Breast Cancer in Kentucky: Progress and Possibilities

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This study examines progress in diagnosing breast cancer at an early stage in Kentucky and seeks to determine whether the rate ratio of early versus late stage diagnosis in Kentucky differs from the rate ratio in the other SEER Cancer Registries; and to assess whether Kentucky's present breast cancer indicators are improved over those reported in the 2003 Kentucky Breast Cancer Report Card.

*All breast cancer cases used in this analysis were drawn from the SEER database and statistics were calculated using SEER*Stat software. Inclusion criteria were based on SEER site recode, derived SEER Summary Stage 2000, race, registry, Appalachian/non-Appalachian residence at diagnosis and age at diagnosis. The cases were categorized as early or late stage. Age-adjusted incidence and mortality rates were calculated from 2006 to 2010. Kentucky Behavioral Risk Factor Survey data was used to analyze mammography screening for women age 50 and older by Appalachian status.*

Compared to SEER, the rate ratio of early versus late stage was lower in Kentucky (2.39 SEER vs 2.28 KY). The rate ratio in Appalachian Kentucky (1.91) was much lower compared to non-Appalachian Kentucky (2.34). Not surprisingly, Appalachian Kentucky had a higher percentage of late stage diagnosis than non-Appalachian Kentucky (34.1% vs 28.9%). Mammography screening was lower in Appalachian Kentucky than non-Appalachian Kentucky. Since the 2003 Breast Cancer Report Card, Kentucky has improved in overall breast cancer screening, increased early stage diagnosis and mortality. The non-Appalachian Kentucky rate of early versus late stage diagnosis is now similar to other SEER rates (2.34 vs 2.39). Disparities remain evident in mammography screening and early versus late stage diagnosis for Appalachian compared to non-Appalachian women.

Given these results, public health practitioners need to work together to establish and communicate consistent evidence-based guidelines for screening and to address the continuing barriers to screening in Appalachian Kentucky.

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BACKGROUND/INTRODUCTION

The American Cancer Society estimates 3,370 new primary female breast cancer cases will be diagnosed in Kentucky during 2014, and 232,670 new cases will be diagnosed in the US[1] With the exception of skin cancer, breast cancer is the most common cancer diagnosed in women in Kentucky and the US[1,2] Female breast cancer in the US decreased by 2% per year from 1995 to 2005, however the rate per 100,000 population remained stable.[3] Mortality rates for female breast cancer declined significantly (1.9% per year) from 1998 to 2009,[3] and

the reduction has been credited to improvements in early detection and treatment.[4] In 2012, 77% of women age 50 and older in the US had a mammogram in the past two years compared to 75% of Kentucky women of the same age.[5]

Appalachian Kentucky is an area of very high cancer burden. This population has a 10% higher all-cancer mortality rate than non-Appalachian Kentucky.[6] Challenges to cancer screening include lack of awareness of the need for screening, difficulties in accessing service and concern for privacy.[7,8] Appalachian Kentucky is characterized by its low percentage of high school graduates, low income, high unemployment rate, high poverty rate and lack of access to health care providers.[9,10] Appalachian Kentucky residents tend to have multiple morbidities, which magnifies barriers such as health care access, competing financial demands, lack of health literacy and risky behaviors (eg, smoking, poor diet, lack of exercise).[11] All-cause mortality in the Appalachian region has been independently linked to high poverty, low education, rural location, sex and race/ethnicity.[10]

In 2003, Friedell et al evaluated Kentucky's progress against breast cancer using Kentucky Cancer Registry (KCR) and Vital Records mortality data from 1995 to 2000.[12] They compared Kentucky breast cancer incidence and mortality rates with data from the National Cancer Institute Surveillance, Epidemiology and End Results (SEER) Program from 1995 to 2000. The authors found that early stage incidence was lower in Kentucky compared to other SEER data. They also found that the ratio between early and late stage cases was lower in Kentucky compared to other data in SEER. Appalachian Kentucky had a lower percentage of early stage cases compared to Non-Appalachian Kentucky. The authors concluded that increased mammography screening, particularly in Appalachian Kentucky, was needed to increase the early stage diagnosis of breast cancer.[12]

