Original Investigation

Transitions into and out of light and intermittent smoking during emerging adulthood

Helene R. White, Bethany C. Bray, Charles B. Fleming, & Richard F. Catalano

Abstract

Introduction: The purpose of this study was to examine transitions in smoking from adolescence into emerging adulthood and to identify factors that might influence these transitions, specifically, movement into and out of light and intermittent smoking.

Methods: This study used Markov models to examine movement across three stages of smoking (nonsmoking, light and intermittent smoking, and heavy smoking) from adolescence into emerging adulthood. Biannual data were collected from 990 young men and women from the 12th grade until 2 years after high school.

Results: At each timepoint, most youth were nonsmokers. Those who were heavy smokers in 12th grade had a 79% chance of also being heavy smokers 2 years after high school. Between 17% and 21% of participants were light and intermittent smokers at each timepoint, and the likelihood of remaining so at the next timepoint ranged from 56% to 72%. Less than one-half of the 12th-grade light and intermittent smokers were light and intermittent smokers 2 years later, and 3% of the sample were light and intermittent smokers across all assessments. Prevalence and transition rates did not differ by gender. College attendees reported less smoking than non-attendees before and after their transition to college, and attendees compared with nonattendees who smoked were less likely to transition from light and intermittent to heavy smoking and remain heavy smokers. Binge drinking was significantly related to 12th-grade smoking stage and to transitions from nonsmoking to smoking. Overall, few emerging adults maintained light and intermittent smoking consistently over time.

Discussion: Light and intermittent smoking during emerging adulthood may not be the same phenomenon as light and intermittent smoking in adulthood.

Introduction

Despite the known health problems associated with cigarette smoking, young people initiate and develop regular patterns of smoking during and following adolescence (Johnston, Bachman, O'Malley, & Schulenberg, 2007). Rates of past month smoking are highest among 21- to 25-year-olds (40%), with 18- to 20-year-olds (36%) and 26- to 29-year-olds (36%) slightly behind (Substance Abuse and Mental Health Services Administration, 2007). Therefore, cigarette use among youth remains a serious public health problem.

Youth generally increase their substance use, including smoking, during emerging adulthood (the stage in the life cycle following high school but before the adoption of adult roles; Arnett, 2000; White, Labouvie, & Papadaratsakis, 2005). These increases are due, in part, to more freedom and less social control than during adolescence (Arnett, 2005). Some researchers have attributed these increases specifically to the transition to college (McKee, Hinson, Rounsaville, & Petrelli, 2004). During that transition, increases occur in both the initiation of smoking and the movement to regular smoking (Wechsler, Rigotti, Gledhill-Hoyt, & Lee, 1998). However, White et al. (2005) reported that it is the transition out of high school, rather than into college, that puts individuals at risk for increased substance use. They found that increases in cigarette quantity/frequency were greater for noncollege than college-bound youth. In sum, emerging adulthood represents an important life stage in which transitions in cigarette smoking often occur. This study focuses on within-individual transitions in smoking from adolescence into emerging adulthood.

Previous research

Relatively little is known about the nature of transitions in smoking during emerging adulthood (Mayhew, Flay, & Mott, 2000; Shadel, Shiffman, Niaura, Nichter, & Abrams, 2000). About one-third to one-half of those who try cigarettes eventually become regular (Kessler, 1995) or dependent (Shiffman,

Helene R. White, Ph.D., *Center of Alcohol Studies, Rutgers University, Piscataway, NJ*

Bethany C. Bray, Ph.D., *Methodology Center, Pennsylvania State University, University Park, PA*

Charles B. Fleming, M.A., *Social Development Research Group, School of Social Work, University of Washington, Seattle, WA*

Richard F. Catalano, Ph.D., *Social Development Research Group, School of Social Work, University of Washington, Seattle, WA*

Corresponding Author:

Helene R. White, PhD, *Rutgers Center of Alcohol Studies, Rutgers University, 607 Allison Road, Piscataway, NJ 08854-8001, USA. Telephone: 732-445-3579. Fax: 732-445-3500. Email: hewwhite@rci.rutgers.edu*

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1991) smokers. However, some individuals maintain long-term cigarette smoking without becoming dependent (Shiffman, 1991; Shiffman & Paty, 2006). Light and intermittent smoking is an increasingly common pattern, with about one-fourth of U.S. smokers smoking less than daily (Shiffman & Paty, 2006). The fact that individuals can smoke regularly without becoming addicted suggests that tobacco exposure alone does not predict addiction (Heyman & Gibb, 2006). Therefore, it is important to understand what protects light and intermittent smokers (also referred to as chippers) from becoming dependent smokers.

