Published in final edited form as:

Addiction. 2011 November ; 106(11): 2031–2038. doi:10.1111/j.1360-0443.2011.03500.x.

The timing of smoking onset, prolonged abstinence, and relapse in men: A prospective study from ages 18 to 32 years

David C. R. Kerr^{1,2}, Lee D. Owen², and Deborah M. Capaldi²

¹Oregon State University Department of Psychology Corvallis, OR 97331 (541) 737-1364
david.kerr@oregonstate.edu

²Oregon Social Learning Center 10 Shelton McMurphey Blvd. Eugene, OR 97401 (541) 485-2711

Abstract

Aim—To describe the rate and timing of smoking onset, prolonged abstinence (≥ 1 year), and relapses across ages 18 to 32 years in initially smoking and nonsmoking men.

Design—A 23-year longitudinal study.

Setting—Untreated community sample.

Participants—154 American boys were recruited at age 10 years to a larger study ($n = 206$) of delinquency risk; 71 participants who smoked cigarettes and did not use smokeless tobacco and 83 participants who did not use tobacco were followed from age 18 to 32 years.

Measurements—Frequency of tobacco use and weekly cigarettes smoked in the past year were assessed annually. Onset (> 6 cigarettes/week), abstinence (0 tobacco uses in the past year), and relapse (> 0 cigarettes/week) were tracked annually.

Findings—36% of smokers achieved 1 or more years of abstinence by age 32 years. 52% who reached abstinence relapsed at least once. One half of men who showed onset after age 18 years were smoking at the end of study, compared to nearly three quarters of men who were smokers at age 18 years. Risk for relapse following prolonged abstinence was strongest initially and diminished thereafter. Transition probabilities were stronger for the second period of abstinence than for the first. Models were limited by sample size and statistical power.

Conclusions—Relapses continue to erode men's quit success even after long periods of abstinence from smoking. Long-term abstinence, despite intervening relapse, bodes well for eventual abstinence. Adolescent onset appears relevant to the likelihood of adult abstinence and relapse patterns.

Keywords

abstinence; adolescence; onset; relapse; tobacco

INTRODUCTION

An estimated 84% of young adults who smoke report seriously attempting to quit in the past year (1). Most who try to quit smoking do so without professional help ["self-quitters" (2) (3)]. However, an estimated 24-51% relapse within 8 days of a quit attempt, 80-90% within 3 months, and 95-97% within 6-12 months (4). Even participants in controlled trials who are

receiving the most efficacious treatments show relapse rates of 70% or greater when followed for more than 5 months (5).

Given low but steady rates of relapse after the first months of quitting, researchers have advocated that prolonged abstinence rates be reported in smoking cessation trials to permit evaluation of the efficacy of existing treatments. Six-month or 12-month continuous abstinence rates have been proposed to more closely approximate lifelong abstinence (6-7). Yet, the accuracy of such an estimate has not been studied extensively. Following Hughes, Peters, and Naud's (8) meta-analysis of trials with 2 or more years of follow-up, they found that new relapses after 1 year of abstinence occurred at an annual rate of approximately 10%. They noted that this low rate of annual relapse could compound significantly over time, but contended that rates are likely to continue to decrease over time. Yet, Hughes, Keely, and Naud (4) found too few prospective studies of long-term (> 6 months) abstinence rates among self-quitters for a meta-analysis of the issue. Thus, long-term studies of the natural history of tobacco cessation are needed.

Experimentation and onset of patterned tobacco use most often occur in adolescence (9). Furthermore, adolescent onset is associated with heavier use in adulthood and decreased likelihood of quitting (9-10), due in part to the sensitivity of the adolescent brain to nicotine exposure (11). Noting these patterns, Piasecki (5) highlighted the importance of using a developmental framework for understanding tobacco use and dependence. Thus, studies of variation in the timing and durability of abstinence and relapse should attend to the timing of smoking onset.

