

# THE WHAM REPORT

## Societal Impact of Research Funding for Women's Health

### IN LUNG CANCER

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Women's  
Health  
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**WHAM, whamnow.org**, is a 501c3 dedicated to funding women's health research to transform women's lives.

This report was conceived by WHAM in response to the considerable funding gap, historical exclusion, and under representation of women in health research.

As businesswomen, we believed that a focused study showing the impact of accelerating sex and gender-based health research on women, their families and the economy by quantifying costs and economic benefits will be an invaluable accountability index. In other words, if more investment is made in women's health research the plausible assumption is that women would benefit from sex-specific prevention strategies, diagnoses and treatments that reduce their burden of disease and thus improve their well-being and hence the well-being of society.

WHAM commissioned the RAND Corporation to conduct a data-driven study of the economic impact to society of increasing the investment in women's health research. This first research project comprises four disease modules: Alzheimer's Dementia, Rheumatoid Arthritis as representative of Autoimmune Disease,

Coronary Artery Disease, and Lung Cancer as representative of cancer. In the future, we plan to study different socioeconomic groups to the extent that the data are available and detail the global data which expands this research.

To the best of WHAM's and RAND's knowledge, this is the first analysis of its kind to create and calibrate a microsimulation model of investments in health R&D that examines differences for women's health research investment, and should become a seminal part of the arsenal in advocating for increased investment in women's health research. The research methodology and the microsimulation models have been vetted by a diverse panel of experts convened by RAND.

We are so thankful for the dedicated, invested partnership of the research team at the RAND Corporation who conducted the analysis presented here and brought their findings to life.

We encourage other leaders, including advocates, economists, scientists, business leaders, public health experts and policy makers to draw from and act upon the results of this report. Together, we can drive meaningful change.

### **Carolee Lee**

Founder and CEO

Women's Health Access Matters (WHAM)

[www.whamnow.org](http://www.whamnow.org) | [www.thewhamreport.org](http://www.thewhamreport.org)

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The technical specifications for the models are publicly available. Please visit [www.thewhamreport.org](http://www.thewhamreport.org) to learn more about using these data and citing this report.

### **WHAM's LEAD COLLABORATORS**

WHAM's leadership of this research project was encouraged through the generous support and collaboration from the following organizations:

**American Heart Association (AHA)** is a relentless force for a world of longer, healthier lives dedicated to ensuring equitable health for all—in the United States and around the world. AHA's signature women's initiative, Go Red for Women® (GRFW), has been the trusted, passionate, relevant force for change to end heart disease and stroke in women all over the world for nearly two decades. GRFW and WHAM will collaborate to directly address the lack of societal level evidence on the economic cost, benefits, and social impact due to the underrepresentation of women in cardiovascular research.

**BrightFocus Foundation** is a leading source of private research funding to defeat Alzheimer's, macular degeneration and glaucoma. Supporting scientists early in their careers to kick-start promising ideas, BrightFocus addresses a full and diverse range of approaches from better understanding the root causes of the diseases and improving early detection and diagnosis, to developing new drugs and treatments. The nonprofit has a longstanding commitment to funding pioneering, sex-based research in Alzheimer's and related dementias.

**Connors Center for Women's Health and Gender Biology at Brigham and Women's Hospital, Harvard Medical School** is a leading local and national force in advancing the health of women, with a rich history and strong foundation of women's health and sex-differences discovery, clinical care, and advocacy for equity in the health of women and is the Lead Scientific Research Partner of The WHAM

Collaborative. The Connors Center shares the bold vision of improving the health of women and a commitment to joining forces to advance scientific discovery for the benefit of all women.

**GO2 for Lung Cancer (GO2)** relentlessly confronts lung cancer on every front, every day. Founded by patients and survivors, GO2 is dedicated to increasing survival for those at risk, diagnosed and living with lung cancer. GO2 serves as the "go-to" for assistance across the care continuum and is the source for improving health policies and leading public awareness to shift the disease away from stigma to hope. The Women and Lung Cancer Research and Preventive Service Act provides a foundation for WHAM and GO2 to engage in strong partnership to advance our shared goal of improving health outcomes for women.

