



Smoking trajectories from midlife to old age and the development of non-life-threatening health problems: A 34-year prospective cohort study

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ABSTRACT

Objective. To examine how trajectories of smoking observed over a 34-year period, were associated with the progression of mobility impairment, musculoskeletal pain, and symptoms of psychological distress from midlife to old age.

Method. The Swedish Level of Living Survey (LNU) and the Swedish Panel Study of the Oldest Old (SWEOLD) were merged to create a nationally representative longitudinal sample of Swedish adults (aged 30–50 at baseline; $n = 1060$), with four observation periods, from 1968 through 2002. Five discrete smoking trajectory groups were treated as predictors of variation in health trajectories using multilevel regression.

Results. At baseline, there were no differences in mobility impairment between smoking trajectory groups. Over time all smokers, particularly persistent and former heavy smokers, exhibited faster increases in mobility problems compared with persistent non-smokers. Additionally, all smoking groups reported more pain symptoms than the non-smokers, at baseline and over time, but most of these differences did not reach statistical significance. Persistent heavy smokers reported elevated levels of psychological distress at baseline and over time.

Conclusion. Smokers, and even some former smokers, who survive into old age appear to be at increased risk for non-life-threatening conditions that can diminish quality of life and increase demands for services.

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Introduction

Numerous studies have reported, and repeatedly confirm, the strong associations between tobacco smoking and several life-threatening diseases, such as cardiovascular or pulmonary diseases, as well as various cancers (U.S. Department of Health and Human Services, 2004). These associations are responsible for smoking being consistently ranked among the top modifiable risk factors for mortality in modern society (McGinnis and Foege, 1993; Mokdad et al., 2004). Still, while most types of exposure to smoking increase risk for life-threatening diseases and mortality, the life expectancies of people with different histories of smoking (e.g., light vs. heavy smokers; short-term vs. long-term smokers) have been found to be quite disparate (Doll et al., 2004; Frosch et al., 2009; Gerber et al., 2012). As a result of this variation, as well as the increasing life expectancy in the population in general, a growing number of adults with a history of smoking behavior are reaching old age, and may be subject to risk for a number of substantial and debilitating health problems (Rosen and Haglund, 2005).

One category of potential health consequences of smoking that has received relatively little attention is that of non-life-threatening

diseases and conditions among smokers who survive into old age. In a Finnish study with 26 years of follow-up, a graded association was found between the daily number of cigarettes at baseline and health-related quality of life among survivors into old age. The largest differences were found between heavy smokers and never-smokers in the physical dimension of health-related quality of life (Strandberg et al., 2008). In the Nurses' Health Study, current smokers scored lower on both the physical and mental components of health-related quality of life compared with both the never-smokers and former smokers (ages 29 to 71 years). However, 8-year changes in the physical and mental components of health-related quality of life were similar for persistent smokers and those who quit smoking during the follow-up (Sarna et al., 2008), perhaps suggesting that the amount of smoking or a longer follow-up time must be considered.

To our knowledge, patterns of smoking behavior, measured prospectively from midlife to old age, have not been investigated in relation to the progression of non-life-threatening, age-related, health conditions during this same period. In the present study we investigated the progression of mobility impairment, musculoskeletal pain and symptoms of psychological distress—three common non-life-threatening conditions that are also important dimensions of health-related quality of life—and their associations with different patterns of smoking over a 34-year period. Studying the linkages between smoking trajectories and health trajectories as people enter old age allows us to examine

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how the amount and persistence of smoking may influence one's health prospects during the aging process.

Material and methods

Study sample

This study used data from the Swedish Level of Living Survey (LNU) and the Swedish Panel Study of Living Conditions of the Oldest Old (SWEOLD). LNU is a longitudinal, nationally representative, study of the Swedish adult population, ages 18–75. It was first carried out in 1968, and subsequently in 1974, 1981, 1991, 2000 and 2010 (Fritzell and Lundberg, 2007). Persons from the LNU sample who have passed the upper age limit of 75 years were included in the SWEOLD study (Lundberg and Thorslund, 1996). SWEOLD has been carried out in 1992, 2002, 2004 and 2011. In both studies, professional interviewers conducted structured interviews with participants in their homes. The interviews addressed questions about work life, family situation, health behaviors, economic conditions, living conditions and health status.

In the current study, data from LNU 1968, 1981, 1991 and 2000 were merged with data from SWEOLD 2002. Together, these datasets allow for up to 34 years of follow-up among a subsample of individuals ages 30–50 at baseline (1968). Only individuals who were interviewed in 1968 and in at least two of the subsequent waves of data collection were included in the study. Of the 2051 individuals aged 30–50 in 1968, 655 persons (32%) died during follow-up and 336 persons (16%) did not participate in two or more of the following data collections or had missing values in the included variables. The final analytic sample consisted of 1060 persons (52% of the original sample, 76% of the survivors).