Until recently, consistent evidence showed that mammography screening increased early detection and reduced late stage diagnosis of breast cancer.[13] However, several recent studies proposed that increased breast cancer screening resulted in increased numbers of early stage breast cancer cases, but has not had a significant impact on reducing the number of late stage cases.[14,15]

In this study, we review Kentucky's progress in diagnosing breast cancer at an early stage and we determine if the proportion or ratio of early versus late stage diagnosis in Kentucky differs from that found in the other 17 SEER Cancer Registries. We also investigate 2006-2010 trends in stage at diagnosis, as well as mammography screening from 2002 to 2010.

METHODS

All of the breast cancer cases used in this analysis were drawn from the SEER database, which includes 18 SEER registries and covers approximately 27.8% of the US population.[16] The Kentucky Cancer Registry (KCR) is one of the SEER Cancer Registries, and since 2000, all cancer cases diagnosed in Kentucky have been included in the SEER database. Even though Kentucky is a SEER Registry, to ensure that the assumption of independence was not violated when SEER rates were compared to Kentucky rates, the SEER rates reported in this study did not include any Kentucky cases.

Statistics were calculated using SEER*Stat software (version 8.1.5). Breast cancer cases included in the study were selected based on SEER site recode, derived SEER Summary Stage 2000, race, registry, Appalachian/non-Appalachian residence at diagnosis and age at diagnosis. Only the first primary breast cancer among women diagnosed during 2006 to 2010 who were age 20 and older were included in the study. 1.7% of SEER cases and 1.3% of Kentucky cases had "unknown" stage at diagnosis and were excluded from the analysis.[17] A total of 354,557 female breast cancer cases were included in the analysis.

The derived SEER Summary Stage 2000 was categorized into two groups: early and late stage. The early stage cases included in situ and localized cases, while the late stage cases included regional and distant cases. The county-level Appalachian/non-Appalachian residence at diagnosis was based on Appalachia Regional Commission definitions. The age-adjusted incidence rates for 2006-2010 and

their standard errors were calculated for Kentucky, the rest of the SEER registries combined, Appalachian Kentucky and non-Appalachian Kentucky populations. The age-adjusted rates were standardized based on the 2000 US population. The rate ratios between incidence of early stage and late stage were also calculated and presented along with their 95% confidence intervals. Statistical significance was determined based on a two-sided rate ratio test with a 0.05 significance level.

In addition, 2006-2010 age-adjusted mortality rates for female breast cancer in Appalachian and non-Appalachian Kentucky were also calculated using SEER*Stat. Utilizing the Kentucky Behavioral Risk Factor Survey data, mammography screening among women age 50 and older was analyzed by Appalachian status for 2002-2010.

Table 1. *Age adjusted incidence rates for female breast cancer, age 20 and older, 2006-2010.*

Region	N	%	Rate per 100,000	Standard Error	Rate Ratio (95% Confidence Interval)
SEER					
Early Stage	237,780	70.6%	144.7	0.3	2.39 (2.37,2.40)
Late Stage	99,219	29.4%	60.7	0.2	
KY					
Early Stage	12,246	69.7%	136.1	1.2	2.28 (2.20,2.35)
Late Stage	5,312	30.3%	59.8	0.8	
NAP KY					
Early Stage	9,295	71.1%	144.8	1.5	2.43 (2.34,2.52)
Late Stage	3,782	28.9%	59.6	1.0	
AP KY					
Early Stage	2,951	65.9%	114.4	2.1	1.91 (1.79,2.03)
Late Stage	1,530	34.1%	60.0	1.6	

RESULTS

Compared to SEER, age-adjusted breast cancer incidence rates for both early and late stage were lower in Kentucky (Table 1). Compared to SEER, the rate ratios of early and late stage were also lower in Kentucky (2.28 vs 2.39), indicating a higher rate of early stage diagnosis among women in the SEER Registries. The rate ratio in Appalachian Kentucky (1.91) is much lower compared to non-Appalachian Kentucky (2.34).

