

Cigarette Smoking Initiation among Substance Abuse Treatment Population: How applicable is the Gateway Hypothesis?

Keywords: Smoking initiation; Smoking progression; Substance abuse; Treatment; Gateway hypothesis

Abstract

Background: Cigarette smoking has been considered a gateway to subsequent, and often, co-occurring usage of other licit or illicit substances in the general population. However, significant deviations from this typical pattern of progression have been observed among substance abusers. Moreover, progression patterns may differ by demographics and substance abuse-related risk factors.

Objectives: This research examines the patterns of cigarette smoking initiation among substance abusers; and explores the correlates of cigarette smoking with demographic and other substance abuse-related factors with different patterns of cigarette smoking initiation in the substance abuse treatment population.

Methods: The sample was comprised of 1,179 substance abuse clients, who received publicly-funded treatment in Tennessee. Data were collected from the clients at intake and six-months post intake.


Results: A significant proportion of clients reported cigarette smoking (82%). Only 34% clients reported typical progression patterns (i.e. cigarette as a gateway substance). Others reported deviations in smoking progression patterns with 48% atypical progression - cigarette smoking initiated post substance use, and 18% reporting as never-smokers. African Americans and college-educated participants were more likely to be atypical progressors or never-smokers. Marijuana users were more likely to be atypical progressors. Also, those who initiated licit or illicit drug use at an earlier age were more likely to be either atypical progressors or never-smokers.

Conclusions: While the Gateway Hypothesis (GH) still holds for about a third of this population, these results suggest that it is insufficient in explaining cigarette smoking initiation among problematic substance users. In addition, the high prevalence of cigarette smoking in this population suggests the need for tobacco cessation efforts, alongside substance abuse treatment. In addition, the development of tailored preventative programs for those at greatest risk is needed to ward off gateway substances preceding problematic illicit drug abuse.

Introduction

The Gateway Hypothesis (GH) has dominated the debate on the progression of substance abuse in the literature [1]. This framework delineates the progression pattern from the use of one or more licit substances to the subsequent use of other licit or illicit substances [2]. Originally, and still at times, tobacco and alcohol are held as the licit gateway substances that precede marijuana, which in turn, lead to the subsequent use of other illicit drugs [2,3]. Some studies have provided

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evidence in support of GH confirming that these gateway substances predict subsequent, illicit drug use [3-7]. However, deviations in substance use progression patterns have been reported and reflect confounding variables such as gender, ethnicity, age, education level, employment status, and mental disorders, be associated with varying substance abuse progression patterns [8-13]. Mackesy-Amiti et al. reported deviations or atypical progression patterns among persons from disadvantaged backgrounds i.e., those with less than a high school education, living in a shelter, unemployed, and whose drug use began at a younger age [11]. These deviations in substance abuse progression patterns by individual and environmental factors point to obvious limitations of the GH framework. The foremost limitations are grounded in the central features of the GH: sequence, association, and causation [14]. The *sequence* paradigm asserts that the onset of a gateway substance antedates the initiation of other, harder drugs, and this existent *association* in substance use increases the risk of not only using these harder drugs, but also of developing problematic substance use. Indeed, sequence and association indicate that substance use initiation and subsequent developmental stages are progressive and hierarchical, which inherently implies a *causality* constituent [2]. Contrary to GH assertions, deviations have been reported. For instance, the lack of, or postponement in, the initiation of a gateway substance, such as tobacco, has not been found to decrease the likelihood of subsequent illicit drug use [15].

Tobacco is still an important addictive substance, regardless of whether or not it is a gateway drug. Two systematic reviews of 94 published papers revealed that the majority of substance abusers being treated for drug abuse also reported cigarette smoking [16,17]. As reported for any given year in both studies (either between 1987 and 2009 or between 1987 and 2013), the prevalence of cigarette

smoking among the substance abuse treatment population exceeded 80%, which greatly surpassed the prevalence observed in the general population [17,18]. Moreover, smoking cessation efforts, alongside substance abuse treatment programs, have become an emergent topic of interest [19]. The increased concern and desire to quit smoking has been documented among substance abuse treatment clients [20,21]. Therefore, studying tobacco among substance abusers is warranted and underscored by the increased likelihood of people dying from smoking-related complications compared to other causes [22-24].

