



Progression of college-age cigarette samplers: What influences outcome

Susan L. Kenford^{a,*}, David W. Wetter^b, Samuel K. Welsch^{c,d},
Stevens S. Smith^{d,e}, Michael C. Fiore^{d,e}, Timothy B. Baker^{c,d}

^aDepartment of Psychology, Xavier University, 3800 Victory Parkway, Cincinnati, OH 45207-6411, USA

^bAnderson Cancer Center, Department of Behavioral Science, The University of Texas M.D., Houston, USA

^cDepartment of Psychology, University of Wisconsin, Madison, USA

^dCenter for Tobacco Research and Intervention, University of Wisconsin, Madison, USA

^eSection of General Internal Medicine, University of Wisconsin Medical School,
University of Wisconsin, Madison, USA

Abstract

Experimental and occasional cigarette use among college students is widespread. Little is known about what differentiates the occasional college smoker who becomes a regular smoker from the one who does not. Possible risk factors include peer smoking, lifestyle factors, such as lack of exercise, and health/addiction concerns. The current study investigated the progression of smoking in a cohort of 321 low-level/occasional smokers. Over the course of 4 years, 45% of low-level/occasional users had become nonsmokers, 35% became occasional smokers, and 20% became daily smokers. Baseline exercise patterns, addiction beliefs, and smoking pervasiveness were modestly related to distal smoking outcome. The level of baseline smoking was strongly related to smoking outcome. These results support the wisdom of limiting access and exposure to cigarettes among the college population. © 2004 Elsevier Ltd. All rights reserved.

Keywords: College students; Smoking; Peer influence; Lifestyle

1. Introduction

Although cigarette smoking is the leading cause of preventable death and disease (Centers for Disease Control and Prevention [CDC], 2002), experimenting with cigarettes remains

* Corresponding author. Tel.: +1-513-745-3451.

E-mail address: kenford@xavier.xu.edu (S.L. Kenford).

the norm for American culture. Over 75% of college students report having tried cigarettes (CDCP, 1997). This number represents a steady increase through the 1990s, and recent national surveys indicate that 30% of college students have smoked in the past 30 days, and more than half on the majority of these days (CDCP, 1997; Wechsler, Rigotti, Geldhill-Hoyt, & Lee, 1998). While rates have remained static since the 1990s, the college years actually represent a fluid period of cigarette use. Past findings indicate that between 19% and 25% of occasional users transition to regular use, while up to 25% quit (Everett et al., 1999; Wechsler et al., 1998). However, it is not clear what differentiates the normative college-age sampler who goes on to regular smoking from the one who becomes a nonsmoker. The risks for progression in this group are poorly understood and may differ from those identified for younger adolescents.

1.1. Peer influence

Peer influence has consistently been found to be an important factor for both the initiation and progression of adolescent smoking (Derzon & Lipsey, 1999; Mayhew, Flay, & Mott, 2000). Peer influence is exerted through both group norms and individual relationships; independent effects have been found for peer smoking and for having a best friend who smokes (Alexander, Piazza, Mekos, & Valente, 2001). Peer smoking is associated both with late onset (post-high school) smoking (Chassin, Presson, Sherman, & Edwards, 1991) and less cessation success (Cohen et al., 1989). Peer smoking among college students may provide both a model of regular smoking behavior and ready access to cigarettes.

1.2. Lifestyle factors

A recurrent finding is that smoking in the general population is positively related to a constellation of unhealthful behaviors and lifestyle choices. Smokers, as a whole, lead a more sedentary lifestyle, eat more high-fat food, consume more alcohol, and have less knowledge about health-related topics (Castro, Newcomb, McCreary, Baezconde-Garbanati, 1989; Dallongeville, Marecaux, Fruchart, Amouyel, 1998; Laaksonen, Luoto, Helakorpi & Uutela, 2002; Rosal et al., 2001). However, the causal and temporal relations between these factors remain unclear. It may be that investment in a healthy lifestyle precedes decisions about smoking and thereby directly reduces the likelihood of future smoking. Alternately, it could be that quitting a smoking habit leads to investment in a generally healthy lifestyle over time. To date, surprisingly, little is known about the role that lifestyle factors play in the progression of young adult smoking. Most research has been cross-sectional and has identified factors that are associated with current cigarette use. For instance, young adult smokers have been found to engage in a constellation of high-risk and unhealthful behaviors, such as excessive alcohol use (Derzon & Lipsey, 1999), illicit drug use (Schorling, Gutgesell, Klas, Smith, & Ketter, 1994), and poor dietary habits (Balding & Macgregor, 1987). Oleckno and Blacconiere (1990) found that among college students, smokers, former smokers, and never-smokers fell on a continuum from least to most healthful lifestyle.

