ORIGINAL INVESTIGATION

Impact of Cigarette Smoking on Utilization of Nursing Home Services

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ABSTRACT

Introduction: Few studies have examined the effects of smoking on nursing home utilization, generally using poor data on smoking status. No previous study has distinguished utilization for recent from long-term quitters.

Methods: Using the Health and Retirement Study, we assessed nursing home utilization by never-smokers, long-term quitters (quit >3 years), recent quitters (quit ≤3 years), and current smokers. We used logistic regression to evaluate the likelihood of a nursing home admission. For those with an admission, we used negative binomial regression on the number of nursing home nights. Finally, we employed zero-inflated negative binomial regression to estimate nights for the full sample.

Results: Controlling for other variables, compared with never-smokers, long-term quitters have an odds ratio (*OR*) for nursing home admission of 1.18 (95% *CI*: 1.07–1.2), current smokers 1.39 (1.23–1.57), and recent quitters 1.55 (1.29–1.87). The probability of admission rises rapidly with age and is lower for African Americans and Hispanics, more affluent respondents, respondents with a spouse present in the home, and respondents with a living child. Given admission, smoking status is not associated with length of stay (LOS). LOS is longer for older respondents and women and shorter for more affluent respondents and those with spouses present.

Conclusions: Compared with otherwise identical never-smokers, former and current smokers have a significantly increased risk of nursing home admission. That recent quitters are at greatest risk of admission is consistent with evidence that many stop smoking because they are sick, often due to smoking.

INTRODUCTION

While a substantial body of research documents the high health care costs associated with cigarette smoking (Levy & Newhouse, 2011), relatively few studies have examined the association between smoking and utilization of nursing home services (Hodgson, 1992; Kaplan, Wingard, McPhillips, Williams-Jones, & Barrett-Connor 1992; Leigh, Hubert, & Romano, 2005; Levy & Newhouse, 2011; Max, Rice, Sung, Zhang, & Miller, 2004; Miller, Zhang, Rice, & Max, 1998; Sloan, Ostermann, Picone, Conover, & Taylor, 2004; Valiyeva, Russell, Miller, & Safford, 2006; Zhang, Miller, Max, & Rice, 1999). With one exception (Kaplan et al., 1992), all of the studies have identified a positive association between smoking and nursing home utilization. Most of this research suffers, however, from limited data on smoking behaviors prior to and near the time of nursing home admission. For example, Valiyeva et al. (2006) had data on smoking status only at baseline, as much as 20 years prior to nursing home admissions during the follow-up period of the study. For respondents 65 and older, Sloan et al. (2004) assumed that all former smokers quit at age 55. At least one study was limited to a small sample of graduates from Harvard, the vast majority of whom were male, White, and had very low current smoking rates (Leigh et al., 2005).

None of the studies distinguished between respondents who had quit smoking recently and those who had quit many years earlier. This is important because, as earlier research has demonstrated (Wagner, Curry, Grothaus, Saunders, & McBride, 1995; Martinson, O'Connor, Pronk, & Rolnick, 2003), recent quitters have a greater risk of health care utilization since many quit because they are sick, often due to their smoking. This phenomenon is especially important for the elderly population.

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Among older adults, recent quitters (in the past 3 years) have a higher risk of death (Gillespie, Halpern, & Warner, 1994; International Agency for Research on Cancer [IARC], 2007), incur greater medical expenditures, and, as we find, are more likely to be admitted to nursing homes than are current smokers.

Using data well-suited to study the relationship between smoking and nursing home utilization, we analyze how smoking affects utilization, considering its impacts on both the probability of nursing home admission and, given admission, length of stay in the nursing home. We examine the relationship for all ages 55 and older, differentiating by smoking status.