Demographic differences have been noted between light and intermittent and heavy smokers. Women compared with men, minorities compared with Whites, and younger compared with older respondents are more likely to be light and intermittent than heavy smokers (Okuyemi et al., 2002).

Some research suggests that motivations for smoking may differ between light and intermittent and heavy smokers (Hajek, West, & Wilson, 1995; Moran, Wechsler, & Rigotti, 2004; Okuyemi et al., 2002; Shiffman, Kassel, Paty, Gnys, & Zettler-Segal, 1994). Further, Shiffman and Paty (2006) found that smoking by light and intermittent smokers, compared with heavy smokers, was under more stimulus control. A key stimulus for smoking is alcohol drinking (Shiffman & Balabanis, 1996). McKee et al. (2004) found that 74% of all smoking occasions among college students occurred while under the influence of alcohol, and this percentage was higher for light smokers (86%) than for heavier smokers (63%). Binge-drinking episodes increased the likelihood that smoking would occur and would be pleasurable. Moran et al. (2004) found that college student occasional smokers were more likely than daily smokers to be social smokers. Social smokers were more likely to be binge drinkers. Thus, binge drinking appears to increase situations for smoking among light and intermittent smokers.

Present study

The purpose of this study was to (a) examine transitions in smoking from adolescence (12th grade) into emerging adulthood (2 years after high school) and (b) identify factors that might influence these transitions. Specifically, we were interested in movement into and out of light and intermittent smoking. Whereas several studies have compared light and intermittent smokers to heavy smokers, few have examined within-individual transitions across stages of smoking, especially during emerging adulthood. To the best of our knowledge, this is the first study to prospectively examine short-term transitions in smoking from adolescence into emerging adulthood as a Markov process. Markov models are especially useful for quantifying and describing behavior when there is a high degree of movement into and out of behavior states. Furthermore, although the phenomenon of light and intermittent smoking has been established among adults, the present study examined whether a stable pattern of light and intermittent smoking can be identified as early as emerging adulthood. Also, we focused on three factors associated with light and intermittent smoking—gender, college status, and binge drinking—and examined whether these factors influenced transitions into and out of light and intermittent smoking.

We hypothesized that (a) transitions forward from one stage of smoking to the next would be most likely to occur immediately

following the transition out of high school, rather than across adjacent timepoints following high school; (b) women would be more likely than men to remain light and intermittent smokers rather than transition from light and intermittent to heavy smoking; (c) college-bound students would be less likely to transition from light and intermittent to heavy smoking; and (d) binge drinking would be associated with greater likelihood of transitioning from nonsmoking into light and intermittent smoking and from light and intermittent into heavy smoking.

Methods

Design and sample

The data were collected as part of the Raising Healthy Children project (Catalano et al., 2003). The Raising Healthy Children study is a longitudinal study of the etiology of problem behavior with an experimental evaluation of an intervention to reduce drug use and other problem behaviors nested within it (Haggerty, Catalano, Harachi, & Abbott, 1998). Covariation matrices among the variables included in this analysis were similar across experimental and control groups in terms of direction, magnitude, and significance levels of associations, and a model in which all possible associations between model variables were constrained to equality across groups showed good model fit (Tucker-Lewis index = .98, root mean squared error of approximation = .03). We, therefore, combined the experimental and control groups for the present study.

In the first 2 years of the project (1993 and 1994), 1,040 students and their parents (76% of those eligible) from 10 suburban public elementary schools in a Pacific northwestern school district consented to participate in the study. At recruitment, 52% were first-grade and 48% were second-grade students. These youth were followed up at least annually until 2 years after high school. All procedures were approved by a University of Washington Institutional Review Board.

