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Characteristics associated with rapid transition to tobacco dependence in youth

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Abstract

Epidemiologic data suggests the smoking trajectory for some adolescents escalates rapidly and that tobacco dependence can develop quickly after initiation. In this study, we examine variation in cigarette consumption and individual characteristics associated with the rapid development of tobacco dependence, focusing particularly on the 24-month interval after tobacco initiation. The analysis is based on public use data files of the National Household Survey on Drug Abuse conducted in 1994–1996. Representative samples of adolescents aged 12–17 years old, totaling 13,831, completed a standardized interview assessing demographic characteristics, tobacco involvement and past year dependence, and psychological functioning over the preceding 6-month period as assessed by the Youth Self-Report. Analyses were restricted to the 1,734 youth who had started smoking within 0–24 months prior to being assessed, of which the onset for 70% of them was between 11–24 months. Logistic regression models took into account sample weights and used a variance estimation procedure appropriate for the complex multistage sampling design. Overall, 210 recent initiators met dependence criteria (13.5%, 95% *CI*=12.0–15.2). Dependent smokers had greater cigarette involvement than youth who had not transitioned to being tobacco dependent by the time of assessment. Variation in mental health and sociodemographic characteristics were also detected. Disruptive behavior (*p=.05*) and being female (*p=.02*) were associated with being tobacco dependent. The rapid transition to dependence in youth depends not only on cigarette consumption features, but may also be associated with individual characteristics.

Introduction

Prior epidemiologic data suggests that some adolescents rapidly begin heavy regular smoking after tobacco initiation (Colder et al., 2001; Stanton, Flay, Colder, & Mehta, 2004). The median length of time for the first expression of problems and dependence due to tobacco use has been estimated to be 12 months (Ridenour, Lanza, Donny, & Clark, 2006). Tobacco dependence and tolerance have been found to emerge earlier among youth with an escalating smoking intensity compared to youth with more stable, non-escalating tobacco usage patterns (Karp, O'Loughlin, Paradis, Hanley, & DiFranza, 2005). An estimated 20% of youth report dependence symptoms within 1 month of initiating monthly smoking (DiFranza et al., 2002).

In addition to the pharmacologic properties of nicotine, the potential to become dependent on tobacco may be associated with individual characteristics. For example, females tend to score higher on several dependence symptoms such as lost autonomy, cravings, and withdrawal, than males smoking similar quantities of cigarettes (O'Loughlin et al., 2003). In addition, females have been found to have shorter transition times (Ridenour et al., 2006). Poor academic performance and having a majority of friends that smoked were strong baseline predictors of

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a class of smokers that had rapid escalating trajectories of involvement with tobacco in a Canadian longitudinal study of secondary school students (Karp et al., 2005).

Insufficient evidence has been accumulated to indicate whether mental health problems are important factors in the rapid emergence of smoking intensity or tobacco dependence. Findings from a longitudinal study of a New Zealand birth cohort suggest that an underlying dimension, rather than any specific mental health condition, is related to a trajectory of escalated use (quantity smoked) and that it may change with age (Stanton et al., 2004). Stanton and colleagues found high depression, attention deficit, and conduct disorder scores predicted rapid escalation, but noted anxiety scores did not vary across different smoking trajectories. Cravings for cigarettes and tobacco dependence may be associated with alcohol dependence and the use of other drugs (Hertling et al., 2005; Stanton et al., 2004), and several biological processes, including cross tolerance and genetic factors, have been proposed as explanations for the high correlation of alcohol and tobacco use (Funk, Marinelli, & Le, 2006).

Ridenour (2006) has proposed that the speed at which smokers progress from initiation to more severe involvement may be a phenotype for the risk of addiction. Knowledge of characteristics and factors associated with rapid transition to tobacco dependence among samples of novice adolescent smokers may help identify a subgroup of youth in need of additional and targeted interventions. The purpose of this study was to explore the relationship between personal and smoking characteristics and the rapid emergence of tobacco dependence among a population-based sample of adolescents who had recently initiated tobacco use.

Method

Sample

Between 1994 and 1996, The National Household Survey on Drug Abuse (NHSDA) annually surveyed independent nationally representative samples of non-institutionalized civilians aged 12 or older using stratified, multi-stage area probability sampling. Household response rates were close to 90%. In each of these years, approximately 4,500 youth were recruited from households chosen as part of the sampling frame. The interviews were conditional on parental or legal guardian permission and participant consent was secured. Details of the research protocols and sampling procedures can be found at the NHSDA website (http://www.oas.samhsa.gov) and in several publications (U.S. Department of Health and Human Services [USDHHS], 1996, 1997, 1998).