The present study traces the timing of smoking onset, prolonged abstinence (1 year or more), and relapses across early adulthood in a community sample of boys who were recruited on the basis of neighborhood risk for delinquency and followed annually from ages 10 to 32 years. Hazard rates for onset of tobacco use have been described in this sample to age 16 years (12); low rates (2-4%) of tobacco use onset were reported in Grades 5 through 7, followed by a tripling of rates (13-14%) by Grades 9 and 10 (12). The men's characteristics and the prevalence and variability in the timing of their tobacco use onset, compared to other U.S. samples [e.g., Monitoring The Future (13)], suggest their smoking patterns may be representative of those of White, lower SES American men, a group at high risk for smoking and smoking-related problems (14).

We first sought to document the rates and long-term success of abstinence from smoking in two groups of young men: those who were regular smokers by age 18 years and those who later became regular smokers. Consistent with neuroscience research and developmental frameworks for theories of nicotine addiction (5), we hypothesized that, compared to men who showed adult onset, those who showed adolescent onset would less often achieve prolonged abstinence and show higher rates of relapse.

Second, we considered the timing and relative risk of transitions to smoking onset, prolonged abstinence, relapse, and subsequent abstinence. We expected that men who were not smokers at the beginning of young adulthood would show low rates of onset. We also predicted that risks for relapse—even after prolonged abstinence—would be stronger than for other use transitions. Finally, we predicted that the likelihood of abstinence will be increased following relapse, given that a desire to quit is implied by a history of abstinence.

METHOD

Participants

A subsample of 154 men were selected from a sample ($n = 206$) recruited at age 10 years to the Oregon Youth Study (OYS), a study of individual, family, and community influences on delinquency. Schools with the highest rates of police-reported delinquent episodes by juveniles in a medium-sized metropolitan region in Oregon were randomly selected for recruitment. Entire fourth-grade classes of boys in these schools were invited to participate during 2 school years (1983-1985); 74% were recruited (15). Annual assessments (except for age 27 years) were conducted from ages 10 to 32 years. Annual participation rates ranged from 93% to 99%. Demographic characteristics of the subsample are reported in Table 1.

The sample was too small to consider the influence of smokeless tobacco (SLT) use on smoking use transitions, and the analytic method permitted consideration of only a limited sequence of transitions (e.g., from onset to abstinence to relapse for one substance). Therefore, men who were using SLT (defined by use of one or more cans/month of chew) at age 18 years were excluded here.

The subsample was comprised of men who, at age 18 years (Time 1 [T1] of the present study), were not SLT users and were either cigarette smokers ($n = 71$) or nonsmokers ($n = 83$). Smokers were defined by self-reported regular smoking (7 or more cigarettes per week during the past year); on average, they reported 977 tobacco use occasions in the past year (minimum = 365). Nonsmokers reported zero self-reported tobacco use occasions in the past year. The following participants were excluded from these analyses: 11 regular cigarette and SLT users; 16 nonsmoking SLT users; 23 men who reported using tobacco one or more times in the past year, but reported smoking between 1 and 6 cigarettes per week (some of whom also used SLT); and two men who did not participate at T1. There were no differences between men who did or did not smoke regularly at T1 in terms of parent education or income at study entry (age 10 years). Compared to men who did not smoke regularly at T1, men who did had a lower level of education and lower income at age 32 years ($t(142) = 4.85$ and 2.03 , respectively, $p < .05$).

Measures

Cigarette and SLT use—At each assessment, interviewers asked participants: (a) “how many times have you used tobacco, including smoking or chewing tobacco, in the last year?” (i.e., tobacco use occasions) (b) “how many cigarettes per week do you smoke?” and (c) “how many cans of chewing tobacco per month?”

The following transitions in cigarette smoking were coded. Among T1 nonsmokers, *onset* of smoking was defined when participants first reported use of seven or more cigarettes per week over the past year. *Abstinence* was defined when smokers (both T1 smokers and T1 nonsmokers who later met onset criteria) reported zero tobacco use occasions in the past year. *Relapse* to smoking was defined when smokers, who had reached abstinence, subsequently reported smoking one or more cigarettes per week. Transition definitions are consistent with research recommendations [e.g., (6)]. Subsequent abstinence and relapse transitions were coded identically.

