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The impact of executive cognitive functioning on rates of smoking cessation in the San Luis Valley Health and Aging Study

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Abstract

Cigarette smoking is one of the leading preventable causes of death. Previous research has shown that many common smoking cessation interventions are effective with older smokers; a few interventions have been tailored to this population. To our knowledge, however, no smoking cessation research or interventions targeted at older adults have addressed the influence of cognition on successful smoking cessation. We hypothesized that impairment of executive cognitive functioning (ECF), which is relatively prevalent among older adults, would negatively influence smoking cessation rates among older smokers. The relationship of ECF to smoking cessation was examined in a population-based sample of 1,338 community-dwelling older persons in Colorado's San Luis Valley, 204 of whom were current smokers. As predicted, current ECF did not predict early smoking behaviour, but was a significant predictor of successful smoking cessation. Older persons suffering from executive dysfunction were less likely to have quit smoking than were their cognitively intact counterparts (OR = 1.10, 95% CI 1.04–1.17, $P<0.01$). Among those with normal ECF, 73.7% had quit smoking, compared with 65.1% of participants showing any level of ECF impairment. Limiting the sample to individuals who were active smokers at or after the age of 65, when executive impairment is relatively common, produced similar results. Individuals with better executive functioning were more likely to have quit smoking (OR = 1.12, 95% CI 1.02–1.23, $P = 0.02$).

Keywords: *executive cognitive functioning, smoking cessation, ageing, San Luis Valley Health and Aging Study, Behavioral Dyscontrol Scale, elderly*

Introduction

Cigarette smoking is a leading preventable cause of death due to lung cancer, ischaemic heart disease, and chronic airway disease [1]. In the United States, approximately 438,000 Americans died annually between 1997 and 2001 from smoking-related illnesses [2,3].

Although smoking rates have declined, 20.9% of Americans in 2004 were active smokers [4]. Older persons have a low rate of cigarette smoking. Whereas approximately 23% of younger adults smoke, only 9% of people 65 and older are smokers [4]. Although older smokers may have greater incentive to quit smoking due to financial constraints and health concerns, the rate of smoking among this group also is influenced by the disproportionately high death rate of smokers [5].

Quitting smoking has significant health benefits. Even after many years of exposure to cigarette smoke, older persons who quit significantly reduce their risk of lung cancer, stroke, coronary artery disease, peripheral vascular disease, and chronic obstructive pulmonary disease [5], thus enhancing the quality and length of life.

Researchers have highlighted a number of barriers to quitting that are particularly relevant to older smokers. For example, Ayanian and Cleary [6] found that older smokers were less likely than younger smokers to recognise the risk of cancer and cardiovascular disease related to smoking. Other investigators have suggested that smokers over age 64 may fail to recognise the effect of smoking on health [5], may lack confidence in their ability to quit, and be unaware that quitting might benefit their health [5, 7]. For long-term

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smokers, the fact that smoking is a habitual daily activity makes quitting more challenging [5].

We tested the hypothesis that age-related impairment of executive cognitive functioning (ECF) is an important barrier to smoking cessation among older persons. Previous research has shown that many common smoking cessation interventions are effective with older smokers [8], and some studies have examined interventions tailored to this population [7]. To our knowledge, however, no interventions targeted at older adults have addressed the influence of cognition on the ability to quit. This research gap is significant because of the high prevalence of cognitive impairment—especially ECF deficits—among older adults.

The executive functions are essential to the capacity for behavioural self-regulation. According to Fuster, the ECFs integrate working memory, and the intentions held therein, with mental representations of the environment and the goal state, and with a prospective motor short-term memory that supports planning for action [9–12]. These functions allow intentions formulated in the past to be maintained across time until the desired behaviour is initiated and completed. Intact ECF is essential for making a deliberate effort to disrupt habitual behaviour [13]. As maintenance of intentions over time is critical for health behaviour change (i.e. breaking existing habits and establishing new habits), impaired ECF is likely to affect the success of smoking cessation efforts.

