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MPIDR Working Paper WP 2025-017 I June 2025
https://doi.org/10.4054/MPIDR-WP-2025-017

Smoking and the length of working life: An examination using the U.S. Health and Retirement Study

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An examination using the U.S. Health and Retirement Study

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Abstract: Inequalities in the length of working life are a major concern in aging societies. However, what is driving these inequalities is poorly understood. In this paper, we use data from the U.S. Health and Retirement Study and analyze the impact of smoking on healthy working life expectancy at age 50 and related measures. We stratify our analysis by gender, race/ethnicity, and educational attainment. We find that smoking consistently reduces heathy working life expectancy: never smokers have the longest healthy working lives (10 years for men and eight years for women), while ex-smokers and smokers experience reductions of approximately two and four years, respectively. Lower educated and racial/ethnic minorities report shorter healthy working lives, and smoking explains up to one-third of these inequalities. Using placebo tests, we provide evidence supporting the causal relationship between smoking and reduced healthy working life expectancy.

Keywords: Healthy Working Life Expectancy, Socioeconomic Inequalities, Smoking Behaviour

Introduction

Populations in many high-income countries are aging quickly. In OECD countries, the share of the population aged 65+ is projected to rise from 18% in 2022 to 27% by 2050 (OECD, 2023). For the United States, the U.S. Census Bureau predicts an increase in this share from 17% to 23% over a similar period (U.S. Census Bureau, 2023). This trend raises concerns on the sustainability of social security and pension systems. Extending working lives has been proposed as a potential remedy to these concerns, and it is intended to reduce the years spent in retirement and to extend the active workforce. Consequently, many governments have raised the statutory retirement age and reduced early retirement options. In the United States, the Social Security retirement age has been increased from 65 to 67 for individuals born in and after 1960[1].

A critical question is whether individuals can continue working into older ages from a health perspective (Epping et al., 2024; Hale et al., 2021). While disability prevalence has stabilized or declined, chronic diseases are increasing (Schram et al., 2022; Boissonneault and Rios, 2021). If health does not improve as retirement ages rise, workers may need to work despite having health issues. Health behaviors are likely among the key factors determining the duration and quality of working life (Solovieva et al., 2024; Dudel, 2021). For instance, Shiri et al. (2021) reported that risky behaviors, such as smoking and low physical activity, shorten employment trajectories. Moreover, health behaviors tend to be highly dependent on socioeconomic status, and might therefore interact with variables such as education and race/ethnicity in shaping health and working trajectories. However, research on how health behaviors impact (healthy) working life expectancy is rare.

This study uses individual-level, longitudinal data from the U.S. Health and Retirement Study (HRS) covering the population aged 50+ for the years 2000 to 2020 to analyze the impact of tobacco smoking on late working life and health. We use healthy working life expectancy as our main outcome. It is defined as the average lifetime spent both employed and healthy. For the assessment of health, we focus on smoking-related conditions like lung disease, cancer, stroke, and heart disease (CDC, 2024; Raghupathi and Raghupathi, 2018). We model the link between smoking and working and health trajectories using a multistate approach, while also exploring socioeconomic inequalities in the impact of smoking by gender, education, and race/ethnicity. Moreover, building on the latter analysis, we show to what extent smoking contributes to overall inequalities in healthy working life expectancy between socioeconomic groups. To address the issue that the impact of smoking on work and health might at least be partly spurious and caused by unobserved confounders, such as other health behaviors that correlate with smoking, we conduct a placebo test using health outcomes not associated with smoking (Eggers et al., 2024).

Smoking has long been known to have major adverse effects on health, such as many lung diseases like chronic obstructive pulmonary disease (COPD; Forey et al., 2011; Raghupathi and Raghupathi, 2018; CDC, 2024). The onset of these diseases often occurs after extended periods of smoking and after age 50. Having these conditions might limit individuals' ability to work or fully impair them (Shiri et al., 2021; Demou et al., 2017; Hanly et al., 2015). Smoking has also been

[1] U.S. Social Security system: https://www.ssa.gov/oact/progdata/nra.html

linked to negative labor market outcomes through channels other than health (Shrestha et al., 2022; David et al., 2023; Demou et al., 2017). For instance, employers might discriminate against smokers. In the U.S., smoking prevalence has declined considerably in recent decades (e.g., American Lung Association, 2025), but among the older population we study, it was not uncommon to smoke during youth and adulthood. About 45% of individuals born in the mid-1940s smoked cigarettes at around age 20, and many continued smoking at least until age 45 (American Lung Association, 2025; CDC, 2024).

In the U.S., there are pronounced socioeconomic inequalities in health and working trajectories (e.g., McDonough et al., 2010). In particular, health and labor market outcomes strongly depend on educational attainment and race/ethnicity (Colby and Ortman, 2015; Braveman et al., 2010). On average, highly educated Whites have the most favorable outcomes and are the least likely to smoke, while individuals with low educational attainment and Blacks and Hispanics have less favorable outcomes and a higher smoking prevalence. Moreover, health and labor market outcomes are highly gendered, and gender interacts with other dimensions of inequality such as race/ethnicity (e.g., Browne and Misra 2003). These inequalities and their intersections have also been shown to be highly relevant for working life expectancy. For instance, highly educated White men have the highest, while Black women with low educational attainment have the lowest working life expectancy (e.g., Dudel and Myrskylä, 2017). Socioeconomic inequalities in healthy working life expectancy have, to the best of our knowledge, not been studied systematically before.

To address potential challenges regarding the causal nature of our estimates, we conduct placebo tests. Generally, establishing causality between smoking and healthy working life expectancy is challenging as the relationship between smoking habits, health, and labor force participation is complex and multifaceted. Research has shown that smoking adversely impacts health, which can in turn influence labor force outcomes, such as employment and productivity (Solovieva et al., 2024; Shiri et al., 2021). However, making causal inferences about this relationship is difficult due to potential confounding factors, such as socioeconomic status, pre-existing health conditions, and behaviors. For instance, lower-income individuals often smoke more and have worse health, complicating efforts to disentangle causality. Reverse causality further complicates the analysis. For example, an individual may quit smoking because of a health concern, such as a diagnosis of COPD or cardiovascular diseases. In this case, the health condition prompts the individual to quit smoking, rather than smoking directly causing the health problem (Hanly et al., 2015). Furthermore, job-related health problems (e.g., employment instability and stress) could also influence smoking behavior, rather than smoking directly impacting labor market outcomes (Demou et al., 2017). In our placebo tests, we address these challenges by estimating the effect of smoking on outcomes that are known to not be affected by smoking, but for which the challenges described above would still apply if present, and would thus bias estimates away from zero.

Overall, this paper contributes to the literature in three major ways. First, our paper is the first to explicitly assess the impact of smoking on inequalities in (healthy) working life expectancy ((H)WLE). The previous literature has focused on inequalities in health, employment rates, and specific labor market transitions, but not on WLE and HWLE. At the same time, previous work on (H)WLE and health behaviors, including smoking, has largely concentrated on the general population and not on group disparities and inequalities (e.g., Li et al. 2024). Moreover, while this work made important contributions to our understanding of the factors shaping (H)WLE, it

remained largely associational. Second, we go beyond existing associational approaches and provide evidence that the estimates of the impact of smoking that we provide have a causal interpretation. Third, related to the second point but more generally, the previous literature on WLE and HWLE has been largely descriptive or associational (Dudel, 2021), while this paper is among the first to provide a causal analysis of a key driver of the length of working life.

Background

Trends and Inequalities in Late Working Life in the United States

In recent decades, the dynamics of late working life in the U.S. have changed significantly. Starting in the 1990s, labor force participation rates for older people began to rise. In 2022, 65.2% of people aged 55-64 were in the labor force, compared to 61.9% in 2002 and 56.2% in 1992 (Dubina, 2023). Similarly, the participation rate of people aged 65+ increased to 26.6% in 2022 from 20.4% in 2002. Participation rates are expected to further increase, at least for individuals beyond retirement age (Dubina, 2023).

These trends have been driven by several factors, but later retirement transitions and working after reaching retirement age play key roles (Dubina, 2023; Dudel and Myrskylä, 2020). The full retirement age (FRA) for Social Security benefits gradually increased from 65 to 66 for individuals born in 1943-1954, and it was increased further for later cohorts, up to age 67 for individuals born in and after 1960. Early claims are possible from age 62, with higher monthly payments being granted for delayed claims up to age 70 (Dubina, 2023; Dudel and Myrskylä, 2020). In 2021, many new retirees were still claiming benefits before the FRA, although a growing number were working beyond traditional retirement ages (Congressional Research Service, 2022; Turek et al., 2022). Older Americans are increasingly active in the workforce post-retirement, with many transitioning to flexible arrangements like part-time or consulting, offering financial security and social engagement (Calvo et al., 2018). This shift is facilitated by an economy increasingly oriented toward less physically demanding jobs (Pedersen et al., 2020), but financial need also motivates many older adults to continue working (Moore et al., 2019).

The length of working life is also influenced by unemployment trends. Over time, the unemployment rate in the U.S. has undergone significant fluctuations, often linked to macroeconomic conditions. For example, after the Great Recession of 2007–2009, the U.S. unemployment rate peaked at 10% in 2010, disproportionately affecting older workers who faced longer durations of unemployment compared to younger groups (Dudel and Myrskylä, 2020; Congressional Research Service, 2022). Older workers have historically had lower unemployment rates than younger workers. In contrast, as of 2022, unemployment rates were higher for the population aged 55–64 and 65+ than for younger workers aged 35–54, reflecting the challenges older adults face when seeking to re-enter the workforce (U.S. Department of Labor, 2025). Currently, older workers are less likely than younger ones to find new employment after job loss, and periods of unemployment often lead them to retire earlier than planned (Turek et al., 2022).

