Cigarette smoking and cognitive performance in healthy Swedish adults

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Abstract

Background: the relationship between cigarette smoking and cognitive function was examined in healthy Swedish adults who were participants in the Betula Prospective Cohort Study of Aging, Memory, and Health.

Subjects: the data are from those individuals in the Betula study who were self-reported continuous smokers contrasted to those who reported never smoking cigarettes.

Design: the dependent variables were cognitive tasks that varied with respect to difficulty and the demand they placed on processing resources.

Results: current smokers performed more poorly than never smokers on the more cognitively demanding tasks; namely, Block Design and free recall.

Conclusions: the findings were interpreted in the light of the assumption that cigarette smoking may exert its greatest deleterious effect on those cognitive tasks that place the heaviest demands on processing resources.

Keywords: cigarette, smoking, cognitive, performance, elderly

Introduction

Cigarette smoking is a pervasive high-risk behaviour that has been linked to the early emergence and rapid progression of chronic disease in middle and late life [1–3]. Given the systemic impact of cigarette smoking on physiological processes, the question arises as to whether chronic smoking could exert an influence on aspects of cognitive functioning in old age as well [4]. Research suggests that cigarette smoking can have both acute and long-term effects on cognitive function and several conceptual models have been proposed to depict this relationship [4]. The empirical data have yielded mixed results; however, with some studies reporting performance advantages in favour of smokers [5, 6] while others have reported no differences between smokers and non-smokers [7], or detrimental effects of cigarette smoking on cognitive performance [8–10]. Thematic in this literature is the postulate that cigarette smoking is associated with poorer performance on those tasks that are more cognitively demanding. In one study that employed a range of cognitive tasks that varied in difficulty [9], college-aged smokers and non-smokers were assessed using a visual search task contrasted to a complex driving simulation procedure. No differences were found between smokers and non-smokers in visual search; however, non-smokers outperformed smokers on the more complex driving simulation task. In a cross-sectional study that contrasted older smokers to non-smokers, performance decrements in the smokers were found only on those tasks that were sensitive to speeded processing [10].

An objective of the current study was to assess the impact of cigarette smoking on cognitive processes with respect to the following questions: (i) To what extent does cigarette smoking impact cognitive performance when individuals across the adult life span are represented? (ii) Does long-term smoking affect performance on tasks that are age-sensitive or that show strong age effects in contrast to tasks that are less affected by the aging process?
The study participants were a subset of healthy Swedish adults from the Betula population-based study of normal aging [11]. The Betula Study was designed to measure cognitive function in healthy individuals across the adult life span. Participants in this study represented a total age group that ranged from 35 to 80 years. They were drawn from the population registry in Umeå, Sweden, a small city in the north-eastern part of the country with an approximate population of 100,000. They were screened to include only healthy community dwelling adults. Each participant was administered a battery of clinical and self-report instruments assessing demographic characteristics and selected indices of health.

Data were analysed from Betula participants who self-reported that they were cigarette smokers, contrasted to those who indicated that they had never smoked cigarettes. Those who were not currently smoking cigarettes, but had a previous history of cigarette use (n = 268) were excluded from this analysis as well as current or former cigar and/or pipe smokers, or snuff users. Thus, the available data examined in this report consisted of 438 never smokers (who reported no collateral tobacco use) and 164 current cigarette smokers who reported continuous smoking for at least five years. Smoking status and frequency were assessed by self-report; namely, daily use frequency: (i) 1–4 cigarettes, (ii) 5–14 cigarettes, (iii) 15–24 cigarettes, or (iv) 25 or more cigarettes. The age at which smoking first began was also used to obtain the number of years a person had been engaged in cigarette smoking.

To test the rationale that smoking status would differentiate between individuals on tasks that varied with respect to their demand for processing resources, several cognitive tasks were identified in the Betula cognitive battery that varied in difficulty. Specifically, two timed tasks (considered cognitively demanding) were Block Design from the WAIS-R [12] and a free recall task that involved learning a list of 12 unrelated nouns while simultaneously engaging in a distractor (sorting a deck of playing cards into two piles) at the point of encoding. In contrast, two untimed tasks, a test of general knowledge about unknown and famous Swedish persons and a word comprehension task, were chosen as less cognitively demanding. The psychometric properties of these four tasks in the Betula protocol are described in detail elsewhere [11].

### Results

With respect to the demographic variables, 64.8% of the 602 of Betula participants were male. There were no sex differences between current and never smokers within each age group. Further, no differences in years of education between current and never smokers were found, although there was a significant education effect across groups with fewer years of schooling reported in the older age-groupings, \( F(3,594) = 63.33; P < 0.01 \). There was no difference in self-reported health between smokers and non-smokers or across age groups on the categorical rating of ‘healthy versus ill’. It should be noted, however, that this was a healthy group of older adults with 73.3% of the smokers and 75.1% of the never smokers rating themselves as healthy.

