Long-term Survivorship in Lung Cancer*  
A Review

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While outcome research in lung cancer has focused mainly on short-term survival and quality of life (QoL), information on long-term (ie, > 5 years postdiagnosis) lung cancer survivorship remains limited. This review addresses the epidemiologic significance of long-term lung cancer (LTLC) survivors, summarizes the current knowledge on their health and QoL, and suggests areas for further research in LTLC survivorship. Based on a small body of literature, lung cancer survivors do not experience the same quantity and QoL as their age-matched peers or as survivors of other cancers. Survival among 5-year survivors of lung cancer relative to the general US population with the same demographic characteristics is approximately 60%, and lung cancer survivors score lowest in health utility among long-term survivors of other cancers. Approximately one-quarter of long-term lung cancer (LTLC) survivors were significantly restricted in physical ability or reported significant depressive symptoms. There is a need to identify and intervene with subgroups of survivors who are at an elevated risk of premature death and diminished QoL. Lung cancer-specific survival alone does not reflect the overall illness burden in LTLC survivors. Patient care in lung cancer survivors should be continuous and comprehensive in considering multiple causes of health deterioration. Multidisciplinary research in epidemiologic, clinical, and basic science approaches is warranted to further our knowledge base for optimal long-term management and to develop the necessary intervention strategies among LTLC survivors.  

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Key words: lung neoplasms; quality of life; survivors

Abbreviations: CES-D = Center for Epidemiologic Studies depression scale; LTLC = long-term lung cancer; MC = mental component; NHIS = National Health Interview Survey; NSCLC = non-small cell lung cancer; PC = physical component; QoL = quality of life; QOL-CS = Quality of Life-Cancer Survivors tool; SCLC = small cell lung cancer; SEER = Surveillance, Epidemiology, and End Results; SF-36 = Medical Outcomes Study 36-item short form; SPLC = subsequent primary lung cancer

Cancer survivorship research is pursued to identify, examine, prevent, and control adverse outcomes related to cancer diagnoses and treatment; to provide a knowledge base regarding optimal follow-up care and surveillance of recurrent or new disease; and to optimize the health of patients after cancer treatment.¹ Prior studies² have focused mainly on the survivors of childhood cancer, and long-term survivorship in patients with adult-onset cancer has only gained attention during the past decade and is a developing field in cancer outcome research. The progressive improvement of survival in several common adult-onset cancers³ and the wide recognition of quality of life (QoL) as an important end point have necessitated the pursuit of this field of research. Long-term survivors of lung cancer are underrepresented in this field of research.⁴ The pursuit of survival remains the exceedingly important priority in lung cancer research, and the high mortality rate has been a barrier to the development of QoL research in the relatively few long-term survivors.
LARGE AND POTENTIALLY INCREASING NUMBER OF LONG-TERM LUNG CANCER SURVIVORS

An estimated 170,000 persons were diagnosed with primary lung cancer in the United States in the year 2005; although overall survival remains low, approximately 26,000 individuals will become long-term lung cancer (LTLC) survivors every year in the US population. More than 140,000 LTLC survivors were present in the United States as of January 1, 2001, and this number is expected to increase. The practice of low-dose CT scanning as an early detection tool could also increase the number of 5-year survivors of lung cancer.

Changes in patient management and survival in patients with early-stage non-small cell lung cancer (NSCLC) may have brought about the majority of the LTLC survivors. After years of research evaluating the benefit of adding systemic therapy to surgery, two phase III trials have shown an absolute survival benefit of 12 to 15% with the use of adjuvant chemotherapy in patients with stage I and II NSCLC. The survival benefit seen in these trials provides resounding approval for adjuvant chemotherapy being the new standard of care for patients with surgically resected early-stage NSCLC. However, it is probably too early to see a big change in survivorship due to adjuvant therapy. This type of treatment is only now becoming more common and will never be appropriate in all patients.