Within the aggregated sample of youth aged 12–17 years old (n=13,831), the focus of the current study was aimed at youth who had initiated smoking within 24 months of the assessment (n=1,734) as determined by subtracting the age of first use (even one or two puffs) from the age at assessment. By focusing on new initiates within a constrained time period, the study design attempted to distinguish “length of smoking involvement” from “onset age” influences (Anthony, Chen, & Storr, 2005). The sample of recently initiated cigarette smokers was 50% female, 11% Hispanic, 11% non-Hispanic Black, 78% non-Hispanic non-Black, 26% 12–13 year olds, 40% 14- to 15-year-olds, and 34% 16- to 17-year-olds.

Measures

The NHSDA is a standardized assessment with a structured format of almost exclusively pre-specified and pre-coded response categories with virtually no probing questions. Trained interviewers administered the 1 hour assessment to respondents at their own residence. Self-administered answer sheets were used for the mental health and drug modules.

Smoking—The questionnaire assessed tobacco involvement, including quantity, age of onset and recent use of cigarettes. Moreover, if a youth had smoked cigarettes in the past year they were asked to provide information on DSM-orientated tobacco dependence criteria. The features common across survey years included: (1) Tolerance: "Whether you have built up tolerance for cigarettes so that the same amount of the cigarettes had less effect than before during the past 12 months?", (2) Compulsion: "Whether you have used cigarettes much more often or in larger amounts than you intended to during the past 12 months?", (3) Cut down: "Whether during the past 12 months, you have wanted or tried to stop or cut down on your use of cigarettes but found that you could not?", (4) Salience: "Whether you had a period of a month or more during past 12 months when you spent a great deal of time getting cigarettes, using cigarettes, or getting over their effects?", and (5) Use causing problems: in 1994 "Whether use of cigarettes has caused you to have problems with your family or friends, problems at work, school, or with the police, or any emotional or psychological problems during the past 12 months?" and in 1995 & 1996, "Whether use of cigarettes has caused you to have any emotional or psychological problems such as feeling uninterested in things, feeling depressed, feeling suspicious of people, feeling paranoid, or having strange ideas?" or "Whether use of cigarettes has caused you any health problems such as liver disease, stomach disease, pancreatitis, feet tingling, numbness, memory problems, accidental overdose, a persistent cough, a seizure or fit, hepatitis, or abscesses during the past 12 months?". In 1994, an additional item assessed use in threatening situations ("Often been under the effects or after-effects of cigarettes in situations where your physical safety was threatened during the past 12 months?"), and an additional criterion in 1995 and 1996 assessed reduction in important activities ("Has your smoking often kept you from going to school or engaging in important social activities in the past 12 months?"). Tobacco dependence was approximated via summing the number of clinical criteria endorsed (Kandel, Huang, & Davies, 2001). A youth experiencing three or more criteria within the 12-month period would be likely to have a high probability of meeting criteria for current tobacco dependence. In spite of the slightly different wording and criteria for determining dependence, an investigation found comparability across the survey years (Epstein & Gfroerer, 1996). Additional analyses determining dependence based on having three out of the four similarly worded criteria did not lead to different conclusions.

Mental health—Adolescents rated their psychological functioning over the preceding 6-month period using the Youth Self Report (YSR) developed by Achenbach (1991). Stratifying by gender, the range of scores for two groups of common adolescent problems, emotional and behavior problems, were determined using data from the entire aggregated youth sample. Responses to six items reflecting symptoms of general anxiety disorder and phobia and 12 items reflecting symptoms of major depressive disorder and dysthymia consistent with the Diagnostic and Statistical Manual of Mental Disorders (4th ed.) (*DSM*–IV) (American Psychiatric Association [APA], 1994) Criteria for Depression and Anxiety Disorders, were totaled to provide a score of emotional problems (internal consistency, Cronbach's alpha=0.97) (Achenbach, Dumenci, & Rescorla, 2001; 2003). Another set of 24 items consistent with *DSM*–IV (APA, 1994) diagnostic categories of attention-deficit hyperactivity (5 items), oppositional (five items) and conduct (14 items) problem behaviors were totaled to provide a score of disruptive behavior problems (Cronbach's alpha=0.97). Any recently initiated smoker with an emotional or disruptive behavior score above the 90th percentile (gender matched) was considered as having a problem worthy of clinical attention (Achenbach, 1991). Achenbach and Rescorla (2001) found the reliability and validity of the DSM-orientated scales tap the problem constructs moderately to very well; test-retest reliability ranged between 0.7–0.9 and discriminate analysis achieved a cross-validated accuracy of 69%.

