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Sociodemographic and Clinical Predictors of Triple Negative Breast Cancer

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Sociodemographic and Clinical Predictors of Triple Negative Breast Cancer

CAPSTONE PROJECT PAPER

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By

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Table of Contents

I. ABSTRACT

II. INTRODUCTION

III. LITERATURE REVIEW

IV. SPECIFIC AIMS

V. OBJECTIVES

VI. METHODS

- A. Study Design
- B. Study Population
- C. Outcome Assessment
- D. Demographic Covariates
- E. Statistical Methods

VII. RESULTS

VIII. DISCUSSION

IX. REFERENCES

X. ACKNOWLEDGEMENTS

XI. BIOGRAPHICAL SKETCH

XII. APPENDIX 1: FIGURES & TABLES

I. ABSTRACT

Background and Objectives

Breast cancer has the highest incidence rates among women and is the second leading cause of death due to cancer in women. Of all breast cancers, triple negative breast cancer (TNBC) accounts for about one-fifth of breast cancer and tends to result in an aggressive form with larger tumors and rates of metastasis and is more frequently found in younger women. This results in an important need in information regarding the risk of diagnosis with triple negative breast cancer over other forms and covariates associated with death and TNBC. This paper studies the relationship between race, tobacco use, age, family history, marital status, insurance status, and menopausal status at diagnosis and the risk of mortality from TNBC.

Methods

Individual breast cancer patient data collected from the Kentucky Cancer Registry were analyzed to determine the association of potential risk factors with TNBC. The data was collected between 2009 and 2014 and contained individuals aged 18 or older that were diagnosed with breast cancer. Univariate and bivariate analysis were used to determine the characteristics of the study population. Logistic regression was used to determine the odds ratios for the covariates of interest in TNBC patients. Survival curves were used to compare survival for TNBC patients compared to all other breast cancer subtypes, and Cox proportional-hazard regression was used to determine the risk of death due to TNBC.

Results

Significant increases in the odds for death due to TNBC were seen with women who were widowed (OR 1.53; 95% CI: 1.01, 2.33), on Medicare (OR 2.90; 95% CI: 1.77, 4.74), uninsured (OR 3.84; 95% CI: 1.85, 8.00), or had a late stage at diagnosis (OR 9.462; 95% CI: 6.616, 13.531). These results are based on married women, privately insured women and women diagnosed at an early stage as the reference categories. There was a statistically significant difference between the survival curves for TNBC and all other subtypes (log-rank $p<0.0001$); patients with TNBC had a lower probability of survival than those with other breast cancer subtypes. TNBC patients that were single (HR: 1.63; 95% CI: 1.06, 2.50), on Medicaid (HR: 1.81; 95% CI: 1.13, 2.88), on Medicare (HR: 2.73; 95% CI: 1.77, 4.20), uninsured (HR: 2.98; 95% CI: 1.57, 5.68), or diagnosed at a late stage (HR: 6.54; 95% CI: 5.03, 8.49) had a significantly higher hazard of death when compared with patients who were married, patients that were privately insured and patients that were diagnosed at an early stage.

Conclusions

The study results show that marital and insurance status may be related to an increase of death due to TNBC. The results support findings from previous studies as well as expand upon previous studies by separating based on breast cancer subtype. Overall, continued screening can help with early diagnosis and treatment. Because TNBC is an aggressive subtype, early diagnosis and treatment may help reduce the mortality rates associated with TNBC. Further research examining the covariates used in the study is needed to reinforce the results found in this study.

II. INTRODUCTION

Breast cancer is the most commonly diagnosed cancer in women in the United States, with more than 230,000 cases in 2013 (U.S. Cancer Statistics Working Group, 2016). In the United States, breast cancer is also the second leading cause of cancer death in women (U.S. Cancer Statistics Working Group, 2016). According the National Cancer Institute, breast cancer is defined as a cancer that forms in the tissues of the breast, and it is considered invasive if the breast cancer has spread from where it began to the surrounding tissue. Breast cancer is typically categorized by the presence or absence of human epidermal growth factor receptor 2 (HER2) and hormone-receptor expression (Elias, 2010). This paper will focus on triple negative breast cancer (TNBC) and possible predictors of this subtype of breast cancer. TNBC lacks HER2 amplification, progesterone receptor (PR) expression, and estrogen receptor (ER) expression (Reyes, et al., 2017).

TNBC accounts for about 15%-20% of all cases of breast cancer (Reyes, et al., 2017). It tends to be more aggressive than other subtypes of breast cancer, generally affects younger women, has been shown to have poorer 5-year survival rates, and has greater chances of metastases and recurrence than other forms of breast cancer (Elias, 2010; Reyes, et al., 2017; Kawai, et al, 2014). Because of the aggressive nature and higher likelihood of affecting younger women, understanding the sociodemographic and clinical predictors of TNBC is important. However, relatively few current publications focus on risk factors for TNBC versus other subtypes of breast cancer (Hudis, et al., 2011).

There are many known risk factors for breast cancer, but few have been examined related to specific subtypes of breast cancer, such as TNBC. Menopausal status, tobacco use, family history, and race are all associated with the risk of breast cancer (Kawai, et al., 2014; Howell, et al., 2014). This paper further examines these risk factors in terms of their association with TNBC. This paper will also examine whether marital status and insurance status are risk factors for TNBC. Married women have been shown to have lower mortality rates when compared with unmarried cancer patients (Martinez, et al., 2017). The main goal of this research is to determine which factors may be related to a higher risk of death in patients with TNBC. A secondary goal is to determine if higher mortality is related to TNBC over all other subtypes of breast cancer.