Clearly, more research is needed to identify patterns of cigarette smoking initiation among substance abusers. Understanding the correlates of cigarette smoking patterns with demographic characteristics and other risk factors may reveal opportunities for targeted smoking cessation interventions along with substance abuse treatment. For instance, using a gateway substance before initiating illicit substance use is less prevalent among Asian (12.5%), Hispanic (21.9%), and African Americans (23.3%) substance abusers compared to non-Hispanic white substance abusers (29.5%), which may create a potential opportunity for targeted interventions for certain ethnic groups [25]. This study examined (1) the patterns of cigarette smoking initiation among substance abuse treatment clients, and (2) the correlates of cigarette smoking with demographic and other substance abuse-related factors with different patterns of cigarette smoking initiation in this population.

Research Methodology

Design and study participants

The study employed a cross-sectional survey design among substance abuse clients six months after their admissions to a publicly-funded treatment facility in Tennessee. This study was part of a Substance Abuse and Mental Health Services Administrator (SAMHSA) funded outcomes research which was administered through the Tennessee Department of Mental Health. The participants in the study were 13 years of age or older, resided in Tennessee, and received substance abuse treatment between July and December in 2004 in any of the 110 treatment facilities located throughout the state. Also, since the publicly-funded program primarily supported indigent clients, all participants were below the poverty line, which in 2004 was \$18,850 for a family of four, as specified by the Poverty Guidelines of the United States Department of Health and Human Services (HHS). Written informed consent to participate in the follow-up interview was collected from adult clients or legal guardians/parents of children younger than 18 years. The University of Memphis Institutional Review Board approved the study and consent forms.

To examine the patterns of cigarette smoking initiation among the substance abuse clients, following Mackesy-Amity et al. study participants were divided into three categories: *Typical progressors* – those who used cigarettes/alcohol, followed by illicit drugs; *atypical progressors* – those who used illicit drugs prior to cigarette/alcohol followed by substance use, and *never-smokers* [11].

Procedures

While the intake data were collected at the time of admission by the facility staff, the six-month follow-up data were collected via telephone by trained interviewers at the University of Memphis

Institute for Substance Abuse Research and Evaluation (I-SARE) between January and June 2005. The interviewers attempted to contact those who provided informed consent to participate in the study. However, clients who either refused to participate, provided no telephone number, listed wrong telephone numbers, or were institutionalized (e.g., in prison, state custody, a hospital, shelter, or group home), still in treatment, or deceased at the time of six-month follow-up were excluded from the study. Interviewers made no fewer than seven attempts (three during the day, three during the evening, and one over the weekend) to contact clients for optimal participation.

Measures

Demographic data (i.e., gender, ethnicity, age, education level, employment status, income, marital status, living arrangement, dependents, and residential location) were compiled from the follow-up data. Substance abuse data were collected both at intake and at six-month follow-up using a questionnaire based on the Addiction Severity Index (ASI) [26,27], which included questions about age of onset of substances abused—namely, alcohol, cocaine (powder and “crack” cocaine), marijuana, opiates/narcotics (e.g., heroin, morphine, methadone, and Demerol), sedatives/hypnotics (e.g., benzodiazepines and barbiturates), stimulants/amphetamines (e.g., methamphetamine and Dexedrine), hallucinogens (e.g., LSD), and other (e.g., “club drugs,” such as Ecstasy, inhalants, and PCP). Whether the client received treatment for only substance abuse or for substance abuse along with a concurrent mental health condition was extracted from intake data. Questions related to family history of substance abuse were also collected at intake and six-month follow-up. Smoking history and behavior information were collected using a 14-item questionnaire developed by smoking cessation experts at the University of Memphis [28].

Data analysis

Descriptive statistics were reported as percentages or means with standard deviations. Comparisons between the three categories were made using ANOVA or chi-square tests, as appropriate. Unadjusted odds ratios (ORs) were calculated using logistic regression analysis; adjusted ORs were determined via multivariate logistic analyses. Separate models were used to compare atypical vs. typical progressors and never-smokers vs. typical progressors. The model included demographics (gender, ethnicity, educational level, and residential location), substance use variables (age of onset, number and type of substances used, whether treated for substance abuse and/or co-occurring mental health issues), and family history of substance abuse as independent variables. To assess the role of substance abuse behavior, a 3-level dummy-coded summary variable was created for number and types of substances used at time of admission (alcohol use only, a single illicit drug only, and multiple substances). The dependent variable was self-reported history of cigarette smoking initiation: typical, atypical, and never-smokers.

