Smoking Relapse during the First Year after Treatment for Early-Stage Non–Small-Cell Lung Cancer

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Abstract

Background: **Non–small-cell lung cancer patients who continue to smoke after cancer diagnosis are more likely to experience disease recurrence, decreased treatment efficacy, and treatment complications. Despite this, many continue to smoke, with estimates ranging from 13% to ∼60%.**
Methods: **Participants were 154 early-stage, non–small-cell lung cancer patients who had smoked within 3 months before surgery. Patients were followed for 12 months after surgery to assess smoking status and duration of continuous abstinence after surgery. Predictors included medical, smoking history, psychosocial, and demographic characteristics.**
Results: **At some point after surgery, 42.9% of patients smoked; at 12 months after surgery, 36.9% were smoking. Sixty percent of patients who lapsed did so during the first 2 months after surgery. Smoking at follow-up was predicted by shorter quit duration before surgery, more intense Appetitive cravings (expectation of pleasure from smoking), lower income, and having a higher level of education. Time until the first smoking lapse was predicted by shorter quit duration before surgery, more intense Appetitive cravings to smoke, and lower income. Among those who lapsed, greater delay before the lapse was associated with abstinence at the 12-month follow-up assessment.**
Conclusions: **Nearly half of non–small-cell lung cancer patients return to smoking after surgery if they have recent smoking histories. Most initial lapses happen within 2 months and occur in response to more recent smoking and more intense cravings. Findings suggest that interventions to prevent relapse should target those who wait until cancer surgery to quit smoking and should be started as soon as possible after treatment.** (Cancer Epidemiol Biomarkers Prev 2006;15(12):2370–7)

Introduction

Smoking is responsible for nearly 90% of all cases of lung cancer in the United States (1, 2). Although the overall lung cancer survival rate is low (3), the most common form, non–small-cell lung cancer, is potentially curable when diagnosed at an early stage (3, 4). Unfortunately, second primary tumors continue to be a problem for patients with lung cancer and other smoking-related cancers (5), especially if they continue to smoke (6, 7). Continued smoking has also been associated with decreased treatment efficacy (8) and increased complications of surgery (9), and may interact with certain cancer treatments (10). It has also been associated with shorter survival (11).

Given the risks of continued smoking, one might assume that most lung cancer patients who smoke at the time of their diagnosis would immediately quit. However, at least seven studies of non–small-cell lung cancer patients have shown that many patients continue smoking despite the risk. These include several smaller studies (12-15) and three larger studies by Gritz et al. (16), Dresler et al. (17), and Sanderson Cox et al. (18). Across the seven studies, estimates of rates of relapse range from a high of ∼60% (13, 16) to a low of just 13% reported by Dresler et al. (17). However, in the Dresler et al. study, the relapse rate was >23% among patients who had smoked within 3 months before surgery. As Sanderson Cox noted, such variability in the reported rates of relapse must be interpreted in light of differences in patient groups under study, differences in their stage of disease and treatment regimen (18).

These studies also investigated predictors of continued smoking among lung cancer patients. Sanderson Cox et al. (18) reported that current smokers at study entry had a heavier smoking history than former smokers. Walker et al. (15) reported that patients who were younger and less educated were more likely to return to smoking after surgery. In addition, they found that patients who reported greater smoking urges and patients who had quit for a shorter time before surgery were more likely to be smokers. Among lung cancer patients and head and neck cancer patients, Schnoll et al. (19) showed that low perceived risk of smoking, perceived disadvantages of quitting, and low self-efficacy for quitting were associated with continued smoking.

This study reports the smoking behavior of a sample of early-stage non–small-cell lung cancer patients who smoked within 3 months before their diagnosis. Predictors for the study were based on previous findings about the roles of demographic characteristics (15, 20, 21), alcohol use (22-25), smoking history (18, 20), cravings to smoke (15, 26), nicotine dependence (21, 27, 28), social support (15, 29-32), and depression (33-38) in smoking or relapse.

This article extends the existing research by examining (*a*) the role of baseline nicotine dependence as a predictor of relapse in this population, (*b*) other clinical and psychosocial predictors of relapse, (*c*) the timing of smoking lapses during the first year following surgery, and (*d*) the prevalence of smoking longitudinally across three time points during the first year following surgery. Consistent with previous research, we hypothesized that greater nicotine dependence, younger age, and lower level of educational attainment would be associated with greater likelihood of smoking.