Advancements in treatment have also potentially improved long-term survival in patients with limited-stage small cell lung cancer (SCLC). In 2002, the change in survival among the control arms of 30 phase III clinical trials involving patients with limited-stage SCLC conducted during 1972 to 1992 in North America was compared with the survival rate of limited-stage SCLC patients seen in the Surveillance, Epidemiology, and End Results (SEER) database during the same timeframe. While a concordant improvement in the median survival rate was observed, the 5-year survival rate in the SEER database doubled from 5.2 to 12.1%.

Population growth and aging will also likely impact the number of long-term cancer survivors including lung cancer in the future. When the cancer incidence rates from the past few years are applied to the US Census Bureau population projection between 2000 and 2050, the total number of cancer patients is expected to double, and the number of cancers occurring in persons aged ≥ 65 years may double within 30 years. The “Annual Report to the Nation on the Status of Cancer” concluded that, despite the decrease in cancer death rates and the stabilization of cancer incidence rates, the overall growth and aging of the population could significantly increase the burden of cancer in the United States.

HEAVY BURDEN OF ILLNESS AMONG LUNG CANCER SURVIVORS

In 1994, Schag et al reported that lung cancer survivors experience more physical and psychosocial problems than survivors of colon or prostate cancer. In their analysis, the length of survival was not associated with QoL ratings in lung cancer patients; however, only five LTLC survivors were included in the study. Some analyses of large population-based cancer survivor cohorts have suggested that lung cancer survivors experience a heavy burden of illness that may persist for a prolonged period of time.

QoL was evaluated in a patient cohort that was identified from the 1998 National Health Information Survey (NHIS) including 54 lung cancer survivors, 92 melanoma survivors, 377 breast cancer survivors, and 169 colon cancer survivors. Health utility as measured by the Health and Activities Limitation Index was assessed according to the time from diagnosis, that is, in acute periods (i.e., <1 year), short-term periods (i.e., 1 to 5 years), and long-term periods (i.e., >5 years). The mean health utility score in lung cancer survivors was lowest (indicating the worst QoL) among all cancer sites, and for both acute and long-term periods. In this study, 20 individuals were LTLC survivors.

Hewitt et al reported the health and disability status among 4,878 cancer survivors based on the NHIS conducted from 1998 to 2000. Relative to female breast cancer survivors, survivors of lung and respiratory (larynx and pharynx) cancer reported significantly poorer general health status and were bothered by more psychological problems.

Yabroff et al compared the general health status, limitations in activity, and health utility among 1,823 cancer survivors and 5,469 matched control subjects who were also identified from the NHIS. Cancer survivors had poorer health outcomes when compared to control subjects, and the measures of illness burden in cancer survivors remained similar regardless of the interval since diagnosis. Lung cancer survivors, when combined with survivors of esophagus, liver, pancreas, and stomach cancer, reported greater illness burden than the survivors of cancers in all other sites.

NEED FOR MORE RESEARCH-BASED KNOWLEDGE AND INFORMATION

Recognizing an increasing number of lung cancer survivors and the paucity of information in all per-
spectives of their health and QoL, the demand for research has mounted. Figure 1, a variant derived from a general conceptual model proposed by Wilson and Cleary, illustrates a five-dimension working model that captures the health and QoL; emphasizing the quality and the quantity of a LTLC survivor’s life. The biological submodels (i.e., primary disease-related or host-related) have a primary focus on the biology, physiology, and clinical presentation; and the psychosocial models have a primary focus on mood, support systems, and coping strategies. Specifically, noted are molecular alterations in lung tumors that have been extensively studied in hopes of identifying additional parameters to explain variability in survival. The most commonly examined or promising potential protein markers that represent expressed genes in key pathways of cancer development and progression should also be evaluated among LTLC survivors. The corresponding antibodies to proteins are commercially available, and their prognostic value, if identified, could be readily usable.

