Published in final edited form as:

J Adolesc Health. 2013 September ; 53(3): 363–367. doi:10.1016/j.jadohealth.2013.04.012.

Longitudinal predictors of stopping smoking in young adulthood

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Abstract

Purpose—This study aims to describe the longitudinal individual and environmental predictors of stopping smoking among a group of young adult smokers.

Methods—From a longitudinal population-based cohort of midwestern youth, semi-annual surveys were analyzed when study participants were between the ages of 18 and 21. Using data from 2001–2008, analyses were restricted to individuals who, at age 18, reported smoking between 1 and 30 days in the previous month ($n=1,022$). Generalized linear mixed modeling was used to analyze demographic, attitudinal, and social-environmental predictors of stopping smoking over time.

Results—After adjusting for smoking frequency at baseline, demographic and attitudinal factors that were associated with stopping smoking over time included increased age and attending college; male gender, smoking frequency and agreeing that cigarettes are calming were significantly associated with continued smoking. Social-environmental factors associated with stopping smoking over time included a household ban on smoking and living in a state with a clean indoor air policy; factors associated with continued smoking included living with a smoker and having close friends who smoke.

Conclusions—Both individual and social-environmental factors can serve as risk and protective factors for stopping smoking between ages 18 and 21. These factors should be used to refine more effective smoking cessation and prevention interventions in young adults.

Introduction

Early adulthood is a time in life when individuals are highly susceptible to social influences on behaviors, including smoking. Although nearly 90% of adult smokers try smoking by age 18 [1], young adults represent the highest risk group for past month smoking, with a

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Declaration of Interests: The authors of this manuscript have no conflicts to declare.

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reported 36% of 18–25 year olds reporting past month cigarette smoking [2]. Motivating this high risk group to quit smoking is essential for both current and future health, as millions of American young people will eventually suffer premature mortality and/or reduced quality of life as a result of smoking-related diseases.

Although quitting smoking by age thirty eliminates most of the excess mortality [3, 4] smoking cessation interventions among youth and young adults have not been highly successful [5, 6]. In a recent review of smoking cessation interventions among young adults (aged 18 to 24 years), only two of 13 interventions reviewed showed any effects beyond 6 months [6]. In the recent meta-analysis on cessation rates for young adults, Suls et al found that any type of cessation intervention remains more effective than the success rates among non-participants [7]. Factors with a robust association with quitting included not having friends who smoke, not having intentions to smoke in the future, resisting peer pressure, older age of initiation, and having negative beliefs about smoking [5]. It was noted that the literature longitudinal predictors of cessation in this age group “is not well developed” [5]. As a result, population-based data on young adult smokers would add valuable information for the development of age-group specific cessation strategies that may be more effective in this challenging population group.

Slightly less than half (48%) of 18 to 24 year old adults are enrolled in college [8]. Yet, most studies have focused on college-based studies of young adults, with few studies conducted with population-based samples. Given that the smoking prevalence among young adults differs substantially between those who attend college, community college or do not attend college [9, 10], population-based samples of young adults will be an important advancement to the current literature, and recommendations have been made to conduct future studies in “diverse young adult populations” outside of formal college or military settings [6].

Attitudes and perceptions of the benefits and disadvantages of smoking are important predictors of smoking behaviors within this age group. The higher functional meaning of tobacco use has been associated with increased smoking over time [11]. Many adolescents and young adults perceive smoking as a means for weight control [12, 13], particularly for female smokers [14]. Concern over potential weight gain after cessation has been demonstrated as a barrier to cessation attempts [15, 16], and may undermine cessation success [17].

In the present study, we focused on describing the predictors of stopping smoking over time among a population-based cohort of young adult smokers. Using data from semi-annual phone surveys regarding smoking behaviors, several factors were evaluated for association with stopping smoking over time between the ages of 18 and 21. We hypothesized that there would be individual and social-environmental factors that significantly differentiate stopping smoking over time among young adults. Factors at the individual and social-environmental levels were investigated as barriers and facilitators to stopping smoking based on these effects in adolescent and adult populations.