Annual surveys were completed every spring, and two additional surveys were included in the fall after high school and the fall after that. For the present study, we used data from the spring of the 12th grade, the first fall after high school (F1), the first spring after high school (S1), the next fall (F2), and the next spring (S2). The annual spring surveys were administered one-on-one by interviewers using laptop computers. For sensitive questions (e.g., about substance use), participants completed questions in a self-administered mode. For the fall surveys, about half of the sample completed the survey over the Internet and half were interviewed in person using similar procedures as the spring surveys. Analyses of those randomly assigned to administration mode in the first fall indicated virtually no differences in responses to sensitive questions between modes of administration (Petrie et al., 2005). For the fall survey in 2006 (of the younger cohort), 65% completed the survey over the Internet and 35% were interviewed in person. Retention has remained relatively high, ranging from 88% in the 12th grade to 87% 2 years after high school.

The final sample for this analysis included 990 participants, who provided data on smoking during at least one of the five assessments included in the analysis. The older cohort did not report on their cigarette smoking during the first fall after high school. These data can be considered to be missing at random as they were missing for all older cohort participants as part of the

study design (Graham, Hofer, & MacKinnon, 1996; Schafer & Olsen, 1998). This assumption is supported by the fact that the smoking stage prevalence rates and the transition rates for the younger and older cohorts were equal at all other waves of data included in the analysis (12th grade, S1, F2, and S2; prevalence rates: $G^2_2 = 0.05$, *ns*; transition rates: $G^2_{18} = 16.42$, *ns*). Maximum likelihood estimates for model parameters were calculated using the expectation-maximization algorithm with the assumption that data were missing at random (Lanza, Lemmon, Schafer, & Collins, 2008). Rates for missing data were as follows: 8% at 12th grade, 55% at F1, 8% at S1, 7% at F2, and 8% at S2. The 50 (5%) youth without smoking data at any of the five assessments did not differ from the analysis sample in terms of gender, age, race/ethnicity, or family income measured at baseline.

The sample was 53% male: 82% were White, 4% Hispanic, 7% Asian or Pacific Islander, 4% Black, and 3% Native American. During the spring of 12th grade, the average age was 18.15 years ($SD = 0.34$). Some 30% of participants received free or reduced-price lunch in the first 2 years of the study.

Measures

All the variables were based on self-reports from the youth. Self-reports of smoking have been shown to be valid in most studies (Patrick et al., 1994).

Participants were asked to report on the number of cigarettes smoked per day in the last month: 0 (coded 1), less than 1 (coded 2), 1–5 (coded 3), about a half-pack (coded 4), a pack (coded 5), or more than a pack (coded 6). Participants were divided into nonsmokers (coded 1), light and intermittent smokers (coded 2 and 3), and heavy smokers (coded 4 or higher). Age at onset was ascertained from annual prevalence data and was the first year that a participant reported smoking.

Gender was coded 1 for males ($n = 525$) and 0 for females ($n = 465$). College status was assessed at F1 and coded 1 for participants enrolled part time or full time in a 2-year or 4-year college ($n = 381$) and 0 for those not enrolled in college (or still in high school; $n = 488$). Most (81%) of the college students were full-time students, and only a small percentage of those classified as college students were part-time students who also held full-time jobs (less than 10% of all college students).

We measured binge drinking as a time-varying covariate. Frequency of binge drinking was the number of times males drank five or more and females drank four or more alcoholic drinks in a row in the prior 30 days (Wechsler, Lee, Kuo, & Lee, 2000). Participants were trichotomized as non-binge drinkers (zero times), infrequent binge drinkers (one to two times), and frequent binge drinkers (more than three times; Wechsler et al., 2000).

Data analyses

We used Markov models to examine within-individual change in smoking stage membership (nonsmoking, light and intermittent smoking, and heavy smoking) over time. Markov models (Collins, Graham, Long, & Hansen, 1994; Collins & Wugalter, 1992) have become widely used in substance use research when substance use is conceptualized as discrete stages in a developmental process (Jackson, Sher, Gotham, & Wood, 2001). Although such models have commonly taken the form of hidden

Markov models (sometimes called “latent transition” models), where stages are measured with multiple indicators, we used a Markov model in which stages are based on a single measure of smoking (quantity per month) with the assumption of no measurement error. These models have advantages over other person-centered techniques when there is a high degree of movement into and out of behavior states.