The functional status or drug metabolism systems of the host also play a role in the fate of a lung cancer patient. Genomic variations of genes responsible for the immune response to the tumor, drug metabolism, or DNA repair systems may be part of the underlying mechanisms affecting long-term adverse clinical outcomes, as has been determined in their role in lung cancer development and progression, and short-term survival. Issues of the significance of genetic susceptibility to a variety of environmental exposures, treatment-related toxicity, and vulnerability to poorer health and worse QoL need to be further investigated simultaneously.

**Health Status and QoL in LTLC Survivors**

**Summary of QoL Outcomes in LTLC Survivors**

The evaluation of QoL with particular focus on LTLC survivors has been limited to that of two cross-sectional cohorts (Table 1). Sarna and colleagues evaluated the demographic and clinical characteristics and QoL among 142 NSCLC patients who had survived for a minimum of 5 years (range, 5 to 22 years; mean, 10 years). The investigators utilized the Quality of Life-Cancer Survivors tool (QOL-CS) and the Medical Outcomes Study 36-item short form (SF-36) to measure QoL outcomes, and the Center for Epidemiologic Studies depression scale (CES-D) to assess distressed mood as a risk factor for poor QoL. While the majority of survivors self-reported that they were in “good” general health, QoL varied widely. When compared to published aggregate norm scores of the SF-36 physical component (PC) and mental component (MC) for a sample of older adults (age, 65 to 74 years), lung cancer survivors scored similarly in both measures. Seventy percent of survivors reported their general health status as “good to excellent,” despite 70% having comorbid medical condi-
tions, 52% having impaired pulmonary function (ie, FEV\textsubscript{1} < 70% predicted), and 66% having existing respiratory symptoms.\textsuperscript{28,29} Greater than 70% of the participants described themselves as hopeful, and 50% of participants viewed their cancer experience as contributing to their positive life changes (as determined by QOL-CS).\textsuperscript{28} However, 21% of the survivors were restricted largely to bed rest and 11% could not leave the house due to severe respiratory symptoms.\textsuperscript{29} Approximately 25% of patients felt fatigue and/or were bothered by aches or pain. Twenty-two percent scored \textgtr 16 on the CES-D,\textsuperscript{28} indicating significant depressive symptoms or distressed mood.

In a multivariable assessment, distressed mood was found to be a significant and major predictor of poor QoL; other factors associated with QoL were white race, older age, living alone, FEV\textsubscript{1} < 70% predicted, time since diagnosis, and more comorbid conditions.

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For the SF-36 PC, older age and having more comorbid conditions were significantly associated with a diminished QoL.\textsuperscript{28} In a separate multivariable assessment of QoL including respiratory symptoms, the presence of dyspnea had a significant impact on QoL subscales as measured by the SF-36 MC and PC. The authors reported that comorbid unstable angina was positively associated with severe distress due to dyspnea. Other factors significantly influencing QoL were the total number of comorbidities, the total number of respiratory symptoms, and marital status.\textsuperscript{29}

Evangelista et al\textsuperscript{30} evaluated health risk behaviors including smoking, exposure to second-hand smoke, alcohol consumption, and weight control (overweight) in the same cohort. Eighteen percent of patients were currently smoking, 58% consumed alcohol, and 51% were overweight at the time of the survey. All four risk behaviors were associated with a perceived poor health status, and the authors addressed the need to promote lifestyle changes to improve QoL.\textsuperscript{30}

A subsample of 29 participants\textsuperscript{31} from the parent cohort of Sarna and colleagues\textsuperscript{28–30} was interviewed, and issues resulting in changed conception of life, the presence of dyspnea had a significant impact on QoL subscales as measured by the SF-36 MC and PC. The authors reported that comorbid unstable angina was positively associated with severe distress due to dyspnea. Other factors significantly influencing QoL were the total number of comorbidities, the total number of respiratory symptoms, and marital status.\textsuperscript{29}