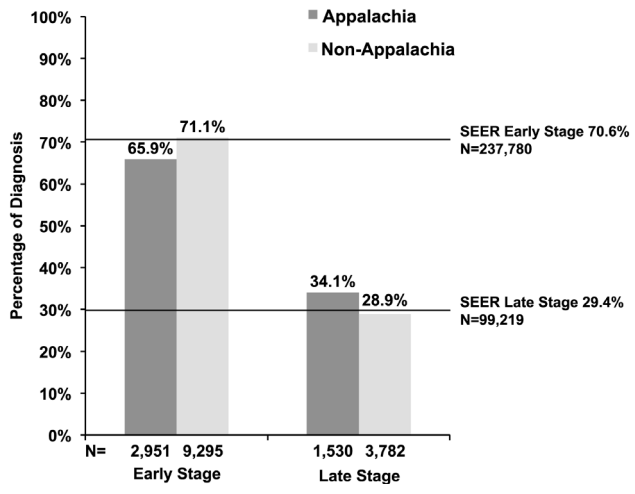

Figure 1. *Proportion of early stage versus late stage cases in Appalachian and non-Appalachian Kentucky women.*

There was little difference between the percentages of early or late stage cases in Kentucky compared to SEER (69.7% vs 70.6%), though the differences became much more substantial when comparing late stage diagnosis in Appalachian Kentucky versus non-Appalachian Kentucky (34.1% vs 28.9%) (Figure 1).

Among women younger than age 50, early and late stage age-adjusted rates were similar in Kentucky and SEER. Appalachian Kentucky has a higher percentage of late stage diagnoses among women younger than age 50, but the difference is not significant.

In women age 50 and older, there are significant differences both between Kentucky and SEER and non-Appalachian Kentucky and Appalachian Kentucky. Kentucky women age 50 and older have a significantly higher percentage of late stage diagnosis compared to SEER women. Appalachian Kentucky women age 50 and older have a significantly higher percentage of late stage diagnosis than non-Appalachian Kentucky (Table 2 and Figure 2).

When considering age and race, there are similar results for white women younger than age 50 and age 50 and older. Among white women younger than age 50, the Kentucky rates were similar to SEER rates; and the non-Appalachian Kentucky rates were similar to Appalachian Kentucky rates.

Table 2. *Age adjusted incidence rates for female breast cancer, age 50 and older, 2006-2010.*

Region	N	%	Rate per 100, 000	Standard Error	Rate Ratio (95% Confidence Interval)
SEER					
Early Stage	187,660	72.1%	284.4	0.7	2.61 (2.59,2.64)
Late Stage	72,608	27.9%	108.8	0.4	1
KY					
Early Stage	9,852	70.7%	266.8	2.7	2.42 (2.33,2.51)
Late Stage	4,085	29.3%	110.3	1.7	1
NAP KY					
Early Stage	7,484	72.1%	285.7	3.3	2.60 (2.49,2.72)
Late Stage	2,890	27.9%	109.9	2.1	1
AP KY					
Early Stage	2,368	66.5%	220.2	4.6	1.98 (1.85,2.13)
Late Stage	1,195	33.5%	111.2	3.2	1

For white women age 50 and older, Kentucky had a higher percentage of late stage diagnosis compared to SEER while Appalachian Kentucky had a higher percentage of late stage diagnosis than non-Appalachian Kentucky (Table 3).

There were no significant differences among late stage diagnosis in black women younger than age 50 or age 50 and older in Kentucky compared to SEER (Tables 4 and 5). Because of the small numbers of black women living in Appalachian Kentucky, rates for them were not reported by Appalachian status.

Kentucky mammography screening rates remained relatively stable from 2002 to 2010, however, there was a significantly lower rate of screening in Appalachian Kentucky vs non-Appalachian Kentucky from 2002 to 2010 (Figure 3).

Age-adjusted mortality rates were similar from 2006 to 2010 when comparing Kentucky and SEER. Age-adjusted mortality rates were higher in Appalachian Kentucky compared to non-Appalachian Kentucky, but not significantly higher (Figure 4).