III. LITERATURE REVIEW

The review of literature given below examines the currently known information related to TNBC and its potential risk when compared with other forms of breast cancer. The information contained comes from published journal articles, national and international organizations reports, and public health organization web sites and fact sheets. PubMed was the major database used to find and access the journal articles of interest.

Breast cancer is a major contributor to incidence and mortality rates for cancer in the United States. This is largely due to the increasing number of women who have many risk factors for breast cancer. These factors include younger age of first menarche, later age of first pregnancy, lower number of overall pregnancies, shorter time or no time spent breastfeeding, and a later age of menopause (Howell, et al.,

2014; Turkoz, et al., 2013). Other factors that have been shown to contribute to the risk of breast cancer include age and family history. Studies have shown links for both of these risk factors related to all breast cancer types collectively (Turkoz, et al., 2013). However, little work has been done specifically examining the effects of age and family history on TNBC patients. One study found that a higher proportion of patients with family history were found within the TNBC patients over the other breast cancer subtypes, but the results were not significant (Turkoz, et al., 2013).

Because of their lack of receptor expression, TNBC tumors are more difficult to treat with targeted therapy, and are mainly treated with cytotoxic chemotherapy (Bae, et al., 2016; Elias, 2010; Reyes, et al., 2017). Some (but few) studies have examined the risk of TNBC compared to other subtypes of breast cancer and have found that TNBC patients have poorer survival rates (Kawai, et al., 2014; Turkoz, et al., 2013). These studies also showed that there is a poorer survival rate for non-Hispanic black women than for all other women with TNBC (Elias, 2010; Kawai, et al., 2014). There have been mixed results relating to smoking and risk of breast cancer. One review found that current smokers had a 15%-40% increased risk of premenopausal breast cancer (Johnson, et al., 2011; Kawai, et al., 2014). Some studies have examined the effect of smoking on breast cancer tumor by subtype but did not appear to show a link between smoking and the risk of TNBC (Kawai, et al., 2014).

Studies have also examined the effects of marital status on mortality rates in breast cancer. One study found that unmarried individuals diagnosed with breast cancer had higher mortality risk than married breast cancer patients (Martinez, et al.,

2017). This shows that marital status may have an important relationship with mortality among female cancer patients, but it does not examine if this risk differs among the different subtypes of breast cancer.

Due to the aggressive nature of TNBC and the greater likelihood of this subtype affecting young women, the risk factors associated with TNBC need to be further examined to determine which factors may be more likely to lead to an increased risk of death with TNBC. There are few studies that examine the effects of family history, marital status, menopausal status at diagnosis, and family history on the risk of death due to TNBC or if there are differences in the factors associated with TNBC compared to other subtypes of breast cancer.

IV. SPECIFIC AIMS

To provide additional information related to covariates associated with risk of death in TNBC patients.

V. OBJECTIVES

To determine whether an association exists between the risk of death in TNBC patients and race, age, tobacco use, family history, marital status, insurance status, menopausal status and stage at diagnosis.

To determine whether there is a difference in survival for TNBC patients when compared to all patients with other subtypes of breast cancer.

VI. METHODS

Study Design

This study is a retrospective cross-sectional study that uses secondary data. All data related to type of breast cancer, race, tobacco use, age at diagnosis, family history, marital status, insurance status, menopausal status at diagnosis, stage at diagnosis and survival status was available at the individual patient level.

Study Population

The study population consists of Kentucky women, age 18 and older that have been diagnosed with any form of breast cancer so long as the specific molecular subtype is known. The data consists of cases diagnosed from 2009 to 2014, as this is when the Kentucky Cancer Registry (KCR) began recording the specified subtype of TNBC. KCR is an ongoing, population-based cancer registry that is specific to the state of Kentucky. It is designed to collect and analyze cancer patient information related to diagnosis and treatment. KCR contacts cases at least once a year to obtain data related to health, vital status, and disease progression.

There were 18,456 cases of breast cancer diagnosed and recorded by KCR during the five-year period. Cases with unknown or undocumented subtype were excluded (n=5,035), resulting in 13,421 cases of breast cancer eligible for inclusion. As there were very few individual cases identified under race categories other than white or black, race was sorted into only those two categories. Excluding cases recorded as unknown or of other races (n=121) left 13,300 breast cancer cases. Those with unknown tobacco use were excluded (n=1,718), as well as those with

unknown family history (n=1,651), unknown menopausal status (n=1,016), and unknown marital status were excluded (n=112), and those with unknown insurance payer status were excluded (n=18). Finally, those with unknown stage of cancer at diagnosis were excluded (n=55).

After the exclusions stated above, the final study population consisted of 8,730 cases of breast cancer: 1,145 cases of triple negative breast cancer and 7,585 cases of all other types of breast cancer. The University of Kentucky Institutional Review Board reviewed and approved the study protocol.

Outcome Assessment

Records pertaining to breast cancer cases that were reported to the Kentucky Cancer Registry were used. The CS site-specific factor 16 was used to determine the subtype of cancer as being triple negative or all other subtypes. The TNBC cases were then analyzed with the covariates of interest and the known patient status (dead or alive).

