Tables: 6
Figures: 1
Words: 4872
Pages: 31

Health Events and the Smoking Cessation of Middle Aged Americans

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Abstract

This study investigates the effect of serious health events including new diagnoses of heart attacks, strokes, cancers, chronic lung disease, chronic heart failure, diabetes, and heart disease on future smoking status up to six years post event. Data come from the Health and Retirement Study, a nationally representative longitudinal survey of Americans aged 51-61 in 1991, followed every 2 years from 1992 to 1998. Smoking status is evaluated at each of three follow-ups, (1994, 1996, and 1998) as a function of health events between each of the four waves. Acute and chronic health events are associated with much lower likelihood of smoking both in the wave immediately following the event and up to six years later. However, future events do not retrospectively predict past cessation. In sum, serious health events have substantial impacts on cessation rates of older smokers. Notably, these effects persist for as much as six years after a health event.

Keywords: Smoking cessation, Health and Retirement Study, Health events, Longitudinal studies, Health behavior

INTRODUCTION

As extensively documented in the Surgeon General's Report on the health consequences of smoking, many smokers begin to suffer the negative health consequences of a lifetime of smoking as they reach late middle age (U.S. Department of Health and Human Services, 1989). However, a range of research illustrates the many potential benefits to smoking cessation both for older smokers (Burns, 2000; Gourlay & Benowitz, 1996; Hirdes & Maxwell, 1994; Rogers, Meyer, Judd, & Mortel, 1985; U.S. Department of Health and Human Services, 1990; Wannamethee, Shaper, Whincup, & Walker, 1995) and even smokers suffering from various health problems such as coronary artery disease (Hermanson, Omenn, Kronmal, & Gersh, 1988; Muller, 1994; Williams, 1996), and COPD (Petty, 1993).

This paper addresses several questions regarding health events and smoking cessation. When serious health events occur, what is the impact on cessation? Are the effects of negative changes in health only observed in the short run or do they persist for several years? Are effects present for a broad range of disease types including both acute and chronic health problems? Identifying a lack of effect, or a non-persistent effect is important for shaping health care practice and policy. For instance, effective interventions for treating ill or hospitalized smokers should be judged against the backdrop of the high (or low) rates of cessation in these groups. Should health events have small effects on cessation, or relatively minor ones, the role for successful interventions would be even greater.

Older smokers are an interesting group to study for a number of reasons. First, because the great majority of older smokers have a long history of smoking, they comprise a self-selected group of smokers who generally have had difficulty quitting and who have potentially built a large stock of addiction. Even the presence of serious health events may not motivate change.

Alternatively, whether in a hospital or other clinical setting, this event may provoke a "teachable moment" that could enable clinicians to promote smoking cessation (Emmons & Goldstein, 1992; McBride, Emmons, & Lipkus, 2003; McBride et al., 1999; Stevens, Glasgow, Hollis, Lichtenstein, & Vogt, 1993). Also, as noted earlier, many smokers begin to experience serious health problems that are attributable to or exacerbated by smoking between the ages of 45 and 64. From a research standpoint, the higher incidence of serious health events in this age range makes it possible to analyze the impact of health events in a representative population that otherwise occur rarely in the population.

Using the Health and Retirement Study, this study examines the extent to which the new diagnosis of acute and chronic diseases affects smoking cessation in late middle age. Importantly, it investigates quitting behavior following a negative health event up to two, four and six years later. By looking at new health events, it identifies how new information influences behavior, rather than simply observing the spurious correlation between health and smoking that would arise from more simple regressions of smoking status on health. The results indicate that older smokers who suffer chronic or acute health events are consistently more likely to quit smoking than those who do not experience a new health event. Up to six years later, these differences persist.

BACKGROUND

Health and smoking cessation

The relationship between smoking and health is multi-faceted. Extensive research has documented the effects of smoking on health (U.S. Department of Health and Human Services, 1989), and smoking cessation has been shown to substantially enhance mortality and quality of

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life among ex-smokers (U.S. Department of Health and Human Services, 1990). Smoking and health have also been linked together through health knowledge, education and social environment (Kenkel, 1991; U.S. Department of Health and Human Services, 1994). Similarly, choices about smoking may be linked with choices about educational attainment, employment, health knowledge acquisition and other health behaviors through differences in individual's preferences toward the future versus present (Farrell & Fuchs, 1982; Grossman, 1972). In sum, health, education and socioeconomic status have well-documented relationships that clearly feed back into one another. Consequently it is important to control for these possible sources of bias if one wishes to identify a causal relationship between health and smoking cessation.

Conceptually, looking at the impact of health *status* on cessation is not very informative since current health status represents a lifetime of choices relating to both. In this context, looking simply at the relationship between ill health and smoking status would yield an uninformative correlation between the two (which would be positive). Similarly, the relationship between ill health and smoking *cessation* is convoluted by these endogeneity problems. For instance, individuals who highly discount the future will be less likely to make many types of lifetime investments in their health (and hence have lower health status) and will be less likely to quit smoking. As such, to summarily conclude that good health is a determinant of cessation would be misleading. Looking at *new* information about health removes a great deal of this endogeneity problem. Instead of a spurious correlation, one sees how smokers respond to the realization of an uncertain health event.

Conceptualizing the influence of health events on smoking

While this paper does not attempt to disentangle the multiple ways in which health events could influence the smoking decision, it is worth discussing several channels through which a

new health event may influence the smoking decision. While many would be thought to encourage cessation, some may in fact discourage quitting. Ultimately it is an empirical question to resolve.

