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AN EXAMINATION OF LUNG CANCER TREATMENT CHARACTERISTICS ON LUNG
CANCER PATIENTS WITH CO-EXISTING HEART DISEASE

by

ELIAS RHANIME

A thesis submitted in partial fulfillment of the requirements for the Honors in the Major Program
in Health Sciences, Pre-Clinical Track in the College of Health Professions and Sciences and in
the Burnett Honors College at the University of Central Florida Orlando, Florida

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Thesis Chair: Raheleh Ahangari, M.D.

ABSTRACT

With the rising rates of heart disease incidents in the United States and the increase in lung cancer deaths, many individuals suffer and get their treatments compromised due to these diseases. Especially considering that many lung cancer and heart disease patients are over 70 years of age, treatment options and success rates drop significantly. Due to this, a significant concern is raised for patients with co-existing heart disease and lung cancer. In this study, we reviewed research articles that discussed lung cancer treatment success in patients with heart disease. Furthermore, we used the 2020 NHIS to review demographic data on the interviewed adults who answered the questions regarding lung cancer and heart disease. At the start, we hypothesized that there wasn't going to be a high success rate for lung cancer treatment in patients with heart disease due to the invasive nature of the treatments available. Upon review, it was found that most patients with co-existing heart disease that sought lung cancer treatment had their condition worsened. In most surgical lung cancer treatment options, patients with co-existing heart disease were more likely to die after the operation than patients without co-existing heart disease. Currently and in future times, it's more likely to find individuals with both diseases due to the rising culture, which endorses poor habits in eating, alcohol consumption, smoking, and the utilization of drugs. Understanding the difficulty and dangers that are found in current treatment options for heart disease patients suffering from lung cancer will allow for innovation and improvement in treating such patients.

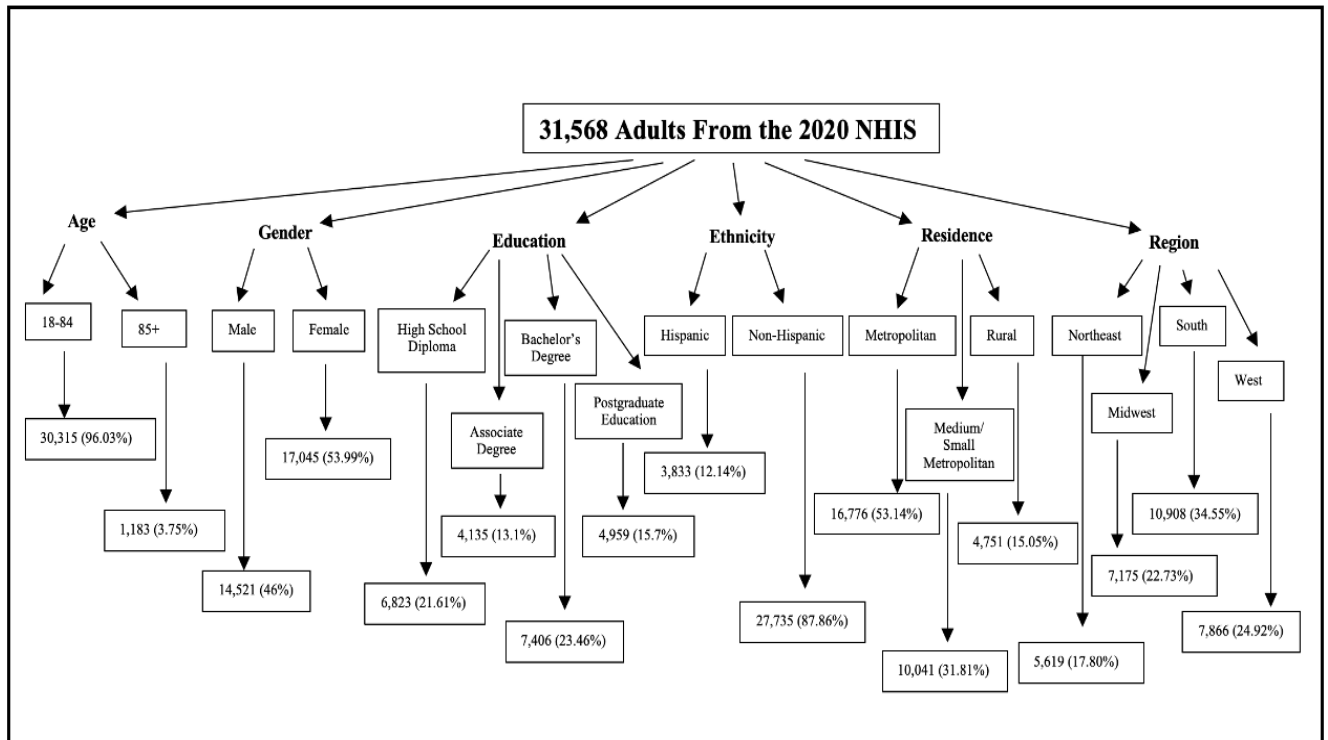
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Answers to the 2020 NHIS Health Questions

Answers	Diagnoses of Diseases				
		Cancer	Lung Cancer (from those with Cancer)	Heart Disease	Myocardial Infarction
	Yes	4,130 (13.08%)	131 (3.17%)	1,901 (6.02%)	1,168 (3.70%)
	No	27,404 (86.81%)	3,978 (96.32%)	29,586 (93.72%)	30,362 (96.18%)
	Refused	20 (0.06%)	7 (0.17%)	16 (0.05%)	17 (0.05%)
	Don't Know	14 (0.04%)	14 (0.34%)	65 (0.21%)	21 (0.07%)

Notes: Data for 2020 NHIS health question answers from 2020 NHIS (National Health Interview Survey, n.d.)