While it is widely accepted that smokers have less healthy lifestyles than nonsmokers do, it is unclear that a healthy lifestyle plays a protective role against smoking progression among college-age individuals. Additionally, most studies have focused on behavioral manifestations of health investment and have not incorporated cognitive (i.e., concerns about disease; importance of health) or environmental (i.e., living situation) factors.

1.3. Total nicotine exposure

The role that cumulative nicotine exposure plays in the development of regular smoking is well documented. Among adolescents, the risks of becoming a habitual smoker have been directly related to the amount of nicotine sampling. [Choi, Pierce, Gilpin, Farkas, and Berry \(1997\)](#) found that youths who smoked an entire cigarette during experimentation were significantly more likely to be smoking 4 years later compared with youths who limited their exposure to a few puffs. Transition from nonsmoker to smoker tends to be progressive and unidirectional. Once adolescents reach a particular level of smoking, they are not likely to revert to previous levels ([Fergusson & Horwood, 1995](#)). [Chassin, Presson, Sherman, and Edwards \(1990\)](#) found that monthly smoking in adolescence increased the risk of smoking in early adulthood by sixfold. Among adults, higher nicotine self-administration has been repeatedly linked to less cessation success ([Cohen et al., 1989](#)).

1.4. Study purpose

The purpose of this study was to examine the influence of health, lifestyle, and tobacco exposure variables on the long-term smoking outcomes of occasional/low-level college smokers. A longitudinal cohort of college students who reported occasional/low-level cigarette use was followed for a 4-year period. This study is part of a larger project investigating the progression of smoking behavior at all levels (i.e., nonsmoking, occasional, daily smoking; see [Wetter et al., 2004](#)). Our interests in this study were more narrowly defined. Specifically, we were interested in understanding how the social realm and lifestyle/health practices of an occasional/low-level smoker were related to distal smoking behavior. We chose to focus on “occasional/low-level” smokers because this level of smoking may be transitional for this group. In addition, relatively few college student smokers smoke heavily; thus, occasional smokers are highly representative of the college-smoker population ([CDCP 1997; Wechsler et al., 1998](#)). Therefore, participants in this study were either low-level daily smokers (≤ 5) or smoked on a less-than-daily basis. Our hypothesis was that the influence of the social milieu and lifestyle-style choices are at their strongest in fledgling smokers. We were particularly interested in determining if factors such as social milieu and lifestyle choices (e.g., exercise, health concerns) have predictive power beyond initial smoking rate. In other words, is the primary determinant of distal smoking the frequency of baseline smoking or do other lifestyle and social factors exert additional influence?

2. Methods

2.1. *Participants and procedures*

Participants were a subset ($n = 374$) of the sample in [Wetter et al. \(2004\)](#). The full sample comprised 698 Introductory Psychology students at the University of Wisconsin, Madison. Participants provided baseline data in the Spring and Fall semesters of 1990. Follow-up data were obtained approximately 4 years later. From the total sample, we selected baseline occasional smokers and light daily smokers (≤ 5 cig/day) for this project. Of the 374 occasional/light daily smokers surveyed at baseline, 321 (85.5%) provided follow-up data.

2.2. *Baseline measures*

2.2.1. *Smoking status and history*

Mutually exclusive smoking status categories were derived: daily smoking, occasional—every few months, occasional—every few weeks, occasional—every few days, and never (which included former smokers). Daily smokers also indicated smoking rate and years smoking.