Methods

Minnesota Adolescent Community Cohort (MACC) Study Design

This study includes data from the Minnesota Adolescent Community Cohort (MACC) Study. The MACC study is a population-based cohort study that began in 2000. In 2000, 3636 participants between 12 and 16 years of age were recruited from Minnesota, as well as 605 from four other upper Midwest states (North Dakota, South Dakota, Kansas, and Michigan). An additional cohort of 12-year-old participants (n=584) were recruited in 2001, for a total sample of 4,825 participants.

Prior to participant recruitment in Minnesota, the state was divided into 129 areas thought to reflect the local tobacco control environment, from which 60 were randomly selected; areas from the comparison states were purposefully selected based on urbanicity and demographic characteristics of the population. A combination of probability and quota sampling methods (to assure equal age distribution) was then used to recruit participants from Minnesota and comparison states. Recruitment was conducted by telephone by Clearwater Research, Inc., using modified random digit dial (RDD) sampling. Households were called to identify those with at least one teenager between the ages of 12 and 16, and within eligible households, respondents were selected at random from among age quota cells that were still open (response rate: 58.5% of known eligibles). Additional details regarding the study design are published elsewhere [18].

Participants completed a telephone survey every six months that included questions about smoking-related attitudes and behaviors. The interviews lasted 10 to 20 minutes, depending on the smoking status of the participant. Participants received \$15 for completion of each survey. The interview was structured so that spoken responses would not be revealing to anyone overhearing the participant. The University of Minnesota Institutional Review Board approved this study and individual participants (and parents until participants were age 18) actively consented to participate.

The present study includes seven rounds of data collected from all eligible participants when participants were between 18 and 21 years of age; this equates to roughly four years of longitudinal data collected, starting in 2003. MACC study participants who completed three or more interviews between the ages of 18 and 21, and reported smoking at least once in the previous month at age 18 were included in the present study. Although the MACC study began in 2000, reference to the “baseline” throughout this article refers to the first round when participants met age and smoking study inclusion criteria.

Measures

Outcome Variable—For the present study, the outcome of interest has been defined as “stopping smoking”; this label has consciously chosen since the stability of stopping smoking may not be permanent, therefore we have chosen not to use the descriptor of smoking cessation. As described above, 100% of the sample for this study reported past month smoking at the baseline round. Following baseline, current smoking was assessed at each round with the item, “Now thinking about the last 30 days, on how many of those days did you smoke a cigarette, even one or two puffs?” At all rounds after baseline, stopping smoking was defined as those who reported 0 days of past month smoking, and continued smoking was defined as those who reported 1 to 30 days of past month smoking.

Predictor Variables—Predictor variables were selected from demographic, attitudinal, and social-environmental factors that have been associated with smoking behavior within this age group. All predictor variables were treated as time-varying variables which were reported on for every round, except for demographic variables and age of initiation. Self-reported demographic variables measured at the baseline included age (in years), sex, race/ethnicity (white/other), and age of initiation (in years) – defined as age at first whole cigarette.

There were several attitudinal variables related to tobacco addiction, confidence in quitting, and the functional meanings of cigarette smoking. To assess self-reported addiction participants were asked “On a scale from 1 to 5, where 1 is ‘not addicted at all’ and 5 is ‘very addicted’, how addicted are you to cigarettes?” which was dichotomized into somewhat/very addicted (response of 4 or 5) or otherwise (response of 1 to 3). To assess self-reported confidence in quitting, participants were asked, “On a scale from 1 to 5 where

1 is 'not at all sure', and 5 is 'very sure', how sure are you that you can quit smoking totally and for good if you wanted to?" which was dichotomized into somewhat/very sure (response of 4 or 5) or otherwise (response of 1 to 3). Three attitudinal variables pertained to the functional meaning of tobacco – "When a person is feeling down, a cigarette can really make them feel better," "Cigarettes can help people control their weight," and "When someone's angry or nervous, a cigarette can calm them down." Each item included response categories in a five-point Likert-type scale ranging from strongly agree (1) to strongly disagree (5). Higher scores on each variable represent greater perceived utility of tobacco use. Each functional meaning was dichotomized into somewhat/strongly agree (response of 3 to 5) or otherwise (response of 1 or 2).