Gender, race/ethnicity, and education impact labor force engagement and retirement. Compared to men, women tend to have shorter careers due to wage gaps, caregiving duties, and more frequent career interruptions (Turek et al., 2022). U.S. Bureau of Labor Statistics data from 2023 show 69.7% of men and 58.8% of women aged 45-64 were in the labor force, compared to 22.5% and 15.5% aged 65+ (Dubina, 2023). In the same year, the employment-to-population ratios for Hispanic or Latino (63.8%), Native Hawaiian and Other Pacific Islander (63.3%), and Asian individuals (63.1%) exceeded those for White (60.2%) and Black or African American individuals (59.6%). Furthermore, Blacks (Moore et al., 2019) and Hispanics (Johnson et al., 2017), along with individuals with lower education, tend to retire later with less financial security than Whites or those with higher education (Turek et al., 2022). Finally, compared to those with higher education, individuals with lower education are more likely to be unemployed and are less likely to remain employed in later life (Dubina, 2023; Turek et al., 2022; McDonough et al., 2010), and tend to face more financial insecurity in retirement (Turek et al., 2022; Braveman et al., 2010).

Health, Employment, and Smoking

Health is also a major determinant of the length of working life. The interplay of health and employment is particularly complex in late working life. Chronic conditions such as heart disease, respiratory diseases, and diabetes become more common with age, affecting productivity and job performance (Reichard et al., 2019), and these conditions are exacerbated by risk factors like tobacco use, poor diet, and sedentary lifestyles. Such lifestyle factors correlate with socioeconomic status and contribute to health inequalities, alongside healthcare access and other factors (Li et al., 2020; Petrovic et al., 2018). Notably, these health disparities in minority and low education groups have been linked to inequalities in work capacity and employability (Turek et al., 2022).

Many older workers continue to work despite having health issues. For instance, a recent study analyzing U.S. data from 2014 to 2017 showed that, on average, individuals aged 50 spend more than two-thirds of their remaining working years living with chronic conditions[2] (Boissonneault and Rios, 2021). Working despite being unhealthy can reduce both productivity and well-being (Solovieva et al., 2024; Boissonneault and Rios, 2021). Financial necessity may force older workers to remain in the labor force despite having chronic illnesses or disabilities. In addition, workers with health issues are more likely to transition to part-time roles or positions with fewer physical demands (Calvo et al., 2018). These adaptations, while helpful, often result in lower earnings and limited career advancement opportunities.

The health consequences of tobacco use are a major public health concern in the United States. For instance, according to the Centers for Disease Control and Prevention (CDC, 2024), smoking causes one in five preventable deaths, and has substantial health impacts that burden healthcare systems. While smoking rates have declined among U.S. older adults (e.g., from 18% in 1965 to 9% in 2020 among individuals aged 65+), many former smokers experience long-lasting health issues (Berman et al., 2017). Thus, it is not only the smoking prevalence during late working life and old age that is relevant, but also smoking behavior in earlier adulthood and youth. For the latter groups, smoking prevalence has been much higher than for older adults, although it has also

[2] Arthritis, cancer, diabetes, heart attack, coronary heart disease, angina, congestive heart failure, hypertension, lung disease, and stroke.

declined (e.g., from 42% in 1965 to 15% in 2020 for individuals aged 45-64). Smoking-related diseases often first appear after age 50 or 55, and can severely limit individuals' ability to work or fully impair them (Schram et al., 2022; Reichard et al., 2019).

Smoking also has adverse effects on work capacity, productivity, and employability that go beyond the health limitations it can cause. Studies have shown that smoking correlates with absenteeism, reduced productivity, and higher disability risk, often leading to early work exit (Berman et al., 2017; Demou et al., 2017). Nicotine cravings can reduce focus at work, and smoking can reduce employment longevity and productivity (Demou et al., 2017; Shrestha et al., 2022). In addition, employers may be less likely to hire smokers due to concerns over healthcare costs and productivity losses (Shrestha et al., 2022). Some U.S. states legally allow employers to restrict the hiring of smokers, although most states protect tobacco user employment rights (Patel and Schmidt, 2017). Smoking is also linked to lower income and education, and associated stigmas may cause additional employment discrimination (David et al., 2023; Demou et al., 2017).

Smoking prevalence differs considerably across socioeconomic groups. Men have historically smoked more than women, and although this gap has declined, gender-based differences in the impact of smoking on health and employment remain (Dudel, 2021; Shiri et al., 2021). Individuals with lower educational attainment tend to have higher smoking prevalence (CDC, 2024; David et al., 2023). In addition, smoking prevalence is higher among non-Hispanic Whites and Blacks than among Hispanics and Asians, though trends vary by subgroup and region (Berman et al., 2017; Ho and Fenelon, 2015).

Finally, the impact of smoking on health and employment differs based on gender, socioeconomic background, and race/ethnicity, contributing to greater inequalities (Li et al., 2024; Shiri et al., 2021). For instance, compared to men, smoking among women is linked to higher risks of various diseases, including lung cancer (Shiri et al., 2021). In addition, individuals from lower socioeconomic groups are less likely to access healthcare, which can result in delayed diagnoses of smoking-related illnesses and poorer health outcomes (Ho and Fenelon, 2015; Li et al., 2024). Certain racial/ethnic minorities often face more significant barriers, including smoking-related health challenges or hiring discrimination (Ho and Fenelon, 2015). For example, Black smokers experience higher rates of smoking-related mortality compared to White smokers, partly due to differences in smoking patterns, such as higher use of menthol cigarettes among Black smokers, and systemic healthcare disparities (Ho and Fenelon, 2015). Examining how smoking impacts employment through health and other factors can offer insights into social determinants of health and labor market outcomes, while underlining the importance of addressing these disparities (Turek et al., 2022; Demou et al., 2017).

(Healthy) Working Life Expectancy

Working life expectancy (WLE) refers to the expected lifetime spent in paid employment, similar to measures such as life expectancy or the expected lifetime spent in disability. It accounts for all employment transitions, like becoming unemployed, retiring, and re-entering the labor market (Dudel and Myrskylä, 2020; Head and Hyde, 2020). As such, it provides a holistic summary of working life, in contrast to measures that only account for specific transitions. Recently, research

on WLE has increased, especially regarding socioeconomic factors (Solovieva et al., 2024; Schram et al., 2022; Weber and Loichinger, 2022), as WLE can be used to show how inequalities in the labor market accumulate.

To expand the scope of WLE studies, two indicators are increasingly employed: healthy working life expectancy (HWLE) and unhealthy working life expectancy (UWLE). These indicators consider both health and work conditions, providing insight into extending working lives with and without compromised health, and offering a comprehensive view of the cumulative health disadvantages affecting workforce participation (Dudel, 2021; Head and Hyde, 2020). For example, HWLE (UWLE) at age 50 measures the average years individuals are both healthy (unhealthy) and employed from age 50 until death.

Parker et al. (2020b) found a lack of studies evaluating the duration of healthy working life among adults aged 50+, revealing HWLE research gaps. Recent estimates of HWLE in countries like Germany and Finland and across the OECD show that trends vary significantly, with HWLE rising in England and Germany, but declining among U.S. men (Hambisa et al., 2023; Heller et al., 2022; Boissonneault and Rios, 2021). UWLE has increased in several countries. For example, in the Netherlands, more older adults work while managing chronic diseases, driven by improved treatments and economic needs (De Wind et al., 2018). Evidence suggests that in OECD countries, the increasing employment rates among older adults are more likely to reflect the labor market participation of individuals with chronic diseases than of healthy individuals (Boissonneault and Rios, 2021).

Research Aims

The study examines the relationship between health, work, and socioeconomic variables, focusing on how smoking affects HWLE and considering heterogeneity by race/ethnicity and education. Specifically, it estimates HWLE and UWLE at age 50 across non-Hispanic Whites, Blacks, and Hispanics, and across educational levels, differentiating never, ex, and current smokers. HWLE measures time spent working without smoking-related diseases (e.g., lung diseases, cancer, heart disease, stroke) (Shiri et al., 2021; Demou et al., 2017). To better understand to what extent inequalities between socioeconomic groups are driven by smoking, we calculate counterfactual scenarios in which disadvantaged groups are assumed to have the same smoking prevalence as the groups with the lowest smoking prevalence. Finally, we also address the question of to what extent the impact of smoking we find is causal or is due to unobserved confounders by implementing a placebo test.

We hypothesize that smokers have lower HWLE and higher UWLE than non-smokers, with smoking's effects on employment extending beyond health. Moreover, we assume that the impact of smoking on HWLE varies across racial and educational groups (Shiri et al., 2021; Demou et al., 2017). Given that previous research shows large differentials in smoking prevalence by socioeconomic status, we expect that a significant part of the differentials in HWLE can be attributed to smoking. For the placebo test, we expect limited confounding and a largely causal smoking impact, as the previous literature has provided overwhelming evidence of smoking's

impact on health, and strong evidence of smoking's impact on employment beyond its health effects (Shrestha et al., 2022; Berman et al., 2017; Demou et al., 2017).

Data and Method

Data: Health and Retirement Study

We use data from the Health and Retirement Study (HRS), a nationally representative longitudinal survey of U.S. adults aged 50+. The first wave of the HRS was collected in 1992, and new waves have been added every two years. Managed by the University of Michigan's Institute for Social Research, with support from the National Institute on Aging and Social Security Administration, the HRS collects data on health, employment, socioeconomic factors, and oversamples minorities (Bugliari et al., 2020). Deaths are derived from relative interviews. We use harmonized data from the RAND version of the HRS (Bugliari et al., 2020), covering the years 2000 to 2020.

Key Measurements: Employment, Health, and Smoking

With respect to employment, we distinguish between working individuals and non-working individuals. Employment status is assessed in each HRS wave using self-reported labor force status. The non-working group includes individuals who reported being retired, being out of the labor force, or being unemployed. The employed group includes individuals who are either working (dependent employment or self-employment) or are on leave, including sick leave.