**La Jolla Institute for Immunology (LJI)** is one of the top five research institutes in the world focused on the study of the immune system. LJI is home to three research centers that harness the efforts of collaborative groups of researchers on defined areas of inquiry, to accelerate progress toward the development of new treatments and vaccines to prevent and cure autoimmune conditions, cancer and infectious disease. Together, LJI and WHAM will create a framework for researchers to re-analyze existing data with sex as a biological variable, to work together to spark new projects, to hire new faculty to build key research areas, to communicate via The WHAM Report, and to establish an ignition point for new leadership in the scientific field.

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WHAM convenes thought leaders, researchers, and scientists to work together to identify problems and devise solutions. Our members include:

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## RESEARCH ADVISORY PANEL

RAND convened advisory panels to help guide the work and elicit insights on the target case study areas of autoimmune and immune disease, cardiovascular disease, and Alzheimer's disease. Central to RAND's work was the creation of health economic models in each case study area. RAND is committed to creating final products with immediate relevance for use by funders, advocacy organizations, researchers, and other stakeholders.

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# Executive Summary

**T**he impact of limited knowledge about women's health relative to men's is far-reaching. Without information on the potential return on investment (ROI) for women's health research, research funders, policymakers, and business leaders lack a basis for altering research investments to improve knowledge of women's health.

Using microsimulation analyses, we examined the societal cost impact of increasing research funding in lung cancer. We quantified the potential impact of increasing funding for women's health on health outcomes and the ultimate societal costs, including healthcare expenditures, labor productivity of informal caregivers, and quality-adjusted life years (QALYs). We calculated impacts across 30 years for doubling the current percentage of the National Institutes of Health (NIH) extramural lung cancer portfolio devoted to women's health. The impact of a current investment was assumed to occur in ten years, with benefits accruing after that.

## Key Takeaways

*Large returns result from very small health improvements.* Assuming health improvements of 0.1 percent or less in terms of age incidence, mortality, and quality of life yields the following results:

- For the U.S. population age 25 and older, more than 22,700 years can be saved across 30 years, with substantial gains in health-related quality of life.
- Approximately 2,500 more labor years (valued at \$45 million in labor productivity) result from increased work time and longer life.



Doubling the investment would have an expected ROI of more than 1,200 percent if it succeeded in generating health improvements of 0.1 percent in mortality and incidence and 0.01 percent in QALYs.

The results establish the potential for investment in women's health research on lung cancer to realize gains beyond additional general research investment.

## Implications

Large societal gains may be possible by increasing investment in women's health research on lung cancer. The potential to recognize

societal gains is greater for research devoted to women's health relative to general research, according to the specifications used here.

We recommend the following policy actions based on this research to inform decisions about research funding allocations:

- Expand the research agenda to address multiple aspects of sex and gender and lung cancer using the limited evidence base, including
  - the unknown interactions of sex and gender with lung cancer etiology, risk factors, and disease progression to inform treatment and prevention research
  - understudied interactions of gender and race with lung cancer risk, health care, and disease progression; in particular, examine obstacles to access to and use of diagnostic technology, including for personalized medicine
  - differences by sex and gender in lifestyle impacts on disease
  - differences in disease course and outcomes by sex and gender based on different patterns of use of formal and informal caregiving.

Considering these findings on the potential for impact on the health-related quality of life of women with lung cancer, further study of the relationship of earlier detection for women and improved disease management, in terms of impact on health and quality of life outcomes, can aid with tracking investment impacts in the future. The following recommendations can provide a foundation in support of research funding allocation decisions:

- Raise awareness of differences between the lung cancer course for women and men and the potential for investment to improve disease outcomes and societal impact.
- Raise awareness among the business community of the potential ROI in women's health research, particularly for women in the workforce.





## Why Focus on Lung Cancer?

Because there are known and, potentially, unknown differences between men and women that affect morbidity and mortality, investment in women's health could be expected to yield a favorable return for society.

The lack of societal-level evidence on the economic costs, benefits, and social impacts of attention to sex and gender in health research is a major obstacle to moving from policies of passive inclusion to an active focus on the medical gender gap.