There were five variables that measured potential influences on smoking behavior from the immediate and distal social environment. Education level was self-reported as attending any type of college during the study period, dichotomized as any college attendance or no college attendance. The number of four closest friends who smoke cigarettes was dichotomized as having no close friends smoke or one or more friends smoke. Family smoking was measured from several survey questions on whether the participant's mother, father, and/or siblings smoke cigarettes (dichotomized as having at least one family member smokes, or no family members smoke). Household smoking ban was measured by two survey items about whether residents and guests are prohibited from smoking inside the participant's home (defined as all residents/guests prohibited from smoking inside home, or residents and/or guests allowed to smoke in home). Living in an areas with a current smoking ban was determined by whether the state of residence had a clean indoor air policy that included a ban on workplace smoking, coded for each round; state of residence was self-reported by the participant at every round, and the clean indoor air policy status was coded for every round based on reports from a public database referencing the date and location of state clean indoor air policies [19].

Data analysis

Descriptive statistics on the study sample were means and percentages, taken at the baseline round (age 18). Bivariate statistical associations were assessed for each of the predictors and the outcome variable of stopping smoking using generalized logistic regression across seven rounds of data. All variables that achieved statistical significance ($p < 0.05$) in the bivariate regression analyses were included in the multilevel logistic regression model, which assumed a binomial distribution and a logit link function. Results are reported as adjusted odds ratios with the corresponding 95% confidence intervals; all analyses were conducted in SAS 9.2 (SAS Institute; Cary, NC).

Results

Baseline characteristics of the cohort participants are shown in Table 1. Slightly less than of the study sample were male (48.6%) and were predominantly white race (88%). More than half (54%) were defined as regular smokers who smoked daily or near daily, 26% smoked at least weekly, and 20% smoked a few times in the past month; the mean number of cigarettes smoked per day was 7.7. The mean age of smoking initiation was 13.8 years. Half had a family member who smoked cigarettes, and nearly all had one close friend who smoked (92%). Less than one third of the study sample was in college at age 18.

Table 2 includes the predictors of stopping smoking over time, organized into demographic, attitudinal, and social-environmental predictors. Bivariate and multivariate adjusted odds ratios are presented, with multivariate results simultaneously modeling all predictors significant in the bivariate model, as well as controlling for the frequency of smoking at baseline. For every year increase in age, there was a 1.85 increase in odds of stopping

smoking ($p<0.05$). Men had significantly 37% lower odds of stopping smoking over time than women (OR: 0.63, CI=0.53–0.75). Attending college was associated with an increased odds of stopping smoking (OR: 1.17, CI=1.03–1.33). For the attitudinal factors, only agreeing that cigarettes are calming was significantly associated with the outcome, with a 43% decreased odds of stopping smoking.

In the social environment, four factors were significantly associated with stopping smoking in the multivariate model. Having a household member who smokes was associated with a 25% decreased odds of stopping smoking over time and having any close friend smoking decreased odds of stopping smoking by 69%. In contrast, smoking bans were associated with increases in stopping smoking. Having a ban on smoking in the home was associated with a 66% increase in the odds of stopping smoking over time and living in an area with a statewide ban on smoking in workplaces was associated with a 44% increase in the odds of stopping smoking ($p<0.05$ for both).