Expectations and Perceptions

Negative health events may motivate change if individuals perceive a curative benefit, or they may reinforce the addiction if individuals no longer see a need to prevent illness that has already occurred. More specifically, the onset of a new disease may change expectations about future health and survival, an individual's perceptions about the harms of smoking, or an individual's perceptions about the benefits of quitting. In prior research, smokers have been shown to accurately perceive the mortality risks from smoking (Schoenbaum, 1997; Viscusi, 1990, 1991) and appear able to update their subjective probability of survival following a negative health event (Smith, Taylor, Sloan, Johnson, & Desvousges, 2001). Ultimately, both the initial level of perceived risk and the change in perceived risk will matter to the smoking cessation decision. A new health event may change the belief about the population risks of smoking, or it may simply inform the smoker that he or she got an unlucky draw. Whatever the change in perceptions about smoking, changes in life expectancy as a result of the new diagnosis may influence quitting behavior in their own right.

Perhaps even more important than changes in life expectancy or perceptions about the harms of smoking is the individual's belief about the benefits of stopping smoking. For instance, an individual may realize that smoking may have contributed to negative health or continue to increase the probability of adverse health events, but not believe that quitting would have any benefit for health problems that have already occurred. Interestingly, some smokers appear to be

overly optimistic about their improved mortality post cessation (Sloan, Smith, & Taylor, 2001), although it is not known if this effect holds for those with serious illness.

Social Setting and "Teachable Moments"

A health event may change behavior for reasons other than shifting perceptions or expectations. After a health event, there may be increased social pressures to quit smoking from frequent interactions with the medical community and the urging of family members and loved ones. Thus, increased social support may be a powerful factor, and has been indicated as a potential determinant of cessation in other medical scenarios such as pregnancy (McBride et al., 1998). The frequent contact with the medical community and the capitalization of this "teachable moment" may also promote cessation in these cases.

Enjoyment of Smoking

A decline in the general ability to perform activities of daily living and new pains associated with smoking related conditions may reduce the pleasure that is gained from smoking. Alternatively this may increase the medicative properties of nicotine. The medicative attributes of nicotine may also become increasingly important as individuals cope with the stresses of a new illness. These effects may directly influence preferences, and consequently smoking behavior.

Economic Factors

The onset of a new health problem may make smoking cost-prohibitive for certain individuals. Since health events are strongly associated with movements out of the labor-force, movements onto disability, less household income, and increased medical expenditures, individuals may not smoke as much as they did before, or may quit altogether due to new financial constraints. If a health event does lead individuals to retire, this may help catapult them

into a new regime, thus providing a needed commitment device. On the other hand, smoking and leisure time might be complementary, thus mitigating the above effects.

Empirical evidence in population studies

While there is a sizeable literature on the determinants of smoking cessation in general, few studies based on population data have looked at the effects of health on cessation. Using data from the Health and Lifestyle Survey, one study estimates a probit model of the probability of "ever having quit" depending on health, medical advice, addiction and social interaction(Jones, 1994) The measures of health are self-assessed health status (excellent/good/fair/poor), self-reported health (presence of specific illness or symptoms), and measured health (forced expiratory volume, lowest pulse rate, and body mass index). This study finds that being in poor health is associated with being less likely to quit, while having a disability or long-standing illness is associated with being more likely to quit. While the result that good health is a motivator of cessation is a provocative one, the use of current health to predict past smoking behavior is problematic (Shmueli, 1996). This paper instead looks prospectively at the influence of health changes on future smoking behavior.

Two other population studies look at the effect of worsening health or specific health events on cessation or smoking quantity. The first looks at the effect of a heart attack on the likelihood of continued smoking (Wray, Herzog, Willis, & Wallace, 1998). A new heart attack is a strong predictor of cessation, and the magnitude of this effect increases with years of education. What is unclear is whether this same strong effect occurs for other diseases and whether these cessation differences persist over a longer horizon. The second study considers the effect of new information about health via heart and lung check-ups, worsening or improved

self-assessed health status, and generally finds that worsening health leads to reduced smoking and cessation one year later (Clark & Etile, 2002).

Empirical Evidence in Medically Ill Smokers

Several studies have looked at the effectiveness of interventions among ill or hospitalized smokers and the predictors of quitting among such smokers (Crowley, Macdonald, & Walter, 1995; Lando, Hennrikus, McCarty, & Vessey, 2003; McBride et al., 1999; Taylor et al., 1996). The extent to which smokers are likely to quit following health events will inform the need for such interventions and the usefulness of capitalizing on such "teachable moments". The focus here on differences between those with and without health events will in essence account for any effects of increased interactions with the medical community (as noted above).

METHODS

Data and Sample Inclusion

The data for this study come from the Health and Retirement Study conducted at the University of Michigan. The Health and Retirement Study (HRS) is a nationally representative sample of individuals born between 1931 and 1941 and their spouses (regardless of age-eligibility). Beginning in 1992, 12,652 individuals from 7,702 households were surveyed in face-to-face interviews. Baseline interviews were conducted in respondents' homes. Mexican-Americans, Blacks and residents of Florida were oversampled. The survey contains extensive information on individual's health behaviors, health and functional status, including self-reports of more objective disease diagnosis, as well as a host of economic and demographic information on both individuals and their spouses. More information on the Health and Retirement Study has been published elsewhere (Juster & Suzman, 1995).

