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Cancer Survival in North Carolina

by
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Abstract

Objectives: Cancer survival rates have not been tracked by the North Carolina Central Cancer Registry (CCR), largely due to the insufficient resources necessary to actively follow up with patients after diagnosis. This study is intended to compare survival rates for North Carolina patients followed via passive methods (i.e., linkages) to survival rates reported by the SEER program, which actively follows patients after diagnosis.

Methods: Incidence data from 1999 through 2005 were used for the analysis, and followed through 2006. Follow up for these cases is conducted annually via linkages to administrative databases. Five-year relative survival rates were computed for North Carolina patients by site, sex, race, and age, and compared to five-year relative survival rates reported for the 17 SEER geographic regions.

Results: Survival patterns in North Carolina were comparable to survival patterns reported for the 17 SEER geographic regions, with rates in SEER regions being slightly higher than rates in North Carolina. For both North Carolina and SEER regions, the five cancers with the poorest survival rates were pancreas, liver, gallbladder, lung/bronchus, and esophagus, while the five cancers with the best survival rates were prostate, testis, endocrine, melanoma, and female breast.

Discussion: The findings of this study indicate that survival rates for patients followed via passive methods closely approximate survival rates for patients followed via active methods, and thus pave the way for continual tracking of survival patterns in North Carolina. These rates will allow cancer control programs to evaluate the progress of early detection efforts and treatment on survival of cancer patients.

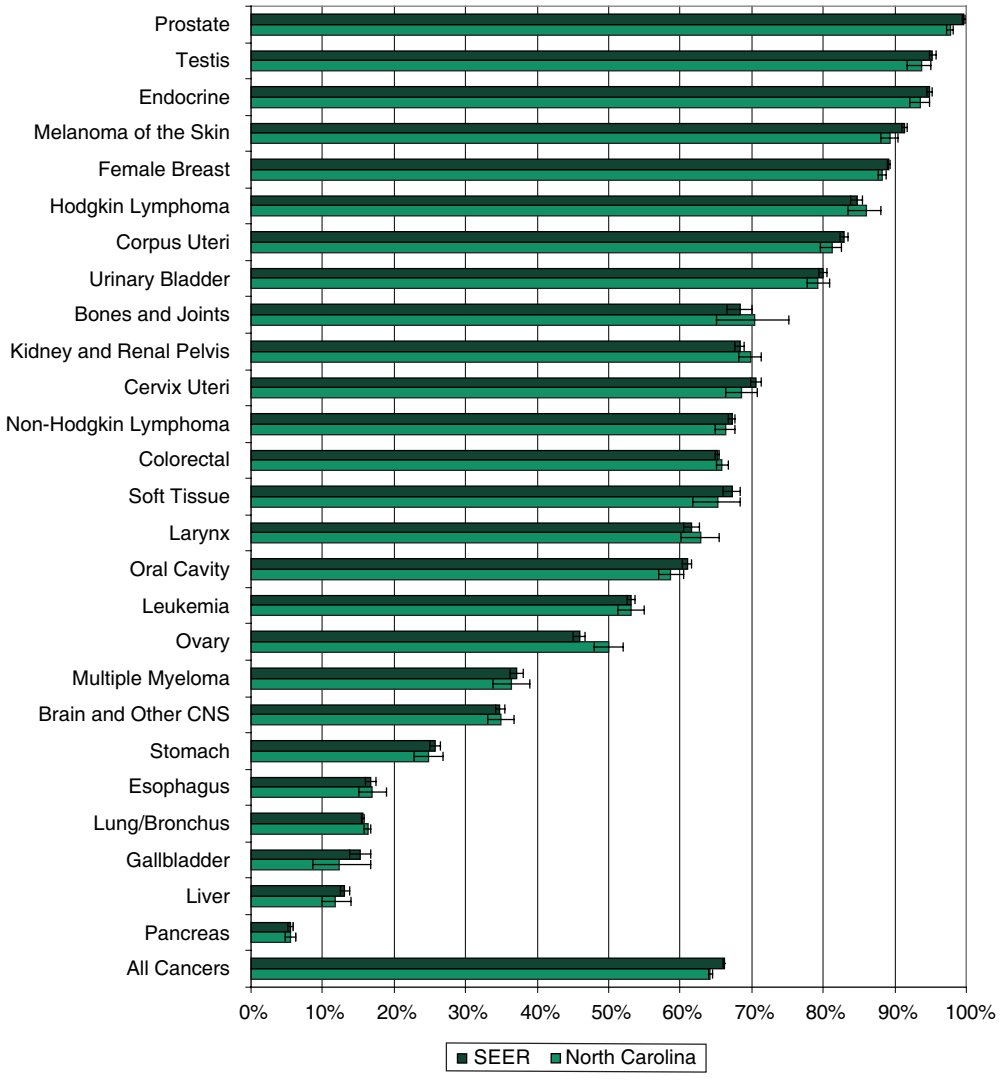
STATE OF NORTH CAROLINA
Department of Health and Human Services
Division of Public Health