In the HRS, respondents are asked, "Has a doctor ever told you that you have …" followed by a list of chronic conditions. This measurement approach implies a tendency for chronic conditions to persist once they have been reported. In this study, health is evaluated based on the presence of the most common smoking-related chronic diseases: lung disease, cancer, heart disease, and stroke (CDC, 2024; Raghupathi and Raghupathi, 2018). Individuals are defined as healthy if they reported having none of these diseases, and are otherwise classified as unhealthy. We focus on smoking-related diseases, as any impact we find for smoking on diseases unrelated to smoking can only be due to confounding. We exploit this fact in the placebo test, as is described further below.

Smoking status is determined by two questions: "Do you smoke cigarettes now?" and "Have you ever smoked cigarettes?" Respondents are classified as current smokers, ex-smokers, or never smokers (Shiri et al., 2021; Bugliari et al., 2020). We drop individuals from the analysis who are observed to start smoking, i.e., individuals who reported never having smoked in the first wave of the HRS in which they participated, but reported being a current or a former smoker or in a later wave. While focusing only on cigarette smoking ignores other means of consuming tobacco (e.g., chewing tobacco, pipes, cigars, vaping), it was and is the main way the older cohorts we study consume tobacco (Cornelius et al., 2020).

Further Covariates: Race/Ethnicity, Education, Gender

Race/ethnicity is classified as Non-Hispanic White, Non-Hispanic Black, and Hispanic. Other groups, such as Native American or Asian American, unfortunately have to be excluded from the analysis due to sample size. Education is categorized as higher (college/university degree), medium (high school graduate/some college), and lower education (less than high school/General Equivalency Degree). Gender is defined in a binary manner. Individuals with missing data on employment, health, and covariates are excluded.

Methods: Multistate Modeling

This study applies the multistate approach to examine work and health trajectories and their relationship to smoking and socioeconomic status. Unlike event history analysis, which examines single transitions, multistate models allow for movement among multiple states. Transitions are described by the transition probabilities between states (Dudel and Myrskylä, 2020; Schram et al., 2022).

In our analysis, we use five states: healthy working, unhealthy working, healthy non-working, unhealthy non-working, and dead. The transitions between these states depend on age, smoking, and socioeconomic variables (gender, education, race/ethnicity). We assume that upon reaching age 99, all surviving individuals are dead. Figure 1 illustrates the state space without age.

[Fig.1. State space of the multistate models.]

Age-specific transition rates are estimated through multinomial logistic regressions, with a general equation that incorporates age (quadratic), education, smoking, and three dummies for retirement peaks at ages 65, 66, and 67:

$$ln\ \frac{p_x^{ij}}{p_x^{ii}} = \alpha_{ij} + \beta_{ij}Age + \gamma_{ij}Age^2 + e_{ij}Education + s_{ij}Smoking +$$

$$u_{ij}D65_{ij} + v_{ij}D66_{ij} + z_{ij}D67_{ij}$$

where p_x^{ij} indicates the probability for an individual with age *x*, observed in state *i* at a certain interview, to find him/herself at the next interview and age *x+1*, in state *j*. The models are stratified by gender and race/ethnicity, which implicitly interacts all covariates in the model with them. Though the HRS framing of chronic condition questions suggests that diseases, once reported, are permanent, acknowledging that real-life health trajectories may involve recovery, i.e., individuals can move from an unhealthy to a healthy state, we allow the model to account for recovery

transitions (Figure 1). This choice is motivated by empirical and conceptual considerations (see methodological considerations for further details).

Transition probabilities are used to construct period state-specific life tables, which allow us to estimate total life expectancy; healthy working life expectancy (HWLE), i.e., the average remaining years in the workforce without smoking-related diseases; unhealthy working life expectancy (UWLE), i.e., the average remaining years in the workforce with smoking-related diseases; healthy non-working life expectancy; and unhealthy non-working life expectancy. We fix smoking status, distinguishing three groups: individuals who never smoked up to age 50, and who do not pick up smoking later; individuals who are ex-smokers at age 50, and who do not relapse; and individuals who are smokers at age 50, and who keep smoking until the end of their lives. Confidence intervals are calculated using the block bootstrap, using 10,000 bootstrap replications (Dudel and Myrskylä, 2020).

To assess smoking's contribution to socioeconomic inequalities in HWLE, we conduct a counterfactual analysis by simulating scenarios in which the smoking prevalence in a reference group (e.g., higher educated) matches that of other the groups (e.g., medium and lower educated). A narrowing of the HWLE gap under such scenarios compared to the main results would indicate the direct impact of smoking on HWLE. Specifically, the counterfactuals are constructed using two key components: HWLE by smoking status and socioeconomic variables, and smoking prevalence by socioeconomic group. To calculate the baseline inequality in HWLE, we first estimate HWLE for all socioeconomic groups without considering smoking status by combining HWLE estimates conditional on smoking and the smoking prevalence for each group. We then calculate HWLE differences between higher educated individuals (or Whites) and all other educational (racial/ethnic) groups. Counterfactuals are constructed by replacing the smoking prevalence of each group with the smoking prevalence of higher educated individuals (or Whites), then calculating the total HWLE for all other educational (racial/ethnic) groups using this prevalence. Finally, we compute the differences in HWLE across groups again and take the proportion of the difference.

To assess the causal impact of smoking, we perform a placebo test (Eggers et al., 2024). In a placebo test, the impact of the treatment of interest is estimated for an outcome for which it is known that the true effect will be zero; if the estimate deviates from zero, this is evidence of confounding. In our case, we conduct the main analysis in such a way that a causal impact of smoking is at least plausible, as we focus on smoking-related diseases for which the causal effect of smoking is firmly established. Nevertheless, some confounding could remain. In our placebo test, we analyze the impact of smoking on placebo diseases for which smoking is generally not considered the primary cause (e.g., high blood pressure, psychiatric issues, arthritis), as well as on diseases for which smoking has an impact that is smaller than that in our main analysis, or for which the causal link is unclear (e.g., lung diseases, cancer, heart disease, stroke, diabetes); we call the latter category of diseases mixed-smoking-related. Using logistic regressions for these placebo outcomes as well as our main health indicator, we include smoking status, age, education, and race/ethnicity as covariates. We compare the average marginal effect of smoking status on binary health indicators based on smoking-related diseases, smoking-unrelated diseases, and mixed diseases; ideally, the effect for smoking-unrelated diseases should be close to zero, or at

least considerably smaller than the effect for smoking-related diseases, while the effect for mixed diseases should be in between these two effects.

All analyses were conducted in R version 4.4.2 (R Core Team, 2024), using the *dtms* package (https://github.com/christiandudel/dtms) to estimate the multistate models and state expectancies. Average marginal effects of smoking on health indicators were calculated with the *margins* function.

Results

Sample Composition and Transition Probabilities

The analysis includes 33,224 individuals and 171,777 transitions, excluding 565 men and 668 women in the "other" ethnicity category due to the small sample size. Table 1 shows the number of observations and transitions by gender, race/ethnicity, education, smoking behavior, and type of transition. The sample consists of 43% men and 57% women. White respondents make up 65% of the sample (69% of transitions), while 19% are Black and 13% are Hispanic. In terms of education, 31% are women with medium education, 21% are men with medium education, 15% are women with low education, and 12% are men with low education. Regarding smoking, women and men who have never smoked represent 14% and 29%, respectively, while women and men who currently smoke represent 10% and 9%, respectively. Over the period, 11,170 individuals died (33%, 32% of women and 36% of men). The transition patterns indicate that 75% of individuals remain healthy and working, with only 4% transitioning to the unhealthy and working state. Conversely, only 66% of individuals who are unhealthy and working remain in that state. The most common state from which individuals transition to death is unhealthy non-working (13%).

[Table 1. Number of observations and transitions by gender, race/ethnicity, education, smoking behavior, and type of transition.]

The data show a relationship between lower education and higher smoking prevalence, with 24% of lower educated individuals being current smokers compared to 9% of higher educated individuals. We find that 51% of women and 32% of men have never smoked (appendix Table A1). Trends in smoking prevalence over the 2000–2020 period show that the proportion of never smokers increases while the proportion of current smokers declines for all racial/ethnic groups, with White and Hispanic individuals showing gradual changes and Black individuals displaying more fluctuation (appendix Figure A1).

Figure 2 shows age-specific probabilities by smoking of remaining healthy and employed (Panel A), of transitioning from that state to being unhealthy and employed (Panel B), and of dying (Panel C). Overall, the likelihood of staying healthy and employed decreases steadily with age, with current smokers having a lower probability (0.87 at age 50) than ex-smokers and never smokers (0.90). Conversely, the probability of transitioning from being healthy and employed to being

unhealthy and employed rises with age until around age 67, after which it declines. Current smokers are at highest risk of experiencing this transition (0.42 at age 50), followed by ex-smokers (0.32) and never smokers (0.27). Finally, mortality rises with age, with mortality being highest among current smokers (0.13 at age 50), followed by among ex-smokers (0.08) and never smokers (0.05).

[Fig. 2. Age-specific probabilities by smoking status of staying healthy and working, of transitioning from being healthy and working to being unhealthy and working, and of dying.]

Healthy Working Life Expectancy by Gender and Smoking Status

Table 2 presents total, healthy working, healthy non-working, unhealthy working, and unhealthy non-working life expectancy for men and women at age 50 who never smoked. For current smokers and former smokers, the table shows the difference between these two groups and individuals who never smoked for each state expectancy. Statistically significant differences are marked (*). For instance, men who smoke during late working life have, on average, a life expectancy that is 9.9 years lower than the life expectancy of individuals who have never smoked.

Smoking significantly affects healthy working life. Among men, those who have never smoked have a HWLE of 10.2 years, while the HWLE of ex-smokers and current smokers is 1.8 years and 4.3 years shorter, respectively. Among women, those who have never smoked have a HWLE of 8.2 years, while the HWLE of ex-smokers and current smokers is 1.4 and 3.3 years shorter, respectively. Across all smoking groups, men have a HWLE that is around 1.0-2.0 years longer than that of women. The UWLE of never smokers, at around 2.0 years (20%), is only slightly different from that of the smoker groups. Unhealthy non-working life expectancy is higher for female smokers than for female never smokers, but is lower for male smokers than for male never smokers. Overall, these results suggest that the loss of HWLE is mainly due to lower life expectancy, and is less attributable to additional unhealthy life expectancy, which is not, or is only slightly, higher for smokers. The latter finding is likely because smokers die much earlier, and are thus not reaching higher ages at which they would typically experience significant reductions in health.

