years 2007–2017 in order to find statistically significant predictors for cancer and a possible link between breast cancer and stroke.

Material and methods

The data used in this work come from the National Health Interview Survey dataset [18] and cover the period 2007–2017. The number of breast cancer and stroke patients examined was 37,634 and 71,227, respectively.

Statistical analysis

The statistical methods used to extract the results of this work are the χ^2 test for categorical and one-way analysis of variance (ANOVA) for continuous variables, to check the statistical significance of human breast cancer in relation to selected characteristics of patients such as gender, age, race, origin, education, family income, poverty status, health insurance coverage, place of residence, and region. Factors that determine the prevalence of cancer were assessed by using multiple logistic regression analysis. To better assess the predictors of cancer, we used data from patients with a new diagnosis of cancer compared to a matched cohort of patients without cancer. Predictors were represented using the OR and 95% confidence intervals, and $p < 0.05$ was considered as statistically significant. The Pearson correlation coefficient was used for the relationship between cancer and stroke for the years 2007–2017. The study was carried out using the IBMSPSS 25 software package for Windows.

Results

To check the zero hypotheses that the mean of the patients in the United States with malignant neoplasms of the breast did not differ according to their socio-economic characteristics, the χ^2 test and one-way analysis of variance (ANOVA) were used. As shown in Table I, there is a statistically significant difference in the number of malignant neoplasms of the breast in relation to gender, and it occurs mainly in women (99.4%). Moreover, the age group with the most frequent occurrence of breast cancer is from 45 to 64 years old (69%), while the most common origin and race is white (88.9%), not Hispanic or Latino (48.6%). The education level that was found to be statistically significant was “less than a high school diploma” (13.2%). Employment status that was found to be statistically significant was “Not employed but has worked previously” (49.4%). The financial status that was found to be statistically significant was “not poor”, with a family income of $35,000 or more (38.6%). Health insurance coverage was found to be statistically significant in both age groups under 65 years (76.5%) and 65 years and over (59.5%) was “private”. In addition, the marital status that the most breast cancer patients had was “married” (52.2%). Finally, the region with the most frequent occurrence of breast cancer was the south (35%), with a population size of one million or more (51.3%).

Table II shows the multiple logistic regression analysis and odds ratios in order to find the predictors for the occurrence of breast cancer.

As shown in Table II, all prognostic factors are statistically significant ($p < 0.05$). According to multiple logistic regression, the risk of breast cancer is significantly higher with female gender (odds ratio (OR) = 1.0), age over 75 years and 45–64 years old (OR 1.0 and 0.99, respectively), white race (OR = 1.94), and high school diploma education status (OR = 1.2). Moreover, those who were unemployed but had worked previously had twice the risk of developing breast cancer (OR = 2.0). In addition, the risk of cancer is significantly higher with family income “$35,000–$49,999” (OR = 1.29), poverty status “not poor” (OR = 1.0), and health insurance coverage “Medicaid” under 65 years old and “Private” over 65 years old (OR = 1.95 and OR = 1.27, respectively). Widowed women had 11 times the risk of developing breast cancer (OR = 11.3). Finally, the risk of breast cancer was significantly higher in the region “northeast” (OR = 1.2) and place of residence “not in a metropolitan statistical area” (OR = 1.0).

Figure 1 shows the trends in breast cancer and stroke during the years 2007–2017 in the United States. The incidence of breast cancer and stroke continued to increase from 2007 to 2017.

Table III shows the Pearson correlation coefficient among the total number of breast cancer and stroke patients for the years 2007–2017. As can be seen from Table III, the incidence of cancer is

Table I. χ^2 and one-way analysis of variance (ANOVA) test

Selected characteristics of breast cancer patients: United States 2007–2017	Number of patients	Percentages	*P*-value
Gender:	37.634		< 0.001
Male	256	0.6	
Female	37.378	99.4	
Age:			< 0.001
18–44	1.651	2.5	
45–64	14.569	69.0	
65–74	10.320	13.5	
75 and over	11.194	14.9	
Race:			< 0.001
White	32.645	88.9	
Black or African American	3.107	8.1	
Asian	1.223	3.0	
Origin:			< 0.001
Hispanic or Latino	2.485	3.3	
Mexican or Mexican American	1.479	1.9	
Not Hispanic or Latino	35.246	48.6	
White, single race	30.440	42.2	
Black or African American, single race	2.996	4.0	
Education:			< 0.001
Less than a high school diploma	4.872	13.2	
High school diploma	5.526	29.5	
Some college	10.512	27.9	
Bachelor's degree or higher	11.061	29.4	
Employment:			
Employed	6.804	23.4	< 0.001
Full-time	4.888	16.9	
Part-time	1.724	6.0	
Not employed but has worked previously	2.378	49.4	
Not employed and has never worked	1.193	4.3	
Family income:			< 0.001
Less than $35,000	12.308	22.9	
$35,000 or more	20.877	38.6	
$35,000–$49,999	5.045	9.6	
$50,000–$74,999	5.424	10.1	
$75,000–$99,999	3.571	6.6	
$100,000 or more	6.838	12.3	

Table I. Cont.