INTRODUCTION

Lung cancer is the leading cause of cancer deaths, accounting for approximately 25% of all cancer-related deaths (*Lung Cancer*, n.d.). It was recorded that in 2022 alone, lung cancer accounted for 68,820 male deaths and 61,360 female deaths in the United States of America (*Lung Cancer*, n.d.). After prostate cancer in men and breast cancer in women, lung cancer is the second most common type of cancer (*Lung Cancer*, n.d.). Signs and symptoms, including loss of appetite, lack of muscular and physical strength, and shortness of breath, often lead to misinterpretation and cause late-stage diagnosis of lung cancer (*Lung Cancer*, n.d.). This is an important factor to consider when most lung cancer patients are diagnosed at approximately 70 years of age (*Lung Cancer*, n.d.). This makes these individuals vulnerable to the assumption that these signs and symptoms are merely a result of old age and therefore get overlooked. Such high-risk patients, particularly individuals exposed to risk factors such as both smoking & secondhand smoking, a family history of lung cancer, and even air pollution, have a higher need for routine lung cancer screenings to avoid misdiagnosis and late-stage diagnosis (*Lung Cancer*, n.d.).

In such individuals over the age of 70, other co-existing conditions are bound to be found in the patient. For this study, we focused on patients with co-existing heart disease. In fact, one of the highest prevalent comorbidities found in lung cancer patients is coronary artery disease and cardiovascular disease, which are both forms of heart disease (Dima et al., 2018). Aside from this, both heart disease and lung cancer are the leading two causes of death in the United States of America, with heart disease being the number 1 leading cause of death. This comorbidity found in patients afflicted with lung cancer makes it difficult to receive many forms of lung cancer treatment that are invasive in nature. In fact, many lung cancer patients with co-

existing cardiovascular disease have a lower chance of receiving any form of lung cancer treatment because of the dangerous outcomes that may arise (Batra et al., 2020). Furthermore, certain lung cancer treatments, such as chemotherapy, radiotherapy, and other invasive treatments, were found to worsen the patient's co-existing heart disease condition (Batra et al., 2020).

LITERATURE REVIEW

Overview

Multiple research articles were utilized to successfully find relevant research material on lung cancer treatment in patients with co-existing heart disease. The articles used were found in the UCF Library database as well as PubMed. In the search for the research articles, key terms, including “treatment of lung cancer in heart disease patients” and “treatment of lung cancer in cardiovascular disease patients” were used to find relevant articles. The articles were then filtered and reviewed according to relevancy to the purpose of this study, significant p-values and/or confidence intervals, and the main outcome of the study. Only articles discussing lung cancer treatments in patients with both lung cancer and heart disease were used. No specification on the type of lung cancer or heart disease was sought. Nine research articles were chosen to be in this study. These nine articles were divided into two main topics that summed the data and results found, with the first being “Lung Cancer Treatment Complications in Heart Disease Patients” and the second being “Lung Cancer Treatment Shown Effective in Heart Disease Patients.” In the first topic, the research articles discussed the complications associated with lung cancer treatment in heart disease patients. Different aspects of lung cancer, such as severity and stage of cancer, were analyzed with respect to the treatments administered to patients with co-existing heart disease, and the resulting complications were reported and discussed. The second topic included research articles that discussed the effectiveness and successes of lung cancer treatments in patients with co-existing heart disease. Lung cancer treatments, as well as treatment plans, were analyzed to see the feasibility of the treatment and whether or not it would be successful for patients with co-existing heart disease.

Lung Cancer Treatment Complications in Heart Disease Patients

Advancement in age renders older patients to be vulnerable to major health complications. It is expected that as an individual grows older, multiple diseases will be found in the patient, and most of the time, the diseases are co-existing. This raises a concern when trying to find treatments and solutions because as one treatment may benefit a disease, it can cause other complications for the other co-existing disease. This is exactly the case for lung cancer treatments for lung cancer in patients with co-existing heart disease. Lung cancer diagnoses are usually made in older patients. It is estimated that 69% of lung cancer diagnoses are made in patients over 65 years of age (Hayat et al., 2007). Furthermore, patients in this age range are also likely to have some sort of heart condition, whether it be cardiovascular disease or any other form of heart disease. The first article on the topic of lung cancer treatment complications in patients with co-existing heart disease conducted a study utilizing a cohort study design which assessed the effects of cardiovascular disease on the survival of NSCLC (Non-small cell lung cancer) patients over the age of 65 (Kravchenko et al., 2015). The data gathered showed that cardiovascular disease did play a role in the survival of NSCLC patients (Kravchenko et al., 2015). In fact, the presence of multiple co-existing cardiovascular diseases, including comorbid heart failure, myocardial infarction, and cardiac arrhythmias, increased the mortality rate of the patients treated with all types of treatments including surgical, chemotherapy, and radiotherapy treatments with a significant p-value of $p < 0.05$ (Kravchenko et al., 2015).