Results

Socio-demographics and patterns of onset of cigarette smoking

Of 1,179 participants in this study, about 68% were male and 76% were non-Hispanic white. The mean age of participants entering treatment was approximately 34 years old. Twenty percent

of participants had a college degree, while 69% had only a high school education or less. Nearly half (48%) of participants reported earning less than \$2,000 the prior year. More than half of participants reported living in a rural area (56%). Also, most reported having no

dependents (61%) and almost half being single and never married (48%). Thirty four percent of participants reported being typical progressors, 48% atypical progressors, and 18% were never-smokers (see Table 1). As for age of onset of cigarette smoking and substance

Table 1: Socio-demographics and other factors by patterns of cigarette smoking (n=1,179).

	Total Sample N=1,179 (100%)	Typical Progressors n= 402 (34.1%) n (%)	Atypical Progressors n= 564 (47.8%) n (%)	Never Smokers n= 213 (18.1%) n (%)
Client Characteristics				
Socio-demographics				
Gender ^b				
Female	384 (32.6)	153 (38.1)	174 (30.8)	57 (26.8)
Male	795 (67.4)	249 (61.9)	390 (69.1)	156 (73.2)
Ethnicity ^c				
African American	278 (23.6)	76 (18.9)	130 (23.1)	72 (33.8)
Caucasian	901 (76.4)	326 (81.1)	434 (76.9)	141 (66.2)
Age ^e (years)	33.97 (10.5 SD)	34.22 (10.2 SD)	33.73 (10.3 SD)	34.03 (11.7SD)
Residential location ^a				
Urban	514 (43.6)	165 (41.0)	233 (41.3)	116 (54.5)
Rural	665 (56.4)	237 (59.0)	331 (58.7)	97 (45.5)
Education ^{a,1}				
Middle/High School	813 (69.0)	291 (72.4)	395 (70.0)	127 (59.6)
College	238 (20.2)	68 (16.9)	115 (20.4)	55 (25.8)
Current employment status ^{e,2}				
Full	230 (19.5)	76 (18.9)	102 (18.1)	52 (24.4)
Other	930 (78.9)	317 (78.9)	454 (80.5)	159 (74.6)
Past year income ^e				
<\$2,000	570 (48.4)	209 (52.0)	265 (47)	96 (45.1)
\$2,000- \$8,500	243 (20.6)	81 (20.2)	124 (22)	38 (17.8)
\$8,500 -\$15,000	149 (12.6)	44 (11.0)	75 (13.3)	30 (14.1)
\$15,000- \$25,000	148 (12.6)	52 (12.9)	68 (12.1)	28 (13.2)
>\$25,000	69 (5.9)	16 (4.0)	32 (5.7)	21 (9.9)
Marital status ^d				
Married	155 (13.2)	45 (11.2)	77 (13.7)	33 (15.5)
Single never been married	562 (47.7)	182 (45.3)	268 (47.5)	112 (52.6)
Divorced/Separated	462 (39.2)	175 (43.5)	219 (38.8)	68 (31.9)
Current living arrangement ^{c,3}				
Living Alone	276 (23.4)	96 (23.9)	146 (25.9)	34 (16)
Living with Others	881 (74.7)	299 (74.4)	405 (71.8)	177 (83.1)
Total no. of dependents ^{d,4}				
None	723 (61.3)	232 (57.7)	345 (61.2)	146 (68.5)
1-2	336 (28.5)	127 (31.6)	165 (29.3)	44 (20.7)
3-5	119 (10.1)	43 (10.7)	54 (9.6)	22 (10.3)
Smoking History				
Age of onset of cigarette smoking				
6-12	200 (20.7)	138 (34.3)	62 (11.0)	---
13-18	614 (63.6)	244 (60.7)	370 (65.6)	---