2.2.2. *Demographics*

Information on age, sex, socioeconomic status, and race/ethnicity was collected.

2.2.3. *Social milieu smoking*

The extent and approval of smoking in the social realm were assessed with the Smoking and Drinking Dynamics Questionnaire. This was developed for the current study and has two primary components: smoking acceptance and smoking pervasiveness. Smoking acceptance was assessed by how approving (five-point scale) important others (parents, siblings, best friend, partner, other friends, roommate) were of the participant's smoking. Smoking pervasiveness was assessed by the frequency (four-point scale) of the participant's smoking in various situations (i.e., at parties, while alone), in their current living situation (i.e., with roommates, with parents), and the number of their important others who smoke (i.e., relatives, friends, roommates).

2.2.4. *Smoking-risk beliefs and lifestyle*

Smoking-risk beliefs and lifestyle variables were assessed with The Health and Activity Questionnaire. This was designed for the study and used a seven-point Likert-type scale to assess three primary realms: exercise; diet, and perceived smoking risks.

2.3. *Follow-up measure*

2.3.1. *Smoking status*

Mutually exclusive smoking status categories were determined for daily smokers, occasional smokers, and nonsmokers at follow-up. Smoking rate was obtained for daily smokers.

2.4. Data analysis

2.4.1. General strategy

Due to the ordered nature of outcome, ordinal logistic regression was used to model the associations of social milieu smoking, lifestyle choices, and smoking-risk cognitions with both baseline and follow-up smoking statuses (1 = non, 2 = occasional, 3 = regular). The ordinal logistic regression analyses used a cumulative logit model in which the probability of increased smoking at follow-up was modeled. Analyses were conducted using SPSS-11 software. Prediction models were developed and tested using the formal model-building steps outlined by Hosmer and Lemeshow (2000).

2.4.2. Factor scores

Due to the large number of variables, an exploratory factor analysis was conducted to identify summary, latent variables for the regression analyses. A maximum likelihood approach with oblique rotation was utilized. Factor scores were created by averaging the constituent items.

3. Results

3.1. Participants

The sample of 321 study completers had a mean age of 18.5, was predominately white (92.5%), self-identified as “white collar” (46.3%), and female (54%). Considerable movement in smoking status occurred. Table 1 reflects the change patterns over time.

3.2. Factor scores

The exploratory factor analysis yielded four interpretable factors: exercise importance, smoking pervasiveness, peer approval, and family influence. Exercise importance (coefficient $\alpha=.84$) and smoking pervasiveness (coefficient $\alpha=.92$) had good internal consistency; peer approval had acceptable internal consistency (coefficient $\alpha=.69$). Family influence had poor internal consistency (coefficient $\alpha=.48$) and was not retained. No coherent factors were

Table 1
Smoking change over time

Baseline smoking rate	Follow-up smoking frequency ($N=321$)			
	Nonsmoker	Occasional smoker	Daily <5	Daily >5
Every few months	58	30	2	4
Every few weeks	49	30	3	14
Every few days	37	39	5	13
Daily ≤ 5	6	14	6	11

Table 2
Final multivariate prediction of follow-up smoking status

Predictor	Unadjusted analyses			Adjusted analyses ^a		
	β	P	Ψ	β	P	Ψ
Smoking pervasiveness	.539	.004	1.7	.589	.002	1.8
Could quit if addicted	-.158	.028	0.85	-.177	.017	0.84

Ψ = odds ratio.

^a Adjusted for sex, age, ethnicity and SES.

identified for the smoking-risks or diet variables. Theoretical predictors that did not cohere into factor scales were assessed using single items. The final set of variables consisted of the three scales, three items assessing beliefs about smoking risks, two items assessing diet, a variable reflecting the total number of smokers in the family, and a variable reflecting the total number of friends who smoke.

3.3. Regression models

Using the model-building techniques of Hosmer and Lemeshow (2000), a multivariate model was derived. After iterative removal of nonsignificant predictors, the final model included only the smoking pervasiveness scale and the single item “Could quit if addicted.” This model was then retested, controlling for sex, age, ethnicity, and SES. All two-way interactions were tested; none was significant ($P > .20$). The pattern of results remained the same as in the unadjusted model (Table 2).