METHODS

We used data from seven waves (every 2 years, 1998 through 2010) of the Health and Retirement Study (HRS). The HRS is a biennial, longitudinal, nationally representative survey of older adults, with individuals added to provide cross-sectionally representative samples of adults aged 55 and older in each survey wave. We arrayed the data into a series of six 2-year panels (1998–2000 through 2008–2010), with respondent characteristics assessed in the first (baseline) wave and nursing home utilization in the following 2 years measured using data from subsequent survey occasions, including information from postmortem interviews with family members of those who died. The study design allows for the assessment of the 2-year nursing home admission risk and overall nursing home utilization in large samples of individuals with varied smoking histories. To maintain representativeness, the sample is limited to respondents who, at the time of the first wave of each panel, are community dwelling (noninstitutionalized) and aged 55 or older. The cumulative sample size was 92,960, with individual panels ranging from 14,147 (2008–2010) to 16,249 (2000–2002).

The outcome measures were as follows: (a) a binary indicator of self-reported nursing home admission in the 2 years subsequent to the baseline interview and (b) the self-reported number of nights spent in a nursing home in the same 2-year period. (In the case of decedents and other participants who are not able to respond, information is provided by family proxies.) The primary independent variable of interest was smoking status, based on self-report of the respondent's history of smoking and current smoking status at the time of the baseline interview. This information was used to create a four-level categorical indicator, identifying those who have never smoked, long-term quitters (who quit more than 3 years prior), recent quitters (who stopped smoking in the past 3 years), and current smokers.

The following sociodemographic measures were included in the analyses as independent variables: age (5-year increments from 55–59 to 85+), gender, race/ethnicity (African American, Hispanic, White/other), net worth (quartiles, which changed with each panel), education (<12 years, 12 years, 13–15 years, and ≥16 years), and potential caregiver network (a spouse residing in respondent's home and/or living children). We assessed differences in the distributions of each sociodemographic measure by smoking status using Rao–Scott chi-square tests.

Using the series of 2-year panels, we estimated three types of statistical models. First, we used logistic regression to examine the determinants of whether or not an individual had a nursing home stay during the 2 years following baseline interview. Second, for those with a stay, we used a negative binomial regression model to assess determinants of the number of nursing home nights. Finally, we employed a zero-inflated negative binomial regression model to estimate the number of nursing home nights for the full sample. For each model, we determined the odds/incidence rate ratios, predictive margins, and average marginal effects of smoking status.

Statistical analyses were performed with STATA (Release 12.1; Stata Corp, College Station, TX). The standard errors and related p values for all parameter estimates were adjusted for the HRS sample design, including the overlap in samples between panels. Full details of the HRS, including information on sampling procedures and the survey questionnaires can be found at the HRS Web site (http://hrsonline.isr.umich.edu).

The Social Sciences Institutional Review Board at the University of Michigan approved the HRS, and the Medical School Institutional Review Board approved the use of HRS data for this study.

RESULTS

Table 1 presents sample characteristics by smoking status. There are far more never-smokers (39,333) and long-term quitters (36,975) than current smokers (12,787) and, especially, recent quitters (3,865). As would be expected, never-smokers and long-term quitters have older age profiles than do recent quitters and current smokers ($p < .001$). While current smokers have the smallest percentage of respondents 80 years or older (4.0%), recent quitters are much closer to them in this regard (5.6%) than to long-term quitters (14.2%) or never-smokers (16.8%). Never-smokers are disproportionately female (68.3%) and long-term quitters disproportionately male (56.1%) ($p < .001$ for each), while recent quitters and current smokers are essentially evenly distributed by gender (50.0% and 49.2% male, respectively, $p = .496$). Overall, race/ethnicity is not substantially different for the four smoking status categories although African Americans constitute a higher percentage of smokers and recent quitters than of long-term quitters and never-smokers (11.9% vs. 8.4%, $p < .001$). Current smokers have the lowest asset profile, followed by recent quitters. Never-smokers and long-term quitters have the highest asset profiles ($p < .001$) but are indistinguishable from each other ($p = .698$). Similarly, current smokers have the lowest education profile, followed by recent quitters, with never-smokers and long-term quitters having similar higher education profiles ($p < .001$). Long-term quitters are most likely to have a married spouse present in the home (65.8%) and current smokers least likely (51.8%) ($p < .001$). Although differences across smoking status as to the likelihood of having at least one living child are statistically significant ($p = .021$), the differences are small, with all groups averaging 92.6%.