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Materials and Methods

Setting and Participants. Data for this study were collected as part of an ongoing longitudinal study in which patients are followed for up to 3 years. The primary focus is the identification of psychological and behavioral predictors of relapse to smoking. The study is being conducted through the Alvin J. Siteman Cancer Center at Barnes-Jewish Hospital and Washington University School of Medicine. Participants were patients who had undergone surgical resection for stage I or II non–small-cell lung cancer at Siteman Cancer Center in St. Louis, Missouri and at M.D. Anderson Cancer Center in Houston, Texas. The study was limited to those who smoked within 3 months before diagnosis because these patients were believed to remain at high risk of relapse following surgery. We excluded patients if they suffered from obvious cognitive impairment, if they were unable to read and understand English, and if they were obviously too ill to participate. No smoking cessation intervention was delivered as part of this study. However, most patients were routinely advised by their physician to quit smoking, and participants who asked study staff about smoking cessation resources were referred to their physicians and to community resources such as the American Lung Association programs. Participants were recruited between May 2001 and May 2005.

Procedure. Potentially eligible patients were identified by the physician's assistant who worked on the surgical unit and through review of surgery schedules and records. Patients were recruited during their inpatient stay after surgery or during the week following their discharge. After obtaining informed consent, the research assistant administered a written questionnaire assessing demographic characteristics and smoking history. Participants also completed an oral interview that included measures of social support, cravings to smoke, and depression. These measures were administered orally at baseline, rather than in writing, because they were part of the follow-up assessment battery scheduled to be administered entirely by telephone at 3, 6, 12, 24, and 36 months. Oral administration at baseline was conducted face to face or by telephone. The Protocol Review and Monitoring Committee at Siteman Cancer Center and the Institutional Review Boards at Washington University School of Medicine and M.D. Anderson Cancer Center approved all study procedures.

Measures

Demography. The survey assessed basic demographic characteristics, including age, race, sex, education, family income, and employment status.

Medical Characteristics. Date of surgery, stage of disease, and Eastern Cooperative Oncology Group performance status, a measure of functional impairment, were abstracted from the medical record.

Alcohol. Alcohol use was assessed in this study with the CAGE alcohol use screening instrument (39) and with three questions assessing recent use.

Smoking. A smoking history questionnaire was developed for this study and included age started smoking, amount smoked before quitting, length of time quit before surgery, number of other smokers in the home, and use of nicotine replacement when quitting. Follow-up interviews at 3, 6, and 12 months after surgery assessed whether patients had smoked since surgery, length of complete abstinence following surgery, and current smoking status. Patients were coded as currently smoking if they answered yes to the question, ''Do you currently smoke?'' or if they scored positive on a test of salivary cotinine, described below.

Current smoking status was biochemically verified with cotinine assays of saliva samples planned to coincide with the 3- and 12-month interviews. These time points were selected to coincide with the patient's first follow-up medical visit (3 months) and with the widely used standard assessment point in smoking cessation research (12 months). Saliva samples were collected with the OraSure Oral Specimen Collection Device (OraSure Technologies, Bethlehem, PA) with the cutoff for positive indication of smoking set at cotinine >10 ng/mL.

Nicotine Dependence. The six-item Fagerstrom Test of Nicotine Dependence was used to assess severity of nicotine dependence (40). This measure is a face-valid index of nicotine dependence that was revised from the earlier Fagerstrom Tolerance Questionnaire (41) and has been widely used in tobacco research. Instructions for this measure specified that patients answer about their smoking behavior before quitting and before experiencing any symptoms of lung cancer.

Social Support. The Social Support Inventory is a 27-item measure of social support that has been used in varied studies of health behavior, including those related to HIV, lupus, diabetes, and cancer (15, 42, 43). The Social Support Inventory distinguishes between Directive support (taking over, prescribing feelings and behavior) and Nondirective support (assisting and cooperating without taking over; refs. 42, 43). Among adults with lung cancer, Directive and Nondirective support were differentially related to urges to smoke (15) and to psychological adjustment over time (44).

Depression. The Beck Depression Inventory is a 21-item self-report measure of depression that is widely used in health behavior research. The Beck Depression Inventory is moderately sensitive and specific for detecting clinically significant depression in medical patients, and its validity and reliability have extensively been documented (see ref. 45 for a review). Technically a measure of depressive symptoms rather than depression, higher values on this measure reflect more (or more intense) depressive symptoms.