A second article falling under this topic also conducted a study that found a relationship between cardiovascular disease and lung cancer treatment (Ambrogi et al., 2003). Specifically, an analysis of the effects of surgical lung cancer treatment on the morbidity of patients with NSCLC

was sought (Ambrogi et al., 2003). This study brought up another aspect of the problem, which was how to approach the treatment plan, including deciding on which disease to treat first. The data showed that the order of the treatment didn't have a significant outcome on the results of the treatment, so physicians could have made a choice on treating either the cardiovascular disease or lung cancer based on the cost/benefit evaluation on how advanced each disease is (Ambrogi et al., 2003). Additionally, it was found that the presence of multifocal vascular disease presented additional complications in receiving lung cancer treatment (Ambrogi et al., 2003). The study concluded that the presence of multifocal vascular disease had an effect on the morbidity in patients that went through surgical treatment for lung cancer. This finding had a significant p-value of $p=0.05$ (Ambrogi et al., 2003).

The third article under this topic conducted a study that assessed the presence of heart disease and its influence the lung cancer treatment (Sandri et al., 2017). In this cohort study, 1,699 patients with coronary artery disease (CAD) were analyzed (Sandri et al., 2017). The lung cancer treatment used was video-assisted thoracoscopic surgery lobectomy (Sandri et al., 2017). Both patients with and without coronary heart disease were analyzed using the same lung cancer treatment to see the effect of coronary heart disease on the outcome of the treatment (Sandri et al., 2017). This analysis is crucial to the study to truly see the differences in patients with just lung cancer compared to those with co-existing heart disease. It was stated that most patients going through lung cancer resection as a treatment often are diagnosed with coronary heart disease (Sandri et al., 2017). The study concluded that the mortality in patients with CAD was five times higher than in the patients without CAD during the 30 days post-operation (Sandri et al., 2017).

The associated p-value for this finding was $p=0.009$, demonstrating a statistically significant p-value for the death rate among CAD patients (Sandri et al., 2017).

The fourth article under this category conducted a retrospective study. The study aimed to extract data upon assessment of surgical lung cancer treatment on patients with co-existing CAD and/or idiopathic interstitial pneumonia (Fukui et al., 2022). 2,830 lung cancer patients with either coronary heart disease and/or idiopathic interstitial pneumonia were utilized (Fukui et al., 2022). 120 patients were excluded from the study due to the use of chemotherapy and radiotherapy (Fukui et al., 2022). Out of the 2,830 lung cancer patients, 174 had only coronary heart disease, 277 had only idiopathic interstitial pneumonia, and 71 patients had both coronary heart disease and idiopathic interstitial pneumonia (Fukui et al., 2022). 2,188 lung cancer patients had no additional co-existing disease (Fukui et al., 2022). During the perioperative period, the data showed that lung cancer patients who had undergone surgical treatment were more likely to experience cardiac complications (Fukui et al., 2022). Despite this, data from the study proved that both short-term and long-term mortality following surgical treatment for lung cancer was independent of CAD (Fukui et al., 2022). Furthermore, only 2 patients out of the 2,710, including all groups with and without coronary heart disease and/ or idiopathic interstitial pneumonia who underwent surgical treatment died from cardiac complications within a year after surgery (Fukui et al., 2022).

The fifth article conducted a retrospective study similar to the previous study. In this study, NSCLC patients with CAD underwent surgical cancer treatment, and the outcomes and results were analyzed (Kanzaki, Inoue, et al., 2017). 43 patients with co-existing CAD were used

in this study (Kanzaki, Inoue, et al., 2017). After surgical treatment, patients were analyzed for postoperative outcomes(Kanzaki, Inoue, et al., 2017). A higher morbidity rate of 42% was found in patients with CAD (Kanzaki, Inoue, et al., 2017). The data from the study showed that NSCLC patients with CAD had a higher risk for complications following surgical treatment than patients without CAD (Kanzaki, Inoue, et al., 2017). Combined decreased organ function, including decreased cardiac function, respiratory dysfunction, and/or deteriorated renal function, were major risk factors for postoperative complications (Kanzaki, Inoue, et al., 2017). These risk factors had a statistically significant p-value of $p=0.04$ associated with them (Kanzaki, Inoue, et al., 2017). Similar to the previous study, this study concluded CAD didn't have an influence on patient outcomes following surgical lung cancer treatment (Kanzaki, Inoue, et al., 2017).

The final article falling under this topic conducted a retrospective study as well. This study analyzed surgical lung cancer treatment for patients with co-existing CAD with previous coronary artery bypass graft (CABG) (Akcam et al., 2021). The study was unique to the previous studies as patients were analyzed during lung cancer treatment and post-treatment for any complications that arose as well as any associated mortality rates (Akcam et al., 2021). The study stated that surgical lung cancer treatment is often the treatment method chosen for patients who have already undergone CABG (Akcam et al., 2021). Both patients with previous CABG and without CABG were analyzed, and results were compared in terms of 30-day mortality and hemorrhage (Akcam et al., 2021). More patients with previous CABG required surgical revision during the early postoperative period when compared to patients without CABG with a statistically significant p-value of $p=0.009$ (Akcam et al., 2021). Patients with CABG also suffered from hemorrhages postoperatively, which led to higher mortality rates (Akcam et al.,

2021). With regards to the 30-day mortality rate, it was higher in patients with CABG than in patients without CABG (Akcem et al., 2021).