According to Grigsby, Kaye, Shetterly, Baxter, Morgenstern *et al.* [14], ECF deficits affect a significant percentage of older adults. In an epidemiologic study of persons 60 years of age or older in southern Colorado [San Luis Valley Health and Aging Study (SLVHAS)], one-third of participants had some degree of executive impairment; 17.4% of participants were mildly impaired, 8.8% were moderately impaired, and 7.6% exhibited severely impaired ECF [14]. Attempts to quit smoking therefore may be particularly challenging for older smokers.

A small body of literature suggests that smoking may contribute to impaired cognition, including ECF. A number of studies have shown poorer ECF, general cognitive functioning, and/or problem-solving among smokers, compared to nonsmokers [15–17]. Among recovering alcoholics who smoke, duration of smoking is inversely related to performance on measures of ECF [15]. Working memory, which serves to maintain plans and intentions in short-term memory so the executive system can organise behaviour in a coherent, goal-directed manner [10, 11, 18, 19], also is negatively affected by smoking [20]. Further, impulsivity, which may represent deficient behavioural self-regulation [21, 22], is associated with higher smoking rates and decreased time to relapse after smoking cessation [23, 24].

Methods

Data were collected in the SLVHAS, a study of chronic illness and disability among Hispanic and non-Hispanic White (NHW) individuals aged 60 and older in two counties in rural southern Colorado [25]. In 1992 and 1993, all occupied households in both counties were identified and enumerated, with an overall 97% response rate. Hispanic ethnicity was determined by response to the question used by the Census Bureau in 1980, 'are you of Spanish or Hispanic origin or descent?' [26].

Participants

All eligible Hispanic persons age 65 and older were invited to participate, as were 49% of Hispanic individuals aged 60–64 years. Among NHWs, we attempted to enroll 37% of those 60–64 years, 58% of those 65–79 years, and all NHWs aged 80 years and older. A total of 1,982 community-dwelling people were invited to participate. Of these, 168 died before an interview could be completed and 139 moved out of the area or otherwise were ineligible. Three hundred and seventeen persons declined to participate, leaving 1,358 community-dwelling individuals who completed a study interview. Slightly more NHW persons (23%) than Hispanics (16%) refused to participate. Those who refused did not differ significantly from participants in gender, education, marital status, or functional ability, but were slightly older and more likely to be NHW.

Of 1,358 participants enrolled, baseline smoking data were available for 1,338. Analyses were restricted to these participants, of whom 58% identified themselves as being of Spanish or Hispanic descent. Participants were from 60 to 99 years of age, with a mean of 74. Education varied widely, but the mean was 10 years, ranging from zero to 17 years.

Measures

Interviewers were bilingual residents of the San Luis Valley. Participants were given the option of being interviewed in Spanish, but only 6% of Hispanics requested interviews exclusively in Spanish. Among bilingual persons, interviews frequently were conducted both in Spanish and English. An extensive interview protocol was used, but we discuss only demographics, smoking history, and ECF.

The Behavioral Dyscontrol Scale (BDS) is a 9-item, 19-point scale adapted from Luria [22]. Developed and standardised with a number of different geriatric populations [14, 21, 27–30], it has been used with other age groups as well. Internal consistency, interrater reliability, and retest reliability are all >0.85 [27].

Most of the items on the BDS [21, 27], assess the capacity to control simple voluntary motor activity. Previous research with the BDS has shown that persons with moderate impairment have significant difficulty with independent living, while those who are severely impaired show problems with ADLs and instrumental ADLs (IADLs) that virtually preclude effective self-care [21, 28–30]. In large part, these problems with functioning reflect difficulty initiating purposeful behaviour and resisting impulses to engage in behaviour contrary to one's goals. In the current context, impaired ECF may make it difficult to resist the urge to smoke, or to initiate and perform behaviours intended to facilitate smoking cessation.

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Data analysis

Descriptive analyses were conducted to examine demographic characteristics and smoking patterns of the sample. Ordinary least squares (OLS) regression models were used to study three continuous variables examining various aspects of participants' smoking patterns (age at which participants started and stopped smoking, and number of cigarettes smoked per day). Logistic regression models were used to examine the influence of ECF on two dichotomous smoking variables (i.e. 'Have you smoked at least 100 cigarettes in your life;' and 'do you smoke now'). All analyses controlled for age, education, and ethnicity. To ensure the findings would not be confounded by general cognitive impairment, analyses examining the effect of ECF on smoking behaviour controlled for participants' performance on the Mini-Mental State Examination (MMSE), a measure of general mental status [31].