Survival analysis is an alternative person-centered technique that could be used to quantify, describe, and predict transitions into light and intermittent smoking, but it does not provide a way to simultaneously model movement into and out of light and intermittent smoking over time. Growth curve and growth mixture modeling are other person-centered techniques that could be used to quantify, describe, and predict trajectories of smoking over time, but smoking must be modeled as a continuous function of time, which is difficult when frequent movement back and forth occurs across different levels of smoking over time.

First, a baseline Markov model was used to describe the prevalence of past month smoking stages at each assessment and to describe the rates of transitions between stages across adjacent timepoints. Second, to take into account smoking history prior to the 12th grade, we added early age at initiation (prior to high school) in the model to predict baseline stage membership (12th grade) and stage transitions. Finally, gender, college status, and binge drinking were added separately to the model to predict 12th-grade stage and transitions. All models were estimated using PROC LTA, a new SAS procedure for latent transition analysis developed by the Methodology Center at Penn State for SAS version 9.1 for Windows. An introduction to a general modeling approach for latent transition analysis with grouping variables and covariates is provided by Lanza and Collins (2008).

Results

Baseline model results

Table 1 presents the prevalence rates of smoking stages at each assessment from 12th grade until S2. The prevalence rates are the proportions of individuals in each smoking stage at each assessment. The proportion of nonsmokers declined slightly from 65% in the 12th grade to 60% at F2. The proportion of light and intermittent smokers was relatively consistent over time, at about 19%. The prevalence of heavy smoking increased slightly over time from 16% in the 12th grade to 21% at S2.

Transition rates also are shown in Table 1. The transition rates are the probabilities of smoking stage membership at time $t + 1$ conditional on smoking stage membership at time t . There is one set of transition rates for each pair of adjacent times; that is, there is a set of rates for the transitions from 12th grade to F1, a set from F1 to S1, etc.

Whereas the movement from nonsmoking to light and intermittent smoking was consistent over time, the largest movement from light and intermittent to heavy smoking occurred during the transition out of high school (12th grade to F1). In contrast, the highest stabilities for all three types of smoking were seen from F1 to S1. The probability of light and intermittent smokers remaining light and intermittent smokers across adjacent timepoints varied over time, ranging from 56% between F2

Table 1. Prevalence rates of past month smoking stages and transition rates between past month smoking stages (*N*= 990)

Prevalence rate			Transition rate		
			Non	LI	Heavy
12th-grade stage	0.65	Non	F1 stage		
	0.19	LI	0.90	0.08	0.02
	0.16	Heavy	0.21	0.57	0.22
F1 stage	0.64	Non	0.10	0.08	0.82
	0.17	LI	S1 stage		
	0.18	Heavy	0.91	0.08	0.01
S1 stage	0.62	Non	0.16	0.72	0.13
	0.19	LI	0.03	0.07	0.90
	0.19	Heavy	F2 stage		
F2 stage	0.60	Non	0.89	0.08	0.03
	0.20	LI	0.22	0.59	0.19
	0.20	Heavy	0.05	0.19	0.75
S2 stage	0.61	Non	S2 stage		
	0.18	LI	0.91	0.08	0.01
	0.21	Heavy	0.25	0.56	0.19
			0.06	0.10	0.84
			Overall transition rate ^a from 12th grade to S2		
			0.84	0.12	0.04
			0.28	0.46	0.27
			0.08	0.12	0.79

Note. F1, first fall after high school; S1, first spring after high school; F2, second fall after high school; S2, second spring after high school; non, nonsmokers; LI, light and intermittent smokers; and heavy, heavy smokers.