As a secondary check on model utility, the derived unadjusted model was tested for its ability to predict baseline smoking status. Consistent with the follow-up findings, smoking pervasiveness (Wald $X^2 = 135.11$; O.R. = 14.44, $P < .001$) and “Could quit if addicted” (Wald $X^2 = 13.78$, O.R. = .77, $P < .001$) were highly related to concomitant smoking status.

Finally, the adjusted model was tested, controlling for baseline smoking status. As seen in Table 3, no theoretical predictor remained significant once baseline smoking level was entered.

Table 3
Adjusted § multivariate prediction model with baseline smoking status included

Predictor	β	S.E.	Wald \times^2	P	Ψ
Smoking every few months ^a	-1.70	0.50	11.33	.001	0.18
Smoking every few weeks ^a	-1.32	0.46	8.11	.004	0.27
Smoking every few days ^a	-1.29	0.44	8.49	.004	0.28
Smoking pervasiveness	0.07	0.23	0.10	.751	1.01
Could quit if addicted	-0.09	0.07	1.6	.202	0.91

§, Adjusted for sex, age, SES, and ethnicity.

Ψ = odds ratio.

^a Smoking daily < 5 is referent.

4. Discussion

The current study indicated that the smoking behavior of young adults who smoke at low levels undergoes considerable change during their college years. A majority (44%) had quit 4 years later, 35% were occasional smokers, and 20% were smoking daily. While almost half of our participants had quit during the 4-year study interval, 55% continued to use cigarettes. Those who had been smoking daily at baseline were distributed across the outcome categories, with 54% either quitting or reducing their smoking to less-than-daily, 6% remaining static as a low-level (≤ 5) smoker, and 27% increasing their daily smoking rate. These findings suggest that occasional smoking in young adults neither compels inveterate use nor is it innocuous. Some data suggest that the highly addictive nature of nicotine would cause even moderate use to promote addiction (U.S. Department of Health and Human Services, 1988). However, the current results show that the majority of occasional users had not become daily smokers over the 4-year study interval.

The degree to which smoking was intertwined with daily experience was strongly related to concomitant and future smoking behavior. The occasional smoker who had already transitioned from smoking only at parties, to smoking while at home, alone or while talking quietly with friends, was much more likely to be smoking 4 years later. Consistent with past research (Staton, Currie, Oei, & Silva, 1996), the influence of peers appeared to diminish over time. Among our sample, it was the number of smoking places and not the number of smoking friends that was key. Additionally, unlike with younger adolescents (Distefan, Gilpin, Choi, & Pierce, 1998), the degree of perceived approval by others was unrelated to distal smoking behavior. Smoking was also found to be negatively related to the importance and regularity of exercise. However, this relationship was much weaker than anticipated and disappeared once the effects of smoking pervasiveness were accounted for. Contrary to our expectation, general health and smoking-risk concerns were not related to distal smoking behavior.

An interesting finding in our sample was that while general health and addiction concerns were unrelated to smoking behavior, individuals had an excellent sense of the ease or difficulty with which they could stop smoking. Those who indicated that it would be hard to quit if they felt they were becoming addicted were, in fact, more likely to be smoking 4 years later. It would be very interesting to identify the information that those smokers were using to make their estimate (e.g., after self-control failures, experience of withdrawal, pleasure from smoking, and lack of motivation to quit).

Our most compelling finding is the impact of cumulative nicotine exposure on outcome for those who were still using cigarettes 4 years later. Baseline smoking status completely absorbed all the predictive power of exercise, smoking pervasiveness, and addiction cognitions in determining outcome. The key element to long-term outcome was total nicotine exposure at baseline. There was a direct, linear increase in risk for each level of baseline smoking, a finding highly consistent with the adolescent literature (Choi et al., 1997). This finding suggests that our other predictors of long-term outcome may function, in effect, as proxy variables for smoking amount. In other words, the amount that one exercises may not influence smoking behavior but be determined by it.