Because this dataset contains such a large number of individuals followed for over eight years, including information about important life and health changes during that time, it is an excellent source of data for analyzing changes in smoking behavior. In general, very few panel datasets with tobacco information are available for evaluating nationally representative populations of smokers. Since most of these individuals are past the age of 50 at the start of the survey, a significant fraction of them, particularly smokers, are likely to undergo serious health events throughout the sample period.

Subjects who had valid information for all relevant variables for the first four waves were included in the sample. Of the 12,652 individuals interviewed at wave 1, 11,594 (92%) remained at wave 2, 10,962 (94%) remained at wave 3, and 9,989 (91%) remained at wave 4, equivalent to 79% of the wave 1 sample. An additional 508 observations (5%) were dropped due to missing data leaving 9481 respondents. The analytic sample consisted of the 26 percent of individuals who reported that they were currently smoking at the time of the initial survey (typically 1992). These 2465 wave 1 smokers were followed until 1998. An additional sample of 3051 smokers present at both wave 1 and 2 regardless of future follow-up was used to test robustness of results and potential bias due to non-random sample attrition.

Measures

Smoking Status: The primary outcome measure, self-reported smoking status, was examined at each of the three follow-up waves, corresponding roughly to the years 1994, 1996, and 1998. This was assessed with the question "Do you now currently smoke cigarettes?"

Health Status and Health Events: A history of acute and chronic health problems was recorded at wave 1 through self-reports of physician diagnosis. Acute health problems considered were

heart attacks, strokes, or cancers (excluding skin). Chronic health problems considered were chronic heart failure, chronic lung disease, diabetes, or heart disease. Respondents answer a series of questions of the form "Has a doctor ever told you that you have the following condition…". Binary variables indicate the history of acute and chronic conditions separately. At baseline, the history of conditions was assessed, and at each of the follow-up periods questions about new diagnoses were asked. Separate measures account for new acute and chronic disease onset between each of the waves for a total of six possible disease occurrences.

Control Variables: Several variables that have been found to be important predictors of cessation in other research were included in the analysis. These included gender, age (in years), race (black, Hispanic origin, all others omitted), education (in years), marital status, psychiatric history, moderate to heavy alcohol use, history of acute health problems, history of chronic health problems, and number of cigarettes smoked at baseline. Psychiatric history at baseline was assessed with the question "Has a doctor ever told you that you had emotional, nervous, or psychiatric problems?" A dummy for moderate to heavy alcohol use was defined as reporting 2 or more drinks per day. It was assessed with the question "In general, do you have less than one drink a day, one to two drinks a day, three or four drinks a day, or five or more drinks a day?"

Analysis

The data analysis involved descriptive statistics of sample characteristics by both health event and smoking status using Anova procedures. Tukey tests of mean differences are reported. Full descriptive details on event diagnosis by smoking status are presented in an Appendix. The bivariate relationship between follow-up smoking status and health events are also shown graphically. In the next phase of the analysis, multivariate logistic regression was used to

analyze a succession of fully specified models for smoking status at each wave controlling for past and/or future health events and the control variables above.

RESULTS

Characteristics of sample by health event occurrence

Table 1 displays the characteristics of the sample of wave 1 smokers by health event type between wave 1 and 2. For illustration, only events between the first waves are shown, since no significant differences exist for later events with the exception of the smoking status markers which will be presented in turn. A major health event occurred for 5.6 percent of the sample (n=138) while 8.4 percent experienced a chronic health event (n=208). These are not mutually exclusive categories, as 20 percent of those with chronic health events also experienced a major health event and 30 percent of those with major health events also experienced a chronic health event.

The number of cigarettes smoked per day at baseline was not significantly different for those with or without health events (sample mean of 19.9, standard deviation 12.7). However, those with major events were less likely to be female (41 percent versus 55 percent), were on average 2 years older (56.2 years versus 54.3 years), had higher rates of prior chronic or major disease diagnosis (37 percent versus 18.9 percent and 26.1 percent and 11 percent, respectively), and were more likely to experience future major and chronic health events than those without a major health event between wave 1 and 2. Years of education, racial/ethnic composition, drinking behavior, and history of psychiatric illness were similar across the two groups. Chronic event sufferers were also less likely to be female (46.6 percent versus 55.1 percent), were older (55.4 years versus 54.3), had less education on average (10.9 years versus 11.7), and had higher

rates of history of psychiatric illness (20.2 percent versus 12 percent), history of chronic disease diagnosis (33.2 percent versus 18.7 percent), and history of major disease diagnosis (25 percent versus 10.6 percent). Future health events were also more common for those with chronic health events, but only statistically so in one case (major health events between wave 2 and 3).

[INSERT TABLE 1 HERE]

Characteristics of sample by follow-up smoking status

Table 2 shows the bivariate relationship between smoking status at each of the follow-up waves and the health event variables and control variables. The relationship between baseline characteristics and future smoking status was similar at all three waves. Those not smoking had smoked fewer cigarettes on average at baseline, were slightly older, were more likely to be black, and were less likely to have 2 or more drinks per day on average. No difference in years of education was detected. History of psychiatric illness, chronic disease diagnosis, and major disease diagnosis all were not related to future smoking status.

[INSERT TABLE 2 HERE]

A clear pattern of health events exists by follow-up smoking status. At wave 2, those not smoking were more likely to have a major health event (11.5 percent versus 4.5 percent) and were more likely to have had a chronic health event (15.5 percent versus 7.1 percent) than were those still smoking. However, there were no meaningful differences in the rates of future (between wave 2 and 3 or wave 3 and 4) health events by smoking status at wave 2. At wave 3, smoking status is clearly related to current or past health events, but not to future health events. At wave 4, events up to 6 years prior are associated with not smoking at that wave. This pattern is further demonstrated in Figure 1.