Analytic approach

Multiple-spell discrete-time event-history analysis (16) was used to predict use transitions at each of 12 assessments from ages 18 to 32 years; models were run separately for T1 smokers and T1 nonsmokers. This approach is similar to survival analysis, but differs in that

(a) once individuals experience an event of interest (e.g., onset), they contribute observations to the prediction of subsequent events of interest (e.g., abstinence); (b) time is marked in discrete units (e.g., years), during which one of the outcome events can occur; and (c) transition events themselves become predictors of the probability of subsequent transition events.

Under the multiple-spell paradigm, once individuals experience the first event of interest, they move from Spell 1 (e.g., a smoker “at risk” for abstinence) to Spell 2 (e.g., an abstinent former smoker at risk for relapse). Period variables identify the number of years that have passed within a given spell (i.e., the number of consecutive years in a state of use or non-use). In the model for T1 smokers, all men started in Spell 1, Period 1. Those who did not reach abstinence remained in Spell 1 and advanced sequentially through periods until either the last assessment (age 32 years) or the abstinence criterion was met, at which point they moved into Spell 2, Period 1. They then advanced in period until either the last assessment or the relapse criterion was met (Spell 3, Period 1). Similarly, in the model for T1 nonsmokers, all men started in Spell 1, Period 1. They remained in Spell 1 and advanced sequentially through periods until either the last assessment or onset, at which point they moved into Spell 2, Period 1. They then advanced in period until either the last assessment or the abstinence criterion was met (Spell 3, Period 1).

Unobserved combinations of spell and period are common; this permitted two simplifications that offered model parsimony. First, simplified time models that did not differ significantly from the fully parameterized time models were generated by collapsing Periods 12 or later in the smokers model, and Periods 10 or later in the nonsmokers model (16). Second, due in part to right censoring at age 32 years, only two T1 smokers were followed to a second relapse, and only three T1 nonsmokers were followed to a second bout of abstinence. In order to avoid unstable or undefined parameter estimates, these spells were not modeled.

Spells were coded using dummy variables. In the T1 smokers models, ‘abstinence’ was coded ‘1’ when a man had achieved abstinence (see definitions above) and thus was at risk for relapse; otherwise it was coded ‘0.’ ‘Relapse’ was coded ‘1’ when a man was smoking subsequent to abstinence and, therefore, was at risk for transitioning to a second bout of sustained abstinence; otherwise, it was coded ‘0.’ Abstinence and relapse dummy codes therefore uniquely identified whether men were at risk for first abstinence (codes = 0, 0, respectively), relapse (codes = 1, 0), or abstinence following relapse (codes = 0, 1).

Similarly, in the model for T1 nonsmokers, ‘onset’ was coded ‘1’ when a man had shown smoking onset and was at risk for abstinence. ‘Abstinence’ was coded ‘1’ when a man had achieved abstinence after onset and was at risk for relapse. Thus, ‘onset’ and ‘abstinence’ dummy codes uniquely specified risk for onset (codes = 0, 0, respectively), abstinence (codes = 1, 0), or relapse (codes = 0, 1).

Period, spell, and period by spell interaction variables were entered in three steps of a hierarchical logistic regression (16). For parsimony, the period variable used in these interactions was a single continuous variable (the natural log fit best).

RESULTS

Descriptive statistics

Table 2 summarizes the smoking transition outcomes for the 71 men who were smokers at T1 (age 18 years). By age 32 years, 35% had achieved 1 or more years of abstinence. Among these men who achieved abstinence, 56% eventually relapsed. Some ultimately

returned to a state of abstinence, as 48% of those who ever reached abstinence were abstinent at the last observation. Yet, 73% of all men who were smokers at T1 were still smoking at the last observation. Figure 1 depicts observed survival curves for T1 smokers who moved through each of the use transitions studied here.