[Table 2. Total, healthy and unhealthy, working and non-working life expectancy at age 50, by gender and smoking status plus 95% confidence intervals (CI) for never smokers as the reference, with differences between never smokers and ex-smokers and current smokers (* shows statistical significance for the differences - Sign.).]

Heterogeneity of the Impact of Smoking by Education and Race/Ethnicity

Figure 3 illustrates HWLE at age 50, with 95% confidence intervals for men and women categorized by education (high, medium, low), race/ethnicity (White, Black, Hispanic), and smoking status. Appendix Table A2 reports life expectancy estimates by state at age 50 for never

smokers, with differences between never smokers and ex-smokers and between never smokers and current smokers, by gender, race/ethnicity, education, and smoking behavior. Never smokers have the highest HWLE, followed by ex-smokers, with current smokers having the lowest HWLE. This pattern is consistent across all racial/ethnic groups and educational levels, and for both women and men, although the magnitude of the impact of smoking varies within groups. For example, among high educated men, the HWLE gap between current smokers and never smokers is larger among Hispanic men (6.2 years) than among White (3.9 years) and Black men (5.0 years). A similar pattern is observed for medium and low educated men, although the differences in HWLE between current and never smokers are about one year smaller. Higher educated men have a HWLE 2.0–4.0 years longer than their lower educated peers. Interestingly, Hispanic men have a longer HWLE than White and Black men in most of the groups.

While the HWLE trends of women reflect those of men, the disparities are slightly smaller. Women generally have a HWLE 2.0 years shorter, although the gender gap is narrower among current smokers, lower educated individuals, and Black individuals (below 1.0 year). The difference in HWLE between current smokers and never smokers is around 2.0 years for White and Hispanic women and is around 3.0 years for Black women. The educational gradient mirrors that of men.

The proportion of HWLE relative to total working years is around 90% for never smokers but decreases significantly for ex-smokers and current smokers. For example, for higher educated Hispanic men who are current smokers, the proportion of HWLE relative to their total working life years is only 63%, whereas for low educated White women who are current smokers, this proportion is only 59%. HWLE by age, smoking, race/ethnicity, and education among men and women is reported in Figure A2 and Figure A3, respectively.

[Fig. 3. Healthy working life expectancy at age 50 (dots) with 95% confidence intervals (CI — lines) for men (top) and women (bottom), by education (high, medium, low), race/ethnicity (White, Black, Hispanic), and smoking status (never, ex, current).]

Counterfactual Analysis

Results of the counterfactual analyses are presented in Table 3, which shows the proportion (%) of differences in HWLE that could be explained by equalizing smoking prevalence across educational levels and racial/ethnic groups. The analysis reveals that equalizing smoking prevalence across educational levels as well as across racial/ethnic groups could significantly impact HWLE. For example, for men, aligning lower educated groups with their highly educated counterparts could eliminate 34.8% of the HWLE gap between high and low educated men. For women, this adjustment could close 15.3% of the HWLE gap between high and low educated women. Interestingly, equalizing smoking prevalence between Hispanic and White women would increase the HWLE gap by 59.7%, likely because Hispanic women have lower smoking rates (appendix Table A1). This suggests that changing smoking behaviors could widen certain health inequalities. The results point to the significant role smoking plays in health- and work-related inequalities. Targeted interventions aimed at reducing smoking could help to address disparities in health and working outcomes.

[Table 3. Counterfactual analysis: proportion (%) of differences in HWLE that could be explained by equalizing smoking prevalence across educational levels and racial/ethnic groups.]

Placebo Test

The average marginal effects (AME) from logistic regression shows a significant association between smoking behaviors and health outcomes, including smoking-related diseases, mixed-smoking-related diseases, and placebo diseases. Estimates and 95% confidence intervals for AMEs are in Table 4. AMEs for smoking-related diseases are significantly larger than those for mixed-smoking-related and placebo diseases. For instance, the AMEs for current smokers and ex-smokers compared to never smokers are 10.9% and 9.6%, respectively. In contrast, the AMEs for mixed-smoking-related and placebo diseases are approximately 4% for ex-smokers and 1% for current smokers. These results highlight the stronger association between smoking and diseases directly linked to smoking, such as lung diseases, cancer, heart disease, and stroke, compared to others in the analysis, such as diabetes, high blood pressure, psychiatric problems, and arthritis, for which smoking's impact is weaker. Notably, ex-smokers show higher AMEs for mixed-smoking-related and placebo diseases compared to current smokers. This is plausible, as individuals may have quit smoking due to health issues, which could be directly or indirectly related to smoking. Thus, the higher AMEs observed in ex-smokers may reflect a greater underlying health burden that led them to quit smoking, making the results for ex-smokers more complex and potentially less directly attributable to smoking alone.

[Table 4. Average marginal effect (AME): estimates and 95% confidence intervals.]

Discussion

Main Findings

Using data from the U.S. Health and Retirement Study to construct period working and non-working healthy and unhealthy life tables, we analyzed the impact of smoking on health and workforce participation, and examined inequalities by gender, race/ethnicity, and education. This study underscores the significant implications of smoking behavior for health and labor market outcomes, particularly through the impact of smoking on HWLE. While our findings confirm that smoking consistently reduces HWLE, they also show that the magnitude of this effect varies between groups. Notably, we found that smoking-related inequalities in HWLE are primarily driven by disparities in smoking prevalence across different populations. Furthermore, the analysis provides evidence supporting the largely causal nature of the relationship between smoking and reduced HWLE, particularly when comparing smokers to never smokers.

Never smokers report the longest HWLE: e.g., 10 years for men and eight years for women at age 50. In contrast, the HWLE of ex-smokers and smokers is approximately two and four years shorter,

respectively. Given that smoking has long been recognized as a major determinant of morbidity and mortality (Shiri et al., 2021), and as a factor negatively influencing workforce participation (Berman et al., 2017; Swan et al., 2018; Demou et al., 2017), the observed reduction in HWLE among smokers is consistent with our expectations. However, this study is the first to establish smoking as a key determinant of HWLE. Our marginal effects analysis reveals that smoking's impact on HWLE is most pronounced for diseases directly linked to smoking, such as lung diseases, heart diseases, cancer, and stroke. In contrast, the effects are smaller for conditions less closely related to smoking, such as high blood pressure, psychiatric disorders, and arthritis, particularly when comparing never smokers to smokers. These findings support the existence of a causal relationship between smoking and reduced HWLE. This aligns with research identifying smoking as a leading risk factor for cardiovascular, cancer, and respiratory diseases (Shiri et al., 2021; Demou et al., 2017; Berman et al., 2017). Interestingly, the primary effect of smoking appears to involve a reduction in life expectancy, as the years of HWLE that are lost are not redistributed to other states (e.g., working with smoking-related diseases), but are instead entirely removed from the lifespan. This suggests that individuals experiencing reduced HWLE due to smoking are not simply living longer in unhealthy or non-working states – they are dying earlier.

These findings have significant implications for policies aiming to extend the state pension age. If certain populations, such as smokers, are losing years of both life and HWLE, raising the pension age may disproportionately disadvantage them. Many individuals in these groups may not live long enough to benefit from extended pensions, highlighting the importance of addressing smoking-related health inequalities to achieve equitable policy outcomes. Notably, even in subpopulations with the longest HWLEs (e.g., 12 years for high and medium educated Hispanic men aged 50), these HWLEs are consistently shorter than the time until the current state pension age in the U.S. (approximately 15 years, until ages 65-67 depending on the birth cohort). This suggests that individuals will face health issues related to smoking, such as cancer, lung and heart diseases, and stroke, before reaching retirement age, raising concerns about workforce sustainability (Loichinger and Weber, 2020; Dudel, 2021). Many workers experience health problems early, placing financial pressure on pension systems as more people come to rely on social security (Tetzlaff et al., 2022; Boissonneault and Rios, 2021). In addition, a high number of unhealthy workers may worsen labor shortages and diminish productivity (Head and Hyde, 2020; De Wind et al., 2018).

We found that inequalities in smoking prevalence contribute significantly to disparities in HWLE. For example, the relationship between smoking and HWLE varies by race and ethnicity. Hispanic individuals, particularly men, have higher HWLE than their White and Black counterparts, even among the low educated. Although previous research reported that Hispanics have a shorter working life expectancy than Whites in the U.S. (Dudel and Myrskylä, 2017), our results support the "Hispanic paradox," which suggests that Hispanic populations often have better health outcomes despite their socioeconomic disadvantages (Lariscy et al., 2015). Our findings imply that this phenomenon extends to HWLE, especially for medium and low educated Hispanic men. Additionally, the racial and ethnic disparities in HWLE we found align with the results of studies indicating that smoking-related health inequalities are more pronounced among Black populations, which has been attributed to a higher burden of smoking-related diseases and lower healthcare access (Lariscy et al., 2015), as well as lower workforce attachment (Dudel and Myrskylä, 2017), in these populations. We also observed marked gender differences, with men generally having

longer HWLE than women across all smoking groups. This may be attributed to higher labor force participation among men, consistent with research highlighting the gendered nature of health inequalities and working outcomes (Hambisa et al., 2023; Heller et al., 2022; Lynch et al., 2022). Additionally, we found that men who currently smoke experience steeper declines in HWLE compared to women and to never smokers and ex-smokers. These findings are in line with research indicating that smoking accelerates the onset of chronic conditions, with disproportionate effects for both genders (Shiri et al., 2021; Demou et al., 2017).