Cravings. Participants completed the 32-item Questionnaire of Smoking Urges, developed by Tiffany and Drobes (46) to assess desire to smoke along two dimensions. These dimensions correspond to Appetitive cravings, reflecting expectations of positive consequences of smoking, and Aversive cravings, reflecting the expectation that smoking will reduce negative affect and/or withdrawal symptoms. Appetitive items from the Questionnaire of Smoking Urges include, ''A cigarette would be very satisfying now,'' and, ''Smoking now would make things seem just perfect.'' Aversive items include, ''Smoking would make me less depressed,'' and, ''I would be less irritable now if I could smoke.'' Appetitive and Aversive cravings were shown to correlate at about $r = 0.7$ (46), and somewhat higher in our previous work (15), but were also shown to measure distinct aspects of craving (46). The Questionnaire of Smoking Urges is valid and reliable and correlates highly with other measures of craving (46).

Statistical Analysis. We calculated zero-order Pearson correlation coefficients to examine the simple relationships among continuous variables in the model. We employed generalized estimating equations with robust SEs to examine predictors of smoking status at 3, 6, and 12 months after surgery. Estimated odds ratios (OR), 95% confidence intervals (95% CI), and P values are reported. We used backward elimination to identify explanatory variables to include in the model, and used the Wald test to compare models with and without a particular variable (47). Cox regression was used to predict time until first smoking lapse following surgery. Hazard ratios, 95% CIs, and P values are reported for these analyses also. We identified explanatory variables using the likelihood ratio test to compare models with and without a particular variable (47). Two-tailed results were interpreted and α was set at 0.05 for all analyses. Statistical analyses were conducted using SPSS version 13.0 and SAS version 9.0.

Results

Sample Characteristics. Through review of surgical records and schedules, we identified 815 potentially eligible patients who had surgery for clinical stage I or II non–small-cell lung cancer, whose medical charts indicated that they had a smoking history. Figure 1 illustrates enrollment of patients into the study. As indicated in the figure, 200 patients were found eligible and agreed to participate, 6 were subsequently excluded as ineligible, 3 died before providing any data, and 25 withdrew or were unreachable before providing any study data. Data collection was pending on another 12 patients. The remaining 154 provided data about time until the first smoking lapse or smoking status at 3, 6, or 12 months and constitute the final study sample.

Participants were 52% female and 83% white, with a mean age of 58.5 years (SD, 10.1). Fifty-two percent of patients had at least some college education. Smoking history and psychosocial characteristics of the sample are reported in Table 1.

Cotinine Assay Analysis and Point Prevalence of Smoking. Of 154 patients in the sample, 131 reported their smoking status at either the 3-, 6-, or 12-month follow-up assessment. The remaining 23 patients had only completed the baseline assessment, but in some cases this was done several weeks after surgery. These 23 patients therefore contributed data on smoking during the early postsurgical period (first several weeks after surgery) and these data were included in the Cox regression analysis of time until the first smoking lapse. However, they contributed no data to the analysis of smoking status at 3, 6, and 12 months.

Of the 131 who reported their smoking status at a follow-up assessment, at least one cotinine assay was completed on 108 (82%) patients. However, due to variability in the scheduling of follow-up office visits, saliva samples were sometimes collected much later (or earlier) than anticipated. Therefore, to assess the reliability of self-reported smoking status, saliva samples were matched to self-report of smoking status when they occurred within 30 days of each other. Those collected outside this interval were considered not valid as a measure of the reliability of self-reported smoking.

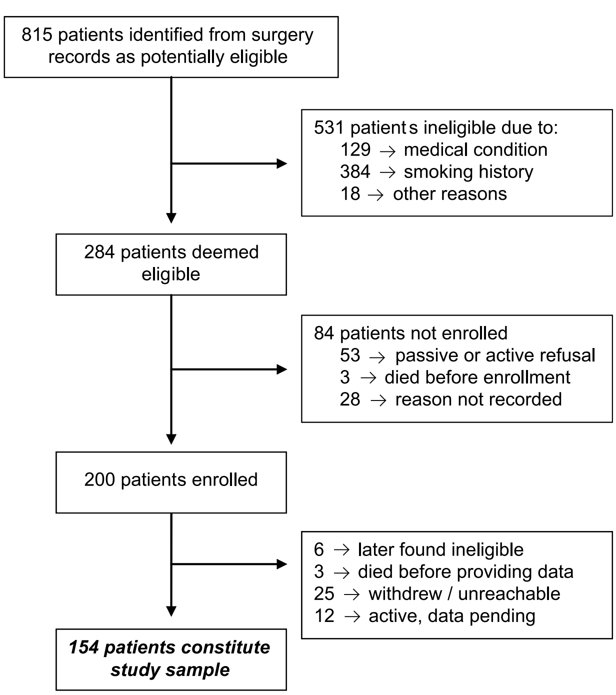

Figure 1. Flow diagram of enrollment of patients in study.