Table 2 also shows the transition outcomes for the 83 men who were nonsmokers at T1 and the 27% who showed onset by age 32 years. Use transitions of this subgroup of smokers from the initially nonsmoking subsample then were compared to those of T1 smokers. In some respects the patterns were similar. Approximately 36% of the T1 nonsmokers who showed onset eventually achieved 1 or more years of abstinence (compared to 35% of T1 smokers). Yet, 38% of those who achieved abstinence had one or more relapses (a proportion that was not significantly different from that of T1 smokers). Though based on a very small sample, T1 nonsmokers who showed onset but eventually reached abstinence ultimately were more likely to be abstinent at the end of the study than were T1 smokers who reached abstinence (0% vs. 48%, $p < .05$). Also notable was that nearly three quarters of T1 smokers were smoking at the end of study compared to only one half of the T1 nonsmokers who showed onset, $p < .05$. Figure 2 depicts observed survival curves for T1 nonsmokers through the use transitions considered here.

Table 2 also summarizes use abstinence and relapse transitions across the combined sample of adult smokers (i.e., T1 nonsmokers who showed onset and T1 smokers). Notably, 52% of adult smokers who achieved abstinence relapsed at least once by age 32 years, and 36% of those who reached prolonged abstinence were smoking at the end of the study. These points are relevant to the contention that 12-month abstinence approximates lifelong abstinence (6). Eleven of the 33 (33%) smokers who reached prolonged abstinence relapsed the following year.

Event-history models

Model for T1 smokers—The entry of period variables in Step 1 was significant, $\Delta\chi^2(12) = 856.43$, $p < .001$, but did not show a clearly discernable trend over time, other than to reflect the strong likelihood that those in a given use state would remain in that state the following year. In Step 2, entry of the smoking transition dummy codes improved the model, $\Delta\chi^2(2) = 37.66$, $p < .001$, suggesting that the average level of risk for transition depends on current-use state. Specifically, relative to the risk of transitioning from smoking to first abstinence (reflected in the period effects when the dummy codes = 0), risk for relapse following a prolonged abstinence and risk for a second bout of prolonged abstinence following relapse were both significantly elevated. These effects are reported in Table 3.

Effects at Step 3, $\Delta\chi^2(2) = 7.70$, $p < .05$, indicated the shape of the hazard curve depended on the transition type. The interaction of abstinence and period suggested that the probability of relapse was strongest initially and diminished thereafter (Exp (B) [95% CI] = .19 [.04-.82], $p < .05$). This effect may be evident in the observed plot of the “at risk for relapse” group in Figure 1, which shows high risk for relapse in the first year after prolonged abstinence and no risk for relapse after a 4th year of prolonged abstinence. Parameter estimates at Step 3 suggested model instability (Exp (B) [95% CI] = 62.6 [11.1-351.6] and 8.7 [3.0-25.0], respectively, $p < .001$). Therefore, the more conservative model at Step 2 is presented (Table 3).

Model for T1 nonsmokers—The entry of the period variables at Step 1 yielded a significant model, $\Delta\chi^2(10) = 1128.37$, $p < .001$, and was suggestive of low risks for transition that became somewhat lower over time. The entry of the smoking transition dummy codes at Step 2 significantly improved the model, $\Delta\chi^2(2) = 6.73$, $p < .05$, suggesting that the average level of risk for transition differed by current use pattern. Compared to the

risk of transitioning from nonsmoking to onset, risk for relapse following abstinence (Exp (B) [95% CI] = 5.6 [1.39-22.35], $p < .05$) was significantly elevated. The risk for abstinence following onset was not significant (Exp (B) [95% CI] = 2.1 [0.9-4.8], $p = .07$) but was suggestive of increased risk relative to the transition from nonsmoking to onset. At Step 3, the entry of period by spell interactions did not improve the model significantly; thus, the model is presented at Step 2 (Table 3).

DISCUSSION

The present study describes the timing of tobacco use onset, prolonged abstinence, and relapse in at-risk men from ages 18 to 32 years. The most striking finding is that approximately one half of smoking men who achieved 1 or more years of abstinence eventually relapsed. This supports speculation that the ostensibly insignificant annual incidence of relapses after 1 year of abstinence steadily accumulate to erode quit success (8). On the other hand, nearly two thirds of men who ever achieved abstinence ultimately were not smoking at our final observation, despite intervening relapses.