Measurements

Each individual's smoking pattern over time, or trajectory, was identified based on smoking status in 1968, 1981, 1991 and 2000/2002. Smoking status at each wave was classified as either current non-smoking, light smoking (i.e., smoking less than 10 cigarettes/day), or heavy smoking (i.e., smoking 10 or more cigarettes/day). Distinctive, homogenous, trajectory groups were created manually according to a set of rules. *Persistent heavy smokers* ($n = 81$) were defined as those who reported smoking throughout the period, with heavy smoking reported during at least three time-points. Similarly, *persistent light smokers* ($n = 63$) were those who reported smoking throughout the follow-up period, but with two or fewer episodes of heavy smoking. The trajectory groups of former smokers consisted of those reporting smoking in the first and/or second waves of data collection, but no smoking in the final wave. *Former heavy smokers* ($n = 107$) reported mostly heavy smoking, while *former light smokers* ($n = 176$) primarily reported light smoking. Finally, the *persistent non-smokers* were those who never reported any smoking ($n = 633$, reference category).

Three non-life-threatening health outcomes covering different aspects of late-life health and function were investigated. *Mobility impairment* was measured with a summary index of three items: the ability to walk 100 m without difficulties, to run 100 m without difficulties, and to go upstairs and downstairs without difficulties. Responses were yes (0) and no (1). The summed index ranged from no mobility problems (0) to problems in all three domains (3). The indices of *Musculoskeletal pain* and *Symptoms of psychological distress* were both based on items from a list of common diseases and symptoms. Respondents were asked whether they had any of the listed diseases or health problems during the last twelve months. Responses were no (0); yes, slight problems (1); and yes, severe problems (2). The index of *Musculoskeletal pain* consisted of three questions regarding perceived pain in hands, elbows, legs or knees; shoulders; and back, hips, sciatica. Responses to these three questions were summed, creating a summary score ranging from 0 (no musculoskeletal pain) to 6 points (severe pain in all three sites). Similarly, the index of *Symptoms of psychological distress* consisted of four questions regarding anxiety, nervousness, anguish; general fatigue; sleeping problems; and depression. Depression rendered 2 points independent of severity. The total score ranged from 0 (no symptoms of psychological distress) to 8 points (severe problems in all measured domains of psychological distress). These measures have been used in previous studies, as indices as well as dichotomous variables (Fors et al., 2008; Meinow et al., 2006; Schön and Parker, 2009).

Age was measured continuously in years (at baseline). Educational level was measured continuously as completed years of education.

Statistical analyses

Bi- and multivariate multinomial regression analyses were run to compare the smoking groups with the persistent non-smokers across various demographic and health characteristics (using SPSS Statistics 20). Furthermore, this study employed multilevel models, with occasions of measurement nested within individuals (Hox, 2002; Shaw and Liang, 2011), in order to model individual-level changes in health over time (measured as years since baseline). Mobility problems, musculoskeletal pain and symptoms of psychological distress were used as time-varying outcome variables. The smoking trajectory groups, age, gender and education were entered as time-fixed predictors of inter-individual variation in the health trajectories. Non-linear changes in health over time were estimated by using the quadratic function, but in order to simplify the models, random effects were not estimated for the quadratic term. This allowed us to describe accurately the average pattern of non-linear change in each health outcome, while focusing only on examining inter-individual variation in the intercepts and linear slopes of the health trajectories. Analyses were run using Hierarchical Linear Modeling (HLM) software (Raudenbush and Bryk, 2002).

Results

Approximately 40% of the sample reported some level of smoking during the study period. Descriptive statistics for the persistent non-smokers and the four trajectory groups of smokers are presented in Table 1. All smoking groups, except for the persistent light smokers, had a higher proportion of men compared with the persistent non-smokers. Furthermore, heavy smokers were significantly younger and more highly educated compared with the persistent non-smokers. Baseline health differences were found for musculoskeletal pain, where the former light smokers reported significantly more pain symptoms, and for psychological distress, where the persistent heavy smokers had significantly higher symptom scores than the non-smokers. However, none of the smoking groups differed significantly from the non-smokers in mobility impairment. Adjusting for the included covariates did not change these results (see also Table 2).

Results from the multilevel models are presented in Table 2 and Figs. 1–3. Fig. 1 shows the association between smoking trajectory groups and the progression of mobility impairment from midlife to old age, controlling for age, gender and education. As presented in the first column of coefficients from Table 2, at baseline, there were no significant differences in mobility problems between the smoking trajectory groups; however the rates of increase in mobility problems over time did differ. Mobility problems increased at an accelerating rate in the persistent non-smoking group over the 34-year period of follow-up, but each of the other smoking trajectory groups exhibited faster increases in mobility impairment. The rate of increase in mobility impairment was steepest among persistent heavy smokers, followed by former heavy smokers. Persistent and former light smokers had steeper progression of mobility problems too, but only the slope for the former light smokers was statistically different from that of the persistent non-smokers.

Similarly, column two of Table 2, and Fig. 2, show results for the association between smoking trajectories and trajectories of musculoskeletal pain. Compared with persistent non-smokers, all smoking groups reported more pain symptoms at baseline, but the only baseline difference that was statistically significant was that for former light smokers. Over time, musculoskeletal pain increased at a decelerating rate among persistent non-smokers, and there were no differences between the smoking trajectory groups in the rate of increase. As such, baseline differences in musculoskeletal pain between the groups persisted over time.

In column three of Table 2, and Fig. 3, the association between smoking trajectories and symptoms of psychological distress is shown.

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