Women are disproportionately represented among nonsmokers with lung cancer. Nonsmoking men represent just 2 percent to 6 percent of total lung cancer cases among men, but nonsmoking women represent approximately 20 percent of cases among women (North and Christiani, 2013). The differences that are not attributable to tobacco exposure may indicate different disease pathophysiology (e.g., Sun, Schiller, and Gazdar, 2007). The role of estrogen in lung cancer is still being evaluated, but evidence supports its relationship to pathology (Rodriguez-Lara and Avila-Costa, 2021). Research on lung cancer to date has yielded some benefits, but lagging attention to women leaves a knowledge gap.

Quantifying the impact of research funding investment is a relatively new area of inquiry (Adam et al., 2018). Microsimulation modeling can help address the gap in knowledge about investment in women's health research on lung cancer and examine the impacts of additional investments (see, for example, Grant and Buxton, 2018). Impacts can be quantified in economic terms. By understanding the impact of the disease and potential disease mitigation on health-related quality of life (as well as other health outcomes), we can ensure that outcomes beyond those that are readily monetized are appropriately considered and included.

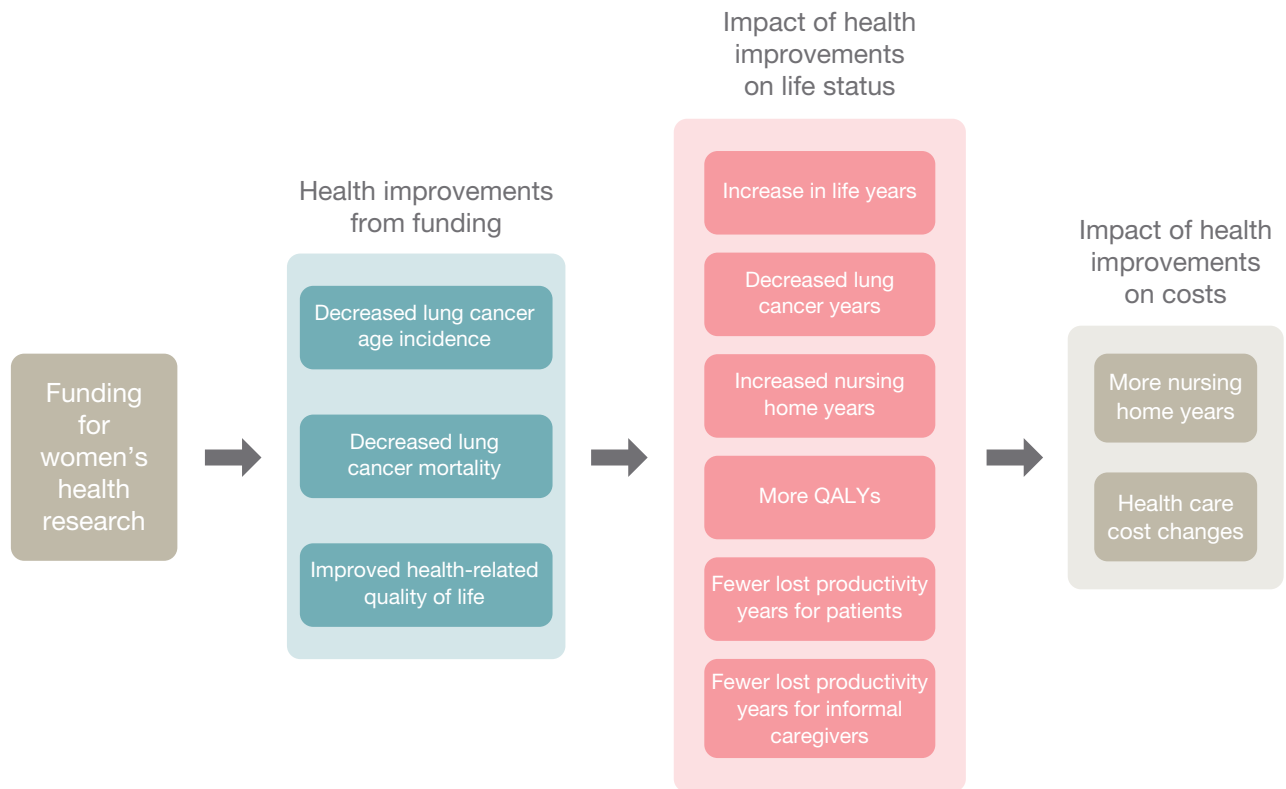
We present the results of microsimulation modeling used to explore the potential for enhanced investment in women's health research, in terms of the economic well-being of women and for the U.S. population. In lung cancer, differences by gender have been explored in terms of rates of diagnosis and treatment (e.g., Rana et al., 2020; National Cancer Institute, undated), but empirical evidence about differences by sex and gender is still limited. *Women's health research* as used in this report refers both to analyses that address sex and/or gender within general sample or population studies and to

Research on lung cancer to date has yielded some benefits, but lagging attention to women leaves a knowledge gap.