Tables 1 and 2 summarise the performance of current smokers and the never smokers on the two cognitively demanding tasks; namely, Block Design and free recall. ANCOVA was utilised to assess between groups effects with education as the covariate. For Block Design, when smoking status was collapsed across age group, there was a significant effect of age favouring the younger age groups, \( F(3,593) = 22.8; P < 0.001 \). Further, when age was collapsed across smoking status, never smokers outperformed current smokers, \( F(1,593) = 11.9; P < 0.01 \). There was no age group by smoking status interaction, \( F(3,593) = 0.5; P > 0.60 \). With respect to the free recall task, there was no smoking status by age interaction, \( F(3,594) = 0.5; P > 0.60 \). Neither smoking status nor age had a significant effect on the free recall task.

### Methods

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### Table 1. Mean (SD) block design performance by smoking status and age grouping

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Current smoker</th>
<th>Never smoker</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>35–40</td>
<td>29.7 (8.6) n = 43</td>
<td>34.7 (8.6) n = 77</td>
<td>32.9 (8.9) n = 120</td>
</tr>
<tr>
<td>45–50</td>
<td>27.6 (8.3) n = 51</td>
<td>31.9 (9.6) n = 72</td>
<td>30.1 (9.3) n = 123</td>
</tr>
<tr>
<td>55–60</td>
<td>25.6 (8.7) n = 35</td>
<td>27.8 (8.7) n = 90</td>
<td>27.2 (8.7) n = 125</td>
</tr>
<tr>
<td>65–80</td>
<td>18.5 (8.0) n = 35</td>
<td>19.8 (8.9) n = 199</td>
<td>19.6 (8.8) n = 234</td>
</tr>
<tr>
<td>Total</td>
<td>25.8 (9.3) n = 164</td>
<td>26.1 (10.8) n = 438</td>
<td>26.0 (10.4) n = 602</td>
</tr>
</tbody>
</table>

### Table 2. Mean (SD) free recall performance by smoking status and age grouping

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Current smoker</th>
<th>Never smoker</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>35–40</td>
<td>4.7 (1.5) n = 43</td>
<td>4.8 (1.4) n = 77</td>
<td>4.7 (1.4) n = 120</td>
</tr>
<tr>
<td>45–50</td>
<td>4.0 (1.5) n = 51</td>
<td>4.4 (1.4) n = 72</td>
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</tbody>
</table>
task, there was a significant age effect favouring the younger age groupings, $F(3,593) = 8.2; P<0.01$. As was the case with Block Design never smokers outperformed current smokers on the free recall task, $F(1,593) = 8.7; P<0.05$, and there was no age group by smoking status interaction, $F(3,593) = 0.9; P>0.50$. Performance on the general knowledge and the word comprehension tasks showed no effect of age and no differences were found between current and never smokers within age grouping.

Among the current smokers ($n=164$), the relationship between self-reported number of years smoked and the frequency of cigarettes smoked per day was also assessed. Because of the high correlation between number of years smoked and chronological age, $r=0.39, P<0.01$, partial correlations were utilised controlling for age. A significant negative correlation was found between number of cigarettes smoked and Block Design, $r = -0.16, P < 0.05$, as well as the free recall task, $r = -0.18, P<0.05$. In both instances the direction of these correlations indicated that poorer performance was associated with a longer duration of cigarette use and a higher frequency of cigarettes smoked per day.

Discussion

This study examined the role of cigarette smoking on cognitive performance in participants from a population-based study of healthy older adults who ranged in age from 35 to 80 years. Previous research investigating this issue has been restricted to either older or younger age groups. This study adds to the existing literature in as much as the adult life span is represented by the age-cohort groupings. Further, given that this was, by design, a healthy group of older adults, the possibility that cognitive performance was influenced by secondary health variables such as cardiovascular and/or pulmonary disease was unlikely.

The cognitive measures chosen for this comparison ranged in complexity or the demand that each task placed on cognitive resources for maximal performance. The overall finding that smoking status was a significant between-groups variable favouring the never smokers on the more demanding cognitive tasks suggests a pattern of results consistent with previous research [9, 10]. For Block Design and the free recall task, poorer performance of the current smokers suggests that cigarette smoking may work against a person’s ability to apply sufficient cognitive resources to achieve maximal performance under progressively more difficult testing conditions (e.g. time constraints, increased stimulus complexity, increased demands to focus on specific task requirements in the presence of distracting material). Additional evidence supportive of this assumption was the finding that among the current smokers, number of cigarettes smoked and more cigarettes smoked, was associated with poorer performance on these two tasks, but not the word comprehension or general knowledge tests.

These data suggest that cigarette smoking status should be considered an important screening variable when conducting research that involves cognitive performance in older adults. A limitation of this study was that although current and never smokers reported that they were in good health, there was insufficient information from the health questionnaires to rule out the possibility that cigarette smoking was simply marking sub-clinical disease states (e.g. hypertension). In future research it may prove difficult to obtain a representative sample of individuals who are normally distributed with regard to health and/or disease, but are also balanced with respect to smoking status.

Key points

- Smoking is associated with poorer cognitive performance in older adults.
- Smokers are disadvantaged on more challenging cognitive tasks.

References


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