



## Tobacco use and motivation to stop smoking among long-term smokers who are ineligible for lung cancer screening



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### ABSTRACT

**Background:** The importance of smoking cessation interventions in lung cancer screening participants has been highlighted. This study aimed to describe the smoking habits of individuals who were ineligible for lung cancer screening and to investigate whether this encounter may represent an opportunity to reduce tobacco use.

**Methods:** Ever smokers between the ages of 55 and 80 and  $\geq 1.5\%$  lung cancer risk over 6 years or having smoked  $\geq 30$  pack-years and with no more than 15 years of smoking abstinence were eligible to participate in the Alberta Lung Cancer Screening Program (ALCSP). A baseline questionnaire exploring tobacco use was administered to all interested individuals as part of the eligibility determination for the program.

**Results:** Among 504 individuals, 254 (50.4%) met the criteria for the ALCSP and 250 (49.6%) were non-eligible for screening. Non-eligible individuals were slightly younger (mean = 60.2 vs. 63.1 years,  $p$ -value < 0.001), and less likely to be current smokers (26.0% vs. 48.8%,  $p$ -value < 0.001). Non-eligible smokers had a lower degree of addiction compared to eligible group, as measured by the Fagerström Test of Nicotine Dependence (Median = 4.0 vs 6.0,  $p$ -value = 0.001), but still in the “moderately dependent” range for this test. There were no significant differences in motivation to quit (98.5% vs. 97.6%,  $p$ -value = 0.689), or motivation to receive help with their quit attempt (89.2% vs. 90.3%,  $p$ -value = 0.813) between these two groups. Only 7.7% of non-eligible and 2.4% of eligible current smokers were currently in a smoking cessation program.

**Conclusion:** A significant proportion of individuals applying to, but not qualifying for a lung cancer screening program are active smokers with significant nicotine dependence. Very few are currently participating in active smoking cessation programs but almost all are interested in quitting and in receiving help with quit attempts. Future studies need to investigate the most effective approaches for smoking cessation in this substantial group of older, long-term smokers, capitalizing on their motivation to receive cessation assistance.

**Abbreviations:** ALCSP, Alberta Lung Cancer Screening Program; COPD, chronic obstructive pulmonary disease; CT, computed tomography; CVD, cardiovascular disease; IQR, interquartile range; NLST, National Lung Screening Trial; REDCap, Research Electronic Data Capture; SD, standard deviation

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## 1. Introduction

Tobacco smoking has been clearly linked to the most common causes of death such as lung cancer [1]. Although smoking rates have declined substantially over the past decade, it remains a major public health concern worldwide [2,3]. In Canada, over 45,000 individuals die from tobacco-related conditions annually [4] and the health care cost associated with smoking has been estimated to be up to 15% of total annual healthcare costs [5]. Smoking prevention and cessation is the most effective primary prevention method to reduce morbidity of lung cancer and many other smoking-related conditions [6].

Evidence suggests that even brief advice to quit smoking, provided by health care professionals, can improve cessation rates [7] and that even a small reduction in smoking prevalence can result in reductions in tobacco-related mortality [8,9]. Therefore, maximizing opportunities to promote smoking cessation at every interaction between smokers and health professionals, is critically important to increase the smoking cessation rate.

Early detection and treatment of lung cancer through low-dose computed tomography (LDCT) screening is one of the most promising strategies to reduce lung cancer mortality [10]. Most of the recommendation for lung cancer screening are based on the National Lung Screening Trial (NLST) criteria (i.e., ever smokers aged 55–74 years,  $\geq 30$  pack-years of smoking and  $< 15$  years since quitting) [11] (e.g., Canadian Task Force on Preventative Health Care [12]) or some modification of this criteria (e.g., United States Preventive Services Task Force (USPSTF) guideline expanded the age for eligibility to 80 [13]). Recently, it has been suggested that the interaction of individuals with an ongoing tobacco addiction with a lung cancer screening program represents an opportunity and so-called “teachable moment” ideal to offer assistance with quitting [14–17]. During the NELSON lung cancer screening trial, Van der Aalst et al. [18] reported that even with a minimal smoking cessation intervention (written information only once at randomization), 16.6% of participants quit smoking within two years of follow-up, higher than the estimated quit attempts in the general population (3–7%) [18]. However, a higher smoking cessation rate was observed among the control group (no screening) compared to screened participants [18]. While evidence from randomized studies confirming the impact of specific smoking cessation modalities is limited [19–23], preliminary results from a recent trial suggest at least short term efficacy of cessation interventions in the screening setting [24]. To date, most efforts have been targeted towards individuals who meet the eligibility criteria and enroll in screening. A substantial number of smokers enquiring but not qualifying for a lung cancer screening program may represent an additional opportunity to reduce the health impact of tobacco use.