### Table 1—Published Studies Evaluating QoL in LTLC Survivors\textsuperscript{*}

<table>
<thead>
<tr>
<th>Study/Year</th>
<th>QoL Instruments</th>
<th>Major Results and Conclusions</th>
<th>LTLC Survivors, No.</th>
<th>Target Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sarna et al\textsuperscript{29}/2002</td>
<td>SF-36, QOL-CS and CES-D</td>
<td>71% of survivors described themselves as hopeful; distressed mood was seen in 22% and was a primary predictor of poor QoL; other factors associated with QoL were white race, older age, living alone, FEV\textsubscript{1} &lt; 70% predicted, time since diagnosis, and more comorbid conditions.</td>
<td>142</td>
<td>Survivors of NSCLC: cancer-free for &gt; 5 yr in Southern California</td>
</tr>
<tr>
<td>Sarna et al\textsuperscript{29}/2004</td>
<td>SF-36</td>
<td>Two-thirds of survivors experienced respiratory symptoms; mean FEV\textsubscript{1} was 68% predicted; symptom burden, rather than ventilatory impairment, contributed to diminished QoL.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evangelista et al\textsuperscript{29}/2003</td>
<td>SF-36</td>
<td>70% of survivors reported their health as good to excellent; smoking, exposure to second-hand smoke, alcohol use, and overweight were predictors of poor health status.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maliski et al\textsuperscript{11}/2003\textsuperscript{†}</td>
<td>SF-36 and CES-D</td>
<td>Survivors with and without distressed mood express positive and negative aspects of survivorship differentially around themes of existential issues, health and self-care, physical ability, adjustment, and support.</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Ko et al\textsuperscript{14}/2003</td>
<td>HALex</td>
<td>Health utility score was higher in long-term (&gt; 5 yr) survivors than in acute-term (&lt; 1 yr) survivors; pain and angina were associated with poor long-term QoL.</td>
<td>20</td>
<td>Survivors of breast, colon, melanoma, or lung cancer in the United States</td>
</tr>
</tbody>
</table>

\*HALex = Health and Activities Limitation Index.

\textsuperscript{†}This study was conducted as a subgroup analysis within participants of the parent study by Sarna et al.\textsuperscript{28}
awareness of health and self-care, changes in physical ability, adjustment to changes, and appreciation and willingness to give back for received support were recognized as important to their QoL. Survivors expressed themselves differentially (ie, positive vs negative) on these issues when grouped into those with distressed mood (CES-D score, ≥16) and those without distressed mood (CES-D score, <16). Demographic and clinical factors, such as age, gender, cancer histology, treatment, and time since diagnosis, between the two groups were similar; whereas, mean scores for the SF-36 PC and MC were both lower, and comorbidity was more common among those in the distressed-mood group.

Twenty LTLC survivors were included in a separate cross-sectional evaluation of QoL within a larger cancer survivor cohort. When the mean health utility score among LTLC survivors was compared to that of lung cancer survivors within the first year of diagnosis, LTLC survivors scored substantially higher (by 47%); however, this was not a longitudinal evaluation of the same patients over time, and the results may be biased. In a multiple regression model evaluating predictors of health utility in LTLC survivors, the presence of pain or a history of angina had significant negative impact on the measured outcomes.

Clinical Events That May Influence Long-term Health and QoL Among Lung Cancer Survivors

Lung Cancer Treatment: The long-term adverse consequence of cancer treatment has received limited attention among patients with adult-onset cancers. Especially in lung cancer patients, the high mortality rate has made it difficult to adequately assess treatment-related late toxicity. The association between treatment modalities and QoL has not been assessed in LTLC survivors, and no studies have evaluated longitudinal changes of QoL in patients following treatment for their lung cancer over a period of >2 years.