Table 2 presents results for the logistic regression predicting nursing home admission (column 1) and the negative binomial regression predicting number of nursing home nights among respondents who have nursing home admissions (column 2). As expected, nursing home admission is highly correlated with age, with respondents 85 and older 30-fold more likely to have an admission than respondents in the reference age group of 55–59. African Americans and Hispanics are less likely than Whites to have a nursing home admission. Admission is also highly correlated with respondents' asset quartile, with the

Table 1. Sample Characteristics by Smoking Status[a]

	Never-smoker (n = 39,333)	Long-term quitter (n = 36,975)	Recent quitter (n = 3,865)	Current smoker (n = 12,787)	Total (n = 92,960)
Age, years					
55–59 (ref.)	6,530 (25.7)[b]	5,096 (21.3)[b]	812 (31.5)[b]	3,387 (37.1)[b]	15,825 (25.9)[b]
60–64	6,839 (17.6)	6,632 (19.2)	941 (23.7)	3,378 (25.3)	17,790 (19.6)
65–69	7,181 (14.5)	7,654 (17.2)	895 (17.7)	2,730 (16.3)	18,460 (16.0)
70–74	6,153 (13.4)	6,666 (15.6)	608 (13.4)	1,704 (11.1)	15,131 (13.9)
75–79	5,098 (12.0)	5,007 (12.5)	336 (8.0)	937 (6.3)	11,378 (11.2)
80–84	3,905 (9.2)	3,473 (8.6)	177 (3.8)	477 (3.0)	8,032 (7.8)
85+	3,627 (7.6)	2,447 (5.6)	96 (1.8)	174 (1.0)	6,344 (5.6)
Gender					
Male (ref.)	11,343 (31.7)	20,422 (56.1)	1,893 (50.0)	5,952 (49.2)	39,610 (44.6)
Female	27,990 (68.3)	16,553 (43.9)	1,972 (50.0)	6,835 (50.8)	53,350 (55.4)
Race/ethnicity					
White/other (ref.)	30,235 (83.9)	29,693 (86.6)	2,797 (79.6)	9,726 (82.5)	72,451 (84.6)
African American	5,509 (8.9)	4,551 (7.9)	713 (12.6)	2,109 (11.7)	12,882 (9.1)
Hispanic	3,589 (7.1)	2,731 (5.6)	355 (7.8)	952 (5.8)	7,627 (6.3)
Asset quartile					
First (low) (ref.)	9,756 (22.5)	8,624 (21.7)	1,367 (32.8)	4,992 (39.0)	24,739 (25.0)
Second	9,897 (24.4)	9,342 (24.7)	1,079 (28.8)	3,512 (26.6)	23,830 (25.0)
Third	9,778 (25.8)	9,458 (26.2)	783 (20.4)	2,606 (20.7)	22,625 (25.0)
Fourth (high)	9,902 (27.4)	9,551 (27.4)	636 (18.0)	1,677 (13.7)	21,766 (25.0)
Schooling					
0–11 years	10,219 (21.4)	9,741 (22.2)	1,284 (28.6)	4,336 (29.8)	25,580 (23.3)
12 years (ref.)	13,794 (34.4)	11,861 (32.1)	1,287 (33.5)	4,657 (36.7)	31,599 (33.8)
13–15 years	7,109 (19.1)	7,586 (21.9)	781 (22.7)	2,354 (20.6)	17,830 (20.6)
16+ years	8,194 (25.0)	7,775 (23.7)	510 (15.2)	1,429 (13.0)	17,908 (22.3)
Potential caregivers					
Married spouse present	24,025 (60.8)	24,759 (65.8)	2,234 (55.2)	6,950 (51.8)	57,968 (61.2)
Living child	36,122 (92.0)	34,236 (93.4)	3,561 (92.7)	11,687 (92.1)	85,606 (92.6)