Introduction

Cancer survival rates indicate how often patients survive their diagnosis for a specified period of time—usually five years—after which prognosis is often viewed as good. Increasing these rates is consistent with national *Healthy People 2010* objectives,[1] but survival is not yet tracked systematically in North Carolina. Having this information would provide a much needed summary measure of the effectiveness of public health efforts and interventions, as increasing survival rates are associated with early detection and more effective treatment.

Calculating accurate survival rates necessitates reliable vital status information. Ideally, a cancer registry could update patients' vital status by conducting active follow up, whereby a patient's vital status is updated each year by contacting the patient, the physician, or having a hospital registrar review the case, but doing so would require resources that many cancer registries lack. Instead, most cancer registries conduct passive follow up via linkages with administrative databases, such as state death records and the Social Security Death Index. Passive follow up, however, is not as reliable as active follow up, as state death records do not capture cancer patients who die out of state, and the Social Security Death Index only tracks patients enrolled in the Social Security program. When the vital status of deceased patients is erroneously coded as "alive," survival rates will be overestimated. For this reason, many registries, including North Carolina's, that lack the resources to conduct active follow up avoid reporting survival rates.

Figure 1.
SEER vs. North Carolina Five-year Relative Survival Rates
All Races, 1999–2005



While overestimation is a valid concern, calculation of reliable survival rates may still be a worthwhile endeavor. A poster presented by the CCR at the 1999 North American Association of Central Cancer Registries (NAACCR) annual meeting compared survival rates for brain cancer patients in North Carolina (passive follow up) to survival rates for brain cancer patients in SEER regions (active follow up), and found that the North Carolina rates were similar to the SEER rates.[2] These findings suggest that survival rates calculated for brain cancer patients followed via linkages approximate those calculated via active methods.

The objective of the current study is to provide a follow up to and an extension of the work conducted previously by the CCR, in the effort to initiate regular reporting of survival rates by the CCR. By doing so, public health practitioners in the state will be given another indicator of

the progress being made in early detection and treatment of cancer.

Relative survival rates for each cancer type and all cancers combined are reported, and compared to the rates reported in the SEER Cancer Statistics Review, 1975–2006.[3] Rates will be reported by sex, race, and age group, in order to determine whether or not the patterns in North Carolina mirror those in SEER regions.

Methods

Data on North Carolina cancer cases were obtained from the CCR which operates under the authority granted in the North Carolina General Statute 130A-208. All health care providers are required by law to report cases to the CCR. While hospitals are the primary source of data, the CCR supplements hospital data with reports from physicians who diagnose cases in a non-hospital setting. The CCR also collects data from pathology laboratories and freestanding treatment centers. For the past four years, data from the CCR received gold certification from NAACCR for its quality, completeness, and timely reporting of cancer.