Similarly, assortative friendships may be formed based on shared levels of smoking behavior, so that what appears to be the influence of peers on smoking may actually be the influence of smoking on peer selection. It is important to note, however, that without a greater number of assessment epochs, it is difficult to identify with confidence the relations between baseline smoking and other risk factors. For instance, baseline smoking may serve as a “final common pathway” for various risk factors and, therefore, mediate effectively the relations between those risk factors and distal smoking outcomes. Definitive conclusions require additional longitudinal research with multiple assessments.

To the extent that nicotine exposure/use powerfully determines progression of tobacco use, these results support the wisdom of limiting nicotine exposure as much as possible. Campus-wide institutional bans should be implemented and smoke-free residences enforced, as any reduction in tobacco use will likely reduce the risk of smoking progression. As discussed by [Wechsler, Lee, and Rigotti \(2001\)](#), such bans may not prompt cessation among established smokers, but they may serve as a sufficient barrier to those not yet addicted. While primary prevention efforts are key for younger adolescents, secondary efforts are highly appropriate for the college population. Our results suggest that interventions seeking to increase exercise levels or publicizing the risks of smoking will be of minimal use. Rather, efforts should be placed on curtailing access to and use of cigarettes.

Our results also underscore the fact that some individuals who use tobacco with some regularity are quite likely to desist. Almost half of our sample had quit at follow-up, and these quitters came from all baseline smoking levels. Clearly, tobacco use alone does not account for why progression occurs. These data suggest that it is not too late to intervene with college-age occasional smokers; many have the capacity to resist a progression to daily smoking.

There are several limitations to the generalizability of the current study results. First, the ethnicity of our predominantly white sample does not reflect national population norms. Second, we lost approximately 15% of the sample at follow-up. We do not know the reasons behind their attrition, and it is possible that it was related to smoking progression. Third, the current study utilized self-report and did not obtain biochemical confirmation of smoking status. However, there is substantive support for the validity of self-report ([Velicer, Prochaska, Rossi, & Snow, 1992](#))—particularly in nontreatment situations, where there is no implicit “correct” smoking status and no incentive for misrepresentation. Fourth, this study had a narrow scope. We selected a limited realm of predictors that were related to social and health, rather than affective, domains (see [Wetter et al., 2004](#), for an exploration of the role of affective processing in smoking progression), as our purpose was to identify how lifestyle choices and factors affected smoking outcome.

References

- Alexander, C., Piazza, M., Mekos, D., & Valente, T. (2001). Peers, schools and adolescent cigarette smoking. *Journal of Adolescent Health, 29*, 22–30.