Note. [a] All distributions of independent variables differ significantly by smoking status ($p < .001$), with the exception of living child ($p = .021$). Nonsignificant differences reported in the text are for specific comparisons, not the overall tests. For example, the distribution of gender varies by smoking status, but the distribution of gender does not vary between recent quitters and current smokers.
[b]Values in parentheses are weighted column percentages. Weighting is adjusted for the HRS complex sample design and allows for the national representativeness of the estimates.

likelihood of admission declining with increased affluence. Respondents with a spouse present in their homes are two thirds as likely to have an admission as are all others. Having a living child also reduces one's likelihood of an admission. Given the controls for age, race/ethnicity, wealth, and potential caregivers, we find no statistically significant difference in probability of admission by gender or schooling.

After adjusting for these covariates, smoking status is highly correlated with the probability of nursing home admission ($p < .001$). Compared with never-smokers, long-term quitters have an odds ratio (*OR*) for admission of 1.18 (95% *CI*: 1.07–1.29). Current smokers' *OR* is 1.39 (1.23–1.57). The group most likely to have an admission is recent quitters, with an *OR* of 1.55 (1.29–1.87).

In an adjusted model (column 2, Table 2), the number of nursing home nights for respondents with admissions rises with age and is higher for females ($p < .05$), lower for the more affluent respondents ($p < .001$), and lower for respondents with married spouses present ($p < .001$). There is no statistically significant association with race/ethnicity or schooling. After adjusting for covariates, smoking status is not associated with length of stay for those admitted to a nursing home.

Not shown are variations on these regressions in which we added respondents' self-reported health status, a well-documented predictor of health care utilization and health outcomes (Perrin, Stiefel, Mosen, Bauck, Shuster, & Dirks, 2011; Pietz & Petersen, 2007), and number of activities of daily living (ADL) limitations, also documented to influence health care utilization and health outcomes (Dalby, Hirdes, & Fries, 2005; Fries, Schneider, Foley, Gavazzi, Burke, & Cornelius 1994). While each of these was correlated in the expected direction with nursing home admissions (and ADLs with number of nights), their inclusion in the regressions—either individually or jointly—did not affect the magnitude or statistical significance of smoking status on the odds of nursing home admission (reducing the *OR*s only slightly). We omitted them from the regression in Table 2 because they likely are, in part, a function of smoking history.

Table 3 presents the predictive margins (also called predicted marginal proportions or model-adjusted risks) and average marginal effects (also known as risk differences) for the three models: probability of nursing home admission, the number of nights for those with admissions, and the combination of the two, that is, the average number of nursing home nights over the entire sample (irrespective of nursing home admission).

Table 2. Predictors of Nursing Home Admission and Number of Nights (Given Admission) During 2 Years Following Baseline Interview

	Probability of admission[a] (1)	No. of nights, given admission[b] (2)
Age, years		
55–59 (ref.)	1.00	1.00
60–64	1.66*** (1.29, 2.12)	1.57 (0.98, 2.53)
65–69	2.79*** (2.26, 3.44)	1.28 (0.90, 1.83)
70–74	5.53*** (4.53, 6.74)	1.58** (1.14, 2.19)
75–79	8.42*** (6.72, 10.56)	1.62** (1.16, 2.26)
80–84	15.64*** (12.38, 19.77)	2.08*** (1.47, 2.93)
85+	31.62*** (25.10, 39.83)	2.35*** (1.66, 3.34)
Gender		
Male (ref.)	1.00	1.00
Female	1.09 (0.99, 1.19)	1.13* (1.01, 1.26)
Race/ethnicity		
White/other (ref.)	1.00	1.00
African American	0.78** (0.68, 0.91)	1.12 (0.93, 1.35)
Hispanic	0.50*** (0.41, 0.60)	1.04 (0.79, 1.39)
Asset quartile		
First (low) (ref.)	1.00	1.00
Second	0.69*** (0.63, 0.76)	0.89 (0.78, 1.02)
Third	0.55*** (0.51, 0.60)	0.67*** (0.58, 0.78)
Fourth (high)	0.47*** (0.42, 0.53)	0.76*** (0.66, 0.88)
Schooling		
0–11 years	0.96 (0.88, 1.06)	0.99 (0.89, 1.09)
12 years (ref.)	1.00	1.00
13–15 years	0.97 (0.85, 1.10)	1.01 (0.86, 1.18)
16+ years	0.96 (0.84, 1.10)	1.00 (0.85, 1.18)
Potential caregivers		
Married spouse present	0.68*** (0.62, 0.76)	0.78*** (0.70, 0.87)
Living child	0.81* (0.69, 0.96)	0.86 (0.72, 1.02)
Smoking status		
Never smoked (ref.)	1.00	1.00
Long-term quitter (>3 years)	1.18** (1.07, 1.29)	0.97 (0.87, 1.08)
Recent quitter (0–3 years)	1.55*** (1.29, 1.87)	1.00 (0.74, 1.35)
Current smoker	1.39*** (1.23, 1.57)	1.05 (0.86, 1.27)