Selected characteristics of breast cancer patients: United States 2007–2017	Number of patients	Percentages	*P*-value
Poverty status:			< 0.001
Poor	2.940	8.7	
Near poor	5.702	17.0	
Not poor	24.906	74.4	
Health insurance coverage:			
Under 65:			< 0.001
Private	12.305	76.5	
Medicaid	2.070	12.8	
Other coverage	840	5.0	
Uninsured	917	5.7	
65 and over:			0.001
Private	16.174	59.5	
Medicare and Medicaid	1.663	6.1	
Medicare only	7.474	28.3	
Other coverage	1.662	6.1	
Marital status:			< 0.001
Married	19.851	52.2	
Widowed	9.055	24.5	
Divorced or separated	5.726	15.4	
Never married	1.966	5.1	
Living with a partner	1.042	2.7	
Place of residence (metropolitan statistical area – MSA):			< 0.001
Large MSA (population size 1 million or more)	19.516	51.3	
Small MSA (less than 1 million)	11.388	30.3	
Not in MSA	6.830	18.4	
Region:			< 0.001
Northeast	7.290	18.9	
Midwest	9.065	24.1	
South	13.164	35.0	
West	8.214	21.9	

statistically significant with stroke ($p < 0.05$). The Pearson correlation coefficient between the total number of cancer patients and stroke patients is 0.872, which indicates that there is a strong correlation between breast cancer and stroke.

Discussion

Increasing attention should be given to the increasing number of breast cancer patients in the United States during the years 2007–2017. It has been noted that the characteristic of patients with the highest risk is their marital status, and more specifically, it was found that widowed women have 11 times higher risk of developing breast cancer (OR = 11.3). Moreover, employment status plays a crucial role in developing this type of cancer. Women who were unemployed but had worked previously had twice the risk of develop-

Table II. Statistically significant predictors of breast cancer in US using multivariate logistic regression

Socio-economic characteristics of breast cancer patients: 2007–2017	Patients	Controls	Odds ratio (95% CI)	*P*-value
Gender:				< 0.001
Male	200	1.127.215	0.07 (0.05–0.07)	
Female	33.477	2.305.890	1.0 (ref.)	
Age:				< 0.001
18–44	1.470	1112863	0.025 (0.024–0.027)	
45–64	13.099	794485	0.99 (0.96–1.0)	
65–74	9.130	224824	0.68 (0.6–0.7)	
75 and over	10.077	170.360	1.0 (ref.)	
Race:				< 0.001
White	29.404	1.841.244	1.94	
Black or African American	2.688	278.992	1.17	
Asian	999	121.990	1.0 (ref.)	
Origin:				0.000
Hispanic or Latino	2.133	338.233	0.64 (0.6–0.68)	
Mexican or Mexican American	1.251	208.223	0.61 (0.57–0.65)	
Not Hispanic or Latino	31.640	1.964.300	1.64 (1.5–1.7)	
White, single race	27.449	1.533.489	1.82 (1.7–1.9)	
Black or African American, single race	2.624	267.881	1.0 (ref.)	
Education:				< 0.001
Less than a high school diploma	4.416	276.082	1.01 (0.9–1.0)	
High school diploma	9.894	520.095	1.20 (1.17–1.24)	
Some college	9.370	571.173	1.04 (1.01–1.07)	
Bachelor's degree or higher	9.871	626.702	1.0 (ref.)	
Employment:				< 0.001
Employed	5.548	727.135	0.5 (0.4-0.53)	
Full-time	4.008	586.800	0.45 (0.42-0.48)	
Part-time	1.433	129.836	0.72 (0.67-0.79)	
Not employed but has worked previously	11.740	386.217	2.0 (1.8-2.1)	
Not employed and has never worked	1.017	67.103	1.0 (ref.)	
Family income:				< 0.001
Less than $35,000	11.094	695.245	1.3 (1.2–1.34)	
$35,000 or more	18.716	1.419.425	1.07 (1.04–1.1)	
$35,000–$49,999	4.639	291.260	1.29 (1.2–1.34)	
$50,000–$74,999	4.923	380.211	1.05 (1.01–1.09)	
$75,000–$99,999	3.184	262.244	0.98 (0.94–1.0)	
$100,000 or more	5.971	485.707	1.0 (ref.)	