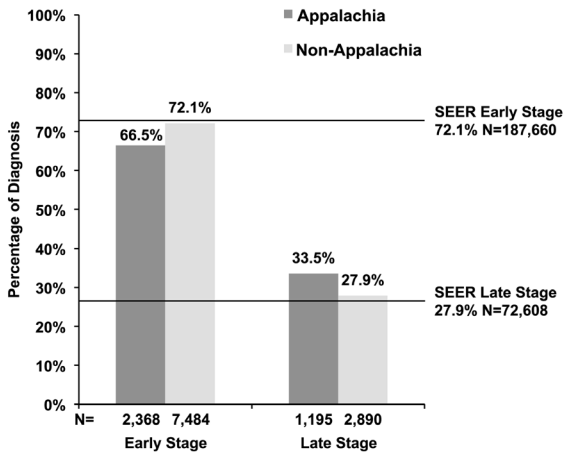

Figure 2. Proportion of early stage versus late stage cases in Appalachian and non-Appalachian Kentucky women age 50 and older.

DISCUSSION/CONCLUSIONS

Since the Kentucky Breast Cancer Report Card in 2003,[12] Kentucky has improved in overall breast cancer screening, increased early stage diagnosis and mortality. The non-Appalachian Kentucky and SEER rates of early versus late stage diagnosis are similar. However, when comparing Appalachian Kentucky women to non-Appalachian Kentucky women, there continue to be similar disparities to those found in the 2003 Breast Cancer Report Card. In 2003, the overall screening rates reported among women age 65 and older (October 2000-September 2002) were 41.0% among Appalachian Kentucky and 48.5% for rural areas of non-Appalachia

Table 3. *Age adjusted incidence rates for female breast cancer among whites, age 50 and older, 2006-2010.*

Region	N	%	Rate per 100, 000	Standard Error	Rate Ratio (95% Confidence Interval)
SEER					
Early Stage	155,534	72.7%	295.8	0.8	2.69 (2.66,2.71)
Late Stage	58,487	27.3%	110.1	0.5	
KY					
Early Stage	9,194	70.9%	267.1	2.8	2.45 (2.36,2.54)
Late Stage	3,769	29.1%	109.1	1.8	
NAP KY					
Early Stage	6,870	72.6%	287.8	3.5	2.66 (2.54,2.79)
Late Stage	2,594	27.4%	108.2	2.1	
AP KY					
Early Stage	2,324	66.4%	219.8	4.6	1.98 (1.84,2.12)
Late Stage	1,175	33.6%	111.3	3.3	

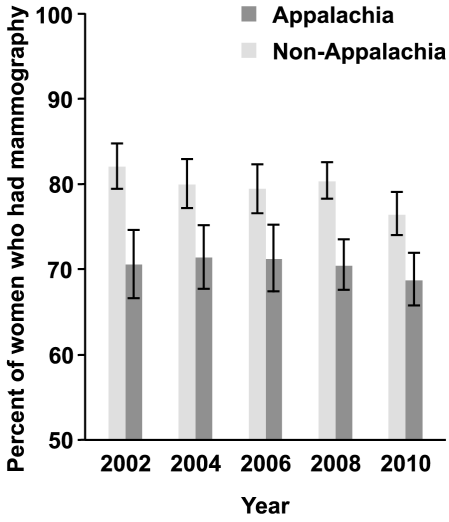

Figure 3. Percentage of Women in Kentucky age 50 and older who have had a mammogram within the past two years.

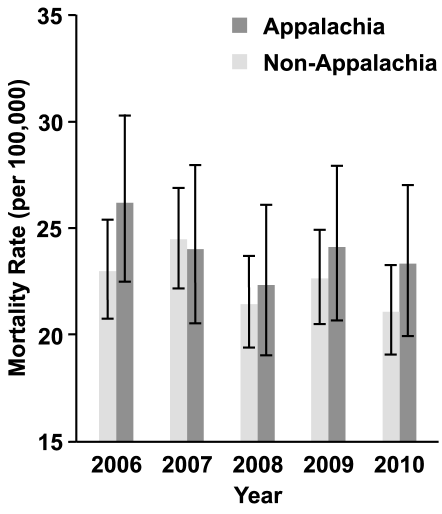

Figure 4. Age adjusted mortality rates for female breast cancer in Kentucky, 2006-2010.