^aOverall transition rates are the probabilities of smoking stage membership in S2 conditional on smoking stage membership in 12th grade. They are not the proportion of participants who were non, LI, or heavy smokers throughout the course of the study.

and S2 to 72% between F1 and S1. In contrast, nonsmokers (89%–91%) and heavy smokers (75%–90%) had higher stability over time. During the 2-year period from 12th grade to S2, 84% of the nonsmokers in 12th grade also were nonsmokers at S2 and 79% of the heavy smokers also were heavy smokers, whereas only 46% of the light and intermittent smokers also were light and intermittent smokers. Of the 12th-grade light and intermittent smokers, 28% were nonsmokers and 27% heavy smokers 2 years later. Among participants with data at all five assessments, 49% were consistent nonsmokers across all five assessments, 3% consistent light and intermittent smokers, and 7% consistent heavy smokers. The latter analysis on consistency over all five assessments was conducted only on the younger cohort because they had data at all five assessments. Given that there were no significant differences in prevalence and transition rates across the two cohorts, these analyses probably provide an accurate description of the whole sample. Of the 375 in the older cohort who had data at all four assessments, 54% were nonsmokers at all timepoints, 5% were light and intermittent smokers, and 9% were heavy smokers.

Some evidence indicated that light and intermittent smoking is a transitional stage both into heavy smoking and out of smoking. Nonsmokers were more likely to transition to light and intermittent than directly to heavy smoking, and heavy smokers were more likely to transition to light and intermittent smoking than directly to nonsmoking, except during the transition out of high school, when they were approximately equally likely to transition to nonsmoking as light and intermittent smoking.

The effect of early smoking

To take into consideration smoking history, we added early (prior to the ninth grade; *n*=340) compared with late (later than eighth grade; *n*=272) age at smoking onset as a grouping variable in the model (Table 2). (Those who never initiated [*n*=305] or had missing data on age at initiation [*n*=73] were eliminated from this analysis.) Group differences were tested for significance using nested *G*²-difference tests, in which the fit of models with across-group equality constraints was compared to models in which these constraints were released. Smoking stage prevalence (*G*²=54.70, *df*=2, *p*<.001) and transitions between stages (*G*²=42.76, *df*=24, *p*<.02) were significantly different for early versus late smoking initiators. Early compared to late initiators were less likely to be nonsmokers and light smokers and more likely to be heavy smokers at all times. Whereas both groups were equally likely to transition from light and intermittent to nonsmoking, early compared to late initiators were more likely to transition from light and intermittent to heavy smoking. At most transition points, heavy smoking was more stable for early compared to late initiators. From the 12th grade to S2, early initiators were more likely to be stable heavy smokers and late initiators were more likely to be stable light and intermittent smokers.

Differences by gender and college status

Next, we examined whether baseline prevalence and transition rates differed by gender and college status. The two variables were added, one at a time, to the baseline model as grouping variables, with prevalence and transition rates allowed to vary across levels

Table 2. Prevalence rates of past month smoking stages and transition rates between past month smoking stages by age of smoking initiation

Early initiators (<i>n</i> = 340)						Late initiators (<i>n</i> = 272)					
Prevalence rate			Transition rate			Prevalence rate			Transition rate		
			Non	LI	Heavy				Non	LI	Heavy
			F1 stage						F1 stage		
12th-grade stage	0.40	Non	0.81	0.12	0.07	12th-grade stage	0.58	Non	0.79	0.20	0.01
	0.26	LI	0.22	0.55	0.24		0.32	LI	0.24	0.57	0.19
	0.34	Heavy	0.09	0.06	0.85		0.10	Heavy	0.17	0.15	0.69
			S1 stage						S1 stage		
F1 stage	0.41	Non	0.88	0.11	0.02	F1 stage	0.55	Non	0.74	0.24	0.02
	0.21	LI	0.16	0.71	0.14		0.31	LI	0.16	0.72	0.12
	0.38	Heavy	0.03	0.07	0.90		0.13	Heavy	0.08	0.10	0.82
			F2 stage						F2 stage		
S1 stage	0.41	Non	0.75	0.17	0.07	S1 stage	0.47	Non	0.81	0.15	0.04
	0.22	LI	0.22	0.52	0.26		0.37	LI	0.23	0.61	0.15
	0.38	Heavy	0.06	0.18	0.76		0.16	Heavy	0.02	0.19	0.78
			S2 stage						S2 stage		
F2 stage	0.38	Non	0.76	0.22	0.02	F2 stage	0.47	Non	0.85	0.15	0.00
	0.25	LI	0.27	0.47	0.26		0.33	LI	0.26	0.63	0.10
	0.37	Heavy	0.05	0.07	0.88		0.20	Heavy	0.06	0.15	0.79
			Overall transition rate ^a from 12th grade to S2						Overall transition rate ^a from 12th grade to S2		
S2 stage	0.37	Non	0.68	0.22	0.09	S2 stage	0.50	Non	0.68	0.24	0.09
	0.23	LI	0.30	0.39	0.31		0.31	LI	0.28	0.52	0.20
	0.40	Heavy	0.08	0.12	0.81		0.19	Heavy	0.18	0.09	0.73