Demographic Covariates

Besides the assessment of breast cancer subtype, the covariates of interest in the breast cancer patients are race, age at diagnosis, tobacco use, family history, marital status, insurance status and menopausal status at diagnosis. Race has been limited to white and black groupings and tobacco use has been grouped into never used tobacco and users of any type of tobacco. Marital status has multiple categories: single, married, separated or divorced, widowed, and unmarried or with domestic partner. Family history was grouped into known family history or no family

history. Insurance status has been grouped into a total of four categories: uninsured, privately insured, receives Medicaid, and receives Medicare. Menopausal status has been grouped into pre-menopausal and post-menopausal. Stage at diagnosis has been reduced to two categories: early stage and late stage. Stages 0, 1, and 2 are grouped under the early category and stages 3 and 4 are grouped under the late category. All covariates used were chosen based on previous literature and the possibility of the covariates linked with specific breast cancer types.

Statistical Methods

Univariate analysis was used to report the characteristics of the entire study population and to determine the characteristics of the study population separated by cancer subtype. Chi-square and logistic regression models were used to determine the odds of survival related to TNBC and the covariates of interest. The relationship between the covariates and survival was analyzed with both bivariate and multivariate analysis. Statistically significant relationships in the bivariate and logistic regression were determined with chi-square tests ($p \leq 0.05$). Survival status for the breast cancer cases based on the cancer subtype was determined by survival curves. Cox proportional-hazard regression was used to determine the risk of death due to breast cancer using the following covariates: race, age at diagnosis, tobacco use, family history, marital status, insurance status, and menopausal status at diagnosis. Death was documented through February 2017 with cases of last contact of more than one year being censored. Survival interval was used as the time component and was determined from date of diagnosis to date of death (or last contact in censoring).

Statistical significance was determined using a p-value ≤ 0.05. All analyses were carried out using SAS 9.4® (SAS Institute, Inc.; Cary, NC). Data used in this publication were provided by the Kentucky Cancer Registry, Lexington, Kentucky.

VII. RESULTS

The majority of the patients included in the study were white (92.68%) non-tobacco users (56.80%), without a family history of breast cancer (57.22%), and married (58.67%) (Table 1). Most of the patients were privately insured or covered with Medicaid or Medicare, with very few being uninsured (2.16%). A large majority of all patients also were documented as being post-menopausal at diagnosis (76.60%), diagnosed at an early stage (83.89%) and were currently determined to be living (86.43%). Of all the documented cases of breast cancer included in the study, 13.12% of these cases were categorized as triple negative.

The characteristics of the patient population specific to TNBC and all other subtypes are given in Table 2. The TNBC population, compared to the population of patients with other breast cancer subtypes, was more likely to include black women (11.53% vs. 6.68%), women with private insurance (53.62% vs. 48.69%), women on Medicaid (10.74% vs. 7.49%), and more diagnosed at a late stage (19.74% vs. 15.56%). On average, the age of the TNBC patients included in the study population was 58.2 ± 12.8 years old, while the age of the patients with other breast cancer subtypes was 61.5 ± 12.7 years old.

Bivariate analysis was used to determine significant association of covariates and death for patients with TNBC (Table 3). The results showed that race and family

history were not associated with death among women with TNBC. Whereas, tobacco use, age at diagnosis, marital status, primary payer status, menopausal status and stage at diagnosis were significantly associated with death. For example, 75.79% of tobacco users were survivors compared to 81.16% of non-tobacco users.

The point estimates for the odds ratios with 95% confidence intervals obtained through logistic regression are given in Table 4. The odds ratios are based on data for TNBC patients, excluding all other cancer subtypes in the study population. Of the ratios showing statistical significance, women who were widowed had 1.70 (95% CI: 1.06, 2.72) times the odds of dying with TNBC when compared to married women. Women who were on Medicare had 2.59 (95% CI: 1.49, 4.51) times the odds of dying with TNBC when compared to privately insured women. Women who were uninsured had 3.04 (95% CI: 1.26, 7.35) times the odds of dying with TNBC when compared to privately insured women. Women who were diagnosed at a late stage had 9.46 (95% CI: 6.62, 13.53) times the odds of dying with TNBC when compared to women who were diagnosed at an earlier stage. The c value for the model was 0.803, meaning that the model has adequate discriminatory accuracy (Chen, et al., 2003; Howell, et al., 2014).

Logistic regression was also used to determine the odds ratios with 95% confidence intervals for the odds of dying based on breast cancer subtype. The results were statistically significant and show that patients diagnosed with TNBC have 2.24 (95% CI: 1.90, 2.64) times the odds of dying than patients diagnosed with other breast cancer subtypes.

The survival curve given in Figure 1 shows the differences in survival rates between patients with TNBC and patients with all other subtypes of breast cancer. Both the log-rank test ($p<0.0001$) and the Wilcoxon test ($p<0.0001$) show a statistically significant difference between the two curves, meaning that those with TNBC have a lower probability of survival than those with other breast cancer subtypes. The survival curve given in Figure 2 shows the differences in survival rates for TNBC patients who were married, single, separated or divorced, or widowed. Both the log-rank test ($p<0.0001$) and the Wilcoxon test ($p=0.0002$) show a statistically significant difference between the curves. The survival curve in Figure 3 shows the differences in survival rates for TNBC patients who were privately insured, on Medicaid, on Medicare, or who were uninsured. Both the log-rank test ($p<0.0001$) and the Wilcoxon test ($p<0.0001$) show a statistically significant difference between the curves. The survival curve in Figure 4 shows the differences in survival rates for TNBC patients who were diagnosed at an early stage or at a late stage. Both the log-rank test ($p<0.0001$) and the Wilcoxon test ($p<0.0001$) show a statistically significant difference between the curves.