Several studies have shown that physical domains of QoL deteriorate early after lung cancer surgery but improve to baseline by 6 months after surgery. To the contrary, Mangione et al reported a persistently declining perception of general health, vitality, physical function, and bodily pain at 12 months after surgery. Impaired cardiopulmonary function following pulmonary resection is an important predictor of immediate postoperative morbidity; meanwhile, an objective assessment of pulmonary function did not significantly contribute to QoL in LTLC survivors. Instead, the survivors’ perception of symptoms was important to QoL, implying the need for monitoring respiratory symptoms after a throracotomy. Chronic pain is the most common complication after lung cancer surgery and, indeed, was one of the most commonly reported problems among LTLC survivors. A usually mild but chronic pain after lung cancer surgery is known as the postthoracotomy pain syndrome and is seen in up to 80% of patients following a thoracotomy, with severe and disabling pain occurring in 5%. Pain could last for >4 years in approximately 30% of the patients. The exact etiology and risk factors for chronic postthoracotomy pain are not well-understood.

The occurrence of clinical pneumonitis and changes in pulmonary function are well-known adverse effects of radiation therapy. Radiation pneumonitis, defined as grade 2 or higher according to the South-West Oncology Group toxicity criteria, was reported in 15 to 20% of lung cancer patients receiving external-beam radiotherapy. The results suggested older age, low performance status, low pulmonary function, high radiotherapy dose, and chemotherapy exposure as possible risk factors.

To evaluate the relative influence of the late toxicity of radiotherapy on long-term survival, Machaty et al calculated the risk of death from intercurrent disease following postoperative radiotherapy in NSCLC patients. Age and radiotherapy dose were marginally associated with a higher risk of death from intercurrent disease; however, the actuarial survival rate at 4 years was only minimally decreased when compared to a matched population.

Many chemotherapy agents cause cardiopulmonary or other toxicities, and several studies have suggested a higher risk of perioperative complications when chemotherapy is administered before pulmonary resection. Information is scarce regarding the long-term adverse effects of chemotherapy in lung cancer patients.

Comorbidity: In general, cancer survivors with other comorbid conditions (comorbidity) possess a 5-to-10 times higher likelihood of poor health and disability when compared to individuals without a history of cancer or other chronic diseases. In other cancer survivors, the presence of comorbidity was significantly correlated with impaired functional status regardless of the period of time from their cancer diagnosis. The prevalence and severity of comorbidity has been reported to be especially high in lung cancer patients when compared to survivors of other cancer sites. However, the relative impact of comorbidity on 1-year survival was among the lowest and was disproportionate to the survival rates. Although most studies report a detrimental effect, the reported relative impact of comorbidity on lung cancer survival is not consistent among studies and may be influenced by the different methods of
data collection or by the use of different assessment tools. Although the relative impact of comorbidity on survival in LTLC survivors is largely unknown, the frequency of comorbid conditions was significantly related to both the physical and mental health domains of QoL. Comorbid angina was a cause of adverse influence on QoL among LTLC survivors in two studies. 

Late Recurrence and New Primary Cancers: Cancer recurrence and the occurrence of new primary cancers are life-threatening clinical events that plague the course of lung cancer survivors. While noting the difficulty in differential diagnosis, many studies have evaluated the occurrence of these events, as summarized below.

Although late recurrence has been reported >10 years after an initial diagnosis of NSCLC, the majority of recurrences are detected within 2 years after the patient undergoes surgical resection. Several studies have reported a 4 to 5% prevalence of recurrent disease in 5-year survivors following surgical resection. Two cohorts of disease-free 5-year survivors of stage I NSCLC have reported an incidence rate of 2 to 3% per patient-year.

Lung cancer survivors are at an increased risk of the development of subsequent primary cancers, including those of the lung. Johnson et al summarized that the risk of developing second lung cancers and other aerodigestive tumors in treated lung cancer patients is approximately 10-fold higher than that of adult smokers. The occurrence of subsequent primary lung cancer (SPLC) in patients undergoing surgical resection for NSCLC has been estimated to be 1 to 2% per patient-year. The incidence of SPLC was reported to increase two-fold after 5 years of surgery when compared to 5 years after surgery. The cumulative risk of SPLC or other smoking-related cancers reaches 13 to 20% at 6 to 8 years after the patient undergoes resection of NSCLC.