Incidence data for malignant cancers for diagnosis years 1999 to 2005 were selected for the analysis, and these cases were followed through 2006. These years were selected to allow for comparison to survival rates for the same years reported in the *SEER Cancer Statistics Review, 1975–2006.*[3] To be consistent with the method followed by SEER, in situ cases, cases identified only from death certificates, and multiple primary cases were excluded from the analysis, yielding a total of 224,094 cases. Every year, CCR records are matched against the North Carolina Death Files and the Social Security Death Index on name, date of birth, and social security number. When a CCR record is linked to a death file record, the vital status of the CCR record is changed to "deceased."

The CCR incidence records were loaded into SEER*STAT,[4] which follows the method described by Ederer et al.[5] to compute relative survival rates. Relative

Figure 2.
SEER vs. North Carolina Five-year Relative Survival Rates
Males, 1999–2005

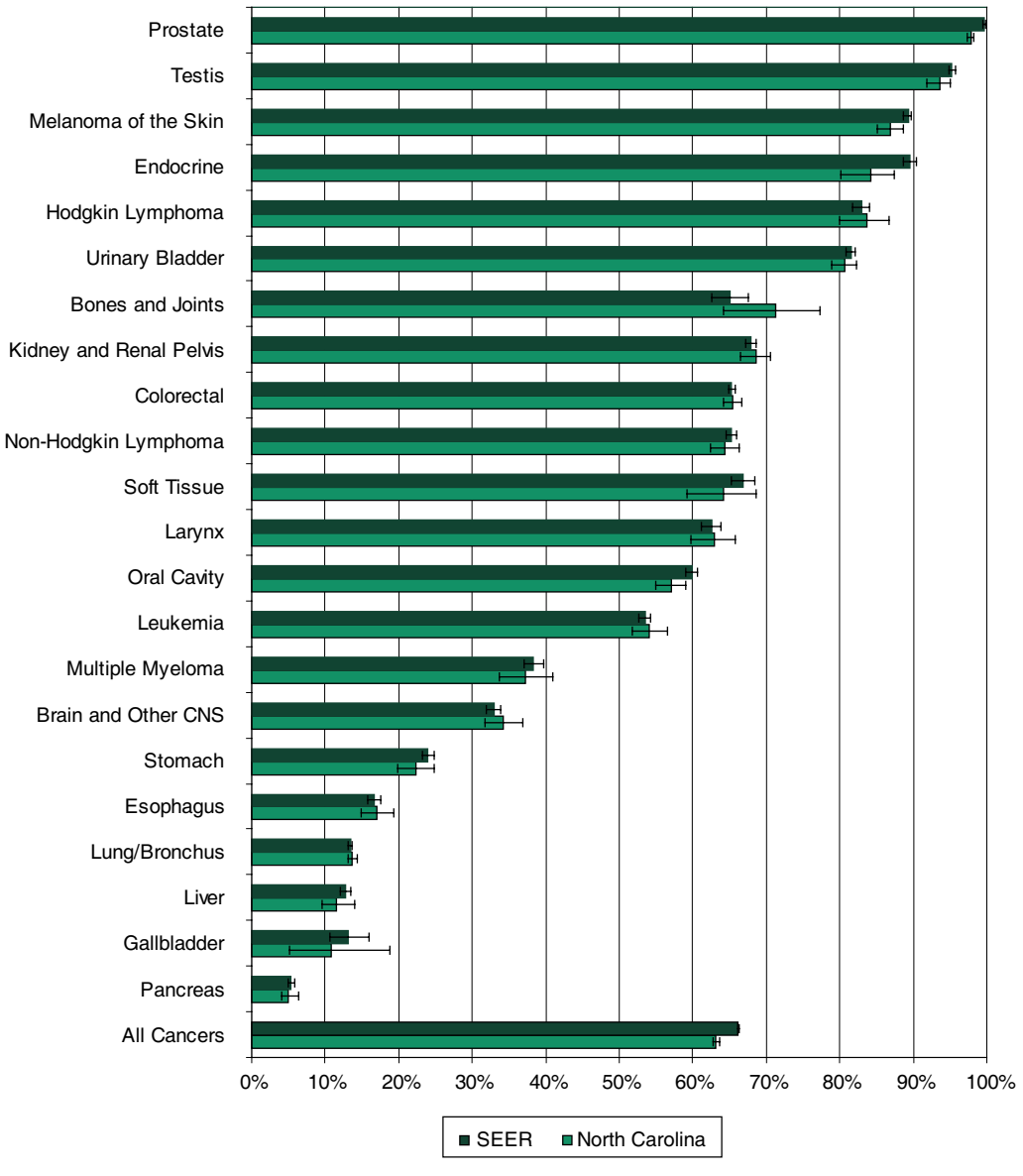
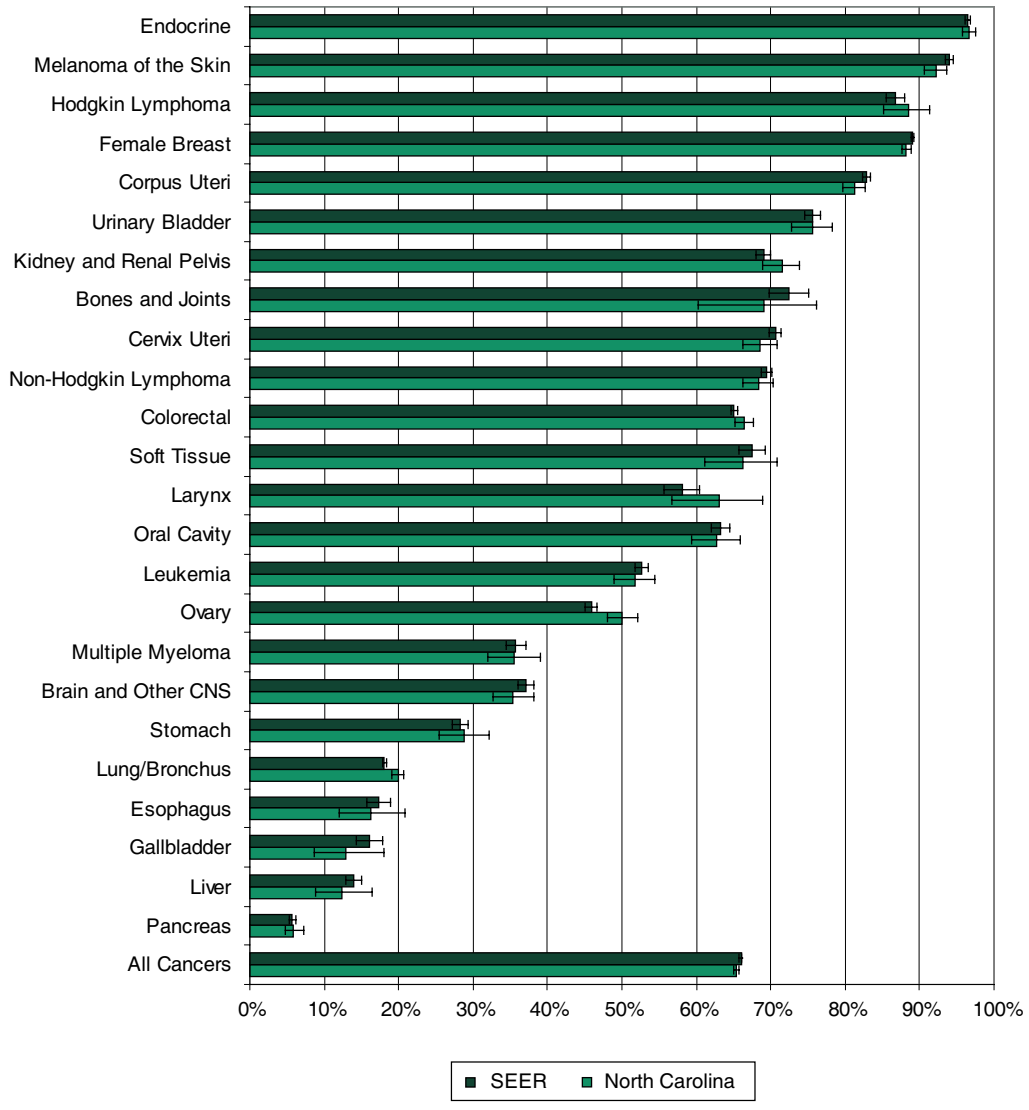