Lung Cancer Treatment Shown Effective in Heart Disease Patients

The increasing co-existence of lung cancer and heart disease found in older patients renders a desire and need for safe and successful treatment options for patients diagnosed with both diseases. The first article on the topic of effective lung cancer treatment in heart disease patients conducted a retrospective study to prove safe and effective CABG and surgical lung cancer treatment for older patients (Li et al., 2019). The study performed these treatments simultaneously on 20 lung cancer patients with severe CAD (Li et al., 2019). The results demonstrated that the simultaneous execution of both treatments was safe and effective. Furthermore, carrying out both treatments simultaneously allowed for the tumor to be removed earlier (Li et al., 2019). In addition to this, the study found no cardiac risk during the perioperative period (Li et al., 2019). The simultaneous execution of both CABG and surgical lung cancer treatment was also more cost-effective. By performing two surgeries in one session, the medical costs were reduced (Li et al., 2019).

A second research article conducted a similar study to the previous one where they administered simultaneous treatment to patients (Kanzaki, Kimura, et al., 2017). The patients chosen were diagnosed with cardiovascular disease and lung cancer (Kanzaki, Kimura, et al., 2017). Cardiovascular disease was defined as CAD, valvular disease, and congenital heart

disease, with CAD making up the majority of patients (Kanzaki, Kimura, et al., 2017). In addition to simultaneous treatments, the study also conducted 2-stage treatments where lung cancer and heart disease were treated at two different stages (Kanzaki, Kimura, et al., 2017). The study mentioned the desirability of simultaneous treatments due to quicker removal of the tumor, as mentioned in the previous study, but continued to mention that simultaneous treatment for lung cancer and heart disease carried a higher risk for postoperative complications than 2-stage treatments don't carry (Kanzaki, Kimura, et al., 2017). Nevertheless, a concern with 2-stage treatment was the delay in treating lung cancer and heart disease (Kanzaki, Kimura, et al., 2017). As time goes on, the tumor continues to grow, and the heart condition continues to worsen (Kanzaki, Kimura, et al., 2017). This is especially the case when recovery after heart disease treatment is prolonged and increases the wait time to treat lung cancer (Kanzaki, Kimura, et al., 2017). Because of this, a shorter time period between treatment for heart disease and lung cancer treatment is preferable to a longer period between the treatments with regards to 2-stage treatment (Kanzaki, Kimura, et al., 2017). Despite this, the outcomes presented were favorable towards the 2-stage treatment due to the lower risk of associated postoperative complications (Kanzaki, Kimura, et al., 2017). The study suggested simultaneous treatment only for patients who would benefit from it due to the high morbidity rates and the invasive approach associated with simultaneous treatment (Kanzaki, Kimura, et al., 2017).

The final article under this category conducted a cohort study to assess the outcomes of lung resection as a treatment for lung cancer patients with co-existing heart disease, particularly CAD (Kitamura et al., 2017). This study, just like the previous ones, expressed concern for the older population of adults who have increasingly been diagnosed with lung cancer and

comorbidities associated with aging, which in this case is heart disease (Kitamura et al., 2017). The study found that it is feasible for major lung resection for lung cancer patients with cardiac disease. There was an increased probability of 90-day or in-hospital death for patients with a history of cardiovascular disease and an associated odds ratio of $OR=3.574$ and a confidence interval of $95\%CI=1.612-7.923$ (Kitamura et al., 2017). Patients with a coronary stent had an increased probability of death following lung resection with an odds ratio of $OR=5.495$ and a confidence interval of $95\%CI=1.754-17.214$ (Kitamura et al., 2017). This raises a major concern for patients with previous heart disease treatment when it comes to getting treated for lung cancer.

Summary of the articles reviewed

As shown by the research articles that were discussed above, there are many complications and concerns when it comes to lung cancer treatments in patients with co-existing heart disease. The complications that arose on most occasions were associated with the postoperative period, where complications, such as hemorrhages, occurred. Furthermore, different treatment methods presented different concerns. The surgical approach to treating lung cancer was often used in the studies conducted in the research articles. This method, although invasive, proved to be efficient in treating lung cancer. At different times, surgical lung cancer treatment was combined with heart disease treatment to execute a simultaneous approach to treating patients with both diseases. Although some studies showed the effectiveness of such treatment, others raised concerns about postoperative complications. A safer approach included a 2-stage treatment plan where one disease was treated at a time to prevent postoperative

complications. The main concern with this approach was the time period between each treatment. To avoid further worsening the disease, the time period between each treatment needed to be short, and the disease treated first needed to be recovered fully prior to moving forward with the second treatment.

AIMS & HYPOTHESIS

The primary aim of this study is to review the data on the outcomes of lung cancer treatments in patients with co-existing heart disease. The secondary aim of this study is to utilize the 2020 National Health Interview Survey (NHIS) to review the prevalence of heart disease and lung cancer in the United States of America, as well as analyze and examine demographic characteristics of the overall sample and compare differences in demographics for patients with lung cancer, heart disease, and a combination of both conditions. The rapid increase in lung cancer cases around the world raises major concerns for older patients who are more susceptible to this disease. Furthermore, lung cancer diagnoses are often accompanied by comorbidities, which in this case, is heart disease. Aging itself is a major concern when it comes to any invasive treatment. To truly know the severity and importance of any disease and any associated treatments, it is crucial to assess the population for the prevalence of the disease. Just like with any disease, certain demographics, including geographic regions, ethnicities, and economic levels, may have higher or lower prevalence rates of the disease. In the case of lung cancer in co-existing heart disease patients, knowing the demographics will help physicians and specialists to understand possible causes, risk factors, and treatment options that are most suitable for the patients in those demographics. If a group of individuals identify as an ethnic minority, have a low education level, are old in age, and live in poor neighborhoods and communities, then they will have a higher prevalence rate of lung cancer and heart disease. This hypothesis is due to the fact that individuals of such demographics typically struggle with negative social influences that affect an individual's health, lack of essential medical education to maintain a healthy lifestyle, and proper nutrition and exercise.