Furthermore, the study found an educational gradient in HWLE for both genders, with higher educational attainment associated with longer HWLE. Research shows that education correlates with health outcomes, as individuals with higher education generally have better health behaviors and healthcare access (Li et al., 2024; Lynch et al., 2024), as well as better working outcomes (Schram et al., 2022; Parker et al., 2020b; Dudel and Myrskylä, 2017). Interestingly, Hispanic men exhibit a smaller educational gradient compared to White and Black men, likely due to the smaller employment rate gaps across educational levels among Hispanics. Research indicates that education has less impact on employment rates for Hispanic populations, meaning that Hispanic individuals with lower educational levels tend to be employed at rates closer to those of their more educated counterparts (Colby and Ortman, 2015). Finally, socioeconomic variables interact with smoking behaviors to exacerbate these disparities. For instance, low educated Black women have the lowest HWLE among all groups, reflecting compounded disadvantages. Counterfactual analysis indicates that aligning smoking prevalence across educational and racial/ethnic groups could close a substantial portion of the HWLE gap, particularly for men. This finding is relevant, as education is a major determinant of health behaviors, with lower educational attainment often linked to higher smoking rates and poorer health outcomes (Li et al., 2024; Turek et al., 2022; Demou et al., 2017).

Our analysis shows that UWLE accounts for approximately 20% of remaining working years at age 50 spent living with smoking-related diseases for both men and women. This highlights the significant burden of poor health for the workforce. Spending one-fifth of remaining working years in an unhealthy condition contributes to increased absenteeism, reduced productivity, and elevated healthcare costs for workers (Solovieva et al., 2024; Tetzlaff et al., 2022). This results in a less efficient workforce, higher turnover, and additional employer costs for compensation and healthcare (Head and Hyde, 2020; Loichinger and Weber, 2020; Reichard et al., 2019). Notably, inequalities are observed in UWLE. For example, higher educated Hispanic men who smoke and lower educated White women who smoke spend approximately 40% of their remaining working years at age 50 with smoking-related diseases. These disparities highlight the complex interplay between smoking, socioeconomic factors, and health, and their combined impact on workforce participation and productivity, emphasizing the challenges faced by vulnerable populations.

In our study, healthy working life expectancy free of smoking-related diseases at age 50 is approximately eight years, regardless of smoking status, gender, education, and race/ethnicity. This estimate is notably higher than the HWLE of approximately three years reported by Boissonneault and Rios (2021) for individuals aged 50 in the U.S. during 2014–2017. The discrepancy likely arises because their analysis accounted for a broader group of 10 health conditions, including lung diseases, cancer, heart diseases, and stroke, which would naturally reduce their HWLE estimates. Our HWLE findings are, however, consistent with recent research

in England, which estimated a HWLE (based on self-reported health) of approximately nine years at age 50 (Parker et al., 2020b). Additionally, our observation that smoking reduces HWLE aligns with a recent study from China, which reported a significant HWLE gap of about one year between smokers and non-smokers (Li et al., 2024). Finally, HWLE inequality patterns match the broader literature showing shorter (healthy) working life for women, smokers, the less educated, and Black individuals, as well as compounding effects for these groups compared to their counterparts (Li et al., 2024; Parker et al., 2020a; Pedersen et al., 2020).

Methodological Considerations

It is important to consider two factors when interpreting our findings. First, our analysis use the period perspective. This perspective assumes that observed conditions remain constant throughout the lifetime of a hypothetical cohort, meaning that the results represent hypothetical scenarios rather than the actual experiences of a real cohort. However, a full cohort perspective has much higher data demands. Moreover, our results provide useful summaries of the conditions prevailing during the time we study. Second, our analysis assumes that smoking status at age 50+ remains stable thereafter. While this assumption is necessary for simplifying the modeling process and reflects the relative stability of smoking behaviors after midlife (Weinberger et al., 2014), other trajectories of smoking behavior are not uncommon. For example, some individuals may stop smoking, but then start smoking again after a few years, before finally quitting for the rest of their lives.

Although HRS measurement of chronic conditions, which is based on whether a doctor has ever given a diagnosis, suggests a static view of disease status, the models allow for recovery. First, real-life health is more dynamic, as health trajectories may involve recovery due to either clinical improvement or changes in self-reporting over time. For example, individuals who experience recovery or successfully manage a chronic condition may initially report a diagnosis but subsequently omit it in later interviews due to perceived improvement. Second, while recovery transitions are rare (Table 1), including them improves the realism and flexibility of the model by accounting for meaningful health improvements, with minimal impact on the overall results.

While our placebo tests indicate that there is no major confounding, reverse causality is likely to be present to some extent for individuals who quit smoking because of declining health (e.g., a diagnosis of cardiovascular disease or COPD). In such cases, even though former smokers experience some long-term health effects from prior smoking, the relationship between smoking, health, and working outcomes may be confounded as the observed benefits of cessation may be underestimated by their pre-existing health conditions. In particular, by the time they quit, their health may already be compromised, making it less likely that they will experience the same health improvements from quitting as individuals who are healthier.

Conclusion

Our findings underscore that smoking significantly reduces healthy working life expectancy, with particularly pronounced effects among women, lower educated individuals, and racial/ethnic

minorities. The rapid aging of populations in high-income countries, including in the U.S., poses critical challenges to the sustainability of social security and pension systems. Extending working lives has been proposed as a potential solution, but our results reveal that without addressing unhealthy behaviors, particularly smoking, and socioeconomic disparities, raising retirement ages could force individuals, especially vulnerable groups, to continue working despite being unhealthy or to retire earlier with unfair financial conditions. This could result in reduced productivity and elevated healthcare costs for workers, exacerbating inequalities.

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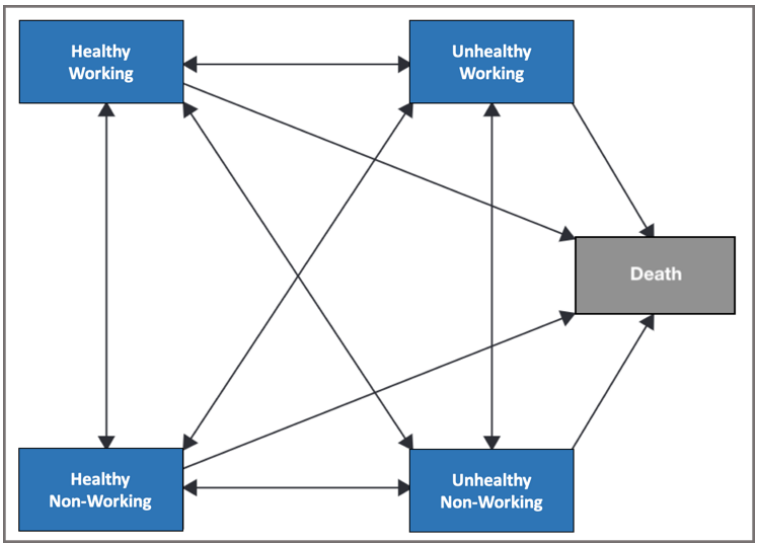

Fig.1. State space of the multistate models.

Table 1. Number of observations and transitions by gender, race/ethnicity, education, smoking behavior, and type of transition.

	Respondents	%	Transitions	%
Men Race/Ethnicity				
White	9483	29	50456	29
Black	2512	8	10774	6
Hispanic	1853	6	8188	5
Other	565	2	2207	1
Women Race/Ethnicity				
White	12003	36	67888	40
Black	3774	11	18110	11
Hispanic	2366	7	11353	7
Other	668	2	2801	2
Total Race/Ethnicity	33224	100	171777	100
Men Education				
High	3356	10	18346	11
Medium	6983	21	34526	20
Low	4074	12	18753	11
Women Education				
High	3454	10	18545	11
Medium	10211	31	55806	32
Low	5146	15	25801	15
Total Education	33224	100	171777	100
Men Smoking				
Never	4653	14	23027	13
Ex	6804	20	37810	22
Current	2956	9	10788	6
Women Smoking				
Never	9562	29	51471	30
Ex	5999	18	35845	21
Current	3250	10	12836	7
Total Smoking	33224	100	171777	100

Transition from Healthy and Working	Transitions	%
To Healthy and Working	28596	75
To Unhealthy and Working	1450	4
To Healthy and Non-Working	7180	19
To Unhealthy and Non-Working	782	2
To Dead	251	1
Total	38259	100
Transition from Unhealthy and Working		
To Healthy and Working	425	4
To Unhealthy and Working	7377	66
To Healthy and Non-Working	110	1
To Unhealthy and Non-Working	3063	27
To Dead	278	2
Total	11253	100
Transition from Healthy and Non-Working		
To Healthy and Working	2719	4
To Unhealthy and Working	147	0
To Healthy and Non-Working	48955	80
To Unhealthy and Non-Working	6458	11
To Dead	2886	5
Total	61165	100
Transition from Unhealthy and Non-Working		
To Healthy and Working	50	0
To Unhealthy and Working	981	2
To Healthy and Non-Working	1812	3
To Unhealthy and Non-Working	50502	83
To Dead	7755	13
Total	61100	100

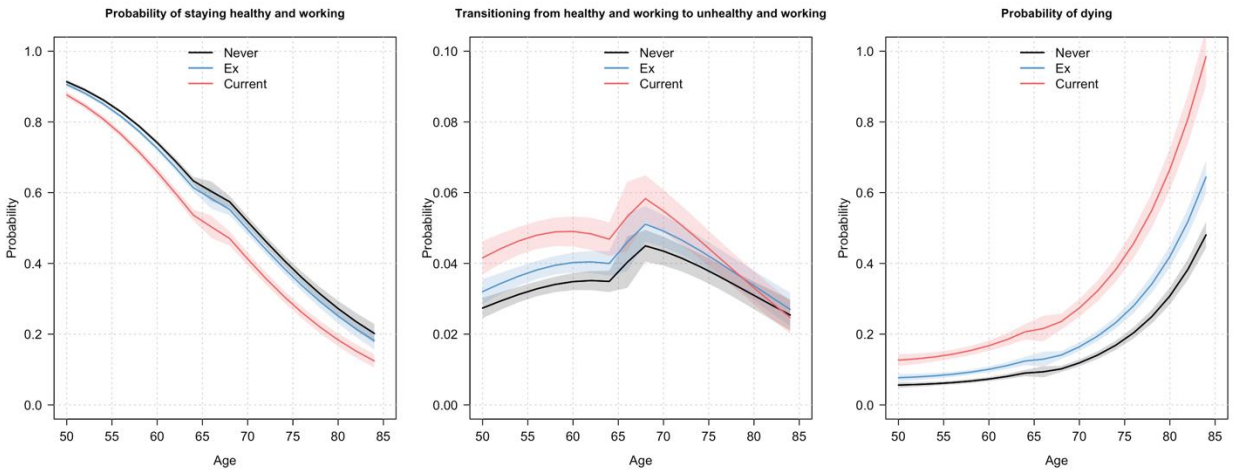

Fig. 2. Age-specific probabilities by smoking status of staying healthy and working, of transitioning from being healthy and working to being unhealthy and working, and of dying.