Figure 3.
SEER vs. North Carolina Five-year Relative Survival Rates
Females, 1999–2005



survival rates, defined as the observed survival in the study group divided by the expected probability of survival in a cohort of cancer free individuals, adjusts for the expected mortality that the cohort would experience from other causes of death. Confidence intervals,[6] defined as $S(t) \pm z_{\alpha/2}$ $se\{S(t)\}$, where $se\{S(t)\} = \{\sum(d_j/n_j(n_j-d_j)\}^{1/2}$ (n_j = number alive at start of interval, d_j = deaths during interval), were computed for each rate. The expected mortality rates were obtained from life tables provided by SEER. The relative survival rates for SEER regions were obtained from the *SEER Cancer Statistics Review, 1975–2006.*[3]

Race was defined as white, African American, other, and all races. Stage at diagnosis was defined according to SEER Summary Stage guidelines as in-situ (IS), localized (L), regional (R), distant (D), and unknown/ unstaged (U).

Results—SEER regions compared to North Carolina

Figures 1–3 contain the five-year relative survival rates with 95 percent confidence intervals for cases diagnosed between 1999 and 2005, for the total population, males, and females.

As seen in figures 1–3, the survival patterns in North Carolina are very similar to survival patterns in SEER regions. The survival rates for North Carolina are slightly lower than SEER rates, but not substantially lower. The five-year survival rate for the total population was 62.4 percent for North Carolina compared to 65.3 percent for SEER. For males, the rate in North Carolina was 61.0 percent compared to 65.1 percent in SEER regions. For females, the rate in North Carolina was 63.9 percent compared to 65.4 percent in SEER regions.