Table 1. Smoking history and psychosocial characteristics of sample

Smoking history	N = 154
Age started smoking (y)	16.8 (5.8)*
Daily cigarettes smoked before quitting at or before surgery	24.6 (12.2)
Using nicotine replacement at baseline	13.1%
At least one other smoker in the home	33.1%
Quit duration before surgery (d)	35.0 (41.7)†
Smoking status (without adjustment for false reporting)	
3-mo follow-up (n = 123)	29 (23.6%)
6-mo follow-up (n = 103)	31 (30.1%)
12-mo follow-up (n = 84)	28 (33.3%)
Any lapse since surgery (n = 154)	63 (40.9%)
Smoking status (adjusted for false reporting)‡	
3-mo follow-up (n = 123)	33 (26.8%)
6-mo follow-up (n = 103)	31 (30.1%)
12-mo follow-up (n = 84)	31 (36.9%)
Any lapse since surgery (n = 154)	66 (42.9%)
Estimated smoking status (extrapolated from rate of underreporting)§	
3-mo follow-up (n = 123)	(30.1%)
6-mo follow-up (n = 103)	(36.6%)
12-mo follow-up (n = 84)	(39.6%)
Any lapse since surgery (n = 154)	(45.1%)
Smoking status (adjusted for false reporting, and assuming dropouts were smokers)‡,‖	
3-mo follow-up (n = 133)	43 (32.3%)
6-mo follow-up (n = 119)	47 (39.5%)
12-mo follow-up (n = 93)	40 (43.0%)
Any lapse since surgery (n = 154)	78 (50.6%)
Psychological characteristics	
Fagerstrom Test of Nicotine dependence >4¶	48.7%
Beck Depression Inventory ≥16**	27.9%
Questionnaire of Smoking Urges—Appetitive	2.16 (1.18)
Questionnaire of Smoking Urges—Aversive	1.78 (1.06)

*Mean (SD).
† Median quit duration was 20 days.
‡ Adjustment was made only among 44% of cases in which biochemical verification was available.
§Rates for the entire sample are estimated based on the rate of underreporting in the 44% of cases across all time points in which biochemical verification was available. Only percentages are reported because values are extrapolated.
‖Patients who could have provided follow-up data but did not were coded as smoking.
¶Mean, 4.52; SD, 2.23.
**Mean, 11.3; SD, 7.9.

We carefully examined the timing and pattern of self-report and cotinine assay results in each discrepant case. Patients who reported not smoking and not using nicotine replacement therapy, but had a positive cotinine assay, were recorded as smoking at that follow-up assessment, and time until the first smoking lapse was recorded as no later than the date of a positive cotinine assay. This approach provided cotinine data for validation of 44% of the self-reports at the 3- and 12-month follow-up assessments (the time points for which cotinine assays were planned). Provision of saliva samples and response rate by follow-up assessment are reported in Table 2.

κ statistics were then calculated to assess the reliability of self-reported smoking status. Results showed that the reliability of self-reported smoking status was technically good as measured against salivary cotinine at both 3 and 12 months (κ = 0.817, P < 0.001; κ = 0.835, P < 0.001) but involved a systematic underreporting bias, indicating that one in six who had relapsed did not admit it.

The self-reported rates (*unadjusted rates*) of smoking at 3, 6, and 12 months in this sample were 23.6%, 30.1%, and 33.3%, respectively. Considering biochemical verification among those on whom valid cotinine assays were available, the rates (*adjusted rates*) were 26.8%, 30.1%, and 36.9%, respectively. Note that the unadjusted and adjusted rates for the 6-month

Table 2. Response rates and rates of biochemical verification, by follow-up assessment

	3 mo	6 mo	12 mo
Completed follow-up assessment*	123/133 (92.5%)	103/119 (86.6%)	84/93 (90.3%)
Provided saliva samples for cotinine assay †	54/123 (43.9%)	16/103 (15.5%)	37/84 (44.0%)

*Includes all patients alive at the time of the scheduled follow-up assessment and for whom the assessment was scheduled before the cutoff for data analysis.
† Includes samples collected within 30 days of the self-report. Note that 24 patients provided samples that could not be matched to any self-report based on this criterion.

assessment are identical because there were few cotinine samples collected in conjunction with the 6-month assessment. Unless otherwise indicated, the analyses reported in the following sections used the adjusted rates—smoking status adjusted for biochemical verification where it was available—as the primary outcome.

As expected, there was no difference in the rate of self-reported smoking between those on whom cotinine assays were conducted and those on whom they were not. Assuming that the rate of underreporting was consistent across these two groups, we estimate that the true rates (*estimated rates*) of smoking at 3, 6, and 12 months in this sample were 30.1%, 36.6%, and 39.6%, respectively.