Two Cox regressions were estimated, one with all breast cancer subtypes to test the hazard of death for TNBC versus all other subtypes, and a second to test the impact of the covariates on TNBC patients only (Table 5). The statistically significant results showed that patients with TNBC had 1.78 (95% CI: 1.55, 2.06) times the hazard of dying when compared to patients with all other breast cancer subtypes. The results of the cox regression for TNBC only patients are given in Table 6. Of the hazard ratios showing statistical significance for those diagnosed

with TNBC, single women have 1.63 (95% CI: 1.06, 2.50) times the hazard of dying when compared to married women. Women on Medicaid have 1.81 (95% CI: 1.13, 2.88) times the hazard of dying when compared to privately insured women. Women on Medicare have 2.73 (95% CI: 1.77, 4.20) times the hazard of dying when compared to privately insured women, and uninsured women have 2.98 (95% CI: 1.57, 5.68) times the hazard of dying when compared to privately insured women. Women diagnosed as late stage have 6.54 (95% CI: 5.03, 8.49) times the hazard of dying when compared to women diagnosed as early stage.

VIII. DISCUSSION

Primary Findings

This study was used to examine the potential risks associated with TNBC and death from TNBC. It assessed the association of TNBC with race, tobacco use, family history, marital status, primary payer status, menopausal status at diagnosis, and stage at diagnosis. All cancer cases in Kentucky over a five-year period were analyzed with cases being grouped by breast cancer subtype.

The results suggest that the TNBC cases had an overall lower age than all other subtypes (58.2 vs. 61.5). Characteristics that may be associated with lower age also are seen to differ in TNBC cases: with a slightly larger percentage of TNBC patients being single (10.57% vs. 9.29%) and being on Medicaid (10.74% vs. 7.49%). There were also fewer TNBC patients widowed (13.71% vs. 17.75%) and on Medicare (32.58% vs. 41.79%). These noted differences in age, as well as the hazard of death

associated with late stage diagnosis (HR: 6.54; 95% CI: 5.03, 8.49), support the current standards of beginning mammography screening at the slightly younger age of 40 (Breast Cancer, 2016).

The results showed many covariates being significantly associated with death in the bivariate analyses (Table 3) but age at diagnosis, tobacco use, and menopausal status were no longer significant in the multivariate analysis. Further studies can be compared to these results to see if the results are corroborated in populations other than Kentucky.

The results also show that married woman had a lower risk of TNBC and lower hazard of dying than women that were single, widowed, or separated or divorced. This may be due to health factors related to happiness and companionship or due to the fact that a partner may help notice signs and obtain treatment early on if this is a factor. Insurance status also appears to be significantly related to TNBC diagnosis with privately insured women having a lower risk of TNBC than women who are uninsured, on Medicaid, or on Medicare. This may be related to the SES of the women as those who are privately insured generally have a higher economic standing than those who are uninsured, on Medicaid, or on Medicare.

Comparison with Other Studies

The percentage of the study population diagnosed with TNBC support the numbers found in other studies, this study found those with TNBC to account for 13.12% of the population and other sources generally found it to be between 10%-20% (U.S. Cancer Statistics Working Group, 2016; Reyes, et al., 2017). Previous studies, and this current study did not find significant links between family history

and risk of TNBC or between smoking and risk of TNBC (Turkoz, et al., 2013). However, this current study examined additional covariates not found in Turkoz, et al. (2013) to add to its understanding of associated risk factors.

Other studies contribute to the understanding of smoking and risk of breast cancer, our study found smoking to be significantly associated with the risk of death, in the bivariate analysis only. This supports the findings in the Kawai, et al. study, in their multivariate analyses; they did not find a significantly increased risk of TNBC in patients with a smoking history (Kawai, et al., 2014). Further examination would be needed to support this with the inclusion of other confounders.

Payer status has been shown in previous studies to be significantly related to survival status, this is likely due to payer status being a known barrier to access to treatment (Shi, et al., 2015). The study found that higher mortality was associated with breast cancer patients on Medicaid or with no insurance (Shi, et al., 2015). Our study went further by separating the breast cancer cases by subtype and found that Medicaid, Medicare, and uninsured TNBC patients had a significantly higher risk of death than privately insured patients. This furthers the Shi, et al. study in that primary payer status is related to aggressive breast cancer and mortality rates.

Studies have examined marital status and its association with breast cancer. One study found that unmarried breast cancer patients had significantly higher risk for death than married patients (Martinez, et al., 2017). Although not all of our findings were significant, they did show an increased risk of death for patients that were single, widowed, and separated or divorced when compared to married patients. Our findings were significant in showing an increased hazard of dying for

patients who were single or widowed when compared with married patients. These results add support to the Martinez, et al. study and show the need for further studies to determine if there is significant association between the risk of death from TNBC and marital status.

The survival curves presented in Figure 1 add further support to the knowledge that TNBC is a more aggressive subtype of breast cancer (Bae, et al., 2016; Elias, 2010; U.S. Cancer Statistics Working Group, 2016). The TNBC curve showed a significantly lower probability of survival than the curve for all other breast cancer subtypes.

Strengths and Limitations

A strength of this study is the relatively large sample size used for analysis as other studies found in the literature had much lower sample sizes. A large sample size gives strength to the results of the analysis. This study also provided information related to covariates specific to TNBC that has not been shown in other studies. This is a strength because the study was able to contribute new understanding to the issues of breast cancer and the TNBC subtype.