Note. [a]Probability of admission modeled using logistic regression.
[b]No. of nights modeled using negative binomial regression.
*$p < .05$; **$p < .01$; ***$p < .001$.

These figures show the predicted risk of nursing home admission, length of stay if admitted, and total nights associated with each smoking status after adjustment for covariates. They indicate that for our entire sample, never-smokers had a 4.6% chance of a nursing home admission during the 2 years of follow up (95% *CI*: 4.2–4.9), while recent quitters had a 6.6% chance (5.6–7.6), an increased risk of 2% points (shown as the average marginal effect) or nearly a 50% relative increase in the risk of admission. Longer term quitters and current smokers had intermediate risks of admission. These differences from the estimated rate for never-smokers are all statistically significant at $p < .01$.

As we found no statistically significant association of smoking with length of stay if admitted to a nursing home, the small differences in numbers of nursing home nights reported for the second regression (Table 2) are not statistically significant. Combining the two effects, however, shows that, taken as a whole and compared with never-smokers, the recent quitters in our sample had a statistically significant increase of 2.47 nights (0.26–4.68), or 43% more nights than the never-smokers. Current smokers had a significant increase as well (2.16 nights, 0.74–3.59). There is no significant difference between long-term quitters and never-smokers.

To lend age-specific perspective, the last two tables break down Table 3's data on probability of nursing home admission (Table 4) and total nursing home nights (Table 5) into age-specific findings. Both tables show that, as expected, the likelihood of nursing home admissions and total nights spent in nursing homes rises with age for all smoking statuses, and does so quite dramatically. The dominance of recent quitters—their greater propensity to utilize nursing home services—is found in every age group in both tables, with current smokers second, again in every age category. The effect of smoking—current or recent past—is proportionately larger for the younger ages. For example, as seen in Table 4, the average marginal effect of being a recent quitter in the 55–59 age group—0.5% (0.2–0.7)—represents an increase of 62.5% in the risk of being admitted to a nursing home over the risk experienced by never-smoking 55–59-year olds (0.8%, $p < .01$).

Table 3. Predictive Margins for Likelihood of Nursing Home Admission, Number of Nursing Home Nights Given Admission, and Average Number of Nights Over the Entire Sample During 2 Years Following Baseline Interview by Smoking Status

	Predictive margins	Average marginal effects	Wald test (smoking status)
Probability of nursing home admission			
Never smoked	0.046 (0.042, 0.049)		$F(3,54) = 13.9$, $p < .0001$
Long-term quitter	0.053 (0.049, 0.056)	0.007** (0.003, 0.011)	
Recent quitter	0.066 (0.056, 0.076)	0.021*** (0.011, 0.030)	
Current smoker	0.060 (0.054, 0.067)	0.015*** (0.009, 0.021)	
No. of nursing home nights among those with an admission			
Never smoked	124.85 (114.16,135.53)		$F(3,51) = 0.28$, $p = .8408$
Long-term quitter	121.17 (109.23,133.11)	−3.68 (−16.55, 9.19)	
Recent quitter	125.05 (90.46,159.63)	0.20 (−37.06, 37.45)	
Current smoker	130.94 (108.77,153.12)	6.09 (−19.07, 31.26)	
Combined (No. of nursing home nights total sample)			
Never smoked	5.81 (5.27, 6.34)		$F(6,51) = 10.92$, $p < .0001$
Long-term quitter	6.44 (5.75, 7.13)	0.63 (−0.08, 1.34)	
Recent quitter	8.28 (6.03, 10.53)	2.47* (0.26, 4.68)	
Current smoker	7.97 (6.59, 9.35)	2.16** (0.74, 3.59)	

Note. *$p < .05$; **$p < .01$; ***$p < .001$.