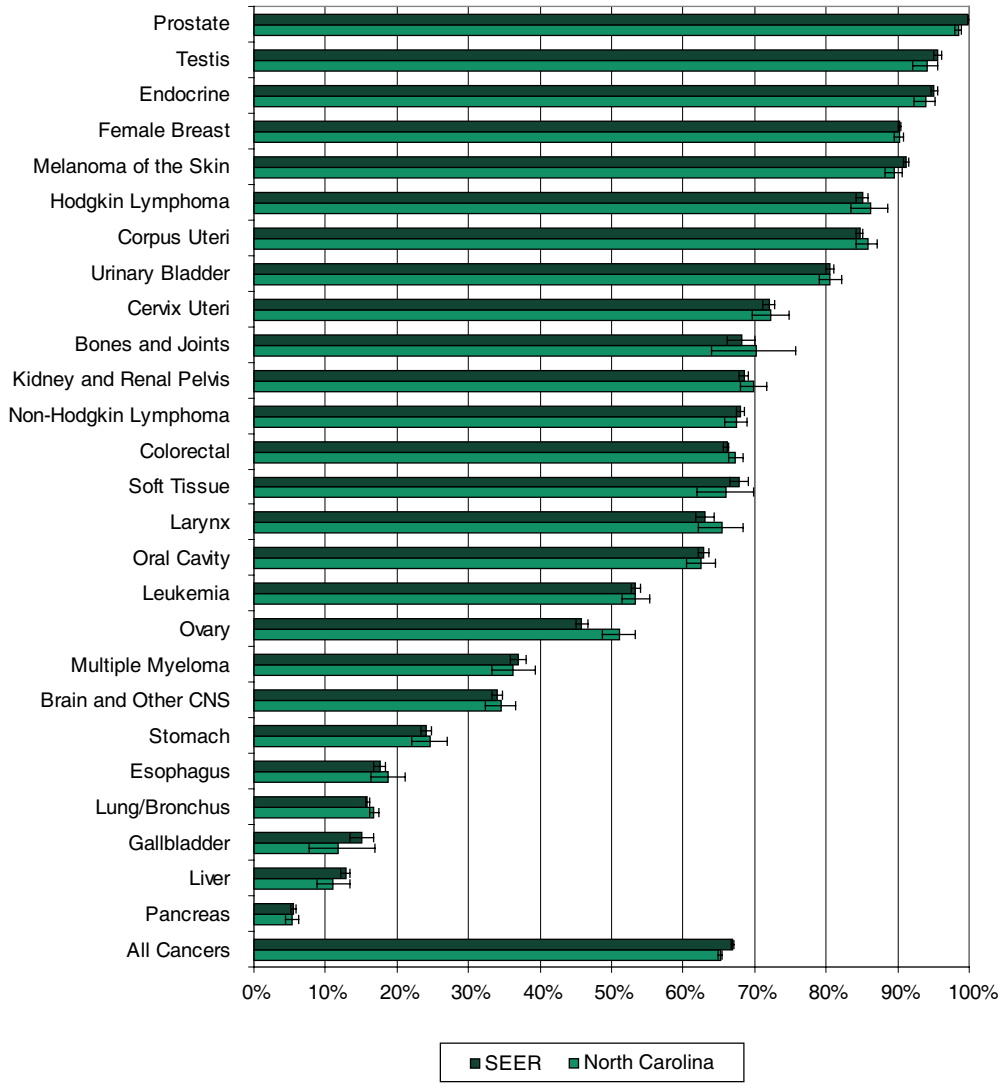
For the total population, males, and females, the five cancers with the poorest five-year relative survival rates for both North Carolina and SEER were pancreas, liver, gallbladder, lung/bronchus, and esophagus. Across the total population, the five cancers with the best five-year relative survival rates for both North Carolina and SEER were prostate, testis, endocrine, melanoma, and female

breast. For males, the five cancers with the best five-year relative survival rates for both North Carolina and SEER were prostate, testis, endocrine, melanoma, and Hodgkin lymphoma. For females, the five cancers with the best five-year relative survival rates for both North Carolina and SEER were endocrine, melanoma, breast, Hodgkin lymphoma, and corpus uteri.

Figures 4–5 contain the five-year relative survival rates with 95 percent confidence intervals for cases diagnosed between 1999 and 2005, for whites and African Americans.

As seen in figures 4–5, the survival patterns for whites and African Americans in North Carolina are very similar to survival patterns in SEER regions. For whites, the rate in North Carolina was 63.6 percent compared to 66.2 percent in SEER regions. For African Americans, the rate in North Carolina was 57.1 percent compared to 56.8 percent in SEER regions.

Figure 4.
SEER vs. North Carolina Five-year Relative Survival Rate
Whites, 1999–2005