Most research on relapse focuses on the earliest outcomes of quit attempts. Indeed, prior studies (17) note that quitting smoking is primarily thwarted by a failure to achieve even short-term (1 week) abstinence. To guide development of treatments that are resistant to later relapses, Piasecki et al. (17) proposed a model of how different risks for relapse (e.g., physical withdrawal, cessation fatigue) change in salience across the first days, weeks, and months of quitting. The present findings suggest an even longer view is needed to identify and counteract the forces that steadily undermine even long-term abstinence.

Of note, our estimate of relapse in the second year of prolonged abstinence (33%) was considerably higher than the annual incidence rate of 10% (95% CI 3-17%) estimated in a meta-analysis by Hughes et al. (8). There are a number of possible reasons for this difference, including that Hughes et al. also considered women and based estimates on medication trials only, which included participants in active treatments of up to 1 year in duration. Additionally, the prevalence of cigarette smoking among men in our full ($n = 206$) sample (37-47% from ages 18 to 32 years) is higher than national prevalence estimates of smoking for young men (25-29%) (18). Demographic characteristics of participants may contribute to this difference, as smoking is more prevalent for less educated men (e.g., 50-51% among men with a GED) and those below the federal poverty level (32-34%) (18). Generalizability may be limited to the extent that participant characteristics (e.g., SES, education, delinquency) that increase risk for smoking (12) influence relapse risk (19).

Models demonstrated the relative strength of the risk for relapse compared to other use transitions, and were suggestive of differences in the shape of the relapse risk curve over time (i.e., very high risk initially). Given the powerful physical and contextual forces on relapse, it is not surprising that the curves for relapse risk were more dramatic in these respects than the curves for onset and abstinence.

Findings regarding young-adult smoking onset extended prior work on this sample (12). Hazards for onset were elevated through approximately age 22 years and then decreased. Patterns within the adolescent-versus adult-onset subgroups were consistent with prior research on the early initiation of tobacco use (9). Specifically, men who achieved prolonged abstinence were more likely to sustain or return to abstinence if they showed adult onset smoking than if they were already regular smokers at age 18 years. Relatedly, nearly three quarters of men who were regular smokers at age 18 years were still smoking at the end of the study, compared to one half of men who showed onset in adulthood. Because these subgroups were analyzed separately, it is possible that uncontrolled confounds may better

account for differences in abstinence and relapse by age of onset. Still, findings are consistent with the notion that prevention efforts must continue to focus on reducing experimentation and initiation of tobacco use in early adolescence.

A final notable finding was that the likelihood of achieving at least a year of prolonged abstinence became stronger following relapse. This is consistent with a report that adults who attempted to quit in the past year were twice as likely to attempt to quit in the following year (10). Such findings appear to extend to longer duration quit attempts and relapses.

This study had some limitations. First, although repeated measures bolstered statistical power, sample size was small and percentage estimates in particular may not be stable. Second, some important transitions in use (e.g., shorter periods of abstinence and relapse) were not captured. Third, participants were primarily White, lower SES, American men, were recruited on the basis of neighborhood risk for delinquency and from the same geographic locale and time period, and were not followed beyond early adulthood; thus, generalizability may be limited. Fourth, unobserved heterogeneity in risk for transitions was not modeled. Finally, abstinence was not biochemically verified.

Adolescent histories of use may impact abstinence and relapse in adulthood. As such, we concur with Piasecki's (5) emphasis on developmental frameworks. Adolescence is a time of great vulnerability to the effects of nicotine on the developing brain, but also a time of great opportunity for preventing an entrenched reliance on tobacco to serve physical, emotion regulation, and social needs (11). Findings reinforce the importance of preventing tobacco use in adolescence (e.g., targeting general problem-behavior pathways; enforcement of laws banning sales to minors).