Discussion

In the present study, there were several significant predictors at the individual level that were associated with stopping smoking during young adulthood. From the cessation literature, it is known that individual characteristics remain an important predictor of attempting to quit and maintaining cessation among young adult smokers [20]. Consistent with other studies, age was positively associated with stopping smoking [21], although in the present study, age of initiation was not significantly associated with stopping smoking after adjustment for all other factors in our model. Being female was associated with stopping smoking, but few other studies have found a significant gender difference within this age group [22]; this finding warrants further exploration in other samples of young adults. Consistent with other studies on adolescents and young adults, having a more favorable attitude about the function of smoking was associated with continued smoking [23].

Although college is an environment where social smoking and tobacco experimentation is common [9, 24], a college education is generally considered as a protective factor for smoking among young adults. In the present study, attendance at any college was a predictor of stopping smoking [9]. A promising development for tobacco-free social norms within American colleges is the diffusion of tobacco-free campus policies with over 700 tobacco-free campus policies [25]; these policies will be an important element of a comprehensive strategy for tobacco control within the high-risk environment of college campuses. Support for environmental barriers to smoking on college campuses, including tobacco-free campus policies as recommended by the American College Health Association [26] have the potential to create an environmental barrier to smoking behaviors, which may affect social norms as well as smoking behaviors.

The target population of young adults are uniquely susceptible to both social and environmental influences to use tobacco [1], which makes the homes, workplaces, and social environments where young adults spend time important venues for public health interventions to decrease smoking uptake and support cessation [27]. Consistent with other studies, our results indicate that individuals who have successfully quit smoking are more likely to have a ban on smoking in the home, compared to those without such rules [28]. The role of parental smoking has been demonstrated to be a significant predictor of smoking behavior, and hindrance to smoking cessation, even into young adulthood [29]. As such, parental influences, household members, and close friends all have significant influence on those social and environmental triggers to smoking behavior. Living in an area with a statewide smoking ban for bars and restaurants has been associated with reduced initiation in adolescents [30]. These policies may not only communicate the social norms around

smoking acceptability [31], but they may create additional workplace barriers as young adults make up more than one-third of employees within hospitality settings [32].

Effective cessation strategies for adult populations may be less effective in this population as young adults may be less likely to self-identify as smokers [33]. In a qualitative study of attitudes toward smoking cessation methods, young adults expressed interest in interventions that focused on personal and social identities related to smoking, and were not explicitly focused around smoking cessation [34]. Ling et al. have illustrated that tobacco industry denormalization has been an effective means to protect against smoking uptake and increase quit intentions within this age group [27, 35]. Future research is needed to expand the evidence based on the strategies that are most effective with this challenging target population; as Cengalli et al. noted, interventions will “remain less than optimally effective” until this evidence base is developed [5].

The present study is not without limitations. The MACC study sample represents the racial and ethnic make-up of the Upper Midwestern United States, but may not be generalizable to other regions with greater heterogeneity. The use of past month smoking as a proxy for cessation behaviors does not account for self-report cessation attempts or actions; yet, it can be assumed that stopping smoking is a volitional behavior. Although self-reported smoking status has been demonstrated to have a high degree of validity [36–38], smoking behavior were not validated by biochemical tests, therefore we cannot exclude some amount of overreporting of stopping smoking due to its social acceptability. Although smoking frequency was adjusted for at baseline, the present study does not assess nicotine dependence; while the lack of information on explicit measures of dependence remains a limitation, there is evidence that dependence is particularly important for daily smokers, but not as strongly associated with quitting among nondaily smokers [39]. Further investigation into nondaily smoking patterns and stopping smoking is warranted. The definition of young adults for the present study was restricted to 18 to 21 years of age, which may represent only a subset of young adulthood.