METHODOLOGY

Study Design

A tertiary study that reviewed data from research articles on the outcomes of lung cancer treatment patients with co-existing heart disease as well as associated success, morbidity, and mortality rates. This study also reviewed data from the 2020 NHIS, which surveyed individuals across all 50 states to assess the prevalence of lung cancer and heart disease in the United States.

Data source

This study utilized data from the 2020 National Health Interview Survey. The NHIS is recognized as the main source of health information on the civilian noninstitutionalized population of the United States (*National Center for Health Statistics*, n.d.-a). Through collection and review of collected data, the NHIS strives to monitor the health of Americans (*National Center for Health Statistics*, n.d.-a). The NHIS's ability to collect and sort data from surveys into different demographic categories is a major strength of the NHIS (*National Center for Health Statistics*, n.d.-a). The 2020 NHIS interviewed 31,568 adults over the age of 18 (*National Health Interview Survey*, n.d.). The 2020 NHIS conducted the interview using a cross-sectional interview design (*National Health Interview Survey*, n.d.). These individuals were noninstitutionalized civilians across all 50 states and the District of Columbia, including household residents and residents of noninstitutional group quarters (*National Center for Health Statistics*, n.d.-a). Regarding this study, the questions asked on lung cancer, heart disease, and myocardial infarctions were of benefit.

Sample

Different categories were created in the NHIS that divided the data into specific demographic groups. These include the sample adult age, gender, education, ethnicity, and residence (*National Health Interview Survey*, n.d.). For this study, age was documented using years, and the genders were divided into males and females (*National Health Interview Survey*, n.d.). With education, this was defined by whether the adult was a high school graduate, or received an associate degree, bachelor's degree, and/or postgraduate education (*National Health Interview Survey*, n.d.). The ethnicity of the interviewed adults was divided into Hispanic and Non-Hispanic (*National Health Interview Survey*, n.d.). Finally, the residence was categorized as urban and rural, with urban divided into metropolitan and medium/small metropolitan (*National Health Interview Survey*, n.d.). The region was also used in relation to the residence and included Northeast, Midwest, South, and West (*National Health Interview Survey*, n.d.). All of these demographic factors were considered with regards to the specific questions asked to the adults about lung cancer diagnosis, heart disease diagnosis, and myocardial infarctions (*National Health Interview Survey*, n.d.). The main exclusionary criteria included adults with no fixed household address (*National Center for Health Statistics*, n.d.-a). This includes adults who are homeless, active-duty military personnel, adults living in long-term institutions such as nursing homes, and other similar individuals.

Review

The data collected from the previous research articles were used for the primary aim of this study. Factors including mortality rates, morbidity rates, and postoperative complications were the main factors in interpreting the outcomes of lung cancer treatment. The secondary aim of this study was to review the prevalence of lung cancer, heart disease, and myocardial infarction in the United States of America. This was measured using the data from the 2020 NHIS. Included in this data are the answers to the questions which were asked to the adults regarding the demographics and lung cancer, heart disease, and myocardial infarction, as well as the demographic data.

RESULTS

From all the research articles used in this study, 6 found lung cancer treatment options to carry high risks for lung cancer patients with co-existing heart disease. In each study, postoperative complications and mortality rates proved the risks of getting such treatments. In one study, there was a significant difference between the death among lung cancer patients with CAD and patients without CAD (Sandri et al., 2017). It was found that 18% of the patients with co-existing CAD died after getting surgical treatment for lung cancer (Sandri et al., 2017). This percentage is much higher than the 3.9% of patients without CAD that had undergone the same treatment and died (Sandri et al., 2017). A p-value of $p=0.009$ proved this death rate to be statistically significant (Sandri et al., 2017). Similarly, a study found higher morbidity rates and postoperative complications following surgical lung cancer treatment (Kanzaki, Inoue, et al., 2017). The data concluded that a morbidity rate of 42% with a statistically significant p-value of $p<0.01$ was found in patients with CAD after surgical lung cancer treatment in the postoperative period (Kanzaki, Inoue, et al., 2017).