[INSERT FIGURE 1 HERE]

The first frame of Figure 1 shows smoking rates at each wave by both chronic event occurrence and major event occurrence between waves 3 and 4. No differences in smoking status appear by health event status until wave 4. However in the second frame showing smoking status by health events occurring between waves 2 and 3, we notice the difference appearing at wave 3 and persisting at wave 4. For events between waves 1 and 2, the differences in smoking rates appear immediately, and persist to wave 4 in all but one case.

The Impact of Health Events on Smoking: Logistic Regression Analysis

Tables 3 through 5 present the unadjusted and adjusted model estimating odds ratios for these effects for smoking status outcomes at waves 2 through 4, respectively. The first column in each of the tables displays odds ratios when only the most recent health event categories are included. The second column of each table includes health events for the remaining intervals. For wave 2 smoking status, this consists of two future health events (1994 to 1996 and 1996 to 1998). For wave 3, the addition involves one prior health event (1992 to 1994) and one future event (1996 to 1998). For wave 4, this consists of two prior health events (1992 to 1994 and 1994 to 1996). Each of these analyses provides slightly different information about the impact of health events on smoking. The final column of each table illustrates the full analyses with all of the control variables included.

[INSERT TABLE 3 HERE]

Smoking status at wave 2 is strongly associated with both major and chronic health events between waves 1 and 2. Those with major or chronic events were less than half as likely to be smoking. This effect is highly significant. Future health events have no impact on smoking status in 1994. The addition of the control variables has little effect on the effects of the

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health event variables. Smoking in 1994 was more common among those smoking more cigarettes per day at baseline, those who were younger, and those with fewer years of education. A prior history of chronic disease also lowered the chance of smoking.

At wave 3 (1996), the effect of a health event between waves 2 and 3 is similar in magnitude to that found for the same time frame in 1994. However, now it is possible to test the effect of events happening 2 to 4 years prior on smoking status in 1996. Unlike future events which have no impact on smoking status in 1996, past chronic health events are predictive of smoking abstinence. Prior major events are also predictive of abstinence, however this effect is not significant. At wave 3, there is persistence in the effect of chronic health events on cessation, but it is not as strong for major events. Similar findings prevail on the control variables of number of cigarettes, age and education. At wave 3, baseline drinking of more than 2 drinks per day is predictive of smoking, and a history prior to 1992 of a major disease event is also associated with smoking.

[INSERT TABLE 4 HERE]

The regression of wave 4 smoking status allows a full analysis of health events as much as 6 years prior. The results reveal quite a large amount of persistence in the effects of health events on cessation. Major and chronic health events between 1992 and 1994, 1994 and 1996, and 1996 and 1998, all have a sizeable negative impact on smoking status in 1998.

[INSERT TABLE 5 HERE]

Changes in quantity smoked and relapse

Smoking abstinence may not be the only consequence of health events. Health events may lower smoking quantity among those who continue to smoke, or it may decrease the chance

of relapse among former smokers. Results of logistic regression of smoking status in 1998 of former smokers from 1992 reveal no effect of recent or past health events on relapse likelihood. It should be noted that for this group overall relapse rates are quite low. A least squares regression of quantity smoked by those continuing to smoke in 1998 reveals only a modest effect of a recent major event on smoking quantity (significant only at the 10 percent level). The bulk of the effect of health events on smoking occurs through cessation.

Moderator effects (gender, education, age)

Separate logistic regressions were also performed to analyze if there are different effects of health events by gender, years of education, or age. The effect of both chronic and acute events was quite uniform by each of these demographic measures.

Non-random sample attrition

To judge the effect of any non-random sample attrition on the results presented, several different samples were compared. These results appear in an appendix table. Although twenty percent of the sample from wave 2 did not appear in the wave 4 follow-up, the overall effect of major or chronic events between waves 1 and 2 on cessation was little affected by this sample attrition. This is the case despite the somewhat higher attrition among those with major or chronic health events. Comparing the effect of health events on wave 2 cessation with two different analytic samples (the sample present at waves 1 and 2 and the sample present at all four waves) revealed little difference in the effect size.

Frequency of events and effects by disease type

The appendix table also reports frequencies of new disease diagnosis by specific breakdown of disease type. Due to smaller samples sizes within each group, it is not possible to identify statistically significant differences in effect sizes across groups. Overall, effect magnitudes appear somewhat similar across disease diagnosis breakdown with a couple of exceptions. Among the acute or major events, cancer diagnoses tend to have lower rates of initial cessation. Among the chronic events, chronic heart failure tends to have higher initial rates of cessation.

DISCUSSION

Perhaps not surprisingly, serious health events are highly associated with smoking cessation. Importantly, the effects do not seem to diminish over time. However, viewed another way, quits that do not occur fairly soon after the health event are unlikely. The effects of long-ago health events are no greater than more recent health events. This finding explains some cross-sectional patterns observed in this and other data. While many with health events cease smoking, those who are left are likely to be the least likely to quit. Therefore, a history of prior health events will not predict cessation if the sample is conditioned on smoking at baseline. It is not that good health predicts cessation, but rather that failing to quit in the face of a serious health event identifies an extremely recalcitrant smoker.

Nearly all of the effect of health events on smoking behavior operates through cessation rather than reduced smoking among those continuing to smoke. This finding reveals a potential need for alternative strategies for the remaining smokers. Reduced smoking may be an option for these smokers, and some evidence exists that this reduction could lead to future cessation (Falba, Jofre-Bonet, Busch, Duchovny, & Sindelar, 2004).