This study also had several limitations. The study only examined retrospective data and did not have information related potential changes in screening methods over time. If women began screening earlier or later during the time period, this could have affected the recorded age at diagnosis. The study also did not examine the cancer cases by treatment used or comorbidities. These factors may have an effect on mortality and could provide useful information in a future study. Another limitation may be from the use of marital status at diagnosis in the

study. The results on survival are based on this variable but they do not show if an individual's marital status changed from diagnosis to death, which may have had an effect on the health of the patient. Further, more factors may have been examined as possible risk factors for TNBC in this study to improve the understanding of what is a risk factor for diagnosis of TNBC or a risk factor for increased death due to TNBC. Other factors of interest in studies that may have been used include obesity and diabetes.

Conclusions

This study contributes to the understanding of risk factors related to TNBC and the need for continued early screening and treatment to help reduce the mortality rates of TNBC. The covariates and outcomes in this study are only a few of those of interest and further examination of risk related to diagnosis of TNBC and death due to TNBC is needed. Overall, screening is key as TNBC is aggressive and leads to higher mortality; early diagnosis and treatment may be beneficial to a reduction in these rates.

IX. ACKNOWLEDGEMENTS

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XI. BIOGRAPHICAL SKETCH

Madison L. Ries earned a Bachelor of Science degree in Biology and a Bachelor of Art degree in Chemistry from the University of Kentucky, in Lexington, KY in May

of 2015. Currently she is a candidate for a Masters of Public Health degree at the University of Kentucky College of Public Health. During her time in the College of Public Health, Ms. Ries has served as an Out of Department Teaching Assistant in the College of Arts and Sciences in the Department of Chemistry. She will be continuing her education by pursuing a medical degree at the University of Kentucky College of Medicine beginning in July of 2017.

XII. APPENDIX 1: FIGURES & TABLES

Table 1: Characteristics of patients diagnosed with breast cancer between 2009-2014 in the study population.

Variables	N	%
Age		
Mean (Standard Deviation)	8730	61.089 (12.805)
Race		
White	8091	92.68%
Black	639	7.32%
Tobacco Use		
Never Used	4939	56.80%
Used Any Tobacco	3756	43.20%
Family History		
Yes	3735	42.78%
No	4995	57.22%
Marital Status		
Single	826	9.46%
Married	5122	58.67%
Separated or Divorced	1263	14.47%
Widowed	1503	17.22%
Unmarried or Domestic Partner	16	0.18%
Primary Payer		
Uninsured	189	2.16%
Privately Insured	4307	49.34%
Medicaid	691	7.92%
Medicare	3543	40.58%
Menopausal Status at Diagnosis		
Pre-Menopausal	2043	23.40%
Post-Menopausal	6687	76.60%
Vital Status		
Alive	7545	86.43%
Dead	1185	13.57%
Breast Cancer Subtype		
Triple Negative	1145	13.12%
All Other Subtypes	7585	86.88%
Stage at Diagnosis		
Early	7324	83.89%
Late	1406	16.11%

Table 2: Characteristics of the patient population separated by subtype.

	TNBC		Other Subtypes	
Variables	**N**	**%**	**N**	**%**
Age				
Mean (Standard Deviation)	1145	58.211 (12.848)	7585	61.523 (12.743)
Race				
White	1013	88.47%	7078	93.32%
Black	132	11.53%	507	6.68%
Tobacco Use				
Never Used	637	55.83%	4302	56.95%
Used Any Tobacco	504	44.17%	3252	43.05%
Family History				
Yes	510	44.54%	3225	42.52%
No	635	55.46%	4360	57.48%
Marital Status				
Single	121	10.57%	705	9.29%
Married	698	60.96%	4424	58.33%
Separated or Divorced	169	14.76%	1094	14.42%
Widowed	157	13.71%	1346	17.75%
Unmarried or Domestic Partner	0	0%	16	0.21%
Primary Payer				
Uninsured	35	3.06%	154	2.03%
Privately Insured	614	53.62%	3693	48.69%
Medicaid	123	10.74%	568	7.49%
Medicare	373	32.58%	3170	41.79%
Menopausal Status at Diagnosis				
Pre-Menopausal	308	21.14%	1735	22.87%
Post-Menopausal	837	78.86%	5850	77.13%
Vital Status				
Alive	903	78.86%	6642	87.57%
Dead	242	21.14%	943	12.43%
Stage at Diagnosis				
Early	919	80.26%	6405	84.44%
Late	226	19.74%	1180	15.56%

Table 3: Bivariate analysis of covariates for TNBC.

	TNBC		Chi-Square
	Dead (%)	Alive (%)	(p-value)
Race			
Black	19.70%	80.30%	
White	21.32%	78.68%	0.6669
Tobacco Use			
Never Used	18.84%	81.16%	
Used Tobacco	24.21%	75.79%	0.0276
Family History			
No	22.36%	77.64%	
Yes	19.61%	80.39%	0.2565
Age at Diagnosis			
23-39	16.46%	83.54%	
40-64	15.52%	84.48%	
65+	33.62%	66.38%	<0.0001
Marital Status			
Married	16.62%	83.38%	
Separated or Divorced	23.67%	76.33%	
Single	25.62%	74.38%	
Widowed	35.03%	64.97%	<0.0001
Primary Payer Status			
Privately Insured	11.73%	88.27%	
Medicaid	21.95%	78.05%	
Medicare	35.39%	64.61%	
Uninsured	31.43%	68.57%	<0.0001
Menopausal Status			
Pre-Menopausal	13.31%	86.69%	
Post-Menopausal	24.01%	75.99%	<0.0001
Stage at Diagnosis			
Early	12.73%	87.27%	
Late	55.31%	44.69%	<0.0001

Table 4: Odds ratio estimates for TNBC patients (calculated with logistic regression)

