Original Article

Black race and lower age at surgery are associated with smoking relapse in a safety-net setting after surgery for stage I non-small cell lung cancer

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Background: Smoking relapse after surgical resection for lung cancer (LC) remains a health concern. This study aims to determine various factors associated with postoperative smoking relapse in patients undergoing surgical resection for stage I non-small cell lung cancer (NSCLC) at an urban safety net hospital.

Methods: We analyzed the demographic and clinical variables of all patients who underwent surgical resection for stage I NSCLC from 2002 to 2016 at our institution. Based on the post-operative smoking history, we segregated the cohort into two groups: relapse and abstinent. Chi-squared and analysis of variance tests were used to identify the variables that registered a significant difference between the two groups. Further, we used univariable and multivariable logistic regression to determine association between variables and smoking relapse.

Results: We analyzed data from 168 patients, excluding those with inadequate smoking history and never smokers. In total, 64 (38.1%) patients experienced smoking relapse, and 104 (61.9%) remained abstinent. The age, annual income, and race showed significant differences between the two groups. Multivariable logistic regression reflected that black patients had higher odds of relapse than white patients [odds ratio (OR) =3.26, confidence interval (CI): 1.54–6.89, P=0.002] and the chances of relapse decreased as the age increased (5-year age gap, OR =0.70, CI: 0.58–0.85, P<0.001).

Conclusions: Black race and younger age at the time of surgery are associated with smoking relapse after surgery for stage I NSCLC. Targeted smoking cessation programs catered towards these patient groups may help reduce the prevalence of post-operative smoking.

Keywords: Non-small cell lung cancer (NSCLC); smoking relapse; diverse patient population; socio-demographic factors affecting smoking relapse; smoking cessation

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Introduction

Globally, lung cancer (LC) is the leading cause of cancer-related mortality, and non-small cell lung cancer (NSCLC) accounts for 85% of the LC diagnosis (1,2). Eighty percent of deaths caused by LC are attributable to cigarette smoking despite it being a modifiable risk factor (3). Additionally, it has been published that racial and ethnic minorities and individuals with low socioeconomic status smoke more regularly and experience tobacco-related illness and death more frequently than the general population (4-6). Even though patients are counseled to quit smoking, especially after the diagnosis of LC has been established, more than half of them are prone to relapse (7).

The higher prevalence of smoking in the vulnerable population is compounded by lower rates of smoking cessation due to barriers present during all phases of access to healthcare. These barriers encountered by the vulnerable population in attempts to quit smoking can be broadly classified into the abilities of the smoker and the dimensions of support available for the same. Lower risk perception, lower self-efficacy, and inability to pay for supportive measures are some of the factors that can be attributed to the individual smoker. Ineffective recruitment strategies for smokers, making smoking cessation a lower priority due to competing health problems, unavailability of supportive measures at the local level, and insufficient intensity and flexibility are examples of barriers attributable to the healthcare system (8).

The consequences of persistent smoking after diagnosis and during LC treatment have been widely studied. Increased risk of all-cause mortality and recurrence have been reported in patients who continue smoking after diagnosis (9). Furthermore, smoking at the time of surgery is associated with increased postoperative complications and poor quality of life, and persistent smoking after surgery is associated with decreased survival, specifically for stage I NSCLC (10-12). Persistent smoking not only contributes to primary LC but also has been associated with an increased risk of second primary lung cancer (SPLC) (13).

Despite the detrimental impact of smoking on the overall prognosis, published data on the rate of smoking relapse after undergoing surgical resection for stage I NSCLC is concerning. A longitudinal study reflected that more than 40% of the patients relapse to smoking after surgery (14). Retrospective analysis of a small number of patients who underwent surgical resection for LC and had survived at least five years reported similar outcomes, as 48% of the former smokers had relapsed to smoking (15). Furthermore, an analysis of the Veteran's Health Administration dataset reported that 58% of their patients continue smoking one year after surgery for LC resection (16).

The rate of smoking relapse after surgery has been widely studied and published, but the factors associated with relapse need further research. We sought to address this knowledge gap by determining the socio-demographic factors associated with smoking relapse after the patients have undergone surgical resection for stage I NSCLC. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-392/rc).

Highlight box

Key findings

- Black race and lower age at the time of surgery are associated with smoking relapse after surgery for stage I non-small cell lung cancer.

What is known, and what is new?

- Despite detrimental effects of smoking at the time of diagnosis and after surgical resection of lung cancer, a substantial proportion of patients relapse to smoking.
- This study examines and highlights the association of demographic and clinical variables associated with smoking relapse after surgery for stage I lung cancer.

What is the implication, and what should change now?

- These findings can help improve the results of smoking cessation programs by helping them concentrate their efforts and resources on a population at a higher risk of smoking relapse.