None of the effects of health events on smoking behavior vary systematically with education, age, or gender.   This is somewhat surprising as age may be an important factor in determining the probability of surviving the illness. Since younger smokers with health events may have a better prognosis post-quitting than older smokers, the lack of an age effect may reveal a need to appeal strongly to these smokers. Given the lack of relationship between education and the effect of health events, no significant gaps in health information are revealed in this context. However, other studies have illustrated that responses to myocardial infarction are greater for those with higher education (Wray et al., 1998).

Limitations

There are some limitations of these findings due to the nature of the data available. For one, we do not know if the health event preceded smoking cessation. This will likely bias the results upward since some former smokers with health events should have been categorized in the control group. In practice, this effect appears small given the persistence of the effect of the health events (where timing is evident). Second, both smoking status, and disease diagnosis are self-reported. Additionally, many effects of distinct health event types may be lost in the presently specified analysis due to small sample size for specific diseases.

The present analysis cannot inform the precise motivation behind the cessation of these individuals. Rather it is descriptive of the magnitude of the effect of health events on cessation. Future work will need to identify the pathways in order to influence more cessation among smokers with health events.

Conclusions

Major and chronic health events are significant predictors of future cessation among middle-aged smokers. Although others have contended that good health may be a motivator for cessation (Jones, 1994), and other factors may discourage cessation following a health event, the results here clearly indicate that health events prompt cessation. While cessation rates are higher than the non-health event population, an open question for policy is whether these cessation rates are still "too low". That is, interventions targeted at medically ill smokers who do not manage to quit smoking on their own may be even more important in light of their continued smoking in the face of serious illness.
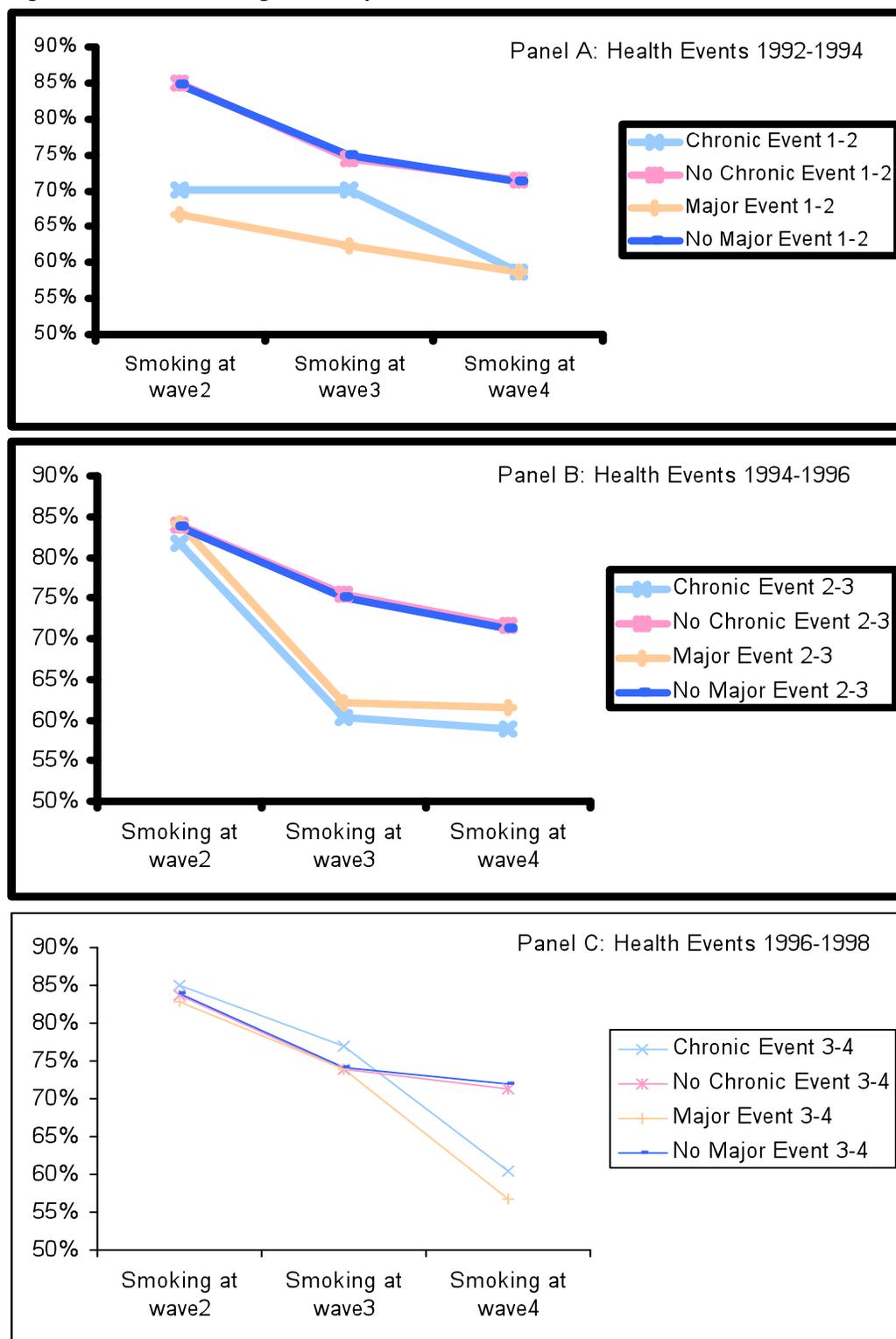
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Figure 1: Future smoking status by health event

A chronic event is a self report of physician diagnosis of chronic heart failure, chronic lung disease, diabetes, or heart disease occurring between specified waves.