Effect	Point Estimate	95% Confidence Limits	
Race:			
Black vs. White	0.788	0.452	1.375
Tobacco Use:			
Never Used vs. Cigarettes Smoker	0.764	0.545	1.070
Family History:			
Yes vs. No	1.084	0.774	1.518
Age at Diagnosis:			
40-64 vs. 23-39	0.697	0.316	1.536
65+ vs. 23-39	1.022	0.382	2.731
Marital Status:			
Single vs. Married	1.424	0.804	2.524
Separated or Divorced vs. Married	1.505	0.935	2.423
Widowed vs. Married	1.698	1.062	2.715
Primary Payer:			
Uninsured vs. Privately Insured	3.037	1.255	7.349
Medicaid vs. Privately Insured	1.447	0.810	2.586
Medicare vs. Privately Insured	2.593	1.491	4.509
Menopausal Status at Diagnosis:			
Post-Menopausal vs. Pre-Menopausal	1.438	0.866	2.387
Stage at Diagnosis:			
Late vs. Early	9.462	6.616	13.531

Figure 1: Survival curve comparing the survival over time (in years) of TNBC and all other breast cancer subtypes

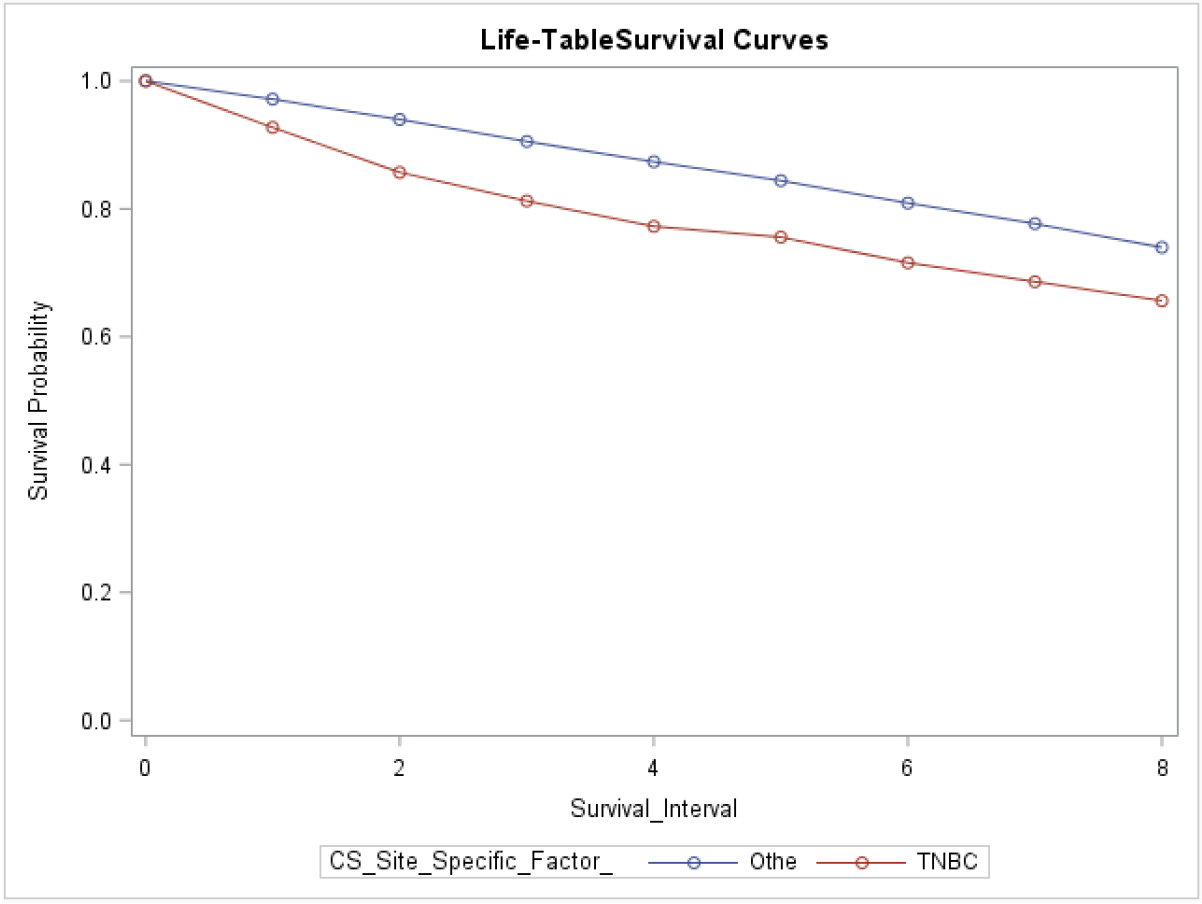

Figure 2: Survival curve comparing the survival over time (in years) for all TNBC patients based on marital status