Other drug use—In other drug specific modules, items assessed past year use of alcohol and marijuana. Youth drinking alcoholic beverages in the year prior to assessment were asked the same set of dependence questions as described above for cigarette smoking, but as they related to alcohol use. A youth endorsing three or more criteria was considered alcohol dependent.

Analysis

Survey statistics in Stata 9 (Stata Corporation, 2005) were used to account for the complex sampling design and weights. Weighted analyses provided unbiased (or nearly unbiased) prevalence estimates; 95% confidence intervals were based on variances estimated by Taylor-series linearization. Contingency table analyses and preliminary logistic regression models estimated the unadjusted association between tobacco dependence and individual factors, including the mental health measures, and various cigarette consumption characteristics. Multiple logistic regression models were used to take into account possible confounding by demographic variables and other drug involvement.

Results

Approximately two-thirds (95% *CI*=67%–72%) of the adolescents who recently initiated tobacco use had started smoking between 12–24 months prior to the assessment (*n*=1208), while the other third (95% *CI*=28%–33%) had started within the 12 months prior to being assessed (*n*=526). The majority were infrequent smokers: 72% (95% *CI*=69%–75%) indicated they smoked less than 12 cigarettes in their lifetime and 78% (95% *CI*=76%–81%) had not begun to smoke daily. A third (36%) had smoked in the 30 days preceding the assessment and among them an estimated one out of five usually smoked within an hour of waking up in the morning.

Overall, 210 recent initiators met the criteria for tobacco dependence (13.5%, 95% *CI*=12.0–15.2). As might be expected, adolescents dependent on tobacco had greater cigarette involvement than youth who had not transitioned to being tobacco dependent by the time of assessment (Table 1). The greater the number of cigarettes smoked in their lifetime and any use in the past 30 days increased the odds of finding a positive association with tobacco dependence. Among the youth who smoked at least 12 cigarettes in their lifetime, 36% (95% *CI*=31%–41%) were tobacco dependent, as compared to 6% (95% *CI*=4%–7%) of the infrequent smokers (<12 cigarettes in their lifetime, $p<.001$). Though rare, youth with a very recent onset and a history of smoking only a few days would meet criteria for dependence. Daily smoking was not a requirement as one third of the dependent smokers never smoked daily.

Variation in the association between tobacco dependence and mental health and sociodemographic characteristics were also detected (Table 2). Youth with emotional problems ($p=.01$) or disruptive behavior ($p<.001$) were more likely to be tobacco dependent than their peers without mental health problems in models that did not control for other factors. Youth with problems in both mental health domains were not more likely to be dependent on tobacco than youth with problems in either one. The addition of gender, age, ethnicity, and other drug involvement attenuated the associations. Disruptive behavior problems ($p=.004$), being dependent on alcohol in the past year ($p<.001$), use of marijuana in the past year ($p<.001$), and being female ($p=.007$) continued to have an increased association with being tobacco dependent once other covariates were accounted for.

Additional analyses explored whether the associations with the mental health measures varied by age, as well as by smoking characteristics. No age and mental health interactions were

evident, however the estimated association between disruptive behavior and tobacco dependence was more than twice the magnitude for 12- to 13-year-olds (adjusted *OR*=4.9) as compared to the estimate obtained for 14- to 15-year-olds (adjusted *OR*=1.5) and 16- 17-year-olds (adjusted *OR*=2.1). Furthermore, the estimates were quite similar regardless if the youth was an infrequent smoker (adjusted *OR*=1.5 and 2.3 for emotional and disruptive behavior problems respectively) or a smoker who had consumed a greater quantity of cigarettes (adjusted *OR*=1.3 and 1.8 for emotional and disruptive behavior problems respectively).

Discussion

Tobacco dependence emerges rapidly among a subset of youth, and while the association becomes stronger as the number of cigarettes smoked increases, dependence can emerge among youth smoking very few cigarettes. A higher proportion of females than males developed tobacco dependence within several months after initiation. A disruptive behavior problem score above the 90th percentile of gender matched peers was associated with a rapid transition to tobacco dependence. Emotional problems were not over-represented among the youth who were dependent as compared to those who had not developed tobacco dependence. Youth using other drugs were also more likely to be among those found to have transitioned rapidly to tobacco dependence.