Note. F1, first fall after high school; S1, first spring after high school; F2, second fall after high school; S2, second spring after high school; non, nonsmokers; LI, light and intermittent smokers; and heavy, heavy smokers.

^aOverall transition rates are the probabilities of smoking stage membership in S2 conditional on smoking stage membership in 12th grade. They are not the proportion of participants who were non, LI, or heavy smokers throughout the course of the study.

of each variable. Differences in model fit for restricted and unrestricted models were nonsignificant for gender, indicating an absence of gender differences in baseline prevalence rates ($G^2 = 0.15$, $df = 2$, $p = .93$) or transition rates ($G^2 = 21.39$, $df = 24$, $p = .62$).

We found significant differences in the prevalence ($G^2 = 90.87$, $df = 2$, $p < .01$) and transition ($G^2 = 60.12$, $df = 24$, $p < .01$) rates for college attendees compared with nonattendees (Table 3). At baseline, individuals who went to college were less likely than nonattendees to be either light and intermittent or heavy smokers. College attendees were less likely than nonattendees to transition out of nonsmoking at all adjacent times; they also were more likely to transition out of heavy smoking except from F2 to S2. College attendees were more likely than nonattendees to remain light and intermittent smokers at all adjacent times and less likely to transition out of light and intermittent smoking into heavy smoking. The greatest movement from nonsmoking to light and intermittent smoking and from light and intermittent to heavy smoking occurred during the transition out of high school (12th grade to F1) for college attendees but not for nonattendees.

Binge drinking as a time-varying predictor

Next, we examined the effects of infrequent and frequent binge drinking on smoking stage membership in 12th grade and on

transitions between smoking stages over time. Binge drinking was treated as a time-varying covariate. The odds ratios for the effects of infrequent and frequent binge drinking on baseline smoking stage and transitions are presented in Table 4. At baseline, binge drinking was strongly related to light and intermittent smoking and even more strongly related to heavy smoking. In 12th grade, infrequent binge drinkers were 2.71 times more likely than nonbingers to be light and intermittent smokers and 3.66 times more likely to be heavy smokers relative to nonsmokers. Compared with nonbingers, frequent binge drinkers were 5.09 times more likely to be light and intermittent smokers and 10.59 times more likely to be heavy smokers.

Frequent binge drinking was related to stability as a heavy smoker. Participants who were frequent binge drinkers were less likely than nonbingers to transition to light and intermittent or nonsmoking, except from F1 to S1, when they were approximately equally likely to transition to light and intermittent smoking as to remain heavy smokers. In general, frequent binge drinking was related to stability as a light and intermittent smoker. Participants who were frequent binge drinkers were less likely than nonbingers to transition to nonsmoking or heavy smoking, given that they were light and intermittent smokers at the previous assessment, except from F1 to S1. The most consistent and strongest effect was the relation between binge drinking and forward transitions for nonsmokers; frequent binge

Table 3. Prevalence rates of past month smoking stages and transition rates between past month smoking stages by college status