We also calculated smoking rates assuming that patients who failed to complete the 3-, 6-, and 12-month assessments were in fact smoking (*adjusted rates including dropouts*). Under this assumption, the rates for the three follow-up assessments were 32.3%, 39.5%, and 43%.

Predictors of Relapse to Smoking. Generalized estimating equations were used to examine key demographic, medical, smoking history, alcohol use, and psychosocial variables as predictors of self-reported smoking status at 3, 6, and 12 months after surgery. Backward elimination was used for entry of candidate variables in the analysis.

Demographic predictors examined for inclusion were gender, age at surgery, race, marital status, education, and income. Medical variables examined for inclusion were stage of disease, Eastern Cooperative Oncology Group performance status, and body mass index. Smoking history variables included daily consumption before quitting, quit duration before surgery, nicotine dependence as measured by the Fagerstrom Test of Nicotine Dependence, age started smoking, and use of nicotine replacement therapy at baseline. Alcohol use measures included the CAGE and three questions about current alcohol use. Psychosocial variables included baseline measures of Appetitive cravings, Aversive cravings, depressive symptoms, and social support.

Results supported a model in which smoking at 3, 6, and 12 months was predicted by education, income, quit duration before surgery, and Appetitive cravings to smoke. Table 3 reports the adjusted ORs, significance levels, and 95% CIs for each variable in the model. As shown in the table, greater likelihood of smoking was associated with higher educational status, lower income, shorter quit duration before surgery, and greater Appetitive cravings, each variable controlling for the others. Quit duration before surgery was modeled as the log of days quit to reflect the nonlinear effect of this variable, indicating that the influence of this variable decreased with increasing quit duration. Marital status approached significance for inclusion in the model (OR, 0.48; 95% CI, 0.20-1.18, $P = 0.11$), suggesting a tendency for unmarried patients to be more likely to be smoking at follow-up, controlling for other variables in the analysis.

We also developed a predictive model using the adjusted rates including dropouts (i.e., assuming that patients who did not complete the 3-, 6-, and 12-month assessments were smokers). Results differed somewhat from the model described above. As shown in Table 3, smoking at 3, 6, and 12 months was predicted by shorter quit duration before surgery and greater Appetitive cravings, as in the previous model. However, educational status and income fell short of statistical significance (p to enter = 0.14 and 0.051, respectively), although the direction of their effects were as described in the previous model. In addition, smoking at 3, 6, and 12 months in this model was predicted by male gender, being unmarried, and use of nicotine replacement therapy at baseline.

Table 3. Adjusted effects of covariates on smoking outcomes among resected lung cancer patients

	Smoking at 3, 6, and 12 mo after surgery	
	Adjusted OR (95% CI)	P*
Based on adjusted rates		
Some college (vs high school or less)	2.73 (1.21-6.17)	0.016
Household income (per $5,000)	0.86 (0.79-0.94)	<0.001
Quit duration before surgery (log-days)	0.75 (0.6-0.95)	0.017
Appetitive cravings	3.62 (2.1-6.22)	<0.0001
Based on adjusted rates including dropouts		
Male (vs female)	2.08 (1.00-4.32)	0.050
Married or living together (vs not)	0.35 (0.16-0.77)	0.009
Used nicotine replacement therapy at baseline (vs not)	1.93 (1.00-3.71)	0.050
Quit duration before surgery (log-days)	0.75 (0.60-0.94)	0.012
Appetitive cravings	2.74 (1.71-4.38)	<0.0001
	Time to smoking lapse	
	Adjusted hazard ratio (95% CI)	P †
Household income (per $5,000)	0.93 (0.89-0.98)	0.003
Quit duration before surgery (log-days)	0.75 (0.65-0.87)	<0.001
Appetitive cravings	1.57 (1.16-2.11)	0.004

*Based on the Wald test.
† Based on the likelihood ratio test.

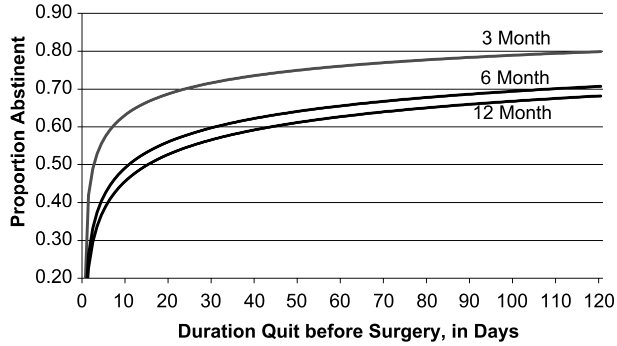

Figure 2. Predicted proportion of patients continuously abstinent at 3, 6, and 12 months after surgery, by quit duration before surgery.