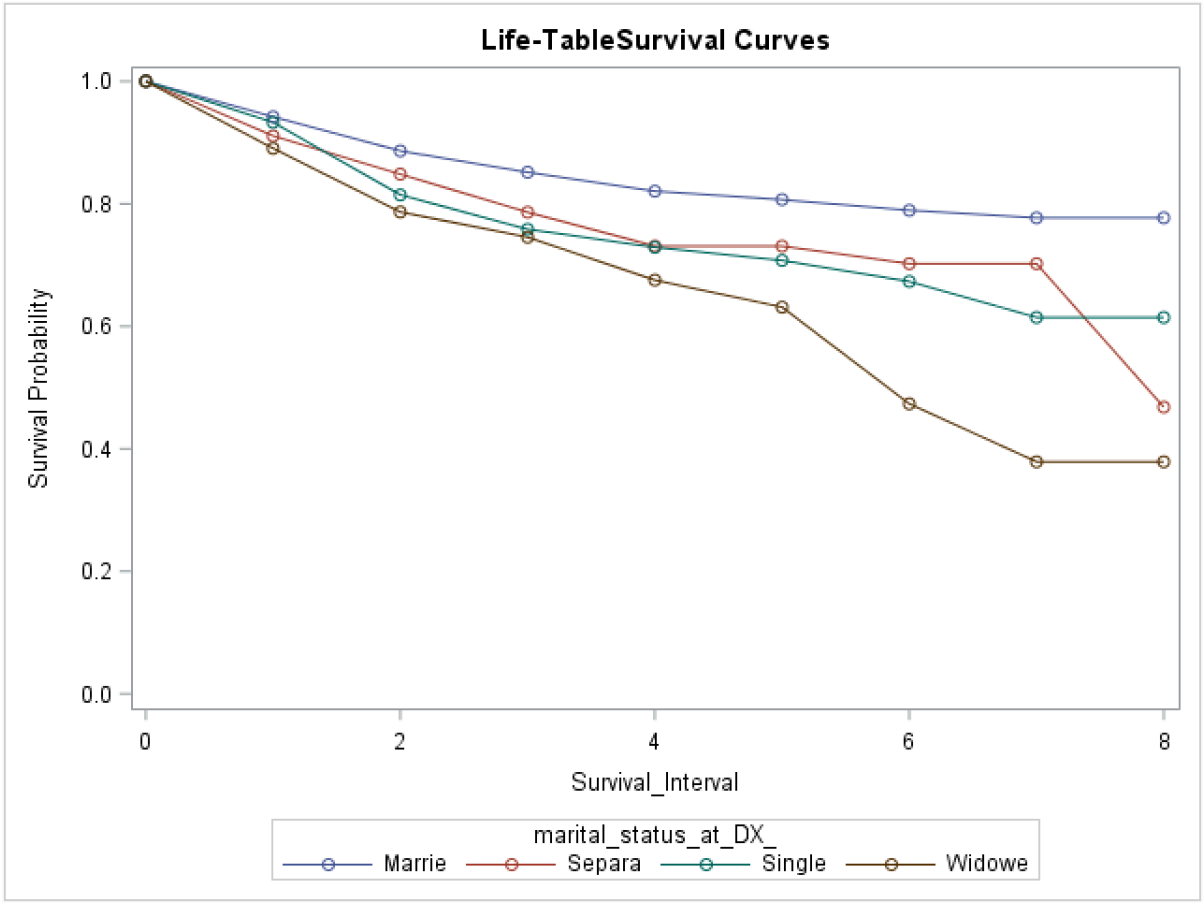

Figure 3: Survival curve comparing the survival over time (in years) for all TNBC patients based on insurance status.