Results

Descriptive analyses

Table 1 provides descriptive information about the history and current smoking status of study participants. Among 1,338 participants for whom information about cigarette smoking was available, 51.9% ($n = 694$) had smoked at least 100 cigarettes during their lives. Of these 694 individuals, 70.6% had quit smoking by the time of participation in the SLVHAS. The remaining 204 subjects continued to smoke.

On average, those who had ever smoked began smoking regularly at 20.0 years of age. Although some did not begin smoking until later in life (the oldest was 69), others reported starting as young children. Thirty-nine participants reported having started before the age of 12.

Among those who had ever smoked, the number of cigarettes smoked per day ranged from one to 100, with an average of 15.8 cigarettes/day. When the 694 participants who had ever smoked were divided into current smokers ($n = 204$) and former smokers ($n = 490$), a difference in the average number of cigarettes smoked per day emerged. In adjusted OLS analyses controlling for age, education, and ethnicity, participants who had quit smoking had smoked significantly more cigarettes per day as active smokers than their counterparts who were still smoking (16.6 versus 13.3; $t = -2.36$, $P = 0.02$, $r^2 = 0.01$).

A large percentage of participants who had ever smoked (70.6%) reported having quit by the time of their baseline study visit. On average, former smokers quit at 50.1 years of age. The age at which smokers had stopped smoking ranged from 6 to 91). To assess whether participants who start smoking as young children differ from individuals who start smoking later, additional analyses examined the smoking histories of childhood smokers. Of 39 participants who had started smoking before the age of 12, 15 were current smokers. The remaining 24 had quit, but not until a mean age of 52.8. Only one childhood smoker quit as a child.

Table 1. Smoking history and current status of study participants

	n
Smoking history	
Ever smoked	694
Never smoked	644
Total sample	1,338
Current smoking status among those who ever smoked	
Current smoker	204
Former smoker	490

Association between ECF and smoking cessation

We hypothesized that ECF status would influence the ability of smokers in this sample to quit smoking successfully. However, we did not expect current executive impairment to predict early smoking patterns. Adjusted regression analyses controlling for age, education, ethnicity, and MMSE score supported these hypotheses. As indicated in Table 2, total BDS score did not predict whether a person ever smoked ($P = 0.57$), the age at which smokers began smoking ($P = 0.45$) or stopped smoking ($P = 0.42$), or number of cigarettes smoked per day ($P = 0.27$).

Executive functioning was, however, a significant predictor of whether participants had stopped smoking (see Table 2). After controlling for age, education, ethnicity, and general mental status, for each increase of one point on the BDS (about one-quarter of a standard deviation) the likelihood of having stopped smoking increased by 10%. Hence, those with better ECF were more likely to have quit. Whereas 73.7% of those with normal ECF had quit, only 65.1% of those with ECF impairment had quit. Smokers who had quit smoking had higher average BDS scores than current smokers (15.1 versus 14.1), and a lower prevalence of impairment on the BDS (scores less than 15) than current smokers (33.1% versus 42.6%).

Table 2. Effect of ECF on smoking behaviour[a]

	Logistic regression results		OLS regression results
	OR	95% CI	Parameter estimate
Ever smoked	0.99	0.95–1.03	—
Age started smoking	—	—	0.10
Age stopped smoking	—	—	0.21
Number of cigarettes per day	—	—	0.23
Has quit smoking	1.10*	1.04–1.17	—

*$P<0.01$.

[a]For dichotomous dependent variables, the odds ratio (OR) and the 95% confidence interval (95% CI) are presented. For continuous dependent variables, the parameter estimate for the effect of ECF on smoking behaviour is presented.

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Table 3. Effect of ECF on smoking cessation among older smokers[a]

	OR	95% CI
Smokers who quit before age 65	0.99	0.83–1.19
Active smokers at or after age 65	1.12*	1.02–1.23

* $P<0.05$.

[a] The odds ratio (OR) and the 95% confidence interval (95% CI) are presented.