Table 4. Probability of Nursing Home Admission During 2 Years Following Baseline Interview for 5-Year Age Groups by Smoking Status

Age, years		Never-smoker	Long-term quitter	Recent quitter	Current smoker
55–59	PM[a]	0.008 (0.006, 0.010)	0.010 (0.007, 0.012)	0.013 (0.009, 0.016)	0.011 (0.009, 0.014)
	AME[b]		0.001** (0.001, 0.002)	0.005** (0.002, 0.007)	0.003*** (0.002, 0.005)
60–64	PM	0.013 (0.011, 0.015)	0.015 (0.013, 0.018)	0.020 (0.016, 0.025)	0.018 (0.014, 0.022)
	AME		0.002** (0.001, 0.004)	0.007*** (0.004, 0.011)	0.005*** (0.003, 0.007)
65–69	PM	0.022 (0.019, 0.025)	0.026 (0.022, 0.029)	0.034 (0.027, 0.041)	0.030 (0.026, 0.034)
	AME		0.004** (0.001, 0.006)	0.012*** (0.006, 0.018)	0.008*** (0.005, 0.012)
70–74	PM	0.044 (0.039, 0.049)	0.051 (0.046, 0.056)	0.066 (0.055, 0.078)	0.060 (0.052, 0.068)
	AME		0.007** (0.003, 0.012)	0.023*** (0.012, 0.034)	0.016*** (0.009, 0.023)
75–79	PM	0.068 (0.060, 0.076)	0.079 (0.072, 0.086)	0.102 (0.083, 0.120)	0.092 (0.079, 0.105)
	AME		0.011** (0.005, 0.017)	0.034*** (0.017, 0.050)	0.024*** (0.014, 0.034)
80–84	PM	0.127 (0.116, 0.139)	0.146 (0.133, 0.160)	0.183 (0.156, 0.211)	0.168 (0.147, 0.188)
	AME		0.019** (0.008, 0.030)	0.056*** (0.030, 0.082)	0.040*** (0.023, 0.057)
85+	PM	0.245 (0.230, 0.260)	0.275 (0.254, 0.296)	0.330 (0.290, 0.370)	0.307 (0.279, 0.335)
	AME		0.030** (0.012, 0.047)	0.085*** (0.047, 0.123)	0.062*** (0.038, 0.086)
Total	PM	0.046 (0.042, 0.049)	0.053 (0.049, 0.056)	0.066 (0.056, 0.076)	0.060 (0.054, 0.067)
	AME		0.007** (0.003, 0.011)	0.021*** (0.011, 0.030)	0.015*** (0.009, 0.021)

Note. [a]Predictive margin (probability, controlling for all other variables).
[b]Average marginal effect compared with never-smokers' predictive margin.
**$p < .01$; ***$p < .001$.

For the oldest group (85+), however, the average marginal effect—8.5% (4.7–12.3)—represents an increase in the risk of admission of only 34.7% over that of an 85+-year-old never smokers (24.5%, $p < .001$). The percentage increase in risk declines for both smokers and recent quitters as age increases (keeping in mind, however, that the absolute risk rises steeply with age). Table 5 shows the same phenomenon, with the recent quitters' proportional increase in total nursing home nights declining from 60% for 55- to 59-year olds to 33.8% for those 85+.