An especially high risk of the development of SPLC has been reported in patients with treated SCLC. The risk per patient-year has been reported to increase from 2 to 13% after the passage of ≥10 years. The cumulative risk of the development of SPLC results in a striking 30% at 10 to 12 years after the initial treatment. Chest radiotherapy and continued smoking were found to significantly increase this risk.

Overall and Disease-Specific Survival

Limited information is available regarding long-term survival rates among lung cancer patients at the population level. Wingo et al reported survival rates at 5, 10, and 15 years among patients with breast, prostate, colon and rectum, and lung malignancies who received diagnoses from 1974 to 1991, based on data collected by the SEER program (Table 2). The relative survival rates were calculated by dividing the observed survival rates for each cancer diagnosis by the survival rates of the general US population with the same gender, race, and age characteristics. Unique to lung cancer survivors was an apparent trend in relative survival in which a higher age at diagnosis was positively associated with a worse survival rate, regardless of race, gender, stage, or length of follow-up. When conditional relative survival rates (ie, the 5-year survival rate among LTLC survivors relative to matched subjects) were calculated in 5-year and 10-year survivors of lung cancer, they were approximately 10 to 30% lower than the same measures observed in other cancer survivors (Table 3). The results indicate that even after LTLC long-term survival, lung cancer patients are still substantially vulnerable to the risks of death from all causes and that elderly survivors have a more pronounced risk.

Favorable disease-specific survival in NSCLC patients has been described in two large cohorts of 5-year survivors following surgical resection. Martini et al followed 686 5-year disease-free survivors of NSCLC in resected stage I-IIIA. The estimated 10-year survival rate, when accounting only for lung cancer-related deaths, was 92.4%. Okada et al reported a similar 10-year survival rate of 91% in 421 5-year survivors. Martini et al reported that among the 369 5-year survivors, 76 had died before 10 years; 18 (24% of all causes of death) from lung malignancy and 58 (76%) due to other causes. Other studies have reported lung malignancy to account for 29 to 49% of all deaths noted among 5-year survivors of NSCLC following surgical resection; however, follow-up time varied among these studies.

The survival characteristics beyond 5 years in patients receiving nonsurgical treatment for NSCLC have been documented in limited reports. In a follow-up study of 49 5-year survivors after undergoing radical radiation therapy for NSCLC, the overall actuarial 10-year survival rate was 65%. Among patients who were free from disease progression at 5 years, 81% remained free from disease progression at between 5 and 10 years. Long-term follow-up data from clinical trials that evaluated the role of combined chemotherapy/radiation in the treatment of unresectable NSCLC were reported by the Cancer and Leukemia Group B and the Japan Clinical Oncology Group. The estimated survival rates for the study arm receiving combined-modality treatment was 19% at 5 years and 13% at 7 years in the Cancer and Leukemia Group B 8433 trial.
was 14% at 5 years and 12% at 7 years in the six Japan Clinical Oncology Group trials.\textsuperscript{83} In the latter study,\textsuperscript{83} the authors noted no deaths after 7 years following treatment.

### Overall Summary and Existing Knowledge Gaps

Lung cancer survivors do not experience the same length of life and QoL as their age-matched peers or other cancer survivors. Lung cancer patients fare less well than survivors of other cancers because the nature of the cancer (\textit{ie}, cancer affecting a vital organ) as well as the predominant smoking history of most of the patients. There is clearly a need to identify and intervene with subgroups of patients who are at an elevated risk of premature death and diminished QoL.