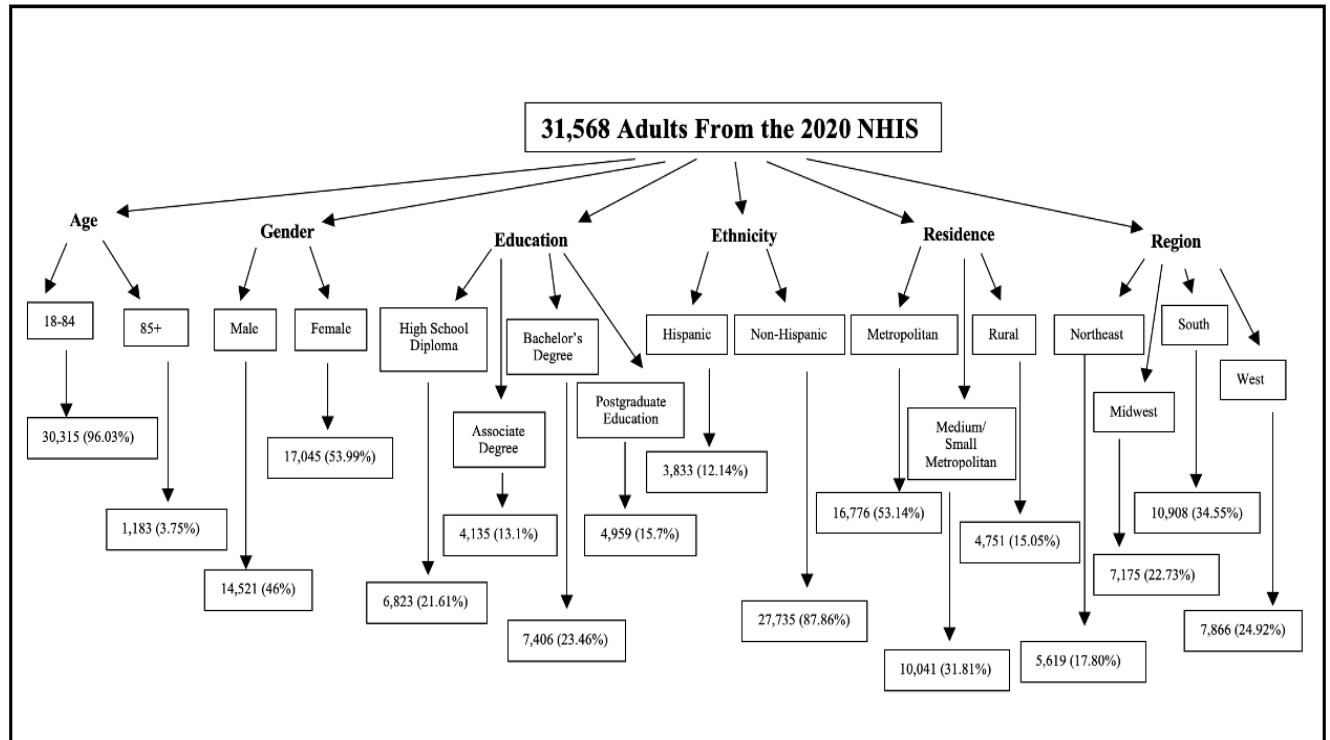
Nevertheless, 3 studies provided data that argued the opposite. A study found that simultaneous treatment for lung cancer patients with co-existing coronary artery disease had been successful (Li et al., 2019). This treatment would entail treating the heart disease and lung cancer in the same operating period (Li et al., 2019). As a benefit of this treatment, lung cancer resection is not delayed, which allows for a more successful recovery (Li et al., 2019). Data from another study concluded that 2-stage treatments for lung cancer patients with co-existing heart disease were more favorable due to the lower chance of postoperative complications (Kanzaki,

Kimura, et al., 2017). The data showed that 31% of patients who had undergone 2-stage treatment for lung cancer and heart disease suffered from postoperative complications, and 43% of patients who had simultaneous treatment suffered from postoperative complications (Kanzaki, Kimura, et al., 2017).

For the 2020 NHIS demographics, 31,568 adults over the age of 18 were sampled (*National Health Interview Survey*, n.d.). Of the 31,568 adults, 30,315 (96.03%) were between the age of 18 and 84, and 1,183 (13.75%) were over the age of 85 (*National Health Interview Survey*, n.d.). For the gender, 14,521 (46%) males and 17,045 (53.99%) females participated in the survey (*National Health Interview Survey*, n.d.). It was found that 6,823 (21.61%) of the 31,568 adults were high school graduates, 4,135 (13.1%) had an associate degree, 7,406 (23.46%) had a bachelor's degree, and 4,959 (15.7%) had a postgraduate education (*National Health Interview Survey*, n.d.). As for ethnicity, 3,833 (12.14%) adults identified as Hispanic, and the remaining 27,735 (87.86%) adults identified as non-Hispanic (*National Health Interview Survey*, n.d.). 16,776 (53.14%) adults resided in metropolitan areas, 10,041 (31.81%) resided in medium and small metropolitan areas, and 4,751 (15.05%) resided in rural areas (*National Health Interview Survey*, n.d.). There were 4 regions that were utilized in the 2020 NHIS (*National Health Interview Survey*, n.d.). 5,619 (17.80%) adults lived in the Northeast, 7,175 (22.73%) lived in the Midwest, 10,908 (34.55%) lived in the South, and 7,866 (24.92%) lived in the West (*National Health Interview Survey*, n.d.). Figure 1 displays a flow chart of the different demographics from the 2020 NHIS which were used in this study.

Figure 1

Demographics of the 2020 NHIS



Notes: Data for demographics is from the 2020 NHIS (National Health Interview Survey, n.d.)