Previous research with the SLVHAS cohort found the prevalence and severity of ECF deficits more pronounced with advancing age [32]. For this reason, we expected ECF to be a particularly strong predictor of smoking cessation among older smokers. To test this hypothesis, we repeated the risk-adjusted logistic regression model examining smoking cessation among individuals who were active smokers at or after age 65.

Table 3 presents the results of these analyses. As expected, ECF predicted cessation rates among persons who had been active smokers at or after age 65 ($P = 0.02$). For each one-point increase in BDS score, the odds of having quit smoking increased by 12%. Among these older smokers, 39.9% of those with normal executive functioning had quit smoking, in comparison with 35.2% of impaired individuals.

Although participants with impaired ECF were less likely to have quit smoking, the majority of impaired persons in the overall sample reported having done so. Among those with normal scores on the BDS, 73.7% had quit, compared with 65.1% of participants showing any ECF impairment. With increasing age (and, presumably, worse ECF), the likelihood of successful quitting appears to decline. Among persons still actively smoking at age 65 or later, only 35.2% of those with impaired ECF had quit smoking, in comparison with 39.9% of older smokers without executive dysfunction. However, although ECF contributes to smoking cessation, many of those with some degree of impairment are able to quit successfully.

Discussion

Performance on a measure of ECF was significantly associated with smoking cessation in this population-based study of older adults. In overall analyses and analyses of smokers 65 and older, scores on the BDS predicted whether or not they had quit smoking, after controlling for age, education, ethnicity, and mental status. As expected, ECF did not predict whether participants had ever smoked, the age at which smokers started or stopped smoking, or the number of cigarettes smoked per day. These findings support our hypothesis that the executive functions that are essential to make deliberate, conscious effort to disrupt habits, especially as entrenched as long-term smoking, play a role in whether older adults stop smoking. The lack of a relationship between ECF and variables associated with events occurring early in life (e.g. age at which one started smoking) is unsurprising, as the incidence and prevalence of ECF deficits begin to increase significantly among persons in their 60s and 70s [14, 32]. Although younger individuals also may have ECF impairment, the percentage of the population for whom this is a problem is considerably higher among older people [27].

These findings suggest that when older adults attempt to stop smoking, the integrity of ECF is a significant determinant of whether they succeed. This may be because ECF is essential to the ability to make a deliberate effort to inhibit or initiate specific behaviours. Although these results indicate that executive functioning influences health behaviour change in the ageing population, the relatively modest impact of executive functioning on smoking cessation suggests that other factors are also at work. In older adults, factors such as the perceived value of quitting, perceived control over the behaviour, family and peer smoking habits, and health status may have a strong influence on the intention to quit and the success of smoking cessation efforts.

Although ECF is not an inordinately strong predictor of smoking cessation, interventions targeting behaviour change in older adults should consider the special needs of those with executive impairment. When an individual has an impaired ability to regulate his or her own behaviour, considerable assistance from others (e.g. reminders from relatives) and environmental structure (e.g. making it more difficult to engage in the smoking habit) may be required. For such persons, smoking cessation programmes that rely heavily on the individual to regulate his or her smoking behaviour independently, without considerable external support, are liable to produce poor outcomes.

In the provision of health care to the geriatric population, physicians and other medical providers often are in a position to recommend smoking cessation to their ageing patients. Knowledge of a patient's executive function status might allow health care providers to arrange the resources and enlist the type of social network support that are likely to enhance a patient's success at quitting. However, although health care providers often assess a patient's cognitive functioning through the administration of commonly used tests such as the MMSE, it is not clear whether such tests of general cognitive impairment can enable providers to identify accurately patients for whom executive dysfunction is likely to serve as a barrier to health behaviour change. The relative independence of the BDS and such tests as the MMSE in predicting functional outcomes [21, 28–30] raises an empirical question about whether such general tests of cognition would predict smoking cessation. In this study, MMSE score was not a significant predictor of smoking cessation, although ECF was.

Key points

- Approximately one-third of persons age 60 and over has impaired ECF.

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- ECF deficits are associated with decreased capacity to make a deliberate effort, disrupt habitual behaviours, and inhibit impulses.
- Executive cognitive impairment among older persons is associated with decreased levels of smoking cessation.
- Efforts to get older individuals with executive cognitive dysfunction to stop smoking may require external structure and support.

Conflict of Interest

There are no conflicts of interest

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