Methods

Study design and subject population

We performed a retrospective study by reviewing electronic medical records of patients diagnosed with stage I NSCLC from 2002–2016 who underwent surgical resection at Boston Medical Center (BMC). The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was exempt from review by the institutional review board at Boston University/BMC, and individual consent for this retrospective analysis was waived.

Demographic variables including age, sex, race, primary language, and health insurance coverage were documented. Despite our institution catering to a diverse population, the number of patients belonging to races apart from black

and white were very few. Therefore, the major categories for race were white, black and others which included patients that were Asian and Hispanic. We grouped the patients based on whether or not they used English as their primary language of communication. Additionally, the median annual household income was determined based on the residential zip code. We categorized the patients into four groups: the poor or near poor (<$32,048), the lower middle class ($32,048–$53,413), the middle class ($53, 413–$106,827), and the upper middle class (>$106,827) (17).

Smoking status of a patient after surgery was determined by reviewing medical records by two independent researchers. We reviewed at least 5 physician encounter per patient after surgery to confirm if they had relapsed to smoking. We reported if the patient had relapsed to smoking in a binary fashion (yes or no). Time to relapse was not calculated due to variable information volunteered by the patients during clinical encounters regarding their smoking habits. If there was no information about the smoking status in the records, these patients were excluded from the study due to insufficient smoking data. Other clinical variables recorded were age at the time of surgery, pathological stage (IA and IB), type of surgery: video-assisted thoracoscopic surgery (VATS) or open, and extent of resection (lobectomy, segmentectomy, wedge resection, and pneumonectomy).

Statistical analysis

Descriptive statistics were applied to the demographic and clinical variables. We used the Pearson chi-square test for categorical variables and the analysis of variance (ANOVA) test for continuous variables to identify differences between the two groups. Furthermore, we performed the univariable and multivariable logistic regression analysis to determine the association between variables that registered a significant difference between the two groups and smoking relapse. All statistical analyses were conducted with R 4.3.2 software (R foundation for statistical computing).

Results

A total of 288 patients underwent surgical resection for stage I NSCLC at our institute from 2002–2016. We excluded 28 patients who were never smokers and 92 patients with insufficient information regarding their smoking status after surgery due to lack of documentation or lost to follow-up. The final study cohort comprised 168 patients, and their data were analyzed.

The study population comprised of 108 (64.3%) white patients, 46 (27.4%) black patients, and 14 (8.3%) patients belonging to other races. Our cohort had a female predominance, with 100 (60.6%) female patients. English was the primary language spoken by 156 (92.8%) patients. According to income, the majority were from the middle class 101 (60.1%), followed by lower-middle class 51 (30.3%), and poor 16 (9.6%). The number of patients covered by private health insurance was 66 (39.3%), 81 (48.2%), and 21 (12.5%) had their expenses covered by Medicare and Medicaid respectively (*Table 1*).

Regarding clinical data, our study cohort's mean cumulative smoking pack year was 48.3. The mean age at the time of surgery was 64.7 years. Most of our patients were diagnosed with stages IA [n=149, (88.7%)]. VATS was performed more frequently than open surgeries [92 (54.8%) *vs.* 76 (45.2%)]. Lobectomy was the procedure of choice as it was performed on 114 (67.9%) patients, followed by wedge resection on 31 (18.4%) patients, segmentectomy on 21 (12.5%) patients and pneumonectomy on 2 (1.2%) patients. Finally, 22 (13.1%) patients died of all-cause mortality within ten years of surgery.

Differences between the relapse and abstinent group

Of 168 patients, 64 (38.1%) relapsed to smoking after surgery, and 104 (61.9%) remained abstinent. Significant differences were observed between the two groups concerning race, annual income, and age at the time of surgery. The proportion of white patients abstaining from smoking after surgery was more than black patients [77 (71.3%) *vs.* 20 (43.5%), P=0.003]. For annual household income, the number of patients that remained abstinent increased in successively higher income groups (P<0.001). ANOVA test reflected that age at surgery registered a statistically significant difference between the two groups (P<0.001). Sex of the patient (P=0.6), cumulative smoking history in pack years (P=0.7), stage of the primary tumor (P>0.99), type of surgery (VATS *vs.* open, P>0.99), extent of resection (P=0.7), and type of health insurance (P=0.1) did not show a significant difference between the two groups (*Table 2*).

Factors associated with smoking relapse after surgery

We performed univariable logistic regression to establish an association between co-variates and smoking relapse.