Kentucky.[12] In 2010, the mammography screening rate for women age 50 and older was 68.8% in Appalachian Kentucky and 76.5% in non-Appalachian Kentucky. Although the screening rate has increased for all women since 2002, the disparities between Appalachian Kentucky and non-Appalachian Kentucky have also increased.

These disparities continue to be highlighted when comparing early versus late stage diagnosis. In 2003, it was reported that Appalachian Kentucky had higher rates of late stage diagnosis than non-Appalachian Kentucky in each year from 1995 to 2000. In 1996 and 1999, the percentage of those diagnosed at late stage diagnosis was twice as high in Appalachian than in non-Appalachian Kentucky (67% vs 34% and 87% vs 39%, respectively).[12] While the disparity continues, significant progress has been made in reducing the percentage of late stage diagnosis among women diagnosed with breast cancer in Appalachian Kentucky. For 2006-2010, 34.1% of cases in Appalachian Kentucky were diagnosed at a late stage compared to 28.9% in non-Appalachian Kentucky.

The ratio of early versus late stage breast cancer among white women age 50 and older in non-Appalachian Kentucky was better from 2006 to 2010 (2.66) than it was in Kentucky in any year from 1995 to 2000.[12] The ratio of early versus late stage breast cancer among

Table 4. *Age adjusted incidence rates for female breast cancer among blacks, age 20-49, 2006-2010.*

Region	N	%	Rate per 100, 000	Standard Error	Rate Ratio (95% Confidence Interval)
SEER					
Early Stage	5,702	58.3%	49.9	0.7	1.40 (1.34,1.46)
Late Stage	4,072	41.7%	35.6	0.6	1
KY					
Early Stage	199	61.6%	56.9	4.1	1.61 (1.28,2.03)
Late Stage	124	38.4%	35.4	3.2	1

Table 5. *Age adjusted incidence rates for female breast cancer among blacks, age 50 and older, 2006-2010.*

Region	N	%	Rate per 100, 000	Standard Error	Rate Ratio (95% Confidence Interval)
SEER					
Early Stage	16,696	65.3%	249.1	2.0	1.91 (1.86,1.96)
Late Stage	8,876	34.7%	130.5	1.4	1
KY					
Early Stage	584	66.4%	268.7	11.3	1.99 (1.72,2.30)
Late Stage	295	33.6%	135.3	8.0	1

white women age 50 and older in Appalachian Kentucky from 2006 to 2010 (1.98) is similar, and sometimes worse, than it was in Kentucky any year from 1995 to 2000. This demonstrates the greatest improvements in the ratio between early versus late stage diagnosis have come in non-Appalachian Kentucky with a continued disparity in Appalachian Kentucky.

While there did not appear to be racial disparities between Kentucky and SEER among black women age 50 and older, the ratio of early versus late stage among black women in Kentucky overall (1.99) is very similar to the ratio of early versus late stage among white women in Appalachian Kentucky (1.98). This is significantly different than the ratio of early versus late stage among whites in non-Appalachian Kentucky (2.66). Both Appalachian Kentucky and black women in Kentucky have lower ratios of early versus late stage diagnosis and an increased disparity in relation to whites in non-Appalachian Kentucky and SEER.

Although there is controversy in the literature related to mammography screening and the impact of screening on late stage diagnosis, there is evidence that within Appalachian Kentucky, there is less mammography screening than in other parts of the state, a larger proportion of cases diagnosed with more advanced disease and a higher mortality rate. Evidence also shows that black women in Kentucky have a higher proportion of cases diagnosed with more advanced disease.

As a result of the Affordable Care Act and kynect in Kentucky, more women are now insured. This is an opportunity where more women in Appalachian Kentucky and black women in Kentucky have insurance coverage for mammography, which will hopefully increase screening and decrease late stage diagnosis. Now that a major barrier has been eliminated, public health and health care practitioners must find ways to help these women access the services.

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