Nonattendees (<i>n</i> = 488)						College attendees (<i>n</i> = 381)					
Prevalence rate			Transition rates			Prevalence rate			Transition rates		
			Non	LI	Heavy				Non	LI	Heavy
12th-grade stage	0.55	Non	F1 stage 0.89	0.07	0.04	12th-grade stage	0.81	Non	F1 stage 0.90	0.09	0.01
	0.22	LI	0.26	0.51	0.22		0.16	LI	0.12	0.69	0.19
	0.23	Heavy	0.12	0.06	0.82		0.04	Heavy	0.10	0.19	0.71
F1 stage	0.58	Non	S1 stage 0.86	0.12	0.02	F1 stage	0.75	Non	S1 stage 0.96	0.04	0.00
	0.17	LI	0.15	0.68	0.17		0.19	LI	0.20	0.73	0.07
	0.26	Heavy	0.04	0.05	0.91		0.06	Heavy	0.00	0.14	0.86
S1 stage	0.53	Non	F2 stage 0.88	0.08	0.04	S1 stage	0.75	Non	F2 stage 0.92	0.07	0.01
	0.20	LI	0.22	0.55	0.23		0.18	LI	0.21	0.63	0.16
	0.28	Heavy	0.06	0.17	0.76		0.07	Heavy	0.08	0.30	0.62
F2 stage	0.52	Non	S2 stage 0.89	0.10	0.01	F2 stage	0.74	Non	S2 stage 0.94	0.06	0.00
	0.20	LI	0.25	0.49	0.25		0.18	LI	0.28	0.63	0.09
	0.28	Heavy	0.07	0.09	0.84		0.08	Heavy	0.00	0.12	0.89
S2 stage	0.54	Non	Overall transition rate ^a from 12th grade to S2 0.81	0.13	0.06	S2 stage	0.74	Non	Overall transition rate ^a from 12th grade to S2 0.88	0.09	0.03
	0.17	LI	0.34	0.38	0.28		0.17	LI	0.25	0.53	0.23
	0.29	Heavy	0.11	0.09	0.81		0.09	Heavy	0.07	0.29	0.64

Note. F1, first fall after high school; S1, first spring after high school; F2, second fall after high school; S2, second spring after high school; non, nonsmokers; LI, light and intermittent smokers; and heavy, heavy smokers.

^aOverall transition rates are the probabilities of smoking stage membership in S2 conditional on smoking stage membership in 12th grade. They are not the proportion of participants who were non, LI, or heavy smokers throughout the course of the study.

drinkers were progressively more likely to transition from non-smoking to light and intermittent smoking over time. Similarly, infrequent binge drinking was related to stability of heavy smoking and to progressively increasing forward transitions from nonsmoking. For light and intermittent smokers, the effect of infrequent binge drinking was inconsistent.

Discussion

The present study extended previous research on light and intermittent smoking in adulthood by examining within-individual transitions into and out of light and intermittent smoking during an important developmental period from adolescence into emerging adulthood. We found that light and intermittent smoking was the least stable during emerging adulthood compared with nonsmoking and heavy smoking. Youth were equally likely to move from light and intermittent to nonsmoking as to heavy smoking. Further, nonsmokers and heavy smokers who changed their smoking behavior were likely to pass through the light and intermittent stage. Given the age range of this sample, we expected a great deal of fluctuation in smoking, as has been seen for other drug use (Arnett, 2005). The lack of stability in light and intermittent smoking was expected, although non-smoking and heavy smoking were relatively stable. Furthermore, only 3% of the sample were light and intermittent smokers

consistently across the five assessments over 2 years. Those who were light and intermittent smokers in the 12th grade were more likely to end up smoking heavily 2 years later than to have remained light and intermittent smokers. Furthermore, earlier age at onset did not appear to have as large an effect on light and intermittent smoking as on heavy smoking. Thus, our findings suggest that the phenomenon of light and intermittent smoking, which has clearly been identified in adult samples, is not well established in emerging adulthood and that there may be important distinctions between light and intermittent smoking during adolescence and emerging adulthood compared to adulthood. More research is needed to address the question of whether light and intermittent smoking is identifiable and predictable in this age range.

We found that transitions did not differ for men and women. Previous research suggests that women tend to maintain patterns of light and intermittent smoking more often than men (Okuyemi et al., 2002). The difference in our findings might reflect the fact that our sample was followed up only into their early twenties. Reductions in smoking, which often occur for women as they reach the childbearing years (White, Pandina, & Chen, 2002), may not yet have been evident.