Table 1 Demographic table for overall study population

Variables	Overall (n=168)
Smoking status after surgery	
Relapse	64 (38.1%)
Abstinent	104 (61.9%)
Sex	
Male	68 (40.4%)
Female	100 (60.6%)
Race	
White	108 (64.3%)
Black	46 (27.4%)
Others	14 (8.3%)
Primary language	
English	156 (92.8%)
Other languages	12 (7.2%)
Income	
Poor	16 (9.6%)
Lower-middle class	51 (30.3%)
Middle class	101 (60.1%)
Type of health insurance	
Private	66 (39.3%)
Medicare	81 (48.2%)
Medicaid	21 (12.5%)
Stage	
IA	149 (88.7%)
IB	19 (11.3%)
Type of surgery	
VATS	92 (54.8%)
Open	76 (45.2%)
Type of anatomical resection	
Lobe	114 (67.9%)
Segment	21 (12.5%)
Wedge	31 (18.4%)
Pneumonectomy	2 (1.2%)
Mean pack-year†	48.3 (34.1)
Mean age at surgery†	64.7 (10.1)
All-cause mortality	22 (13.1%)

†, expressed as mean (standard deviation). VATS, video-assisted thoracoscopic surgery.

Table 2 Differences between two groups

Variables	Relapse	Abstinent	P value
Sex			
Male (n=68)	24 (35.3%)	44 (64.7%)	0.6
Female (n=100)	40 (40.0%)	60 (60.0%)	
Race			
White (n=108)	31 (28.7%)	77 (71.3%)	0.003*
Black (n=46)	26 (56.5%)	20 (43.5%)	
Others (n=14)	7 (50.0%)	7 (50.0%)	
Primary language			
English (n=156)	60 (38.5%)	96 (61.5%)	0.9
Other languages (n=12)	4 (33.3%)	8 (66.7%)	
Income			
Poor (n=16)	7 (43.7%)	9 (56.3%)	<0.001*
Lower-middle class (n=51)	30 (58.8%)	21 (41.2%)	
Middle class (n=101)	27 (26.7%)	74 (73.3%)	
Type of health insurance			
Private (n=66)	24 (36.4%)	42 (63.6%)	0.1
Medicare (n=81)	28 (34.6%)	53 (65.4%)	
Medicaid (n=21)	12 (57.1%)	9 (42.9%)	
Stage			
IA (n=149)	57 (38.3%)	92 (61.7%)	>0.99
IB (n=19)	7 (36.8%)	12 (63.2%)	
Type of surgery			
VATS (n=92)	35 (38.1%)	57 (61.9%)	>0.99
Open (n=76)	29 (38.2%)	47 (61.8%)	
Extent of anatomical resection			
Lobe (n=114)	40 (35.1%)	74 (64.9%)	0.7
Segment (n=21)	9 (42.9%)	12 (57.1%)	
Wedge (n=31)	14 (45.2%)	17 (54.8%)	
Pneumonectomy (n=2)	1 (50.0%)	1 (50.0%)	
Smoking history in pack-years†	48.1 (35.5)	48.4 (33.4)	0.7
Age at surgery†	60.9 (9.4)	67.1 (9.80)	<0.001*

The data are shown as the number (%) or mean (SD), *, represents statistically significant P value; †, analyzed using ANOVA test. VATS, video-assisted thoracoscopic surgery; ANOVA, analysis of variance.

Table 3 Univariate logistic regression analysis

Variable	OR	CI	P value	Overall P value
Race (*vs.* White)				
Black	3.22	1.57–6.61	0.001*	0.003*
Others	2.48	0.80–7.67	0.11	
Age†	0.70	0.59–0.84	<0.001*	
Annual income (*vs.* poor)				
Lower-middle class	1.83	0.59–5.71	0.29	<0.001*
Middle-class	0.46	0.15–1.38	0.17	

†, calculated odds ratio for a 5-year age gap; *, represents statistically significant P value <0.05. OR, odds ratio; CI, confidence interval.

Table 4 Multivariate logistic regression analysis

Variable	OR	CI	P value	Overall P value
Race (*vs.* White)				
Black	3.26	1.54–6.89	0.002*	0.007*
Others	1.85	0.54–6.28	0.32	
Age†	0.70	0.58–0.85	<0.001*	

†, calculated odds ratio for a 5-year age gap; *, represents statistically significant P value <0.05. OR, odds ratio; CI, confidence interval.

During our analysis, we excluded data regarding pneumonectomies as the sample size was too small to establish a confidence interval. The results revealed that the patient's race and age at surgery were associated with smoking relapse (*Table 3*). These variables maintained their statistical significance as the multivariable logistic regression reflected that black patients were more likely to experience smoking relapse after surgery than white patients (odds ratio =3.26; P=0.002). Additionally, the calculated odds ratio for age difference reflects that a patient has a 30% less chance of experiencing smoking relapse when compared to a patient who is five years younger (odds ratio =0.70; P<0.001) (*Table 4*).