- Balding, J. W., & Macgregor, I. D. M. (1987). Health-related behavior and smoking in young adolescents. *Public Health, 101*, 277–282.
- Castro, F. G., Newcomb, C. H., McCreary, C., & Baezconde-Garbanati, L. (1989). Cigarette smokers do more than just smoke cigarettes. *Health Psychology, 8*, 107–29.
- Centers for Disease Control and Prevention. (1997). Youth risk behavior surveillance: National college health risk behavior survey—United States, 1995. *Morbidity and Mortality Weekly Report, 46*, 1–56.
- Centers for Disease Control and Prevention. (2002). Annual smoking-attributable mortality, years of potential life lost, and economic costs—United States, 1995–1999. *Morbidity and Mortality Weekly Report, 51*, 300–303.
- Chassin, L., Presson, C. C., Sherman, S. J., & Edwards, D. A. (1990). The natural history of cigarette smoking: Predicting young adult smoking outcomes from adolescent smoking patterns. *Health Psychology, 9*, 701–716.
- Chassin, L., Presson, C., Sherman, S. J., & Edwards, D. (1991). Four pathways to young adult smoking status: Adolescent social–psychological antecedents in a midwestern community sample. *Health Psychology, 10*, 409–418.
- Choi, W. S., Pierce, J. P., Gilpin, E. A., Farkas, A. J., & Berry, C. C. (1997). Which adolescent experimenters progress to established smoking in the United States? *American Journal of Preventive Medicine, 13*, 385–389.
- Cohen, S., Lichtenstein, E., Prochaska, J. O., Rossi, J. S., Gritz, E. R., Carr, C. R., Orleans, C. T., Schoenbach, V. J., Biener, L., Abrams, D., DiClemente, C., Curry, S., Marlatt, G. A., Cummings, K. M., Emont, S. L., Giovino, G. L., & Ossip-Klein, D. (1989). Debunking myths about self-quitting: Evidence from ten prospective studies of persons who attempt to quit by themselves. *American Psychologist, 44*, 1255–1265.
- Dallongeville, J., Marecaux, N., Fruchart, J. C., & Amouyel, P. (1998). Cigarette smoking is associated with unhealthy patterns of nutrient intake: A meta analysis. *Journal of Nutrition, 128*, 1450–147.
- Derzon, J. H., & Lipsey, M. W. (1999). Predicting tobacco use to age 18: A synthesis of longitudinal research. *Addiction, 94*, 995–1006.
- Distefan, J. M., Gilpin, E. A., Choi, W. S., & Piece, J. P. (1998). Parental influences predict adolescent smoking the United States, 1989–1993. *Journal of Adolescent Health, 22*, 466–474.
- Everett, S. A., Husten, C. G., Kann, L., Warren, C. W., Sharp, D., & Crossett, L. (1999). Smoking initiation and smoking patterns among U.S. college students. *Journal of American College Health, 48*, 55–60.
- Fergusson, D. M., & Horwood, L. J. (1995). Transitions to cigarette smoking during adolescence. *Addictive Behaviors, 20*, 637–642.
- Hosmer, D. W., & Lemeshow, S. (2000). *Applied logistic regression*. (2nd ed.). New York: Wiley.
- Laaksonen, M., Luoto, R., Helakorpi, S., & Uutela, A. (2002). Associations between health-related behaviors: A 7-year follow-up of adults. *Preventive Medicine: An International Journal Devoted to Practice and Theory, 34*, 162–170.
- Mayhew, K. P., Flay, B. R., & Mott, J. A. (2000). Stages in the development of adolescent smoking. *Drug and Alcohol Dependence, 59*, S61–S81 (Suppl.) .
- Oleckno, W. A., & Blacconiere, M. J. (1990). A multiple discriminant analysis of smoking status and health-related attitudes and behaviors. *American Journal of Preventive Medicine, 6*, 323–329.
- Rosal, M. C., Ockene, J. K., Yunsheng, M., Hebert, J. R., Merriam, P. A., Matthews, C. E., & Ockene, I. S. (2001). Behavioral risk factors among members of a health maintenance organization. *Preventive Medicine, 33*, 586–594.
- Schorling, J. B., Gutgesell, M., Klas, P., Smith, D., & Keller, A. (1994). Tobacco, alcohol and other drug use among college students. *Journal of Substance Abuse, 6*, 105–115.
- Stanton, W. R., Currie, G. D., Oei, T. P. S., & Silva, P. A. (1996). A developmental approach to influences on adolescents' smoking and quitting. *Journal of Applied Developmental Psychology, 17*, 307–319.
- US Department of Health and Human Services. (1988). *The health consequences of smoking: Nicotine addiction*. A report of the Surgeon General. USDHHS, Public Health Service, Office on Smoking and Health. DHHS Publication No. (CDC) 88-8406.
- Velicer, W. P., Prochaska, J. O., Rossi, J. S., & Snow, M. G. (1992). Assessing outcome in smoking cessation studies. *Psychological Bulletin, 111*, 23–41.

- Wechsler, H., Lee, J. E., & Rigotti, N. (2001). Cigarette use by college students in smoke-free housing. *American Journal of Preventive Medicine*, 20(3), 202–207.
- Wechsler, H., Rigotti, N., Gledhill-Hoyt, J., & Lee, H. (1998). Increased levels of cigarette use among college students: A cause for national concern. *Journal of the American Medical Association*, 280, 1673–1678.
- Wetter, D. W., Kenford, S. L., Welsch, S. K., Smith, S. S., Fouladi, R. T., Fiore, M. C., & Baker, T. B. (2004). Prevalence and predictors of transitions in smoking behavior among college students. *Health Psychology*, 23, 168–177.