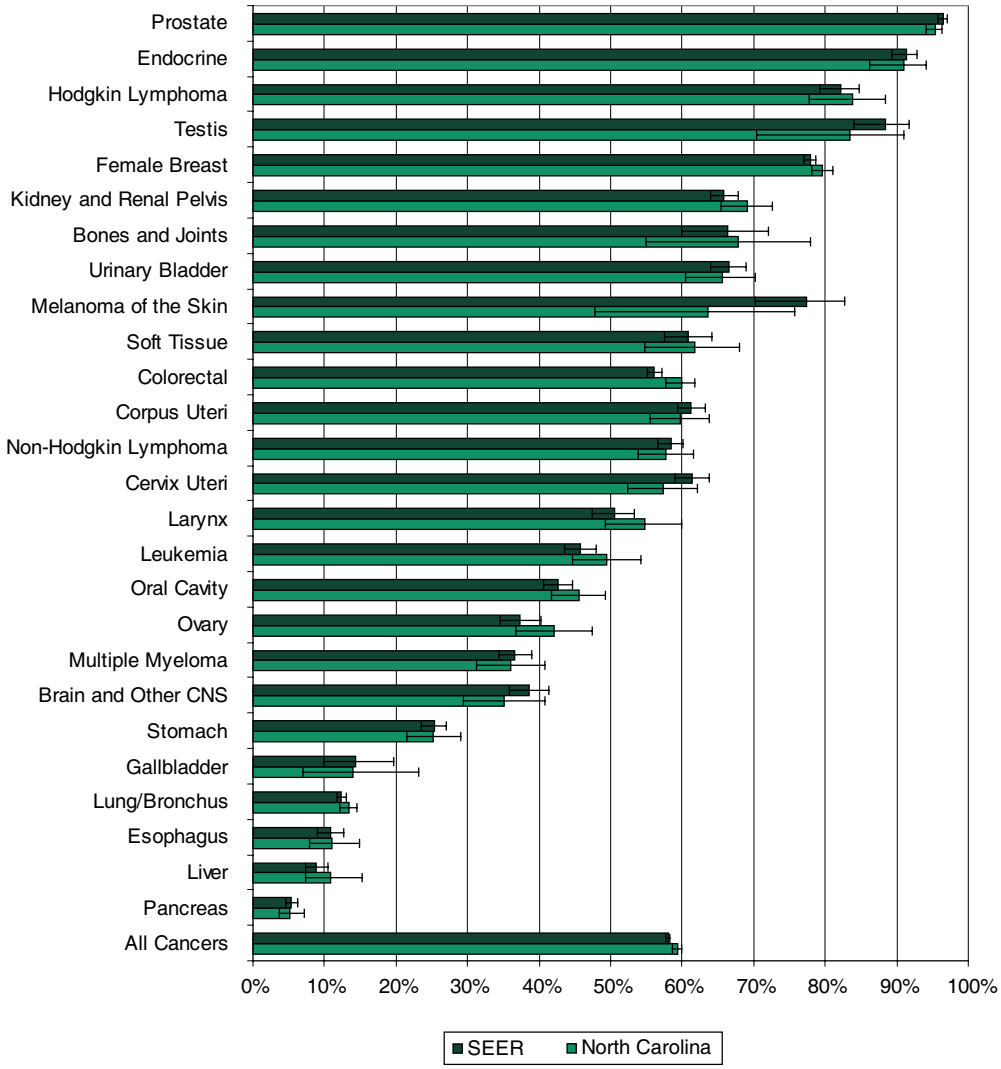
For both whites and African Americans, the five cancers with the poorest five-year relative survival rates for both North Carolina and SEER were pancreas, liver, gallbladder, lung/bronchus, and esophagus. For whites, the five cancers with the best five-year relative survival rates for both North Carolina and SEER were prostate, testis, endocrine, female breast, and melanoma. For African Americans, the five cancers with the best five-year relative survival rates for both North Carolina and SEER were prostate, endocrine, Hodgkin lymphoma, testis, and female breast.

Figure 6 displays survival rates by age group. While SEER rates are slightly higher than North Carolina rates across all age groups, the patterns are similar, with survival rates falling as patients grow older.