Findings indicated that less than one third of men who smoked regularly in adulthood were able to achieve prolonged abstinence that lasted to age 32 years, and that men who were already regular smokers by age 18 were even less able. More than one half of smoking men who ever achieved a year or more of abstinence relapsed at least once by age 32 years. Further strategies need to be developed not only for young adults to achieve prolonged abstinence but to help them sustain that abstinence. Long-term follow-up data are needed to evaluate the ultimate success of cessation strategies.

Acknowledgments

The project described was supported by awards from National Institutes of Health (NIH), U.S. PHS to Dr. Capaldi: Award Number 1R01AA018669 (Understanding Alcohol Use over Time in Early Mid-Adulthood for At-Risk Men) from the National Institute on Alcohol Abuse and Alcoholism (NIAAA); R01 DA 015485 (Adjustment Problems and Substance Use in Three Generations) from the National Institute of Drug Abuse (NIDA); and HD 46364 (Risk for Dysfunctional Relationships in Young Adults) from the National Institute of Child Health and Development (NICHD). The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH, NIAAA, NIDA, or NICHD.

REFERENCES

1. Messer K, Trinidad DR, Al-Delaimy WK, Pierce JP. Smoking cessation rates in the United States: A comparison of young adult and older smokers. *American Journal of Public Health*. 2008; 98(2): 317–22. [PubMed: 18172143]
2. Curry SJ, Sporer AK, Pugach O, Campbell RT, Emery S. Use of tobacco cessation treatments among young adult smokers: 2005 National Health Interview Survey. *American Journal of Public Health*. 2007; 97(8):1464–9. [PubMed: 17600243]
3. Fiore MC, Novotny TE, Pierce JP, Giovino GA, Hatziandreu EJ, Newcomb PA, et al. Methods used to quit smoking in the United States. Do cessation programs help? *JAMA*. 1990; 263:2760–5. [PubMed: 2271019]

4. Hughes JR, Keely J, Naud S. Shape of the relapse curve and long-term abstinence among untreated smokers. *Addiction*. 2004; 99:29–38. [PubMed: 14678060]
5. Piasecki TM. Relapse to smoking. *Clinical Psychology Review*. 2006; 26:196–215. [PubMed: 16352382]
6. Hughes JR, Keely JP, Niaura RS, Ossip-Klein DJ, Richmond RL, Swan GE. Measures of abstinence in clinical trials: issues and recommendations. *Nicotine and Tobacco Research*. 2003; 5:13–6. [PubMed: 12745503]
7. Pierce JP, Gilpin EA. A minimum 6-month prolonged abstinence should be required for evaluating smoking cessation trials. *Nicotine and Tobacco Research*. 2003; 5(2):151–3. [PubMed: 12745486]
8. Hughes JR, Peters EN, Naud S. Relapse to smoking after 1 year of abstinence: A meta-analysis. *Addictive Behaviors*. 2008; 33:1516–20. [PubMed: 18706769]
9. U.S. Department of Health and Human Services. Preventing tobacco use among young people: A report of the Surgeon General. Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; Atlanta, GA: 1994.
10. West R, McEwen A, Bolling K, Owen L. Smoking cessation and smoking patterns in the general population: a 1-year follow-up. *Addiction*. 2001; 96:891–902. [PubMed: 11399220]
11. Jamner LD, Whalen CK, Loughlin S, Mermelstein R, Audrain-McGovern J, Krishnan-Sarin S, et al. Tobacco use across the formative years: A road map to developmental vulnerabilities. *Nicotine and Tobacco Research*. 2003; 5:S71–S87. [PubMed: 14668088]
12. Dishion TJ, Capaldi DM, Yoerger K. Middle childhood antecedents to progression in male adolescent substance use: An ecological analysis of risk and protection. *Journal of Adolescent Research*. 1999; 14:175–206.
13. Jackson KM, Sher KJ, Schulenberg JE. Conjoint developmental trajectories of young adult substance use. *Alcoholism: Clinical and Experimental Research*. 2008; 32:723–37.
14. Thorn SL, Malarcher A, Maurice E, Caraballo R. Cigarette smoking among adults—United States, 2007. *Mortality and Morbidity Weekly Report*. 2008; 57:1221–6.
15. Capaldi, DM.; Patterson, GR. Psychometric properties of fourteen latent constructs from the Oregon Youth Study. Springer-Verlag; New York: 1989.
16. Willett JB, Singer JD. It's déjà vu all over again: Using multiple-spell discrete time survival analysis. *Journal of Educational and Behavioral Statistics*. 1995; 20:41–67.
17. Piasecki TM, Fiore MC, McCarthy DE, Baker TB. Have we lost our way? The need for dynamic formulations of smoking relapse proneness. *Addiction*. 2002; 97:1093–108. [PubMed: 12199822]
18. Thorne SL, Malarcher A, Maurice E, Caraballo R. Cigarette smoking among adults -- United States, 2007. *Morbidity and Mortality Weekly Report*. 2008; 57(45):1221–6. [PubMed: 19008790]
19. Tucker JS, Ellickson PL, Orlando M, Klein DJ. Predictors of attempted quitting and cessation among young adult smokers. *Preventive Medicine*. 2005; 44:554–61. [PubMed: 15917052]