Discussion

Current study determined the prevalence of postoperative smoking relapse in patients who underwent surgical resection for stage I NSCLC at an urban, safety net hospital. A safety net hospital provides health care services to uninsured, unhoused, and other vulnerable patients thereby catering to a diverse population. Furthermore, we focused on determining the possible clinical-demographical variable associated with smoking relapse. To keep our study population uniform, we only included patients with stage I NSCLC. We found that 38.1% of our cohort had relapsed to smoking after surgery. These results are like those published by Davison and Duffy, who reported that 48% of their patients became regular smokers again after a year of surgery (15). Similarly, Walker *et al.* conducted a focused study with a larger sample size of 154 patients with early-stage NSCLC and reported that 42.9% of the patients had relapsed to smoking after surgery (14). The fact that more than one-third of our patients relapsed to smoking is very concerning, as persistent smoking after surgery for LC is associated with poor postoperative quality of life and diminished long-term survival (10,16). Furthermore, the odds of developing recurrent LC or SPLC increase with persistent smoking after surgery (13,18).

In addition to determining the relapse rate, we aimed to delineate the at-risk population as our hospital caters to safety net patients from racial and ethnic minorities and low socioeconomic status. Our results indicate that race is a significant factor, as black patients were 3.26 times more likely to relapse when compared with white patients. It is known that patients belonging to racial minorities tend to smoke more regularly and experience tobacco-related illness and death more frequently than the general population (4-6). Our results highlight that these patients may also be at risk for relapsing or continuing to smoke after curative intent surgery.

The increased rate of smoking prevalence can be mitigated by practical smoking cessation efforts comprising both pharmaceutical adjuvants and non-medical measures to address the underlying problems. However, multiple barriers exist in all phases of care that makes it very difficult for the patient to quit smoking. van Wijk *et al.* summarized these barriers and classified them in to two broad groups: the abilities of a smoker from the vulnerable population to quit smoking and problems related to the dimensions of support available (8). Smokers in the at-risk population have low motivation to quit and have a lower risk perception due to inadequate information about the toxic effects of smoking (19,20). Smoking also serves as an automatic coping mechanism to the stressful living conditions (21). The pro smoking social norms in this population due to

high acceptance of smoking and embedment of smoking in social structures diminishes the ability of a smoker to perceive the need for support (22). Other problems related to the dimensions of support available to quit smoking are ineffective recruitment strategies, presence of competing health problems that make smoking cessation a lower priority and higher costs of healthcare which make it unaffordable for a smoker to utilize these support measures (8,23).

The fact that smoking cessation measures can be hard to access for a population that resembles our cohort are verified by the results of several studies. Fu *et al.* found that medical interventions to address tobacco dependence are less available for minority groups (24). Cokkinides *et al.* reported that compared to non-Hispanic white smokers, non-Hispanic black and Hispanic smokers were significantly less likely to have been screened for tobacco use and advised to quit by their healthcare provider (25). Furthermore, it has been reported that racial and ethnic minorities were less likely to use effective smoking cessation methods (24,26). This hesitation might be due to multiple reasons, such as difficulty accessing these resources, inability to afford recommended solutions, and lack of information. A comprehensive approach involving healthcare professionals and social workers can yield better results as this will provide a multi-pronged approach to the problem.

Our initial findings revealed that the proportion of patients that experienced smoking relapse reduced in successively higher income classes. These finding aligns with the fact that smoking is becoming increasingly concentrated among individuals with the lowest education, income, and occupational status levels (27). Another finding of significant importance was the age at the time of surgery, as an older patient had a 30% less chance of smoking relapse than a patient five years younger. These findings can help improve the results of smoking cessation programs by helping them concentrate their efforts and resources on a population at a higher risk of smoking relapse. Many institutions, including ours, have an established smoking cessation program, which is effective (28).

The strength of this study was that it was conducted at a safety net hospital that caters to a diverse population, as evidenced by a higher proportion of black and lower-income patients. These results help elucidate the factors that affect the minority population that might not be present in studies conducted at a national level as the composition of their cohort is significantly different. This study also had some limitations. The fact that this study was conducted in a single institute and the smoking history of 92 patients could not be traced resulted in a small sample size affecting the study's power reflected in broad confidence intervals for various parameters. Furthermore, the association between annual income and smoking relapse could not be established despite the fact there were significant differences between the two groups.

Conclusions

This study highlights that black and younger patient have higher chances of smoking relapse after undergoing surgical resection for stage-I NSCLC. These results urge us to conduct research in institutions with diverse cohorts to elucidate further the factors contributing to this persisting problem.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-392/rc

Data Sharing Statement: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-392/dss

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-392/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was exempt from review by the institutional review board at Boston University/Boston Medical Center, and individual consent for this

retrospective analysis was waived.

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