A major event is a self report of physician diagnosis of heart attack, stroke, or cancer (exlcuding skin).

Table 1: Characteristics of sample by disease event between waves 1 and 2

	Health Events Between Wave 1 and 2			
	Major Health Event	No Major Event	Chronic Health Event	No Chronic Event
N	138	2327	208	2257
(%)	(5.6%)	(94.4%)	(8.4%)	(91.6%)
# cigs/day at wave 1	21.9	19.8	19.7	19.9
(std dev)	(12.4)	(12.7)	(11.0)	(12.9)
female	41.3%	55.1% *	46.6%	55.1% *
age at wave 1 (years)	56.2	54.3 *	55.4	54.3 *
(std dev)	(4.6)	(5.4)	(5.4)	(5.4)
education (years)	11.4	11.6	10.9	11.7 *
(std dev)	(3.4)	(3.0)	(3.2)	(3.0)
black	14.6%	17.7%	22.3%	17.1%
hispanic	9.4%	7.2%	7.2%	7.4%
drink2+/day at wave 1	8.7%	9.1%	8.2%	9.1%
drink4+/day at wave 1	2.9%	2.5%	2.9%	2.5%
history of psychiatric illness [a]	14.5%	12.6%	20.2%	12.0% *
history of chronic disease diagnosis [a,b]	37.0%	18.9% *	33.2%	18.7% *
history of major disease diagnosis [a,c]	26.1%	11.0% *	25.0%	10.6% *
major health event between w1 and w2 [c,d]	-	-	20.2%	4.3% *
chronic health event between w1 and w2 [b,d]	30.4%	7.1% *	-	-
major health event between w2 and w3 [c,d]	13.8%	6.2% *	10.1%	6.3% *
chronic health event between w2 and w3 [b,d]	18.1%	7.8% *	10.1%	8.2%
major health event between w3 and w4 [c,d]	16.7%	8.7% *	11.5%	8.9%
chronic health event between w3 and w4 [b,d]	9.4%	8.0%	11.5%	7.8%
smoking at wave 2	66.7%	84.8% *	70.2%	85.1% *
smoking at wave 3	62.3%	74.8% *	70.2%	74.5%
smoking at wave 4	58.7%	71.2% *	58.7%	71.6% *

* Tukey tests of significance across columns at the 5 percent level.

[a] History indicates respondent ever had condition as of wave 1.

[b] Self report of physician diagnosis of chronic heart failure, chronic lung disease, diabetes, or heart disease.

[c] Self report of physician diagnosis of heart attack, stroke, or cancer (exlcuding skin).

[d] New occurrence of condition between waves.

Table 2: Characteristics of sample by future smoking status

	Wave 2		Wave 3		Wave 4	
	Smoking	Not Smoking	Smoking	Not Smoking	Smoking	Not Smoking
# cigs/day at wave 1	20.9	14.8 *	21.0	16.8 *	21.3	16.7 *
(std dev)	(12.6)	(11.8)	(12.6)	(12.5)	(12.6)	(12.5)
female	54.4%	54.1%	54.6%	53.7%	56.0%	50.3% *
age at wave 1 (years)	54.3	55.0 *	54.2	55.2 *	54.0	55.4 *
(std dev)	(5.5)	(5.1)	(5.4)	(5.3)	(5.4)	(5.4)
education (years)	11.5	11.9	11.5	11.8	11.6	11.7
(std dev)	(3.0)	(3.0)	(3.0)	(3.1)	(2.9)	(3.2)
black	16.4%	23.4% *	16.7%	19.9%	15.9%	21.4% *
hispanic	7.2%	8.0%	7.1%	8.2%	6.6%	9.1% *
drink2+/day at wave 1	9.7%	5.5% *	10.0%	6.3% *	10.4%	5.8% *
drink4+/day at wave 1	2.7%	1.5%	2.8%	1.6%	3.0%	1.4% *
history of psychiatric illness [a]	13.1%	10.8%	13.0%	11.8%	13.1%	11.8%
history of chronic disease diagnosis [a,b]	19.2%	23.3%	19.4%	21.0%	19.2%	21.6%
history of major disease diagnosis [a,c]	11.8%	12.3%	12.2%	10.8%	12.0%	11.6%
major health event between w1 and w2 [c,d]	4.5%	11.5% *	4.7%	8.2% *	4.7%	7.8% *
chronic health event between w1 and w2 [b,]	7.1%	15.5% *	8.0%	9.7%	7.0%	11.8% *
major health event between w2 and w3 [c,d]	6.7%	6.5%	5.6%	9.7% *	5.8%	8.7% *
chronic health event between w2 and w3 [b,]	8.2%	9.5%	6.8%	12.9% *	7.0%	11.7% *
major health event between w3 and w4 [c,d]	9.1%	9.8%	9.1%	9.3%	7.4%	13.5% *
chronic health event between w3 and w4 [b,]	8.2%	7.5%	8.4%	7.2%	7.0%	10.9% *
smoking at wave 2			94.0%	54.5% *	93.6%	60.4% *
smoking at wave 3	83.2%	27.3% *			90.0%	36.3% *
smoking at wave 4	78.8%	27.8% *	85.6%	27.3% *		

* Tukey tests of significance across columns at the 5 percent level.

[a] History indicates respondent ever had condition as of wave 1.

