Longer Lengths of Time Smoking Predict Poorer Cognitive Performance Later in Life among Former Smokers without Dementia

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Background

- As of 2016, approximately 15% of adults 18 years of age or older in the U.S. smoke.[1]
- Chronic smoking is associated with cognitive deficits[2] and marked by neurological abnormalities,[3] global brain atrophy,[4] and is associated with an increased risk of dementia.[5]
- Decline in cognitive functioning is typically seen on measures of global function and higher-order processes (executive function, memory, processing speed).[6]
- Prior research focused on those who have stopped smoking compared to those who have not quit or those who never started[6] and usually within the context of the development of dementia.[5]
- Although smoking appears to be a factor accelerating cognitive aging,[4] less attention has been given to the chronic effects smoking may have on cognitive function when considering lifetime smoking-related variables, among former smokers and who are cognitively normal.

- There remains a need to investigate:
   1) the impact smoking characteristics might have on cognitive domain changes over time in later life among former smokers
   2) the within-subject effects smoking habits may have on cognitive function over time in a large sample of cognitive normal older adults

Aims/Significance

The primary purposes of the present study are to:

1) Investigate the effects of the length of time a person smokes on their cognitive functioning in later life among those who have quit smoking among cognitively normal sample
2) Investigate whether there is evidence that smoking accelerates cognitive aging and impacts higher-order cognitive function, e.g. executive functioning and memory

We hypothesize that those participants who had smoked for greater periods of time will perform more poorly over time among cognitive functions most vulnerable to increased age, i.e. processing speed, executive function, and memory.

Method

Participants
- The U.S. National Alzheimer's Coordinating Center (NACC) Uniform Data Set (UDS) is a prospective, standardized, and longitudinal data set consisting of clinical evaluations of patients.
- Version 2 of the UDS was used in this study and consists of a clinical history and an evaluation, including smoking behaviors, as well as a battery of neuropsychological tests that consists of brief measures of attention, processing speed, executive function, episodic memory, and language.[7]

- Participants were 1,964 individuals who:
  - Were deemed clinically cognitively-normal at every visit
  - Had a Clinical Dementia Rating Global score and Functional Activities Questionnaire score of zero at baseline and subsequent visits
  - Were at least 55 years of age at baseline
  - Had smoked for at least 1 year
  - Had smoked more than 100 cigarettes in their lifetime
  - Had quit smoking before entering the UDS
  - Had at least 3 visits

Measures
Measures included the Mini Mental State Examination (MMSE); Semantic Fluency (Animals and Vegetables); Digit Span Forward and Backward; the Wechsler Memory Scale-Revised (WMS-R) subtests Logical Memory IA and IIA (immediate and delayed recall); Trail Making Test Parts A and B; Wechsler Adult Intelligence Scale-Revised (WAIS-R) Digit Symbol subtest; Boston Naming Test

Statistical Analysis
We investigated changes in cognitive functioning over time using mixed effect modeling. We tested the full model using length of time the participants smoked to predict a decline in performance over time (i.e. length of time smoked by years in study interaction), while including sex, age, education, baseline neuropsychological test score, history of stroke, history of hypertension, and amount the person smoked (packs per day) as covariates. Alpha was set at 0.05.

Results

Table 1
Demographic and Smoking History Information and Baseline Neuropsychological Test Scores

		N (%) / M (SD)
Sex (% Female)		1,233 (62.8%)
Age, Years		72.8 (7.88)
Years of Education		15.6 (2.69)
Race		
	White	1,656 (84.3%)
	Black	278 (14.2%)
	Asian	20 (1.0%)
Smoking Variables		
	Quit Age	41.2 (13.7)
	Years Smoked	20.1 (13.18)
	Number of Packs Smoked	2.3 (1.24)

Neuropsychological Tests		
Cognitive Domain		M (SD)
Global Cognitive Function	Mini Mental State Examination	29.1 (1.24)
Verbal Fluency	Semantic Fluency: Vegetables	15.1 (4.27)
Verbal Fluency	Semantic Fluency: Animals	20.8 (5.62)
Memory: Working	Digit Span Forward	8.8 (1.99)
Memory: Working	Digit Span Backward	7.2 (2.18)
Memory: Immediate Recall	Logical Memory Ia	14.0 (3.70)
Memory: Delayed Recall	Logical Memory IIa	13.7 (9.75)
Processing Speed	Digit Symbol Coding*	48.1 (11.61)
Processing Speed	Trail Making Test: Part A*	33.8 (13.98)
Executive Functioning	Trail Making Test: Part B*	86.3 (44.43)
Language	Boston Naming Test	27.5 (2.73)

Note. *Seconds for task completion.

Descriptive statistics for demographic characteristics and neuropsychological test scores were calculated. See Table 1.

Mixed effects modeling was used to see what neuropsychological scores changed over time based on amount of time the person smoked. When conducting the unconditional growth model for the Boston Naming Test, the results revealed insufficient variance to account for any change in performance over time, and, therefore, no additional model building followed.

The duration of time the participant smoked did not predict poorer performance over time in MMSE scores ($P = 0.813$), Immediate Recall ($P = 0.258$), Digit Span Forward ($P = 0.505$), Digit Span Backward ($P = 0.708$), or Trail Making Test Part A, ($P = 0.076$).

The duration of time the participant smoked was associated with poorer performance on measures of categorical fluency, Vegetables, $\beta = -0.004$, $F(1, 4015) = 8.09$, $P = .005$, and Animals, $\beta = -0.004$, $F(1, 4060) = 4.81$, $P = .028$.

Results Continued

Although the duration of time participants smoked did not predict poorer performance in immediate recall ($P = .28$), it did predict poorer performance over time in delayed recall, $\beta = -0.003$, $F(1, 4090) = 5.27$, $P = .022$, executive functioning, Trail Making Test Part B, $\beta = 0.051$, $F(1, 3960) = 13.26$, $P < .001$, and processing speed, WAIS-R Digit Symbol, $\beta = -0.011$, $F(1, 3807) = 15.12$, $P < 0.001$.

Discussion

Main Findings
- Former smokers who smoked for longer durations performed more poorly on measures of higher-order functions (processing speed, delayed recall, executive functioning), consistent with prior studies.[6]
- Length of time did not predict decline in immediate recall and working memory

Clinical Impact
- Quitting smoking sooner likely reduces the risk of poorer cognitive performance later in life even if a neurodegenerative disease (e.g. AD) does not develop.

Conclusions
- This study provides additional insight into the effect that smoking has on later-life cognition in cognitively intact former smokers.

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