The 2020 NHIS also documented the answers to questions asked regarding lung cancer, heart disease, and myocardial infarction (*National Health Interview Survey, n.d.*). As mentioned previously, 31,568 adults over the age of 18 were sampled (*National Health Interview Survey, n.d.*). These adults were asked whether they had ever been told by physicians that they had cancer (*National Health Interview Survey, n.d.*). Out of the 31,568 adults, 4,130 (13.08%) answered yes to having been told that they have cancer (*National Health Interview Survey, n.d.*).

This included all types of cancers. From the 4,130 adults who were told they had cancer, 131(3.17%) mentioned having lung cancer (*National Health Interview Survey*, n.d.). When asked regarding the age when sample adults were first told they had lung cancer, 124 (94.66%) of the adults were told between the age of 1 and 84 years of age, and 6 (4.58%) were over the age of 85 when they were first told they had lung cancer (*National Health Interview Survey*, n.d.).

Additionally, the 31,568 adults were asked whether they had ever been told by physicians that they had coronary heart disease (*National Health Interview Survey*, n.d.). Of the 31,568 adults, 1,901 (6.02%) answered yes to having been told that they had coronary heart disease (*National Health Interview Survey*, n.d.). Finally, the sample adults over the age of 18 were asked whether they had been told by physicians that they had a myocardial infarction (*National Health Interview Survey*, n.d.). 1,168 (3.70%) adults answered yes to being told that they had a myocardial infarction (*National Health Interview Survey*, n.d.). A summary of the answers collected from the 2020 NHIS health questions is displayed in table 1.

Table 1

Answers to the 2020 NHIS Health Questions

Answers	Diagnoses of Diseases				
		Cancer	Lung Cancer (from those with Cancer)	Heart Disease	Myocardial Infarction
	Yes	4,130 (13.08%)	131 (3.17%)	1,901 (6.02%)	1,168 (3.70%)
	No	27,404 (86.81%)	3,978 (96.32%)	29,586 (93.72%)	30,362 (96.18%)
	Refused	20 (0.06%)	7 (0.17%)	16 (0.05%)	17 (0.05%)
Don't Know	14 (0.04%)	14 (0.34%)	65 (0.21%)	21 (0.07%)	

Notes: Data for 2020 NHIS health question answers is from the 2020 NHIS (National Health Interview Survey, n.d.)

DISCUSSION

The primary aim of reviewing the outcomes of lung cancer treatments on patients with co-existing heart disease was sought in this study. This was done through the review of any associated risk factors, mortality rates, morbidity rates, and postoperative complications that resulted from the patient receiving treatment in the previous research articles. The secondary aim of this study, which was reviewing the prevalence of lung cancer, heart disease, and myocardial infarction in the United States of America, was done by utilizing data from the 2020 NHIS.

The data from the research articles demonstrated great concern for the outcomes of lung cancer treatments for patients with co-existing heart disease. Of the 9 total research articles utilized in this study, 7 articles provided data proving serious negative outcomes of lung cancer treatment for such patients. All 7 research articles documented complications that were associated with lung cancer patients having heart disease as a comorbidity. One of these studies used 43 NSCLC patients with co-existing CAD to analyze the outcome of lung cancer treatments on them (Kanzaki, Inoue, et al., 2017). The results showed a morbidity rate of 42% in patients with co-existing CAD after surgical treatment (Kanzaki, Inoue, et al., 2017). Another one of these studies concluded that it is possible for lung cancer patients with co-existing heart disease to receive lung cancer treatments (Kitamura et al., 2017). Despite this, the study continued to state that an increased chance of 90-day or in-hospital death was a major concern for patients with a history of cardiovascular disease (Kitamura et al., 2017). This data was associated with a 95% confidence interval of 95%CI=1.612-7.923 (Kitamura et al., 2017).

From the 9 research articles used in this study, 2 articles claimed success and safety with regards to administering lung cancer treatment to lung cancer patients with co-existing heart disease. Both research articles analyzed the use of simultaneous treatment. The first research article conducted a study that focused only on the simultaneous treatment of lung cancer and heart disease, while the second analyzed the use of 2-stage and simultaneous treatments. The first study utilized 20 lung cancer patients with co-existing cardiovascular disease (Li et al., 2019). The data proved that administering simultaneous treatment is safe and effective. Although the volume of blood lost was high and the operation time was longer, the overall result was favorable (Li et al., 2019). The second study utilized 33 NSCLC patients with co-existing cardiovascular disease (Kanzaki, Kimura, et al., 2017). Upon analyzing the short-term and long-term outcomes of both treatments, the study concluded that the outcome of lung cancer treatment on the 33 patients was favorable, with a survival rate of 85% (Kanzaki, Kimura, et al., 2017). With that said, the study stated that the 2-stage treatment option was safer for the patients as a lower probability of postoperative complications was associated with this treatment when compared to the simultaneous treatment (Kanzaki, Kimura, et al., 2017).

Upon review of the data from the research articles, it is apparent that there are concerns for lung cancer patients with co-existing heart disease, especially for older adults, when it comes to treatment options. The studies that raise concern for lung cancer treatments for these patients and the ones that claim the safety of such treatments both carry some limitations that would strengthen the claims made if they weren't present. Future studies should increase the number of patients utilized to solidify the data results. This is especially the case for the 2 studies in favor of the use of lung cancer treatments in patients with co-existing heart disease, where both studies

only used 20 and 33 patients with co-existing heart disease. Furthermore, future studies in this field should include race and ethnicity. Although the countries in which the studies were carried out were mentioned, nothing was documented regarding the ethnicity and/or race of the patients. By choosing a larger and more diverse patient population of different races and ethnicities, significant and beneficial outcomes may come out from future studies on this topic. Future studies should also explore different treatment options. The studies used in this study mainly focused on surgical treatment options, which were highly invasive and aggressive. Although chemotherapy and radiotherapy also pose a threat to a patient's heart disease condition, a definitive answer on which treatment option is safer cannot be made (Batra et al., 2020).