Discussion

The findings of this study indicate that survival rates for patients followed via passive methods appear to closely approximate survival rates for patients followed via active methods. In both North Carolina and SEER regions, the five cancers with the poorest survival rates were pancreas, liver, gallbladder, lung/bronchus, and esophagus. The five cancers with the best survival rates were prostate, testis, endocrine, melanoma, and female breast. It is important to note, however, that while passive follow up may produce

Figure 5.
SEER vs. North Carolina Five-year Relative Survival Rates
African Americans, 1999–2005



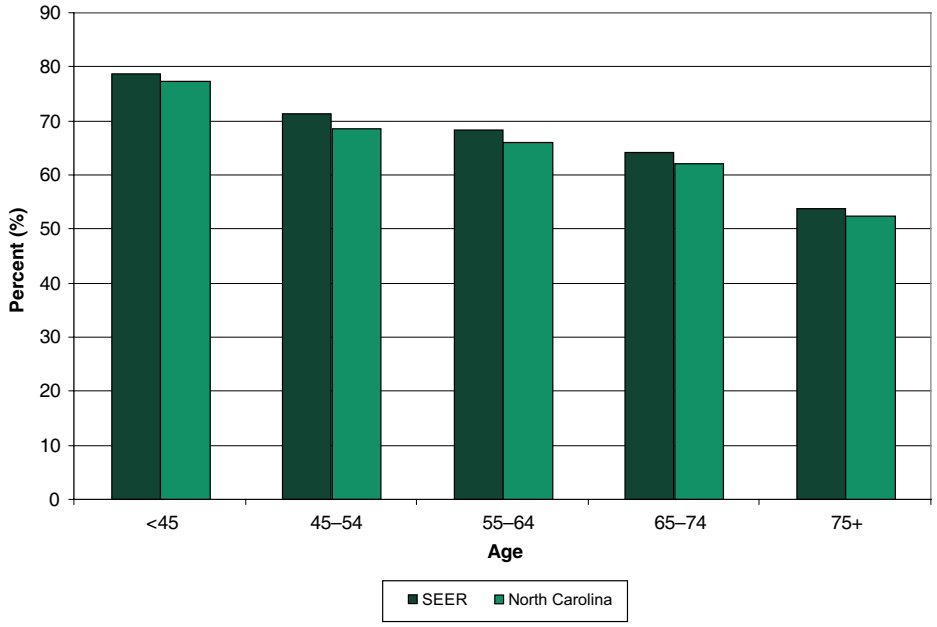
results similar to active follow up, it is not as comprehensive as active follow up. Deaths will be missed during passive follow up that would have been caught via active follow up, and thus, survival rates produced via passive follow up techniques will likely overestimate actual survival rates. Nonetheless, the ability to approximate survival rates in North Carolina provides an excellent opportunity to track and investigate changes in survival patterns. Specifically, it will now be possible to examine the relationship between intervention efforts to improve early detection and treatment techniques and changes in survival rates.

While subgroup differences are not the focus of this study, the data presented here have implications for cancer control programs. For example, survival rates for African Americans are lower than survival rates for whites across many cancers. This presents an opportunity for programs to make an impact and implement measures to improve survival among African Americans. It will be important, however, for future research to examine the observed disparities further and determine their source.

It is important to discuss some limitations to these results. The passive method of follow up used by the registry relies primarily on linkages to death files. During the performance of these linkages, a large number of potential matches must be manually reviewed, so some matches may be missed as a result of human error and additional matches may be missed due to strict match criteria. That is, if there is a measure of uncertainty in evaluating the match status of two records, those two records are usually deemed to be non-matches. Finally, if a patient's death has not been captured in the death files, then that patient's vital status will remain unchanged. For these reasons, it is assumed that the survival rates reported in this paper are slightly different than the true survival rates in North Carolina.

Survival rates are an important indicator of cancer burden. This study lays the foundation for tracking survival rates in North Carolina, and thereby provides researchers, legislators, and public health practitioners another tool for evaluating the progress of cancer control programs.

Figure 6.
SEER vs. North Carolina Five-year Relative Survival Rates by Age Group, 1999–2005



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