Time until First Smoking Lapse. As in the generalized estimating equation analysis, the Cox regression analysis examined key demographic, medical, smoking history, alcohol use, and psychosocial variables as predictors of time until the first smoking lapse. Results showed that time until smoking lapse was predicted by a model that included income, quit duration before surgery, and Appetitive cravings to smoke, χ^2 (3, N = 154) = 39.394, $P < 0.001$. As above, quit duration before surgery was modeled as the log of days quit to reflect the nonlinear effects of this variable. Gender fell short of significance by conventional criteria (P = 0.086) but was included as a stratification variable in the analysis because the difference in time to smoking lapse across gender seemed to be clinically relevant (if not statistically significant). Greater risk of smoking lapse was associated with having less income, having a shorter quit duration before surgery, having greater Appetitive cravings, and (nonsignificantly) being male. We also tested whether desire to smoke was more strongly associated with time until the first smoking lapse among recent smokers. However, the interaction between quit duration and Appetitive cravings was nonsignificant, indicating that the effect of Appetitive cravings in predicting time to smoking lapse did not vary with quit duration before surgery.

Figure 2 illustrates the relation between quit duration and predicted cumulative survival at 3, 6, and 12 months for male lung cancer patients with median income and cravings. Table 3 reports the adjusted hazard ratios, significance levels, and 95% CIs for covariates in the model. Figure 3 shows predicted survival for male and female lung cancer patients at the median values of income ($35,000), cravings (1.53), and quit duration before surgery (20 days).

Additional Analyses. In the model of adjusted smoking rates, we found that higher education was associated with greater likelihood of smoking at follow-up. This is at odds with most of the literature about education and smoking (48-51). Therefore, to follow-up on this unexpected finding, we conducted tests of group differences to ascertain whether education was confounded with indicators of dependence in this sample. Such confounding might explain the effect of education and the nonsignificance of dependence in predicting smoking status at follow-up. T tests of educational level (high school or less versus some college) were nonsignificant for quit duration before surgery, age started smoking, daily smoking rate before quitting, and Fagerstrom Test of Nicotine Dependence (all $P > 0.20$). A χ^2 test of independence indicated no difference between education groups in the proportion that used nicotine replacement therapy when quitting. Binary logistic regression analyses were conducted to further explore the possible confounding of education with indicators of dependence such as Fagerstrom Test of Nicotine Dependence. Fagerstrom Test of Nicotine Dependence was marginally unrelated to smoking status at 12 months, unrelated in a multivariate model, and the effect of education was essentially unchanged by the inclusion of Fagerstrom Test of Nicotine Dependence in a multivariate model. Overall, these analyses failed to support the presence of confounding between nicotine dependence and education.

Although 42.9% of the total sample of 154 patients lapsed at some point after surgery, this percentage includes 23 patients on whom limited longitudinal data were available (i.e., those who completed only the baseline measures within the first few weeks after surgery). Among the 131 patients who completed at least one follow-up assessment, the lapse rate was 50.4%, and it was 51.2% (n = 43) among the 84 patients who completed the 12-month follow-up. Because a smaller number (31 patients) reported (or were biochemically shown to be) smoking at the 12-month follow-up, these values indicate that 12 of 43 patients who lapsed at some point after surgery were nonsmokers by the 12-month follow-up.

In this sample of 43 patients, we examined Appetitive cravings at baseline, quit duration before surgery, and duration of abstinence after surgery (i.e., time until the first smoking lapse) as predictors of smoking status at 12 months. Results of this analysis showed that Appetitive cravings and quit duration before surgery, both significant predictors of time until smoking lapse, did not significantly predict subsequent abstinence among those who had lapsed. Instead, results showed that only time to smoking lapse (log-transformed) significantly predicted smoking status at 12 months (P = 0.017). Because of the log transformation, the OR varied along the continuum of time until smoking lapse. However, the odds of quitting at 12 months for a patient who lapsed exactly 30 days after surgery was 1.84 (1.12-3.02) times the odds for a patient who did not lapse until 60 days. Thus, the longer patients waited before smoking, the more likely the smoking episode was to be temporary, and the less likely patients were to be smoking at 12 months. These findings strongly suggest the importance of latency to relapse as a criterion measure in research on smoking cessation in medical populations such as this.