Figure 1. Observed survival plots for men who were smokers at age 18 years for transitions to (a) abstinence among smokers, (b) relapse among those who achieved abstinence, and (c) subsequent abstinence among those who relapsed.

Figure 2. Observed survival plots for men who were nonsmokers at age 18 years for transitions to (a) smoking onset, (b) abstinence among smokers, and (c) relapse among those who achieved abstinence.

Table 1

Demographic characteristics of the subsample (n = 154) at study entry (age 10 years) and completion (age 32 years).

Race	White	90.9% (<i>n</i> = 140)
	Black	1.9% (<i>n</i> = 2)
	American Indian	1.3% (<i>n</i> = 2)
	Mexican-American	1.3% (<i>n</i> = 3)
	“Other”	4.5% (<i>n</i> = 7)
Age 10 years		
Family Annual Income	< \$5,000	15.6% (<i>n</i> = 24)
	\$5000 to \$9999	18.8% (<i>n</i> = 29)
	\$10,000 to \$14,999	16.9% (<i>n</i> = 26)
	\$15,000-\$19,999	14.9% (<i>n</i> = 23)
	\$20,000-24,999	16.2% (<i>n</i> = 25)
	\$25,000-29,999	7.8% (<i>n</i> = 12)
	\$30,000-39,999	7.1% (<i>n</i> = 11)
	\$40,000+	2.6% (<i>n</i> = 4)
Parent Education (highest of parent)	11 th grade or less	12.3% (<i>n</i> = 19)
	H.S. graduate	31.8% (<i>n</i> = 49)
	1-3 yrs. college	39.6% (<i>n</i> = 61)
	College grad	13.0% (<i>n</i> = 20)
	Graduate training	2.6% (<i>n</i> = 4)
	Missing	0.6% (<i>n</i> = 1)
Age 32 years		
Personal Annual Income	<\$5,000	3.9% (<i>n</i> = 6)
	\$5,000-\$ 9,999	6.5% (<i>n</i> = 10)
	\$15-19,999	11.7% (<i>n</i> = 18)
	\$20-24,999	7.1% (<i>n</i> = 11)
	\$25-29,999	7.8% (<i>n</i> = 12)
	\$30-39,999	21.4% (<i>n</i> = 33)
	\$40,000-49,000	13.0% (<i>n</i> = 20)
	\$50,000+	22.1% (<i>n</i> = 34)
	Not reported	6.5% (<i>n</i> = 10)
Educational Attainment	11 th grade or less	18.1% (<i>n</i> = 28)
	GED	16.9% (<i>n</i> = 26)
	H.S. diploma program	7.1% (<i>n</i> = 11)
	H.S. graduation	33.8% (<i>n</i> = 52)
	2 yr. college graduate	8.4% (<i>n</i> = 13)
	4 yr .college graduate	14.3% (<i>n</i> = 22)
	Masters or PhD	1.3% (<i>n</i> = 2)

Table 2

Cumulative abstinence and relapse rates for initially smoking vs. nonsmoking men from ages 18 to 32 years.