Table 2. Total, healthy and unhealthy, working and non-working life expectancy at age 50, by gender and smoking status plus 95% confidence intervals (CI) for never smokers as the reference, with differences between never smokers and ex-smokers and current smokers (* shows statistical significance for the differences - Sign.).

	Total Life Expectancy (95% CI and Sign.)		**Healthy Working (95% CI and Sign.)**		**Healthy Non-working (95% CI and Sign.)**		**Unhealthy Working (95% CI and Sign.)**		**Unhealthy Non-working (95% CI and Sign.)**	
Men										
Never (reference)	31.9	(31.4-32.5)	10.2	(9.6-10.8)	9.1	(8.5-9.6)	2.5	(2.1-2.8)	10.2	(9.7-10.7)
Ex (difference)	-3.0	*	-1.8	*	-0.9		0.1		-0.5	
Current (difference)	-9.9	*	-4.3	*	-3.5	*	-0.5		-1.7	*
Women										
Never (reference)	34.0	(33.6-34.4)	8.2	(7.8-8.5)	13.3	(12.9-13.8)	1.9	(1.7-2.1)	10.6	(10.2-11.0)
Ex (difference)	-3.3	*	-1.4	*	-2.6	*	0.4		0.3	
Current (difference)	-8.4	*	-3.3	*	-6.4	*	0.0		1.3	*

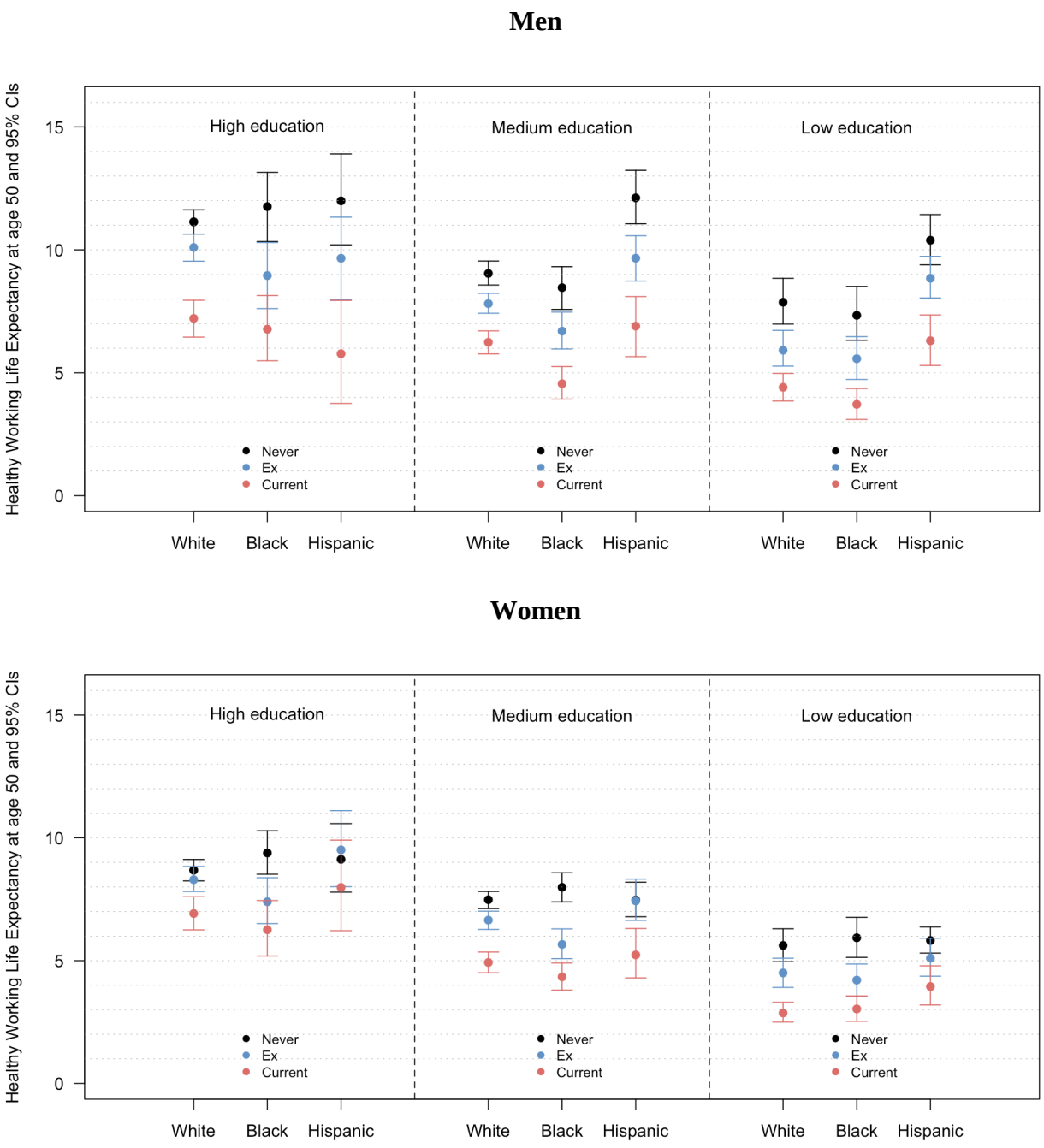

Fig. 3. Healthy working life expectancy at age 50 (dots) with 95% confidence intervals (CI — lines) for men (top) and women (bottom), by education (high, medium, low), race/ethnicity (White, Black, Hispanic), and smoking status (never, ex, current).

Table 3. Counterfactual analysis: proportion (%) of differences in HWLE that could be explained by equalizing smoking prevalence across educational levels and racial/ethnic groups.

Counterfactual Group	Women (%)	Men (%)
Education		
High	*Reference*	*Reference*
Medium	19.6	33.1
Low	15.3	34.8
Race/Ethnicity		
White	*Reference*	*Reference*
Black	27.9	18.6
Hispanic	-59.7	9.6

Table 4. Average marginal effect (AME): estimates and 95% confidence intervals.

	Smoking-related diseases	Mixed-smoking-related diseases	Placebo diseases
Never smoker (reference)	-	-	-
Ex-smoker	9.6 (9.2-10.0)	4.8 (4.4-5.2)	4.1 (3.7-4.4)
Current smoker	10.9 (10.3-11.5)	1.3 (0.8-1.9)	1.4 (0.9-1.9)

Smoking-related: lung diseases, cancer, heart diseases, stroke
Placebo: high blood pressure, psychiatric problems, arthritis
Mixed-smoking-related: lung diseases, cancer, heart diseases, stroke, diabetes, high blood pressure

Appendix

Tables

Table A1. Distribution of smoking behaviors across gender, race, and education

		Smoking		
		Never	Ex	Current
Gender	Males	32%	47%	21%
	Females	51%	32%	17%
Race	White	42%	41%	17%
	Black	42%	33%	25%
	Hispanic	49%	35%	16%
Males	White	32%	51%	18%
	Black	32%	38%	30%
	Hispanic	33%	46%	21%
Females	White	49%	34%	17%
	Black	48%	31%	22%
	Hispanic	61%	26%	13%
Education	High	53%	38%	9%
	Medium	42%	39%	19%
	Low	37%	39%	24%

Table A2. Total (TLE), healthy working (HWLE), unhealthy working (UWLE), healthy non-working (HNLE), and unhealthy non-working (UNLE) life expectancy at age 50 with 95% confidence intervals (CI), by gender, race/ethnicity, education, and smoking behavior, with differences between never smokers and ex-smokers and current smokers.