Defining a conceptual model as a guide, such as that in Figure 1, analyses should focus on disease-specific survival as well as survival from competing causes of death in order to thoroughly evaluate the illness burden in lung cancer survivors. As the aging of the population is inevitable, survivors of lung cancer, especially those who are elderly, should receive continuous attention regarding their health and QoL beyond the expected cure of their primary cancer. Advanced age is associated with other chronic health problems; thus, the assessment of comorbid conditions is extremely important and should be carefully conducted.\textsuperscript{84,85} Methodologies in comorbidity assessment among lung cancer survivors call for further development.\textsuperscript{55,85} Little information is available on the assessment of the late effects of cancer treatment in lung cancer survivors. A change in standard patient management, including the wider application of multimodality treatment options may or may not influence the significance of the issue of the possible late side effects of treatment. The occurrence of secondary cancers is an important health matter among LTLC survivors. These events should be further evaluated for risk factors, including the genetic and molecular effects of smoking and lung cancer treatment and the susceptibility possessed by the host and primary tumor.

The impact of multiple factors that influence medical complications and QoL in LTLC survivors needs to be better characterized individually and in combination. The significance of the interaction between aging-related comorbidities and frailty, and the adverse effects of lung cancer therapy, smoking, and their relationship with the vulnerability for subsequent death or other causes of health deterioration are largely unknown.\textsuperscript{32} An understanding of these factors will allow precise risk estimation for efficient disease prevention strategies. One of the most important, and also challenging, steps is to establish a representative patient population to allow

### Table 2—Long-term Survival of Selected Common Cancers, SEER 1974–1991\textsuperscript{*}

<table>
<thead>
<tr>
<th>Variables</th>
<th>Lung cancer (n = 181,054)</th>
<th>Cancer colon/rectum (n = 167,400)</th>
<th>Prostate cancer (n = 137,888)</th>
<th>Breast cancer (n = 179,249)</th>
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<tr>
<td></td>
<td>5-yr</td>
<td>10-yr</td>
<td>15-yr</td>
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<tr>
<td></td>
<td>Observed Survival Rate, %</td>
<td>Observed Survival Rate, %</td>
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<td>Observed Survival Rate, %</td>
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<tr>
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<td>Conditional Relative Survival Rate, †%</td>
<td>Conditional Relative Survival Rate, †%</td>
<td>Conditional Relative Survival Rate, †%</td>
<td>Conditional Relative Survival Rate, †%</td>
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<td>2</td>
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<td>White women</td>
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<td>Cancer colon/rectum</td>
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<td>Breast cancer</td>
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<td>Black women</td>
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<td>85</td>
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<tr>
<td>White women</td>
<td>70</td>
<td>80</td>
<td>78</td>
<td>85</td>
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</tbody>
</table>

\textsuperscript{*}Partially adapted from several tables within the article by Wingo et al.\textsuperscript{77}

\textsuperscript{†}Observed survival divided by survival rates for gender-matched, age-matched, and race-matched subgroups for the general US population.

\textsuperscript{‡}Relative survival rates restricted to 5-yr survivors.

\textsuperscript{§}Relative survival rates restricted to 10-yr survivors.
multidimensional research, which will enable the assessment of a longitudinal change in QoL and allows for an estimation of significant predictors of QoL in their relationship to different time points in survivorship. Finally, intervention research on behavioral changes should be promoted to generate accurate knowledge as well as to develop long-term management and intervention strategies.

SEARCH METHODS FOR PUBLISHED LITERATURE RELEVANT TO THIS REVIEW

A PubMed search was performed to identify articles published in the English language up to March 2005 using the key words “(lung) neoplasms,” “quality of life,” and “(long-term) survivors.” The references of relevant articles were also consulted. The literature was reviewed for pertinent information with emphasis placed on studies reporting clinical outcomes, especially in LTLT survivors. Clinical factors that were considered to be relevant to these outcomes, including lung cancer treatment, comorbidity, and the occurrence of secondary cancers, were additionally reviewed with a focus on their long-term influence.

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