Our results focus on a behavioral definition of stopping smoking over a four year period among a group of regular smokers at age 18, and include several years of follow-up during the critical period of ages 18 to 21. This prospective, multi-level investigation into predictors of stopping smoking provides frequent measures of smoking behavior, which is especially important during this period of time when smoking behaviors may be in transition [40]. Results from the present study contribute to our knowledge of the factors that predict stopping smoking among young adults, and may help to inform efforts to identify successful strategies for permanent cessation for this priority population.

Acknowledgments

Funding: This research was funded by the National Cancer Institute (R01 CA86191; Jean Forster, Principal Investigator) and ClearWay Minnesota (RC-2007-0018; Jean Forster and Debra Bernat, Co-Principal Investigators).

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Implications and Contribution

Results from this population-based, longitudinal study enhance our understanding of the role of individual and social-environmental factors that may promote or serve as a barrier to smoking behaviors. These results can be used to refine smoking cessation interventions targeting this challenging population group.

Table 1

Descriptive characteristics of adolescent smokers at age 18: Minnesota Adolescent Community Cohort (MACC)

Variables	Total (n=1,022)
Mean number of completed surveys	3.8 (range: 3–7)
State of residence	
Minnesota	84.9% (868)
Kansas	7.7% (79)
North Dakota	1.7% (17)
South Dakota	1.3% (13)
Michigan	1.2% (12)
Other	3.2% (33)
Male	48.6% (497)
White race	87.8% (897)
Mean age (SD)	18.3 (0.22)
Mean age in years of first cigarette (SD)	13.8 (2.3)
Smoking frequency at baseline	
Past month smoker	19.8% (202)
Past week smoker	26.2% (268)
Daily or near daily smoker	54.0% (552)
Mean cigarettes per day at baseline (SD)	7.7 (6.9)
Stopped smoking at least once during follow-up	36.2% (270)
Any family smokes	50.9% (436)
Mom smokes	31.5% (245)
Dad smokes	31.3% (212)
Any close friend smokes	92.2% (942)
College status at age 19	
Not in college	39.9% (326)
2-year college	45.3% (370)
4-year college	14.8% (121)
Living in at area with a local clean indoor air policy	0.5% (5)

Table 2

Bivariate and multilevel predictors of stopping smoking between 18 and 21 years: Results from the Minnesota Adolescent Community Cohort (MACC) study

Predictors	Bivariate Odds ratio (CI)	Multivariate adjusted Odds ratio* (CI)
<i>Demographic</i>		
White race	1.00 (0.78 – 1.27)	--
Age (in years)	1.74 (1.62 – 1.86)	1.84 (1.70 – 2.00)
Male gender	0.65 (0.56 – 0.76)	0.64 (0.54 – 0.76)
Age of initiation (in years)	1.18 (1.14 – 1.23)	1.03 (0.99 – 1.07)
Attending any college	1.42 (1.28 – 1.57)	1.29 (1.08 – 1.54)
Smoking frequency at baseline	0.40 (0.37 – 0.44)	0.47 (0.42 – 0.52)
Number of cigarettes smoked per day	0.70 (0.13 – 3.64)	--
<i>Attitudinal</i>		
Self-efficacy in quitting smoking	2.97 (0.62 – 14.30)	--
Agreeing that cigarettes are calming	0.50 (0.43 – 0.58)	0.57 (0.47 – 0.68)
Agreeing that cigarettes are good when you are down	0.57 (0.46 – 0.70)	0.86 (0.68 – 1.09)
Agreeing that cigarettes help control weight	0.85 (0.72 – 1.01)	--
<i>Social-environmental</i>		
Anyone in household smokes	0.44 (0.34 – 0.51)	0.76 (0.64 – 0.92)
Ban on smoking in the home	2.40 (2.02 – 2.86)	1.65 (1.35 – 2.02)
Having any close friends smoke	0.20 (0.17 – 0.25)	0.32 (0.25 – 0.40)
Living in an area with a statewide clean indoor air policy for bars and restaurants	1.82 (1.39 – 2.38)	1.44 (1.06 – 1.94)

Bold indicates $p < 0.05$