After a review of the data from the 2020 NHIS, many observations were made. To start, the NHIS strived to be as inclusive as possible by including adults from all 50 states, with the exception of the adults with no fixed household address (*National Center for Health Statistics*, n.d.-a). This means that the data provided by NHIS should be representative of the American population. Although 31,568 adults participated in the 2020 NHIS, 4,130 (13.08%) adults stated that they had cancer (*National Health Interview Survey*, n.d.). Furthermore, only 131 (3.17%) of those who had cancer mentioned having lung cancer (*National Health Interview Survey*, n.d.). With the numerous data on the prevalence of lung cancer around the world, specifically in the United States, a higher number of adults with lung cancer was expected. Even for heart disease, which is the number 1 cause of death in the United States, only 1,901 (6.02%) adults out of 31,568 stated that they had coronary heart disease, and 1,168 (3.70%) adults stated that they had a myocardial infarction (*National Health Interview Survey*, n.d.). A main reason why the prevalence of these diseases seems so low may have to do with the COVID-19 pandemic. As the

survey was conducted in 2020, the NHIS shifted from in-person to remote interviews, which resulted in a decline in the number of responses, as stated on the National Health Statistics website(*National Center for Health Statistics*, n.d.-b). Because of this, the true prevalence of these diseases may be higher than what was documented in the 2020 NHIS. With life coming back to normal after the pandemic, it is expected that more adults will participate in future surveys of the NHIS.

A couple of main demographics were used in assessing the prevalence of lung cancer, heart disease, and myocardial infarctions. The demographics collected demonstrated that the majority of the adults who participated in the 2020 NHIS were living in the middle class, as over 50% (16,776 adults) of the sampled adults lived in metropolitan areas (*National Health Interview Survey*, n.d.). Also, among the education criteria set for this study, the majority of adults (31.8%) had a bachelor's degree, which indicates a relatively educated group of adults (*National Health Interview Survey*, n.d.). This may have also played a role in the low prevalence of lung cancer, heart disease, and myocardial infarctions in the 2020 NHIS. A well-educated middle-class adult is less likely to have the diseases mentioned in this study because of the higher probability of access to a good diet, exercise, and healthy habits.

Other demographics, such as age, ethnicity, region, and gender, were not useful in the assessment of the prevalence of lung cancer, heart disease, and myocardial infarctions. This was due to the vague nature of the questions that were asked. The NHIS, in the future, should integrate specific demographics into the questions regarding lung cancer, heart disease, and myocardial infarctions. This can be done by categorizing the questions into specific

demographics or including the demographics in the answers. This would be very helpful in finding accurate and specific information on the prevalence of the diseases mentioned. Also, more questions need to be asked regarding the different aspects of the diseases, including past or possible future treatments. Asking these questions will allow for a deeper assessment of the success and/or failure of the treatments, as well as why some adults choose not to proceed with the treatment.

CONCLUSION

As both lung cancer and heart disease are gaining popularity among the older American population, more and more research is needed in this area of public health. Just like any other concern in life, finding beneficial, safe, and effective solutions are of primary importance. The aggressive and invasive treatments for lung cancer, as they are, pose a great threat to the health and safety of older lung cancer patients. With the added comorbidity of heart disease, it was found that the lung cancer treatments available, including surgical, chemotherapy, and radiotherapy options, pose an even greater threat and concern (Batra et al., 2020). This study reviewed the outcomes of lung cancer treatments on patients with co-existing heart disease for any concerns, complications, safety, and effectiveness.

The data used in this study from previous research articles seemed to suggest that going through with lung cancer treatment in patients with co-existing heart disease, which in most cases was surgical, posed a great probability of complications and higher mortality and morbidity rates following the treatment. The studies claiming that lung cancer treatments on patients with co-existing heart disease were safe and effective had limiting factors, which included a small patient sample in their studies, that weakened their claims. The data from the 2020 NHIS also suggested a low prevalence of lung cancer, heart disease, and myocardial infarction among the American population (*National Health Interview Survey*, n.d.). Having the majority of sampled adults living in metropolitan areas, as well as having a decent education, may have been the reason for the low prevalence of these diseases. Another possible reason for this may have been

the low response rate from the American population for the 2020 NHIS due to the COVID-19 pandemic.

With the concerns, risks, and possible dangers of lung cancer treatments in patients with co-existing heart disease in mind, it is crucial to further expand the research done on this topic to allow for the development of safer treatments for these individuals. As limited resources on this topic were a major limitation of this study, future studies done on the outcomes of different lung cancer treatments, other than surgical treatments, on patients with co-existing heart disease may help attain a better review of the success and safety of such treatments. Other studies done on the effects of lung cancer on patients with co-existing heart disease can also be beneficial for coming up with a new treatment for these patients. In addition to the research, more awareness needs to be brought to the topic of lung cancer and comorbidities as both lung cancer and heart disease incidences continue to grow.

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