DISCUSSION

With the population aging rapidly (Vincent & Velkoff, 2010), and the number of available family caregivers declining in the coming decades (Institute of Medicine, 2008), the utilization of nursing home services likely will become increasingly important among America's numerous health care challenges. As this study demonstrates, cigarette smoking plays a statistically significant and important role in nursing home utilization. The quality of the HRS data allowed this study to examine this

Table 5. Nursing Home Nights for Entire Sample (Not Conditioned on Admission) During 2 Years Following Baseline Interview for 5-Year Age Groups by Smoking Status

Age, years		Never-smoker	Long-term quitter	Recent quitter	Current smoker
55–59	PM[a]	0.5 (0.3, 0.7)	0.6 (0.3, 0.8)	0.8 (0.4, 1.2)	0.7 (0.4, 1.1)
	AME[b]		0.1 (0.0, 0.2)	0.3* (0.0, 0.5)	0.2** (0.1, 0.4)
60–64	PM	1.3 (0.8, 1.7)	1.5 (0.9, 2.1)	2.0 (1.2, 2.8)	1.9 (1.2, 2.6)
	AME		0.2 (0.0, 0.4)	0.7* (0.1, 1.3)	0.6** (0.2, 1.0)
65–69	PM	1.8 (1.4, 2.1)	2.0 (1.6, 2.4)	2.7 (1.7, 3.7)	2.5 (1.9, 3.2)
	AME		0.2* (0.0, 0.5)	1.0* (0.2, 1.7)	0.8** (0.3, 1.3)
70–74	PM	4.4 (3.7, 5.2)	5.0 (4.1, 5.9)	6.7 (4.7, 8.7)	6.3 (4.8, 7.9)
	AME		0.6* (0.0, 1.2)	2.3* (0.5, 4.1)	1.9** (0.7, 3.2)
75–79	PM	7.2 (5.9, 8.5)	8.1 (6.7, 9.5)	10.7 (7.5, 14.0)	10.2 (7.9, 12.5)
	AME		0.9* (0.0, 1.8)	3.5* (0.6, 6.4)	3.0** (1.1, 4.9)
80–84	PM	17.9 (15.6, 20.2)	19.9 (17.2, 22.6)	25.7 (18.5, 32.8)	24.7 (20.1, 29.3)
	AME		2.0 (-0.2, 4.2)	7.8* (0.9, 14.6)	6.8** (2.4, 11.2)
85+	PM	41.1 (36.7, 45.5)	44.6 (39.5, 49.7)	55.0 (39.6, 70.4)	53.9 (44.2, 63.6)
	AME		3.5 (-1.2, 8.3)	13.9 (–0.9, 28.7)	12.8* (3.1, 22.5)
Total	PM	5.8 (5.3, 6.3)	6.4 (5.8, 7.1)	8.3 (6.0, 10.5)	8.0 (6.6, 9.3)
	AME		0.6 (-0.1, 1.3)	2.5* (0.3, 4.7)	2.2** (0.7, 3.6)

[a]Predictive margin (probability, controlling for all other variables).
[b]Average marginal effect compared with never-smokers' predictive margin.
*$p < .05$; **$p < .01$.

phenomenon with more precision and in greater detail than previous research. Controlling for potentially confounding demographic variables, smoking status is highly correlated with nursing home admissions and total nursing home nights, but not with the number of nights conditional on admission.

These findings are generally quite consistent with those reported in previous studies. As in our study, both Sloan et al. (2004) and Valiyeva et al. (2006) found that smoking was associated with nursing home admission but not with number of nights conditional on admission. The relative risk of smokers for admission reported by Valiyeva et al. (2006)—1.56 for 45- to 64-year olds and 1.32 for 65- to 74-year olds—is consistent with our *OR* of 1.39. Findings were not identical, however. Sloan and colleagues (2004) concluded that the admission effect was driven solely by females; that is, they did not find a statistically significant increase in the risk of admission associated with smoking by males. Further, while they did not find statistically significant effects of smoking on length of stay, given admission, they observed a tendency that led them to report "If anything, use rates for smokers were lower than those for nonsmokers" (p. 115). We found no such tendency.