Table II. Cont.

Socio-economic characteristics of breast cancer patients: 2007–2017	Patients	Controls	Odds ratio (95% CI)	*P*-value
Poverty status:				< 0.001
Poor	2.598	277.817	0.61 (0.59–0.64)	
Near poor	5.068	369.495	0.90 (0.88–0.93)	
Not poor	22.221	1.470.210	1.0 (ref.)	
Health insurance coverage:				< 0.001
Under 65:				
Private	11.073	1.265.457	3.69 (3.4–3.9)	
Medicaid	1.856	198.207	3.95 (3.6–4.2)	
Other coverage	721	83.015	3.66 (3.3–4.0)	
Uninsured	831	351.007	1.0 (ref.)	
65 and over:				< 0.001
Private	15.032	195.568	1.27 (1.2–1.3)	
Medicare and Medicaid	1.538	26.007	0.98 (0.91–1.0)	
Medicare only	7.141	99.370	1.19 (1.12–1.26)	
Other coverage	1.535	25.478	1.0 (ref.)	
Marital status:				< 0.001
Married	17.596	1.236.918	2.5 (2.4–2.7)	
Widowed	8.257	132.025	11.3 (10.6–12.1)	
Divorced or separated	5.202	258.718	3.6 (3.4–3.9)	
Never married	1.716	505.169	0.6 (0.57–0.67)	
Living with a partner	911	165.756	1.0 (ref.)	
Place of residence (metropolitan statistical area – MSA):				< 0.001
Large MSA (population size 1 million or more)	17.321	1.223.889	0.81 (0.79–084)	
Small MSA (less than 1 million)	10.247	719.703	0.82 (0.79–0.85)	
Not in MSA	6.208	358.941	1.0 (ref.)	
Region:				< 0.001
Northeast	6.400	405.297	1.12 (1.0–1.1)	
Midwest	8.142	532.672	1.09 (1.05–1.1)	
South	11.831	836.763	1.0 (0.9–1.03)	
West	7.402	527.800	1.0 (ref.)	

ing breast cancer (OR = 2.0). Finally, white race is a prognostic risk for this type of cancer; it was found that white women in the U.S. have two times higher risk of developing breast cancer (OR = 1.94).

The importance of this study lies in the association of multiple socio-economic variables with cancer, which reflects the complexity and multidimensional nature of deprivation as well as the various roles of these dimensions throughout life, which in turn reflects the longest gestation period for cancer. More specifically, we found that partner and work deprivation were two determinants in an adult's life, which rapidly increased the risk of cancer. We also found that not only deprivation but also the death of a partner plays a key role in the increased risk of developing cancer.

Moreover, we found a link between breast cancer diagnosis and stroke. One possible explana-

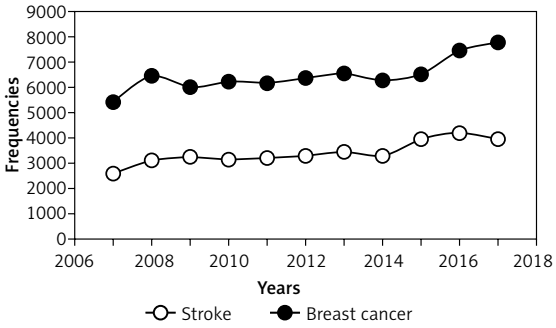

Figure 1. Trends in breast cancer and stroke during the years 2007–2017 in the United States

Table III. Pearson correlation coefficient

Variable	Pearson correlation *r*	*P*-value
Breast cancer	1	
Stroke	0.872	< 0.01

tion is that cancer can cause a hypercoagulable state through circulating microparticles, secretion of proliferative factors, and alterations in platelet activity and endothelial function [19, 20]. Additionally, several cancer treatments, particularly platinum-based compounds, may increase thrombotic risk [19, 21].

In conclusion, this paper has highlighted that different socioeconomic variables are associated with different cancer risks, while deprivation (of work and husband) proved to be the primary prognostic risk factor for cancer. Moreover, incident cancer is associated with an increased risk of stroke.

Conflict of interest

The authors declare no conflict of interest.

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