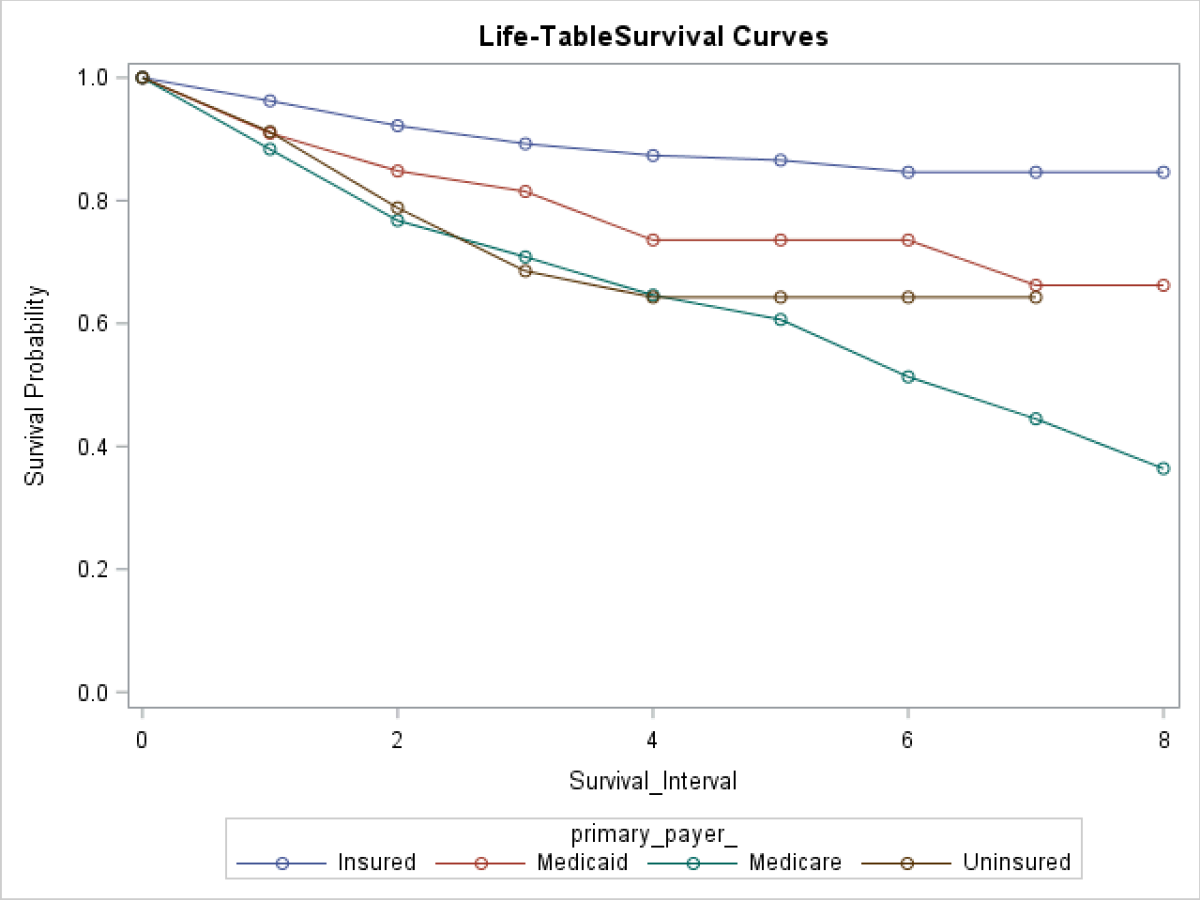

Figure 4: Survival curve comparing the survival over time (in years) for all TNBC patients based on stage at diagnosis.

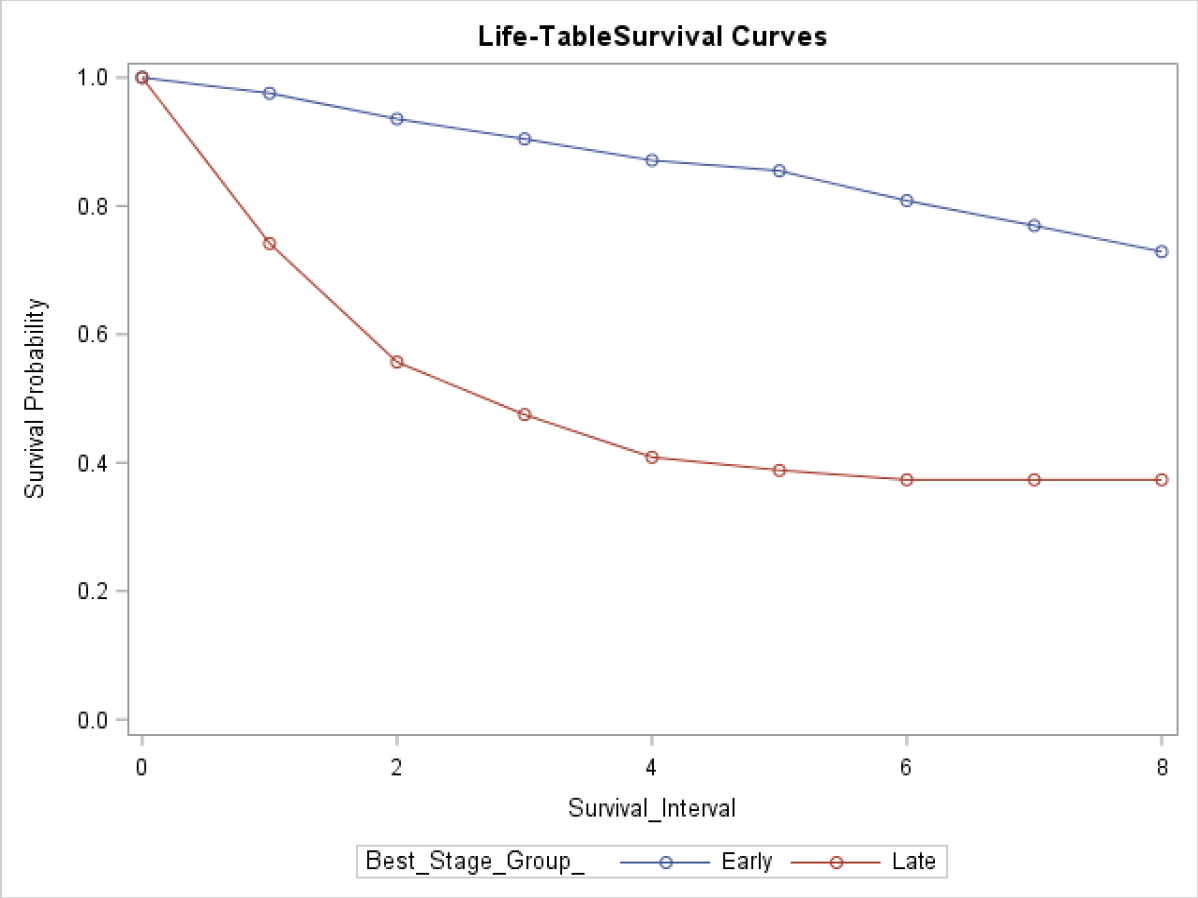

Table 5: Hazard ratios for TNBC patient data.

	Pr > ChiSq	Hazard Ratio	95% Confidence Limits	
Age at Diagnosis: 40-64	0.4983	0.797	0.414	1.536
65+	0.8227	0.913	0.412	2.025
Race: Black	0.3806	0.825	0.536	1.269
Tobacco Use: Never Used Tobacco	0.0817	0.794	0.612	1.030
Family History: Yes	0.9023	0.984	0.757	1.278
Marital Status at Diagnosis: Single	0.0253	1.628	1.062	2.497
Widowed	0.1280	1.310	0.925	1.855
Separated or Divorced	0.1078	1.356	0.936	1.966
Primary Payer: Medicaid	0.0128	1.805	1.134	2.875
Medicare	<0.0001	2.725	1.767	4.203
Uninsured	0.0009	2.983	1.568	5.677
Menopausal Status at Diagnosis: Post-menopausal	0.1117	1.411	0.923	2.156
Stage at Diagnosis: Late Stage	<0.0001	6.535	5.033	8.486