Our findings support the identification of a subset of youth that escalate into dependence within a relatively short time span after initiating tobacco smoking (DiFranza et al., 2000; O'Loughlin et al., 2003; Storr, Zhou, Liang, & Anthony, 2004) and indicate there may be different factors related to the rapid emergence of dependence (Karp et al., 2005; Stanton et al., 2004). Longitudinal trajectories of young novice smokers have distinguished classes of smokers with rapid increases in smoking intensity (Colder et al., 2001; Karp et al., 2005; Stanton et al., 2004) and increases in smoking frequency have been associated with tobacco dependence in adolescents (O'Loughlin et al., 2003). Yet very few of the longitudinal trajectory studies include tobacco dependence predictions shortly after onset of use. Tobacco dependence was found to be common among youth with escalating smoking trajectories (79% for slow to moderate and 95% for rapid escalation) as compared to only 12% with slow rates of consumption acceleration in a sample of students followed for a mean of 24 months after smoking onset (Karp et al., 2005). Stanton and colleagues (2004) found behavior problems and depression predicted rapid escalation in their cohort sample, which was 96% White. This study found that the association between mental health problems and the quick onset of tobacco dependence was independent of age of smoking onset within a fairly wide age range of 12–17 years (e.g., different birth cohorts) and that this association extended to samples of adolescents with a wider ethnic representation. The findings that gender and other drug use were associated with rapid dependence also concur with previous longitudinal findings reported by Ridenour and colleagues (2006).

This report sheds light on a population subgroup of novice adolescent smokers who are in greater need of both drug (smoking and alcohol) and mental health interventions. However, longitudinal studies are needed to untangle the associations between tobacco dependence and psychopathology to determine whether behaviors and emotions are consequences or influences on the rapid transition to tobacco dependence. Unfortunately a limitation of this study is that the temporal sequencing of events cannot be determined within the NHSDA data. The study sample focused on novice smokers who initiated within a 2-year period by "looking backwards" to classify recent onset users. There is potential for misclassification based on the self-report of ever smoking and age of onset. For example, experimenters or sporadic smokers may differentially acknowledge ever smoking a cigarette, or smokers might incorrectly recall their age of onset, even over the very recent time period focused on in this study. Forward telescoping or reported ages of age related smoking events (i.e., age of onset) have been found

to become closer to the assessment date as a function of age (Johnson & Schultz, 2005). Other study limitations include threats of insufficient power despite aggregating across three national probability samples of youth, and being limited to variables available (e.g., no parental or peer smoking information). Tobacco consumption and dependence questions were based on adult nosology and may not be appropriate for the sporadic and low consumption patterns common among young novice smokers (Nichter, Nichter, Thompson, Shiffman, & Moscicki, 2002; Piper, McCarthy, & Baker, 2006) and may not be congruent with clinical diagnoses.

In conclusion, the findings describe smoking and personal characteristics of adolescents who became dependent on tobacco within months after their onset of smoking. A greater understanding of the scope of factors that are involved with the various stages of adolescent tobacco involvement is needed. We have begun to realize that factors predicting or linked with escalating smoking frequency are often different from the ones related to smoking initiation. Further study using prospective data is needed to assess subgroup differences among novice smokers and the speed of developing tobacco dependence.

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Table 1

Smoking characteristics associated with rapid progression to tobacco dependence among recently initiated cigarette smokers