FIGURE 1

Conceptual Model of Research Funding Impacts for Lung Cancer



health-related quality of life. Not all impacts are improvements. For example, the model suggests that reduced mortality associated with lung cancer could lead to the development of other chronic disabling diseases, resulting in a net increase in nursing home years.

We used the Medical Expenditure Panel Survey because of its large sample and range of ages, clear diagnosis indicators, detailed data on medical expenditures, and detailed employment and income data.

## A Key Contribution: Addressing Future Earnings Equality

In the United States, earnings for white males exceed those of Black and Latino males and exceed those for all women. Rather than use race and ethnicity and gender to adjust earnings for the hypothetical cohort, we chose to base earnings calculations for everyone on the earnings of non-Hispanic white males. This avoids the gender- and race-based labor market discrimination that is inherent in the different (and lower) earnings for women and non-Hispanic white males.

etary value of workers being able to stay in the labor force longer as a result of decreased caregiving burden.

## Investment Impacts on Health Improvements

The model provides information on the ROI associated with multiple innovation impacts. Models address each of the following health improvement impacts separately and then address all three impacts occurring together:

1. decreased age incidence of disease (probability of onset at a given age)
2. decreased mortality rates for lung cancer patients, given age and gender
3. improvements in health-related quality of life, with the assumption that reduction in symptoms and more functional independence would account for more QALYs.

## How Much Health Improvement?

Given uncertainty regarding overall health improvements that investment in research can produce, we examined three levels of improvement: 0.01 percent, 0.1 percent, and 1 percent improvement. That is, we estimated the reduced disease incidence, reduced severity, and improved quality of life together to sum to an overall health improvement at these three levels. Using preliminary analyses, we chose a base case of 0.1 percent improvement in incidence and mortality combined with a 0.01 percent improvement in QALY.

## Who Benefits?

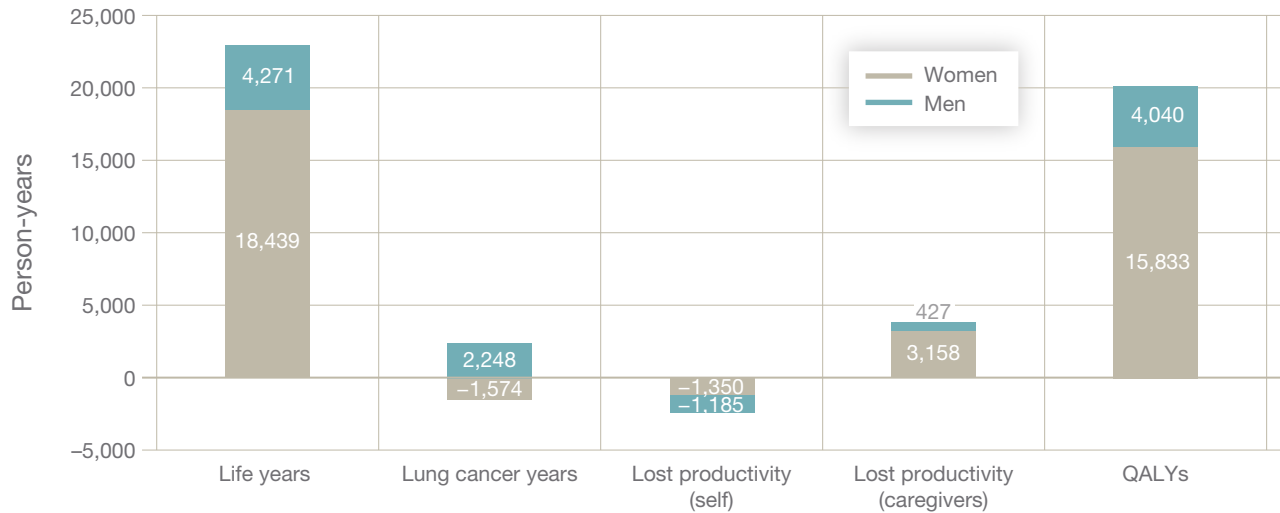
The main model assumption was that health improvements for women were three times that of men for a targeted investment in women's lung cancer research. Investment in women's health research can be expected to benefit women, but some of the innovation will benefit everyone.