Education	Smoking	TLE	(95% CI and Sign.)	HWLE	(95% CI and Sign.)	UWLE	(95% CI and Sign.)	HNLE	(95% CI and Sign.)	UNLE	(95% CI and Sign.)
Hispanic Men											
	Never (reference)	32.3	(28.9-35.6)	12.0	(10.1-13.8)	2.6	(1.4-3.7)	8.8	(6.4-11.0)	8.9	(6.1-11.6)
High	Ex (difference)	-1.4		-2.3		1.7		-1.2		0.4	
	Current (difference)	-6.2		-6.2	*	2.0		-3.1		1.1	
	Never (reference)	31.3	(29.1-33.5)	12.1	(10.9-13.2)	1.3	(0.8-1.8)	10.1	(8.4-11.7)	7.8	(6.0-9.5)
Medium	Ex (difference)	-1.7		-2.5	*	1.4	*	-1.0		0.4	
	Current (difference)	-6.6	*	-5.2	*	0.8		-3.1		0.9	
	Never (reference)	31.1	(29.1-33.1)	10.4	(9.3-11.4)	1.0	(0.6-1.3)	11.7	(10.0-13.4)	8.0	(6.3-9.5)
Low	Ex (difference)	-1.5		-1.6		0.5		-0.5		0.0	
	Current (difference)	-6.3	*	-4.1	*	0.2		-2.6		0.2	
White Men											
	Never (reference)	34.9	(34.2-35.6)	11.1	(10.6-11.6)	3.2	(2.8-3.6)	9.3	(8.5-9.9)	11.3	(10.6-11.9)
High	Ex (difference)	-2.5	*	-1.0		-0.2		-1.1		-0.1	
	Current (difference)	-9.5	*	-3.9	*	-0.5		-3.7	*	-1.4	
	Never (reference)	31.7	(31.0-32.4)	9.0	(8.5-9.5)	3.0	(2.6-3.3)	8.7	(8.1-9.3)	11.1	(10.4-11.6)
Medium	Ex (difference)	-2.8	*	-1.2	*	-0.1		-1.3	*	-0.3	
	Current (difference)	-9.5	*	-2.8	*	-0.7		-3.6	*	-2.5	*
	Never (reference)	29.3	(28.3-30.3)	7.9	(6.9-8.7)	2.2	(1.6-2.7)	8.3	(7.3-9.2)	10.9	(10.0-11.7)
Low	Ex (difference)	-3.5	*	-2.0	*	0.5		-2.2	*	0.1	
	Current (difference)	-10.4	*	-3.5	*	-0.3		-4.0	*	-2.7	*
Black Men											

	Never (reference)	31.3	(28.6-34.0)	11.8	(10.3-13.1)	2.5	(1.5-3.3)	7.4	(5.6-9.1)	9.7	(7.4-11.9)
High	Ex (difference)	-3.0		-2.8	*	-0.1		0.3		-0.5	
	Current (difference)	-5.4		-5.0	*	0.3		-1.4		0.7	
	Never (reference)	28.6	(26.8-30.3)	8.5	(7.5-9.3)	2.1	(1.5-2.6)	8.0	(6.7-9.1)	10.1	(8.6-11.5)
Medium	Ex (difference)	-2.8		-1.8	*	-0.3		0.2		-0.9	
	Current (difference)	-5.5	*	-3.9	*	-0.5		-1.3		0.2	
	Never (reference)	25.6	(23.7-27.4)	7.3	(6.2-8.4)	1.4	(0.8-1.8)	9.1	(7.5-10.5)	7.8	(6.5-9.1)
Low	Ex (difference)	-2.9		-1.8		-0.1		-0.4		-0.7	
	Current (difference)	-5.8	*	-3.6	*	-0.3		-2.1		0.2	
Total Men											
	Never (reference)	34.4	(33.7-35.1)	11.3	(10.8-11.7)	3.1	(2.7-3.4)	9.0	(8.4-9.6)	11.0	(10.4-11.6)
High	Ex (difference)	-2.4	*	-1.5	*	0.0		-0.9		0.0	
	Current (difference)	-8.4	*	-4.4	*	-0.2		-3.1	*	-0.6	
	Never (reference)	31.2	(30.5-31.7)	9.3	(8.9-9.7)	2.6	(2.3-2.8)	8.7	(8.1-9.2)	10.5	(9.9-11.1)
Medium	Ex (difference)	-2.7	*	-1.5	*	0.1		-1.1	*	-0.2	
	Current (difference)	-8.6	*	-3.5	*	-0.5		-3.1	*	-1.6	*
	Never (reference)	29.3	(28.5-30.1)	8.8	(8.2-9.3)	1.6	(1.3-1.9)	9.5	(8.8-10.2)	9.3	(8.7-9.9)
Low	Ex (difference)	-2.9	*	-1.6	*	0.2		-1.3	*	-0.2	
	Current (difference)	-9.3	*	-4.0	*	-0.2		-3.6	*	-1.5	*
Hispanic Women											
	Never (reference)	35.1	(30.7-39.5)	9.1	(7.7-10.5)	1.7	(0.8-2.5)	16.2	(12.5-19.9)	8.1	(5.1-10.9)
High	Ex (difference)	-1.5		0.4		0.0		-1.7		-0.2	
	Current (difference)	-1.9		-1.1		0.2		-5.6		4.7	
	Never (reference)	35.4	(33.6-37.1)	7.5	(6.7-8.1)	1.5	(1.1-1.9)	17.2	(15.4-19.0)	9.2	(7.5-10.7)
Medium	Ex (difference)	-1.7		0.0		0.3		-2.0		0.0	
	Current (difference)	-2.1		-2.2	*	1.2		-7.7	*	6.7	*

	Never (reference)	33.0	(31.6-34.3)	5.8	(5.2-6.3)	1.1	(0.8-1.4)	16.2	(14.8-17.5)	9.9	(8.7-11.0)
Low	Ex (difference)	-2.1		-0.7		0.0		-2.1		0.7	
	Current (difference)	-1.9		-1.9	*	0.5		-6.8	*	6.4	*
White Women											
	Never (reference)	36.8	(36.1-37.4)	8.7	(8.2-9.1)	2.3	(2.0-2.6)	14.4	(13.6-15.2)	11.3	(10.5-12.0)
High	Ex (difference)	-2.7	*	-0.4		0.2		-2.3	*	-0.1	
	Current (difference)	-7.7	*	-1.8	*	-0.4		-6.0	*	0.4	
	Never (reference)	34.6	(34.1-35.1)	7.5	(7.1-7.8)	2.4	(2.1-2.6)	13.0	(12.3-13.5)	11.8	(11.3-12.)
Medium	Ex (difference)	-3.0	*	-0.8	*	0.3		-2.6	*	0.1	
	Current (difference)	-8.3	*	-2.6	*	0.2		-6.4	*	0.5	
	Never (reference)	31.1	(30.4-31.8)	5.6	(4.9-6.3)	2.1	(1.6-2.5)	11.4	(10.4-12.3)	12.0	(11.1-12.8)
Low	Ex (difference)	-3.6	*	-1.1		0.3		-3.0	*	0.3	
	Current (difference)	-9.2	*	-2.8	*	0.0		-6.7	*	0.3	
Black Women											
	Never (reference)	35.0	(33.0-37.0)	9.4	(8.5-10.2)	2.1	(1.4-2.7)	13.4	(11.5-15.2)	10.2	(8.5-11.8)
High	Ex (difference)	-3.8		-2.0	*	0.2		-2.0		-0.1	
	Current (difference)	-6.0	*	-3.1	*	-0.5		-3.8	*	1.5	
	Never (reference)	32.5	(31.3-33.6)	8.0	(7.4-8.5)	2.0	(1.6-2.3)	11.7	(10.6-12.7)	10.9	(9.7-11.9)
Medium	Ex (difference)	-4.5	*	-2.3	*	0.0		-2.3	*	0.2	
	Current (difference)	-6.5	*	-3.7	*	-0.2		-4.3	*	1.7	
	Never (reference)	29.0	(27.6-30.4)	5.9	(5.1-6.7)	1.2	(0.8-1.5)	11.0	(9.7-12.2)	10.9	(9.6-12.1)
Low	Ex (difference)	-4.5	*	-1.7	*	-0.2		-2.3		-0.3	
	Current (difference)	-6.5	*	-2.9	*	-0.3		-4.2	*	0.9	
Total Women											
	Never (reference)	36.4	(35.7-37.0)	8.8	(8.4-9.1)	2.2	(1.9-2.4)	14.4	(13.6-15.1)	11.0	(10.3-11.6)
High	Ex (difference)	-2.8	*	-0.6		0.2		-2.3	*	-0.1	
	Current (difference)	-7.1	*	-2.0	*	-0.3		-5.8	*	1.0	

	Never (reference)	34.2	(33.8-34.6)	7.6	(7.2-7.8)	2.2	(1.9-2.3)	13.0	(12.5-13.5)	11.5	(11.1-11.8)
Medium	Ex (difference)	-3.2	*	-1.0	*	0.3		-2.6	*	0.1	
	Current (difference)	-7.7	*	-2.8	*	0.2		-6.3	*	1.2	*
	Never (reference)	31.3	(30.7-31.8)	6.0	(5.5-6.3)	1.4	(1.2-1.6)	13.1	(12.5-13.7)	10.8	(10.2-11.3)
Low	Ex (difference)	-3.9	*	-1.4	*	0.2		-3.3	*	0.5	
	Current (difference)	-8.6	*	-2.8	*	0.1		-7.1	*	1.2	