[b] Self report of physician diagnosis of chronic heart failure, chronic lung disease, diabetes, or heart disease.

[c] Self report of physician diagnosis of heart attack, stroke, or cancer (exlcuding skin).

[d] New occurrence of condition between waves.

Table 3: Logistic Regression of Smoking Status at wave 2 (1994)

	O.R.	(95% C.I.)	O.R.	(95% C.I.)	O.R.	(95% C.I.)
major health event btwn w1 and w2 [c,d]	0.48 ***	(0.34-0.67)	0.47 ***	(0.34-0.66)	0.47 ***	(0.33-0.66)
chronic health event btwn w1 and w2 [b,]	0.43 ***	(0.29-0.63)	0.43 ***	(0.29-0.63)	0.39 ***	(0.26-0.59)
major health event btwn w2 and w3 [c,d]			0.89	(0.61-1.31)	0.78	(0.53-1.16)
chronic health event btwn w2 and w3 [b,d]			1.20	(0.75-1.92)	1.11	(0.68-1.81)
major health event btwn w3 and w4 [c,d]			1.17	(0.77-1.77)	1.02	(0.66-1.56)
chronic health event btwn w3 and w4 [b,d]			0.94	(0.63-1.38)	0.89	(0.59-1.33)
# cigs/day at wave 1					1.05 ***	1.04-1.07)
age at wave 1 (years)					0.98 +	(0.96-1.00)
female					1.10	(0.87-1.40)
black					0.90	(0.67-1.20)
hispanic					1.14	(0.70-1.84)
education (years)					0.94 **	(0.91-0.98)
drink2+/day at wave 1					1.61	(0.90-2.86)
drink4+/day at wave 1					0.98	(0.33-2.92)
history of psychiatric illness [a]					1.18	(0.82-1.69)
history of chronic disease diagnosis [a,b]					0.73 *	(0.55-0.98)
history of major disease diagnosis [a,c]					1.28	(0.88-1.85)

*** p<.001 ** p<.01 *p<.05 +p<.10

[a] History indicates respondent ever had condition as of wave 1.

[b] Self report of physician diagnosis of chronic heart failure, chronic lung disease, diabetes, or heart disease.

[c] Self report of physician diagnosis of heart attack, stroke, or cancer (exlcuding skin).

[d] New occurrence of condition between waves.

Table 4: Logistic Regression of Smoking Status at wave 3 (1996)

	O.R.		(95% C.I.)	O.R.		(95% C.I.)	O.R.		(95% C.I.)
major health event btwn w1 and w2 [c,d]				0.89		(0.64-1.23)	0.89		(0.64-1.25)
chronic health event btwn w1 and w2 [b,d]				0.62	*	(0.43-0.90)	0.59	**	(0.40-0.86)
major health event btwn w2 and w3 [c,d]	0.54	***	(0.40-0.73)	0.55	***	(0.41-0.75)	0.52	***	(0.37-0.71)
chronic health event btwn w2 and w3 [b,]	0.63	**	(0.45-0.89)	0.62	**	(0.44-0.89)	0.52	***	(0.36-0.75)
major health event btwn w3 and w4 [c,d]				1.22		(0.86-1.73)	1.16		(0.81-1.66)
chronic health event btwn w3 and w4 [b,d]				1.14		(0.82-1.60)	1.05		(0.75-1.49)
# cigs/day at wave 1							1.03	***	(1.02-1.04)
age at wave 1 (years)							0.97	***	(0.95-0.99)
female							1.11		(0.91-1.35)
black							1.00		(0.78-1.29)
hispanic							0.86		(0.59-1.27)
education (years)							0.96	**	(0.93-0.99)
drink2+/day at wave 1							1.44	+	(0.94-2.22)
drink4+/day at wave 1							1.05		(0.47-2.39)
history of psychiatric illness [a]							1.06		(0.79-1.42)
history of chronic disease diagnosis [a,b]							0.86		(0.68-1.09)
history of major disease diagnosis [a,c]							1.50	*	(1.09-2.07)

*** p<.001 ** p<.01 *p<.05 +p<.10

[a] History indicates respondent ever had condition as of wave 1.

[b] Self report of physician diagnosis of chronic heart failure, chronic lung disease, diabetes, or heart disease.

[c] Self report of physician diagnosis of heart attack, stroke, or cancer (exlcuding skin).

[d] New occurrence of condition between waves.

Table 5: Logistic Regression of Smoking Status at wave 4 (1998)

	O.R.	(95% C.I.)	O.R.	(95% C.I.)	O.R.	(95% C.I.)
major health event btwn w1 and w2 [c,d]			0.61 **	(0.45-0.83)	0.61 **	(0.44-0.83)
chronic health event btwn w1 and w2 [b,d]			0.71 +	(0.50-1.03)	0.70 +	(0.48-1.03)
major health event btwn w2 and w3 [c,d]			0.62 **	(0.46-0.84)	0.58 ***	(0.42-0.80)
chronic health event btwn w2 and w3 [b,d]			0.90	(0.63-1.29)	0.72 +	(0.50-1.05)
major health event btwn w3 and w4 [c,d]	0.69 *	(0.51-0.93)	0.70 *	(0.52-0.96)	0.64 **	(0.46-0.88)
chronic health event btwn w3 and w4 [b,·]	0.54 ***	(0.41-0.72)	0.58 ***	(0.43-0.78)	0.51 ***	(0.37-0.69)
# cigs/day at wave 1					1.04 ***	(1.03-1.05)
age at wave 1 (years)					0.96 ***	(0.94-0.98)
female					1.35 **	(1.11-1.64)
black					0.84	(0.66-1.07)
hispanic					0.67 *	(0.46-0.97)
education (years)					0.95 **	(0.92-0.98)
drink2+/day at wave 1					1.73 *	(1.13-2.65)
drink4+/day at wave 1					1.09	(0.48-2.49)
history of psychiatric illness [a]					1.06	(0.80-1.42)
history of chronic disease diagnosis [a,b]					0.85	(0.68-1.08)
history of major disease diagnosis [a,c]					1.58 **	(1.16-2.14)

*** p<.001 ** p<.01 *p<.05 +p<.10

[a] History indicates respondent ever had condition as of wave 1.