In data and methods, our study is most similar to that of Sloan and colleagues (2004). Like us, they used negative binomial models and HRS data although the latter only for the age 51–64 cohort. For those aged more than 64, they employed data from the AHEAD study (Asset and Health Dynamics of the Oldest Old). This was the study for which the authors, lacking information on former smokers' numbers of years quit, assumed that all former smokers aged more than 64 had quit at age 55.

While our characterization of respondents' smoking status is likely superior to that of previous work, our study has limitations as well. The HRS data come from self- or proxy reports and therefore are subject to potential recall bias. We have no reason to suspect that recall bias would vary by smoking status but cannot know. Information on nursing home admissions and length of stay derived from administrative records would likely be more accurate than information based on respondents' recall. There are plans to link nursing home administrative data with the Health and Retirement Study which would allow future studies to test whether the source of nursing home information has an important impact on our results. Above we addressed our exclusion from the analysis of respondents' self-reported health status and number of ADLs. Fortunately, their inclusion did not alter our qualitative findings at all (and our quantitative findings only minimally). Other exclusions might have affected our findings, however. A notable example is respondents' disease conditions responsible for their admission to nursing homes. Presumably it would be desirable, if possible, to examine separately admissions that are related to conditions that are known to be smoking related from those that are not. We intentionally omitted respondents' specific disease conditions in part because so many would be smoking related (and therefore should not be "controlled for"), while others might be exacerbated by smoking without being identified explicitly as caused by smoking. Yet another omission is respondents' insurance status, particularly their coverage by Medicare.

Other studies have used data and methods that are arguably less well-suited than ours to the analytical task of assessing the relationship between smoking and nursing home utilization. The most recent work, by Levy and Newhouse (2011), relied on data from the 1999 National Nursing Home Survey (NNHS). Because the NNHS had no data on respondents' smoking behaviors and history, the authors assumed that age-specific smoking status was the same for the nursing home population as for the general noninstitutionalized population. They used the relative risk of dying from individual smoking-related diseases to develop disease-specific smoking-attributable fractions (SAFs). They then treated these SAFs as if they affected nursing home utilization according to the diagnoses leading to nursing home admission, well documented in the NNHS.

The authors acknowledge the limitations of this approach. In fairness, to both them and Sloan et al. (2004), each group's studies were far more ambitious than the present one in that they were assessing the effects of smoking on the full range of health care utilization, and not just nursing home care. A recent, highly acclaimed analysis of the health care implications of smoking (and more, including Social Security and tax revenue implications) had no explicit focus on nursing home care (Congressional Budget Office, 2012).

Our analysis found that smokers who quit more than 3 years prior to their HRS intake interview, smokers who quit within 3 years of their interview, and current smokers had elevated risks of nursing home admission compared with never-smokers. Earlier research has demonstrated that recent quitters are more likely to die within a year than are current smokers, especially at older ages and especially with regard to lung cancer (Gillespie et al., 1994; IARC, 2007), and utilize more health care services (Wagner et al., 1995; Martinson et al., 2003). The explanation for this phenomenon, well documented by Martinson et al. (2003), is that recent quitters have a high probability of having quit precisely because they are sick, often due to their smoking. Distinguishing recent from more distant quitters is important because classifying all former smokers together, as have the vast majority of previous studies, mutes evidence of the beneficial effects of quitting smoking when well. This is particularly important when considering quitting by older smokers.

The fact that current and former smokers experience more nursing home nights than comparable never-smokers does not necessarily mean that smoking adds to the nation's aggregate bill for nursing home services. Never-smokers are far less likely to experience early deaths, and thus a hypothetical population in which no one had ever smoked would have a larger number of older adults, the population most at risk of admission to nursing homes. Whether the net effect of smoking on total nursing home utilization is positive or negative depends on whether the excess risk of nursing home admissions by smokers and former smokers at each age outweighs the greater propensity of never-smokers to reach the older ages at which nursing home utilization is most common. Our data did not permit analysis of this issue. We are examining it in ongoing research that uses other data and analytical methods along with the findings of this study.

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DECLARATION OF INTERESTS

None declared.

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