	Non-dependent		Tobacco dependent			
	n	%[a]	*n*	%[a] (95% *CI*)	Unadjusted odds ratio	Adjusted[b] odds ratio
Months since onset						
0–11 months	479	91.4	47	8.6 (6.1–12.2)	1.0	1.0
12–24 months	1045	84.4	163	15.6 (13.0–18.7)	2.0 (1.3, 3.0)	1.8 (1.1, 3.0)
Ever smoke daily						
No	1290	93.8	75	6.2 (4.8–8.1)	1.0	1.0
Yes	227	58.9	134	41.1 (34.5–48.0)	10.5 (7.2, 15.3)	11.4 (7.5, 17.5)
Missing	7	91.1	1	8.8 (1.1–45.4)		
Number of days smoked in life						
1–2 days	904	97.1	25	2.9 (1.8–4.8)	1.0	1.0
3–11 days	293	87.3	43	12.7 (9.0–7.6)	4.8 (2.6, 9.1)	4.5 (2.3, 8.6)
12–100 days	158	67.7	67	32.3 (25.3–40.1)	15.8 (8.7, 28.9)	13.2 (7.1, 24.5)
⩾101 days	142	59.9	73	40.0 (32.9–47.6)	22.1 (11.8, 41.5)	26.9 (14.7, 49.2)
Missing	27	96.4	2	3.6 (0.7–16.7)		
Number of days used in past 30 days						
0 days	847	96.4	29	3.6 (2.4–5.4)	1.0	1.0
1–2 days	250	90.6	25	9.4 (5.5–5.7)	2.8 (1.3, 5.9)	2.3 (1.0, 5.3)
3–7 days	88	71.2	37	28.8 (18.9–41.4)	10.9 (5.5, 21.6)	10.2 (4.9, 21.4)
8–14 days	38	57.9	18	42.1 (29.2–56.1)	19.6 (9.1, 42.0)	16.2 (6.7, 39.1)
22–31 days	91	52.3	64	47.7 (38.5–57.1)	24.6 (14.1, 42.9)	23.6 (13.5, 41.2)
Not applicable	210	82.8	62	17.2 (12.5–23.2)		
Time until first smoke upon waking (past 30 days)						
⩾1 hours	347	76.6	102	23.4 (19.0–28.4)	1.0	1.0
31–60 minutes	18	35.1	24	64.9 (45.8–80.2)	6.0 (2.7, 13.7)	6.5 (2.8, 15.0)
6–30 minutes	30	49.2	19	50.8 (35.1–66.3)	3.4 (1.6, 7.3)	3.0 (1.2, 7.6)
≤5 minutes	39	65.1	14	34.9 (19.0–54.9)	1.8 (0.7, 4.3)	1.8 (0.7, 5.0)
Not applicable	1090	95.1	51	4.9 (3.5–6.7)		

[a] *Note*. Weighted prevalence.

[b] Models included covariates for demographic characteristics (age, gender, ethnicity), past year marijuana use and alcohol dependence.

Table 2

Individual characteristics associated with rapid progression to tobacco dependence among recently initiated cigarette smokers

	Non-dependent		Tobacco dependent			
	n	%[a]	*n*	%[a] (95% *CI*)	Unadjusted odds ratio	Adjusted[b] odds ratio
Gender						
Female	760	83.7	112	16.3 (13.3–9.8)	1.0	1.0
Male	764	89.2	98	10.8 (8.4–3.8)	0.6 (0.4, 0.9)	0.6 (0.4, 0.9)
Age group						
12–13 years old	361	89.5	36	10.5 (7.4–14.7)	1.0	1.0
14–15 years old	611	84.7	92	15.2 (11.9–19.5)	1.5 (0.9, 2.6)	1.1 (0.6, 1.9)
16–17 years old	232	86.3	82	13.7 (10.5–17.7)	1.4 (0.9, 2.1)	1.0 (0.6, 1.6)
Ethnicity						
Hispanic	371	87.3	47	12.7 (8.6–19.3)	1.0	1.0
Black, non-Hispanic	314	91.2	28	8.8 (5.7–13.2)	0.7 (0.3, 1.3)	0.8 (0.4, 1.6)
Non-Black, non-Hispanic	839	85.7	135	14.3 (11.8–17.2)	1.1 (0.7, 1.9)	1.4 (0.8, 2.4)
Anxiety and depression problems[c]						
No	1301	87.7	159	12.3 (10.5–14.4)	1.0	1.0
Yes	197	79.6	46	20.4 (15.0–27.0)	1.8 (1.2, 2.8)	1.2 (0.6, 2.4)
Disruptive behavior problems[c]						
No	1259	89.3	133	10.7 (8.9–12.8)	1.0	1.0
Yes	228	73.4	71	26.6 (21.0–33.0)	3.0 (2.0, 4.5)	2.2 (1.3, 3.6)
Dependent on alcohol in past year						
No	1452	90.7	129	9.3 (7.7–11.4)	1.0	1.0
Yes	72	44.0	81	56.0 (45.6–65.0)	12.4 (7.9, 19.3)	8.2 (4.7, 14.4)
Marijuana use in past year						
No	1177	91.0	106	9.0 (7.5–10.8)	1.0	1.0
Yes	347	71.6	104	28.4 (23.3–34.2)	4.0 (2.7, 5.8)	2.9 (2.0, 4.4)

[a] *Note*. Weighted prevalence.

[b] Adjusted for duration of use and other covariates in table.

[c] Score ⩾90th percentile of gender-specific general population range.