For comparison purposes, we examined results assuming equal health innovation impacts on men and women: i.e., assuming research investments in general research rather than research on women's



FIGURE 2

**Health and Economic Improvements of Increased Investment in Women’s Lung Cancer Research**



NOTE: Figure represents the U.S. population age 25 and older of about 225 million and shows a 0.1 percent impact on mortality and incidence and a 0.01 percent impact on QALYs, assuming the impact is three times larger for women than men.

Fewer years of lung cancer create fewer lost earnings, and more years of life allow for more years of work.

**Lost Productivity for People with Lung Cancer**

Health improvements increase employment and earnings of the lung cancer population in two ways. Fewer years of lung cancer create fewer lost earnings, and more years of life allow for more years of work. This yields around 1,350 more years of work for women and 1,185 more for men.

**Caregiver Productivity**

Caregiver work productivity drops by around 3,200 years for caregivers of female patients and 400 years for caregivers of male patients. Innovations result in more years of life for patients, but more of those years at a less severe level of impairment may lead to an added burden in terms of informal caregiving.

**Increased Quality of Life**

Delayed onset reduces the years of lung cancer burden, which increases quality of life. Decreased mortality rates lead to more years alive, which increases quality of life. In addition to the health improvements of delayed onset of lung cancer and decreased mortality rates, we assumed an increased quality of life for lung cancer patients from the health improvements, representing potential innovations that do not change the onset or severity of the disease but decrease the





zons, demonstrating the potential for shorter timelines for peer review and publication of research results. These models assume a single cohort without replacement. Although impacts were scaled up to the U.S. population, cumulative impacts of health improvements may be greater than presented here, given the movement of individuals over 30 years.

One key consideration when modeling using labor force participation and earnings is selection of earnings profiles. We chose to apply earnings of non-Hispanic white males for all races and ethnicities and genders in the informal caregiving population. This has the advantage of avoiding assumed ongoing bias but represents a departure from the strict matching of other economic modeling studies.

Health research investments affect society through many pathways. The models examined here focused on a small but important subset of potential impacts on population health using investment in women's health research. Although a cure and/or preventive intervention may be possible for lung cancer over the coming decades, these analyses assume relatively small health impacts from research investment. More-optimistic scenarios are not unreasonable.

## Limitations

All models involve assumptions, by design. The assumptions made for the models reported here were (in general) selected to return more-conservative results: that is, results that bound the lower end of possibilities for investment in women's health research. The potential impact of health improvements on patient functioning may lead to workforce productivity loss for informal caregivers, underscoring the importance of identifying policy scenarios that address possible transitions between informal caregiving and formal long-term care if innovations extend time in functionally impaired stages. The analyses here do not reference transgender or other sex and gender identities. This is not to deemphasize the importance of wider consideration of sex and gender identities, but the focus here is on a first view of the underresourced area of women's health.



## Conclusion

Understanding the full range of societal impacts from health research investment requires consideration of multiple factors and, given the uncertainty of the future, requires assumptions. Differences in etiology, detection, care access, and treatment by sex and gender are well-documented in lung cancer and can provide specifics to inform an agenda for research. Furthermore, the financial investment needed to realize the goals of that agenda requires planning. Investing more in research on women's health is likely to deliver net positive societal impacts. A clear understanding of the potential for investment can improve decisions about where and how to invest in order to recognize positive impacts for women and for society as a whole.