Returning to analyses of the entire sample, Appetitive cravings were more strongly associated with relapse than were Aversive cravings. Because these variables overlap significantly (r = 0.796, $P < 0.001$), Aversive cravings made no independent contribution to the prediction of relapse. To

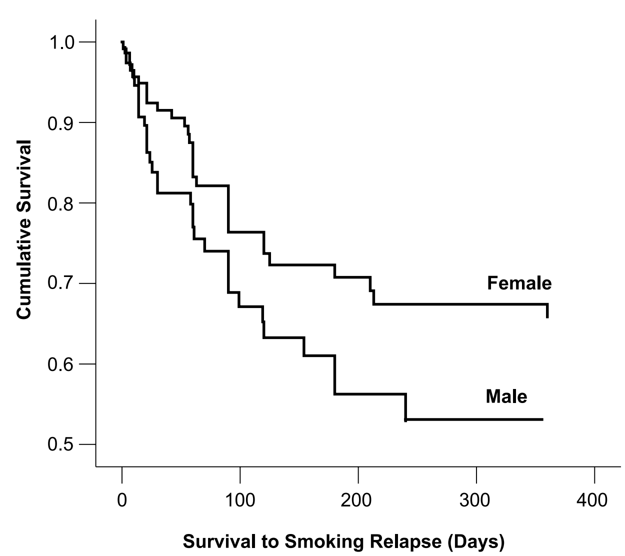

Figure 3. Survival to smoking lapse after surgery for early-stage lung cancer.

Table 4. Ratio of patients relapsed at 3 months after surgery, by baseline Appetitive and Aversive cravings (*n* = 123)

		Appetitive cravings	
		Moderate/weak	Strong
Aversive cravings	Moderate/weak	9/70 (13%)	5/13 (38%)
	Strong	1/6 (17%)	18/34 (53%)

explore further the association of these variables with relapse, we dichotomized Appetitive and Aversive cravings to provide categories corresponding to strong and moderate to weak cravings. Table 4 shows the proportion of patients who were smoking at 3 months within each class of Appetitive and Aversive cravings.

As shown by the frequency of cases on the main diagonal, the intensities of Appetitive and Aversive cravings were strongly related. However, strong Appetitive craving was associated with a high risk of relapse even when Aversive craving was weak. In contrast, strong Aversive craving was not associated with relapse unless Appetitive craving was also strong.

Finally, we considered the possibility that Aversive cravings might interact with depression in predicting smoking status. We therefore examined the effect of this interaction on smoking status at 12 months. Results were clearly nonsignificant, indicating that the effect of Aversive cravings did not vary with depressive symptoms.

Discussion

This study examined relapse to smoking among non–small-cell lung cancer patients who smoked within 3 months before surgery. Results showed that nearly half of the patients smoked at some point during the first year after surgery, and ~37% were smokers at the 12-month follow-up. Examination of time to smoking lapse and of smoking status at 3, 6, and 12 months both indicate that shorter quit duration before surgery, more intense Appetitive cravings at baseline, and lower income were associated with greater risk of relapse. Findings also suggested that having more education was a risk factor for smoking at follow-up.

These findings support previous research that shows that continued smoking after treatment is a common problem among lung cancer patients (12, 15, 16, 18). However, our results also contribute to the understanding of the timing of relapse and to the identification of risk factors for relapse. Although our data do not distinguish between isolated slips or lapses and full-blown relapses, our results showed that patients were at risk of smoking almost immediately after discharge from the hospital following surgery. Most (60%) of those who experienced a lapse or relapse did so within the first 2 months after surgery. Our analysis also showed that more than one in four patients who smoked after surgery were nonsmokers at the 12-month follow-up, highlighting the appreciable plasticity of smoking behavior in this population, consistent with previous findings (16). Notably, among patients who did smoke after surgery, the longer they waited before smoking, the less likely they were to be smokers at 12 months. Thus, although those who waited longer before smoking had less time to regain complete abstinence by the 12-month follow-up, their smoking was apparently more likely to be transient.

Biochemical verification of smoking status was available for only 44% of patients who completed the 3- and 12-month follow-up assessments. Among these, cotinine assays indicated that one in six patients who were smoking denied it. Although some patients may have feared that their physicians would be told of their smoking status, patients were assured during the consent process that this would not happen. This suggests that the rate of underreporting may be even higher in clinical settings and clearly indicates the need for routine clinical use of cotinine assays among high-risk patients such as these.