[b] Self report of physician diagnosis of chronic heart failure, chronic lung disease, diabetes, or heart disease.

[c] Self report of physician diagnosis of heart attack, stroke, or cancer (exlcuding skin).

[d] New occurrence of condition between waves.

Appendix Table: Breakdown of Disease Diagnosis by Sample Attrition and Future Rates of Smoking

	Frequency of Diagnosis by Sample							Smoking Rates				
	(A) Present waves 1 & 2		(B) Present waves 1, 2 & 3		(A)-(B)	(C) Present all 4 waves		(A)-(C)	(A) Present waves 1 & 2	(C) Present all 4 waves	(B) Present waves 1, 2 & 3	(C) Present all 4 waves	(C) Present all 4 waves
Wave 1-2 Events	N	%	N	% of B	attrition	N	% of C	attrition	Wave 2	Wave 2	Wave 3	Wave 3	Wave 4
	3051	100.0%	**2733**	100.0%	89.6%	**2465**	80.8%	80.8%					
Major Event	204	6.7%	158	5.8%	77.5%	138	5.6%	67.6%	65.2% *	66.7% *	63.9% *	62.3% *	58.7% *
No Major Event	2847	93.3%	2575	94.2%	90.4%	2327	94.4%	81.7%	85.1%	84.8%	74.8%	74.9%	71.2%
Heart Attack Diagnosis	95	3.1%	73	2.7%	76.8%	63	2.6%	66.3%	55.8% *	60.3% *	64.4%	61.9% *	50.8% *
No Heart Attack Diagnosis	2951	96.9%	2657	97.3%	90.0%	2399	97.4%	81.3%	84.6%	84.5%	74.5%	74.5%	71.0%
Stroke Diagnosis	41	1.3%	34	1.2%	82.9%	33	1.3%	80.5%	58.5% *	60.6% *	70.6%	72.7%	60.6%
No Stroke Diagnosis	3009	98.7%	2699	98.8%	89.7%	2432	98.7%	80.8%	84.1%	84.1%	74.3%	74.2%	70.6%
Cancer Diagnosis	81	2.7%	60	2.2%	74.1%	51	2.1%	63.0%	75.3% *	72.5% *	60.0% *	56.9% *	60.8%
No Cancer Diagnosis	2968	97.3%	2672	97.8%	90.0%	2413	97.9%	81.3%	84.0%	84.0%	74.5%	74.5%	70.7%
Chronic Event	286	9.4%	239	8.7%	83.6%	208	8.4%	72.7%	72.0% *	70.2% *	72.4%	70.2%	58.7% *
No Chronic Event	2765	90.6%	2494	91.3%	90.2%	2257	91.6%	81.6%	85.0%	85.1%	74.4%	74.5%	71.6%
Chronic Heart Failure	55	1.8%	44	1.6%	80.0%	36	1.5%	65.5%	58.2% *	58.3% *	65.9%	61.1%	55.6% *
No CHF Diagnosis	2988	98.2%	2685	98.4%	89.9%	2425	98.5%	81.2%	84.2%	84.2%	74.3%	74.3%	70.8%
Chronic Lung Disease	130	4.3%	107	3.9%	82.3%	93	3.8%	71.5%	75.4% *	73.1% *	74.8%	73.1%	62.4%
No Chronic Lung Disease	2920	95.7%	2626	96.1%	89.9%	2372	96.2%	81.2%	84.1%	84.2%	74.2%	74.2%	70.8%
Diabetes Diagnosis	70	2.3%	59	2.2%	84.3%	53	2.2%	75.7%	74.3% *	71.7% *	74.6%	73.6%	54.7% *
No Diabetes Diagnosis	2979	97.7%	2672	97.8%	89.7%	2411	97.8%	80.9%	84.0%	84.1%	74.2%	74.1%	70.8%
Heart Disease Diagnosis	102	3.3%	83	3.0%	81.4%	68	2.8%	66.7%	71.6% *	69.1% *	75.9%	72.1%	58.9% *
No Heart Disease	2945	96.7%	2648	97.0%	89.9%	2395	97.2%	81.3%	84.2%	84.3%	74.1%	74.2%	70.9%
No Major or Chronic Event	2630	86.2%	2385	87.3%	90.7%	2161	87.7%	82.2%	85.6% *	85.6% *	74.9% *	75.0% *	72.0% *
Major or Chronic Event	421	13.8%	348	12.7%	82.7%	304	12.3%	72.2%	72.2%	71.4%	69.5%	68.1%	60.2%

* Tukey tests of significance between rows at the 5 percent level.

Note: Three different samples are compared to evaluate sample attrition, frequency of diagnosis and the follow-up smoking status by disease diagnosis.

(A) includes sample present at wave 1 and wave 2, (B) includes only those continuing to wave 3, and (C) includes only those continuing to wave 4.