In accordance with the previous research, we found that college attendees smoked less than nonattendees during adolescence

Table 4. Odds ratios for effects of infrequent and frequent binge drinking on 12th-grade (baseline) prevalence and transition rates

Odds ratios for effects at baseline				Odds ratios for effects on transitions		
				Non	LI	Heavy
12th-grade stage	Infrequent binge drinking	Non	F1 stage			
			LI	1.38	NA	
			Heavy	0.59		
	Frequent binge drinking	Non	LI	1.08	NA	
			LI	3.06	1.15	
			Heavy	0.02		
F1 stage	Infrequent binge drinking	Non	S1 stage			
			LI	2.73	NA	
			Heavy	1.15		
	Frequent binge drinking	Non	LI	0.51	NA	
			LI	5.78	2.47	
			Heavy	1.43		
S1 stage	Infrequent binge drinking	Non	F2 stage			
			LI	3.00	NA	
			Heavy	1.27		
	Frequent binge drinking	Non	LI	0.98	NA	
			LI	4.11	0.73	
			Heavy	0.29		
F2 stage	Infrequent binge drinking	Non	S2 stage			
			LI	4.16	NA	
			Heavy	1.54		
	Frequent binge drinking	Non	LI	0.75	NA	
			LI	6.20	0.85	
			Heavy	0.34		

Note. F1, first fall after high school; S1, first spring after high school; F2, second fall after high school; S2, second spring after high school; non, nonsmokers; LI, light and intermittent smokers; and heavy, heavy smokers. This analysis included all participants who had no missing data on the five assessments of binge drinking ($n = 705$); dashes indicate the reference stage. NA = odds ratios are not presented for transitions for which fewer than 5% of stage members made the transition.

and emerging adulthood (White et al., 2005). We had expected that youth would increase their smoking once they left high school and were free from social controls on smoking. We found increases during this developmental transition for college students, but not nonstudents, suggesting that the transition out of high school has a greater impact on smoking for the former than the latter group. We also found that college attendees, compared with nonattendees, were less likely to be heavy smokers but were equally likely to be light and intermittent smokers during emerging adulthood. However, college attendees who transitioned out of light and intermittent smoking were more likely to transition to nonsmoking than to heavy smoking, whereas nonattendees were approximately equally likely to transition to nonsmoking as heavy smoking. Therefore, college attendees may mature out of smoking, as has been shown for heavy drinking (White et al., 2005).

As predicted, binge drinkers were more likely to smoke than were non-binge drinkers. In addition, forward movement through the stages of smoking was more likely among binge drinkers, especially frequent binge drinkers, than among non-

binge drinkers. With our data, we cannot tell if the smoking was paired with the binge drinking. However, other research with emerging adults has found that drinking makes smoking more pleasurable (McKee et al., 2004). Observational studies and real-time assessments should be conducted to examine these temporal associations. In addition, smoking interventions for emerging adults also should focus on drinking behavior.

Some limitations of this study should be noted. First, our group of light and intermittent smokers was heterogeneous and included less-than-daily smokers as well as smokers who smoked as many as 5 cigarettes/day. Because there was no measure of frequency of smoking, we do not know how often the former group smoked or how many cigarettes they might smoke on a given occasion. Second, some of the less-than-daily smokers may have been classified incorrectly as nonsmokers if they reported that they smoked zero cigarettes daily. However, additional analyses examining those who reported past year smoking but zero cigarettes in the past month suggest that possible misclassification would affect only a small percentage of the total sample. Third, smoking in the past month may not

reflect smoking behavior for the full year. More refined measurement should be considered in future research. Fourth, we were missing smoking data at F1 for the older cohort. However, additional analyses indicated statistical equivalence of smoking stage prevalence rates and transition rates for the younger and older cohorts at all other waves included in the present study. Fifth, we considered only a few potential predictors; future studies should include others. Finally, the sample came from one suburban community and was predominantly White. Thus, our findings should be replicated in more diverse samples. Despite these limitations, this study was the first to specifically assess light and intermittent smoking during emerging adulthood and to use Markov models to examine short-term transitions in smoking. Overall, the findings suggest that light and intermittent smoking during emerging adulthood may not be the same phenomenon as light and intermittent smoking in adulthood.

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Declaration of Interests

None declared.

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