This large group of potentially motivated smokers has not, to our knowledge, been investigated with regards to tobacco use and motivation to quit in past studies.

## 2. Methods

### 2.1. Study population

Albertans between the ages of 55 and 80 with a history of smoking ( $\geq 30$  pack-years and with no more than 15 years of smoking abstinence) were invited to participate in the Alberta Lung Cancer Screening Program (ALCSP, 2014–2019) [25]. ALCSP is an ongoing 5 year research project, which aims to screen 800 high-risk Albertans for lung cancer with low-dose computed tomography (CT) scan imaging.

### 2.2. Study design

Recruitment for the study was performed through media press releases picked up by television, print and radio news outlets, as well as

through social media advertising and communications to local primary care clinics (2015–2017). Individuals interested in participating were referred to a website where an enrolment questionnaire could be printed, filled out and mailed to the study office. Once received, a study coordinator contacted each participant by phone, ensured that the questionnaire was complete, described the study in more detail and informed the participant as to their eligibility for screening. The participants were not compensated for participating in this study.

The enrollment questionnaire included information on smoking status and prior use, degree of addiction (Fagerström test [26]), motivation to quit, prior and current quit activities and interest with regards to smoking cessation support for those still smoking (e-Appendix A). The participants were further divided into two groups. Group 1 (eligible participants) were individuals aged 55–80 who had 1.5% or greater lung cancer risk over 6 years using a risk prediction tool [27] or met the National Lung Screening Trial (NLST) inclusion criteria (age 55–74, smoking  $\geq 30$  pack-years and quit  $\leq 15$  years) [11]. Group 2 (non-eligible participants) did not meet the above-mentioned inclusion criteria, were lost to follow-up due to not meeting the inclusion criteria (e-Appendix B), or withdrawing consent.

### 2.3. Statistical analyses

The study aimed at enrolling 250 non-eligible participants with all eligible participants included up to the date on which the last non-eligible participant was identified. Descriptive analyses were used to determine the characteristics, smoking rates, degree of addiction, and motivation to quit among non-eligible and eligible participants and among active smokers in each group as appropriate. Independent sample *t*-test, Mann-Whitney *U* test, and Chi-square test were used to determine significant differences between groups for continuous and categorical variables, respectively. Two-sided *p*-values  $< 0.05$  were considered to be statistically significant. Study data were collected and managed using REDCap (Research Electronic Data Capture) electronic data capture tools hosted at the University of Calgary Clinical Research Unit [28]. All analyses were performed using SPSS, version 24 (IBM Corp., Armonk, N.Y., USA).

## 3. Results

### 3.1. Characteristics

Baseline questionnaires were received from 504 individuals, with 254 (50.4%) (Current smokers:  $n = 124$ , ex-smokers:  $n = 130$ ) meeting the eligibility criteria for the ALCSP and 250 (49.6%) (Current smokers:  $n = 65$ , ex-smokers:  $n = 172$ , and never smokers:  $n = 13$ ) non-eligible for screening. Non-eligible individuals were younger [mean (SD) = 60.2 vs. 63.1 years,  $p$ -value  $< 0.001$ ], less often current smokers (26.0% vs. 48.8%,  $p$ -value  $< 0.001$ ), and had a lower risk of lung cancer over 6 years compared to eligible participants [median (range): 0.60 (0.0–8.8) vs. 2.4 (0.50–19.9),  $p$ -value  $< 0.001$ ]. No significant differences were observed in gender, education, or ethnicity between the two groups (Supplementary Table 1). 10% of non-eligible volunteers, and 23.6% of eligible participants had a history of COPD, emphysema or chronic bronchitis at baseline ( $p$ -value  $< 0.001$ ) (Supplementary Table 1).

There were no significant differences between these two groups regarding recruitment source, and the majority of smokers in both groups were self-referred (Smokers: 93.7% vs. 97.1%,  $p$ -value = 0.080) (Table 1).

Non-eligible smokers were younger [mean = 54.5 vs. 61.9 years,  $p$ -value  $< 0.001$ ], and had a lower risk of lung cancer over 6 years compared to eligible smokers [median (range): 0.9 (0.0–8.8) vs. 3.1 (0.6–13.7),  $p$ -value  $< 0.001$ ]. No significant differences were observed in weight, education, or ethnicity between the two groups (Table 1).

Non-eligible smokers were less likely to have a history of COPD,

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