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## References

- Adam, Paula, Pavel V. Ovseiko, Jonathan Grant, Kathryn E. A. Graham, Omar F. Boukhris, Anne-Maree Dowd, Gert V. Balling, Rikke N. Christensen, Alexandra Pollitt, Mark Taylor, Omar Sued, Saba Hinrichs-Krapels, Maite Solans-Domènech, and Heidi Chorzempa, “ISRIA Statement: Ten-Point Guidelines for an Effective Process of Research Impact Assessment,” *Health Research Policy and Systems*, Vol. 16, February 8, 2018.
- Baird, Matthew D., Melanie A. Zaber, Andrew W. Dick, Chloe E. Bird, Annie Chen, Molly Waymouth, Grace Gahlon, Denise D. Quigley, Hamad Al-Ibrahim, and Lori Frank, *Research Funding for Women’s Health: A Modeling Study of Societal Impact. Findings for Lung Cancer*, Santa Monica, Calif.: RAND Corporation, WR-A708-4, 2021. As of [publish date]: [https://www.rand.org/pubs/working\\_papers/WRA708-4.html](https://www.rand.org/pubs/working_papers/WRA708-4.html)
- Cruz Rivera, Samantha, Derek G. Kyte, Olalekan Lee Aiyegbusi, Thomas J. Keeley, and Melanie J. Calvert, “Assessing the Impact of Healthcare Research: A Systematic Review of Methodological Frameworks,” *PLoS Medicine*, Vol. 14, No. 8, 2017.
- Grant, Jonathan, and Martin J. Buxton, “Economic Returns to Medical Research Funding,” *BMJ Open*, Vol. 8, No. 9, 2018.
- Hansen, Johan, Natasha Azzopardi Muscat, Ilmo Keskimäki, Anne Karin Lindahl, Holger Pfaff, Matthias Wismar, and Peter Groenewegen, “Measuring and Improving the Societal Impact of Health Care Research,” *Eurohealth*, Vol. 19, No. 3, 2013, pp. 32–35.
- Luce, Bryan R., Josephine Mauskopf, Frank A. Sloan, Jan Ostermann, and L. Clark Paramore, “The Return on Investment in Health Care: From 1980 to 2000,” *Value in Health*, Vol. 9, No. 3, 2006, pp. 146–156.
- National Cancer Institute, “Surveillance, Epidemiology, and End Results Program,” webpage, undated. As of September 24, 2021: <https://seer.cancer.gov/>
- National Institutes of Health, “Notice of Special Interest: Sex and Gender Differences in Alzheimer’s Disease and Alzheimer’s Disease–Related Dementias (AD/ADRD),” August 5, 2020a. As of April 5, 2021: <https://grants.nih.gov/grants/guide/notice-files/NOT-AG-20-038.html>
- , “Research Portfolio Online Reporting Tools Expenditures and Results (RePORTER),” updated November 7, 2020b. As of November 17, 2020: <https://projectreporter.nih.gov/reporter.cfm>
- NIH—See National Institutes of Health.
- North, Crystal M., and David C. Christiani, “Women and Lung Cancer: What Is New?” *Seminars in Thoracic and Cardiovascular Surgery*, Vol. 25, No. 2, Summer 2013, pp. 87–94.
- Rana, Rezwanul Hasan, Fariha Alam, Khorshed Alam, and Jeff Gow, “Gender-Specific Differences in Care-Seeking Behaviour Among Lung Cancer Patients: A Systematic Review,” *Journal of Cancer Research and Clinical Oncology*, Vol. 146, No. 5, May 2020, pp. 1169–1196.
- Rodriguez-Lara, Vianey, and Maria Rosa Avila-Costa, “An Overview of Lung Cancer in Women and the Impact of Estrogen in Lung Carcinogenesis and Lung Cancer Treatment,” *Frontiers in Medicine*, Vol. 8, 2021.
- Scott, Troy J., Alan C. O’Connor, Albert N. Link, and Travis J. Beaulieu, “Economic Analysis of Opportunities to Accelerate Alzheimer’s Disease Research and Development,” *Annals of the New York Academy of Sciences*, Vol. 1313, No. 1, April 2014, pp. 17–34.
- Sun, Sophie, Joan H. Schiller, and Adi F. Gazdar, “Lung Cancer in Never Smokers—A Different Disease,” *Nature Reviews Cancer*, Vol. 7, No. 10, October 2007, pp. 778–790.