Figures

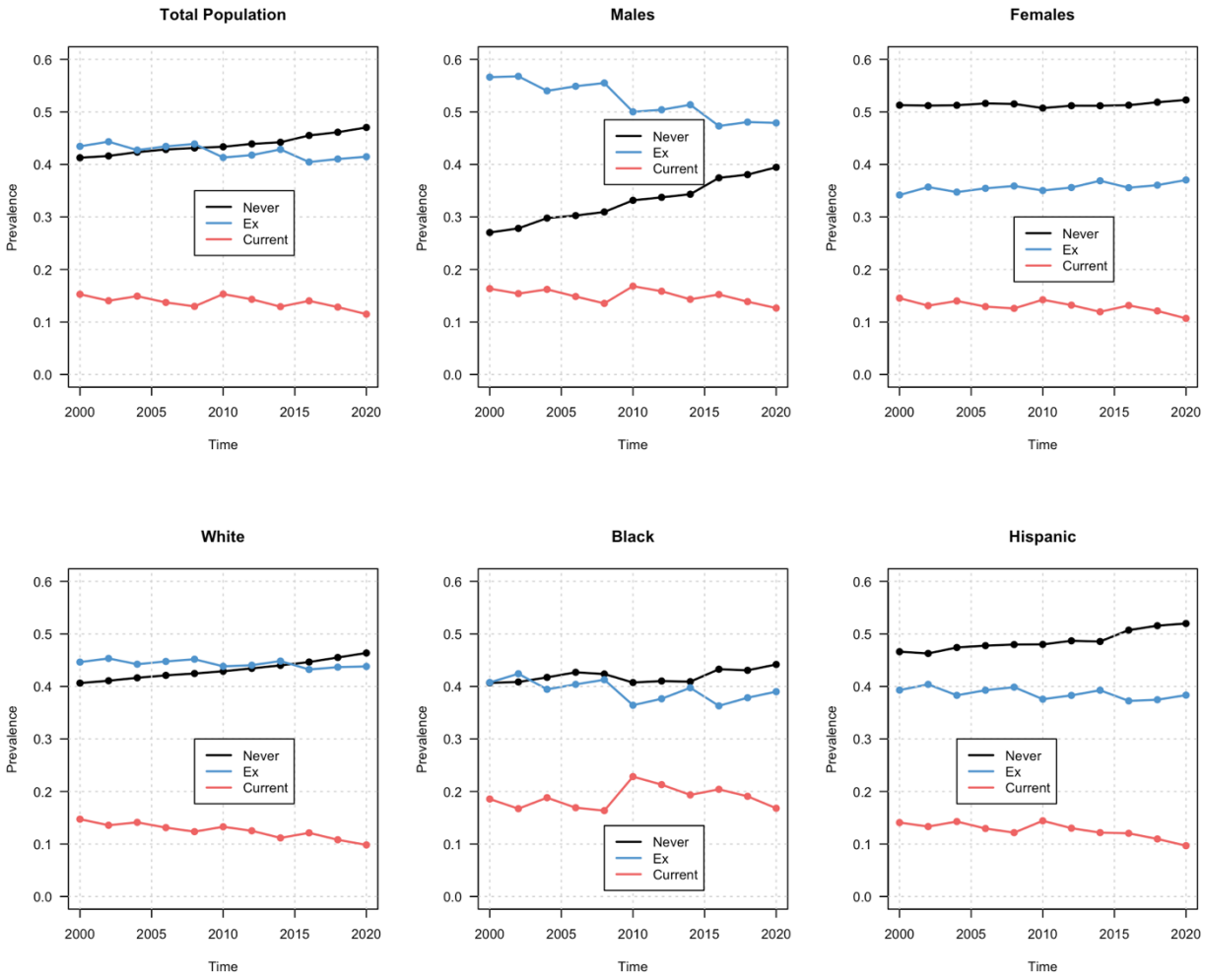

Figure A1. Prevalence of smoking behaviors (never smokers, ex-smokers, and current smokers) in 2000–2020.

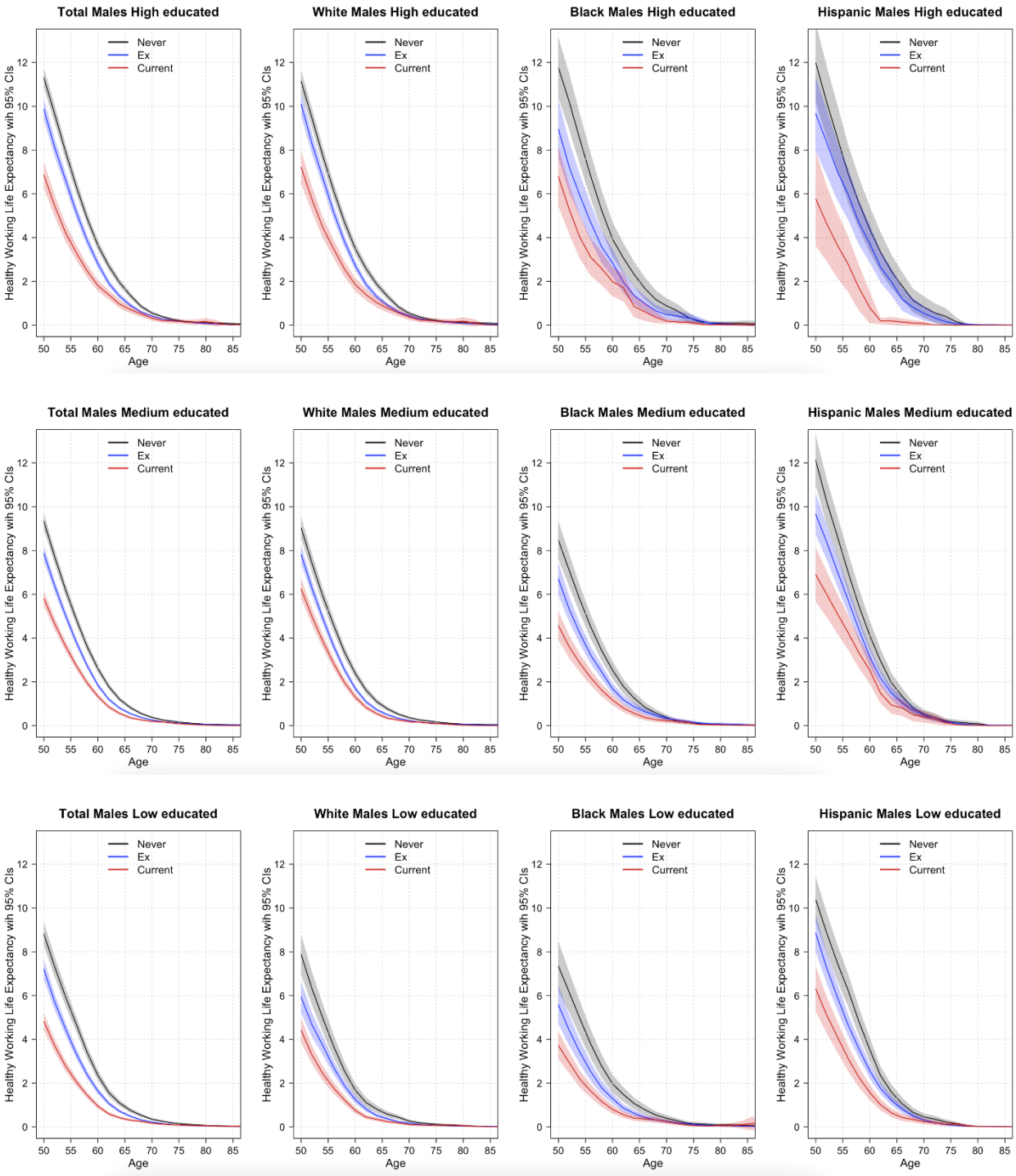

Fig. A2. Healthy working life expectancy by age, smoking, race/ethnicity, and education, among men.

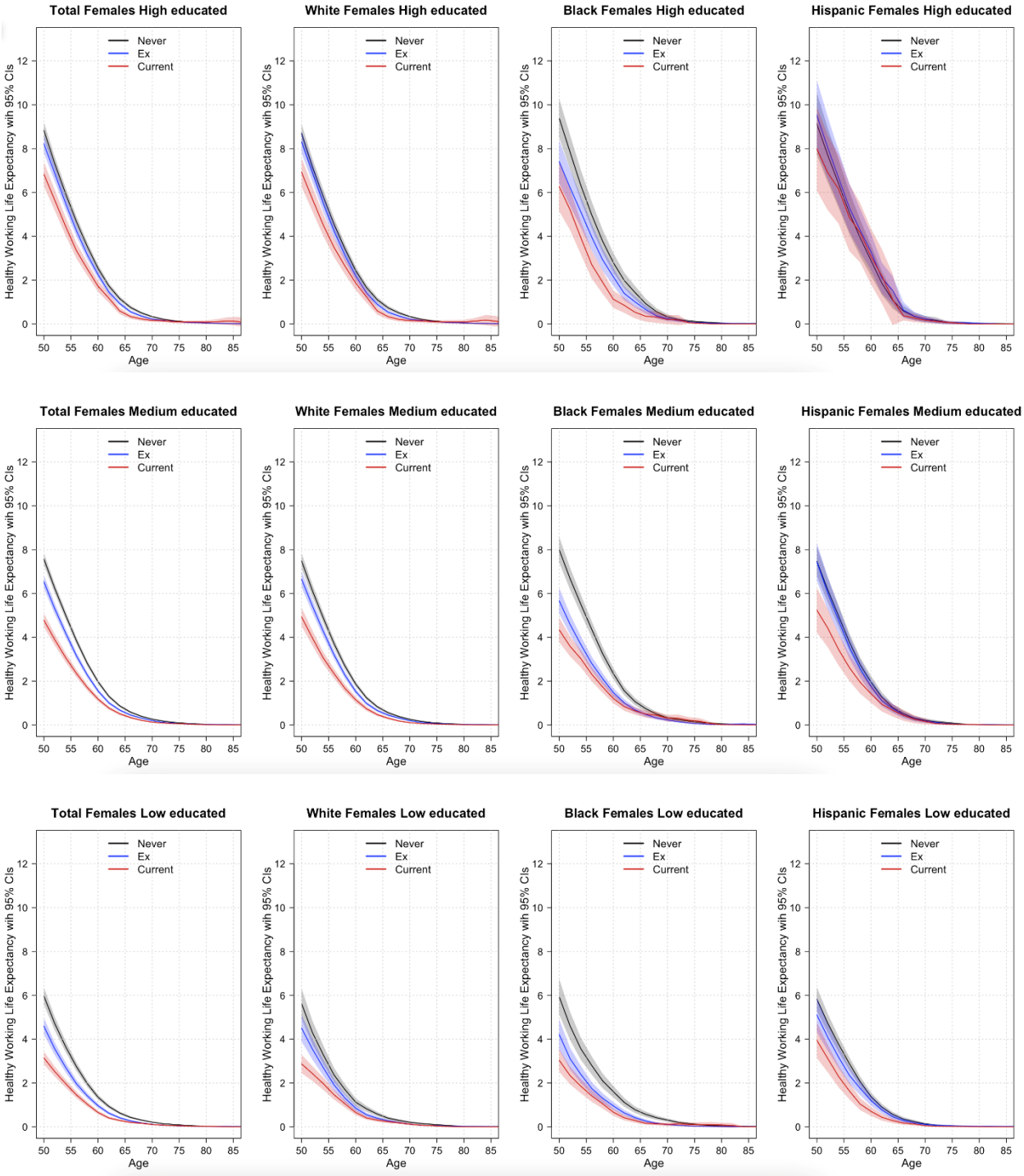

Fig. A3. Healthy working life expectancy by age, smoking, race/ethnicity, and education, among women.