Results showed smoking relapse to be associated with lower income, consistent with well-established findings (48) in the general population, and suggested that it may be associated with marital status, consistent with several studies about the effect of marital status on smoking among healthy adults (e.g., refs. 49, 52). Controlling for other variables as shown in Table 3, results from one analysis indicated that patients with at least some college education were more likely to be smokers at follow-up than patients with a high school education or less. This pattern conflicts with findings from much previous research in patient and nonpatient populations, which show lower education to be associated with greater prevalence of smoking and lower probability of quitting (15, 48-51). The effect did not seem to be especially robust across models, and thus may be spurious. However, if it is genuine, the effect may be related to the fact that smoking cessation at surgery was essentially forced, at least for the duration of the surgery and hospitalization. In any case, simple confounding of education and nicotine dependence did not seem to explain this finding. Further research about the role of education in smoking cessation in medical contexts is needed.

Findings about the several measures of severity of nicotine dependence were nonsignificant, contrary to our expectations and to previous research in healthy adults (40, 53, 54). Daily consumption before quitting, age started smoking, total years as a smoker, and dependence as measured by the Fagerstrom Test of Nicotine Dependence were all nonsignificant in predicting either time until the first smoking lapse or smoking status. Measures of alcohol use were also nonsignificant in predicting relapse. However, quit duration before surgery and self-reported cravings to smoke did predict smoking relapse. The absence of significant findings for measures of nicotine dependence may be due to ceiling effects. Nearly all the patients were long-time smokers and arguably highly dependent. Quit duration before surgery and self-reported craving, in contrast, may simply have functioned as proxy measures of self-efficacy for quitting and staying quit, a construct not directly measured in this research. Regardless, it was the patient's own presurgical smoking behavior and stated urge to smoke that best predicted relapse.

Notably, these findings indicate that Aversive cravings did not independently predict smoking status or the timing of smoking lapses. Although depression has been strongly linked to smoking (36, 37), and despite evidence linking Aversive cravings to depression (15, 46), results showed that baseline Appetitive cravings to smoke were more strongly predictive of later smoking behavior. This suggests that Appetitive cravings provide the path through which potentially curable lung cancer patients relapse, and that Aversive cravings are associated with relapse in this population primarily because of their association with Appetitive cravings.

Three key features of the present findings have strong implications for interventions targeting this population. First, those who had quit for a shorter period before surgery were more likely to relapse. Second, those who lapsed sooner following surgery were more likely to be smoking at 12 months after surgery. Third, Appetitive cravings were stronger predictors of relapse than Aversive cravings.

This pattern strongly suggests the importance of interventions to prevent relapse as opposed to interventions to help those who have relapsed regain abstinence. Such interventions might target efforts at getting patients to quit earlier relative to their surgery, should be promoted especially among those who have quit for only a brief period before surgery, and should provide more intensive intervention during the first 2 months after surgery. The apparent effect of delayed smoking lapse on later smoking status suggests that interventions might also encourage patients to focus on not smoking *now* rather than on not smoking *ever*. Such interventions should also target the cognitions that underlie Appetitive cravings to smoke. These include beliefs such as that smoking would make the patient feel happier or less bored, that the cigarette would taste good and be pleasant, and that the urge to smoke is outside the patient's control. Research about the efficacy of such interventions among medical patients is also needed.

Health care providers should emphasize the importance of quitting not only for the perioperative period but well in advance of surgery if possible. They should not assume that getting lung cancer will by itself be a ''wakeup call'' sufficient to enable patients to quit and stay quit (55). Rather, they should identify resources to help patients stay quit during the first weeks and months after surgery. They should also follow up with patients to send clearly the message that staying quit is important, and to enhance patients' own sense of accountability about their smoking. Repeated counseling, over time, by multiple providers, with instruction on coping with cravings to smoke, general support for patient's quitting efforts, and consideration of pharmacotherapy, provides an effective approach to helping patients quit smoking (56-59).

This study is limited in several ways. Although our total sample included 154 patients, subanalyses included fewer patients. This limited the sensitivity of our analyses and the complexity of the models we tested. We intended to obtain biochemical verification of smoking status for all patients but were able to obtain valid measures concurrent with self-reports on only 44% of the sample. Because noncollection of saliva samples was primarily due to logistical problems, and not refusal by participants, we think that it is unlikely to have systematically biased our findings. However, it may have suppressed our estimate of the lapse rate somewhat. Some patients may have sought formal smoking cessation treatment during the period under observation, and patients may have received varying amounts of admonition to quit smoking from their physicians. Data about these characteristics of their care may be related to relapse, but were not collected as part of this study. Finally, we studied smoking relapse among early-stage lung cancer patients who underwent a potentially curative, discrete treatment episode that required at least several days of smoking cessation. Findings may not generalize to patients with other cancers or to lung cancer patients who do not undergo surgery.

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