	A T1 Smokers (n = 71)	B T1 Nonsmokers who onset (n = 22)	A+B All adult smokers (n = 93)
percent of total who were abstinent ≥ 1 year	35.2% ^a 25/71	36.4% ^a 8/22	35.5% 33/93
percent who reached abstinence who had ≥ 1 relapse	56.0% ^b 14/25	37.5% ^b 3/8	51.5% 17/33
percent who reached abstinence who were smoking at end of study	48.0% ^c 12/25	0.0% ^c 0/8	36.4% 12/33
percent of total who were smoking at end of study	73.2% ^d 52/71	50.0% ^d 11/22	67.7% 63/93

Note. T1 chewing tobacco users were excluded from all groups.

$$^a \chi^2(1, N = 93) = 0.01, p = .92)$$

$$^b \chi^2(1, N = 33) = 0.83, p = .36)$$

$$^c \chi^2(1, N = 33) = 6.03, p = .01)$$

$$^d \chi^2(1, N = 93) = 4.15, p = .04)$$

Table 3

Two multiple spell discrete time event-history models predicting a transition in use among men who were smokers (Model 1) or nonsmokers (Model 2) at age 18 years.

Predictor	Model 1: Smokers at age 18 years (<i>n</i> = 71; <i>person-year observations</i> = 879)				Model 2: Nonsmokers at age 18 years (<i>n</i> = 83; <i>person-year observations</i> = 1016)			
	<i>B</i>	<i>SE</i>	Wald	Exp(B) [95% CI]	<i>B</i>	<i>SE</i>	Wald	Exp(B) [95% CI]
Period 1	-3.68	.48	59.78**	.03 [.01-.06]	-3.48	.51	47.32**	.03 [.01-.08]
Period 2	-3.93	.53	54.37**	.02 [.01-.06]	-2.78	.40	48.50**	.06 [.03-.14]
Period 3	-4.40	.67	43.42**	.01 [.00-.05]	-3.14	.48	42.62**	.04 [.02-.11]
Period 4	-3.95	.59	44.27**	.02 [.01-.06]	-3.09	.48	40.66**	.05 [.02-.12]
Period 5	-3.04	.48	40.18**	.05 [.02-.12]	-3.89	.73	28.48**	.02 [.01-.09]
Period 6	-2.90	.50	34.09**	.06 [.02-.15]	-4.52	1.01	19.89**	.01 [.00-.08]
Period 7	-3.82	.75	26.01**	.02 [.01-.10]	-4.48	1.01	19.50**	.01 [.00-.08]
Period 8	-3.33	.72	21.44**	.04 [.01-.15]	-3.00	.53	32.43**	.05 [.02-.14]
Period 9	-2.81	.59	22.40**	.06 [.02-.19]	-4.33	1.01	18.27**	.01 [.00-.10]
Period 10 ^a	-2.44	.52	21.95**	.09 [.03-.24]	-4.79	.71	45.34**	.01 [.00-.03]
Period 11	-3.09	.72	18.28**	.05 [.01-.19]	-	-	-	-
Period 12 ^b	-4.36	1.01	18.74**	.01 [.00-.09]	-	-	-	-
Onset ^c	-	-	-	-	.75	.41	3.27 [†]	2.11 [.94-4.76]
Abstinence	2.57	.44	33.60**	13.06 [5.5-31.1]	1.72	.71	5.89*	5.58 [1.39-22.35]
Relapsed ^d	1.92	.52	13.73**	6.85 [2.5-19.0]	-	-	-	-

[†] Note. *p* < .10.

* *p* < .05.

** *p* < .001.

^a For nonsmokers, Periods 11 and higher were recoded as Period 10.

^b For smokers, Periods 13 and higher were recoded as Period 12.

^c Smokers had, by definition, met onset criteria at study entry; thus, this spell was modeled for nonsmokers only.

^d Only three nonsmokers were followed until they were at risk for second period of abstinence (i.e., following onset, abstinence, and relapse); this group was too small to be modeled. $\chi^2(1, N = 93) = 4.15$, $p = .04$.