Table 1 continues

19 +	152 (15.7)	20 (5.0)	132 (23.4)	---
Substance abuse-related factors				
Age of onset of substance use				
6-12	205 (17.4)	30 (7.5)	148 (26.3)	27 (12.7)
13-18	616 (52.3)	166 (41.3)	336 (59.5)	114 (53.5)
19+	358 (30.4)	206 (51.2)	80 (14.2)	72 (33.8)
Number of substances used at intake ^a				
Alcohol only	259 (22.0)	67 (16.7)	136 (24.1)	56 (26.3)
Single illicit drug only	262 (22.2)	141 (35.1)	60 (10.6)	61 (28.6)
Multiple substances used	658 (55.8)	194 (48.3)	368 (65.3)	96 (45.1)
Drug use reported at intake ^f				
Alcohol ^c	724 (61.4)	186 (46.3)	411 (72.9)	127 (59.6)
Cocaine ^a	491 (41.7)	181 (45.0)	236 (41.8)	74 (34.7)
Marijuana ^c	447 (37.9)	101 (25.1)	271 (48.1)	75 (35.2)
Opiates/ narcotics ^c	243 (20.6)	109 (27.1)	102 (18.1)	32 (15.0)
Sedatives/hypnotics ^e	129 (10.9)	53 (13.2)	58 (10.3)	18 (8.5)
Stimulants/ amphetamines ^b	119 (10.1)	54 (13.4)	54 (9.6)	11 (5.2)
Hallucinogens/other drugs ^a	45 (3.8)	7 (1.7)	27 (4.8)	11 (5.2)
Primary Treatment ^{e,5}				
Substance abuse only	1057 (89.7)	362 (90.0)	505 (89.5)	190 (89.2)
Substance abuse and mental health	114 (9.7)	37 (9.2)	54 (9.6)	23 (10.8)
Family History of Substance Use ^f				
Parents abused substances ^e	519 (44.0)	181 (45.0)	255 (45.2)	83 (39.0)
Sibling abused substances ^e	382 (32.4)	134 (33.3)	183 (32.5)	65 (30.5)
Other relative abused substances ^e	440 (37.2)	157 (39.1)	207 (36.7)	76 (35.7)

^ap<0.05; ^bp<0.01; ^cp<0.001; ^dp<0.10; ^eNot significant; ^fMultiple responses. Missing Values: ¹=128, ²=19, ³=22, ⁴=1, ⁵=8

use, roughly 64% and 52% reported their initiation between 13 and 18 years old, respectively. At intake, 56% of participants used multiple substances, rather than alcohol only (22%) or a single illicit drug (22%). The most commonly reported substance used at intake was alcohol, followed by cocaine, marijuana, opiates/narcotics, sedatives/hypnotics, stimulants/ amphetamines, and then, hallucinogens/other drugs. Most participants were only being treated for substance use (90%), and rest for a co-occurring substance use and mental health condition. Participants reported a history of substance abuse among their parents (44%), siblings (32%), and/or some other relative (37%).

Most of the socio-demographic and substance abuse-related trends remained consistent across patterns of cigarette smoking initiation, except for their reported residence and drug use at intake. The majority of typical and atypical progressors lived in rural areas, whereas most never-smokers resided in urban areas (see Table 1).

Atypical progressors vs. typical progressors

Several findings were revealed in the adjusted model (see Table 2). As opposed to unadjusted model, in adjusted model gender, age of onset (i.e., 13 to 17 years age range vs. greater than 18 years), alcohol, opiates, and “other” drugs were no longer significant between atypical and typical progressors. Age of onset (i.e., less than 12 years old vs.

greater than 18 years), number of substances used at admission (i.e., single illicit substance vs. alcohol only), and marijuana used at admission remained significant, while ethnicity, education, and the number of substances used at admission (i.e., multiple illicit substances vs. alcohol only) became significant in the adjusted model. In other words, ethnicity and education were the only significant demographic variables, and age of onset of substance use, the number/type of drug use reported at admission, and marijuana use reported at admission were the significant substance-related variables. African Americans were more likely to be atypical progressors (OR=1.85; 95% CI=1.19-2.89, p<0.01). Participants with a high school degree or less were more likely to be typical progressors (OR=0.61; 95% CI=0.4-0.91, p< 0.05), compared to college-educated participants. Similar to the unadjusted model, participants who began using substances before 12 years of age were 8.77 times more likely to be an atypical progressor. Concerning the number of substances used at admission, participants who reported using either one illicit substance or multiple substances, rather than alcohol only, were more likely to be typical progressors, (OR=0.24; 95% CI=0.12-0.46, p<0.001) and (OR=0.50; 95% CI=0.27-0.93, p<0.05), respectively. Regarding the type of substance use at admission, marijuana users were more likely to be atypical progressors (OR=2.36; 95% CI= 1.55-3.58, p< 0.001).

Table 2: Multivariate analysis.

	Atypical vs. Typical Progressors		Never-smokers vs. Typical Progressors	
	Unadjusted OR (CI)	Adjusted OR (CI)	Unadjusted OR (CI)	Adjusted OR (CI)
Demographics				
Gender				
Male vs. Female (ref)	1.38 (1.08, 1.80) ^a	1.06 (0.77, 1.47)	1.72 (1.19, 2.49) ^b	1.34 (0.89, 2.02)
Ethnicity				
African American vs. Caucasian (ref)	1.29 (0.94, 1.77)	1.85 (1.19, 2.89) ^b	2.19 (1.50, 3.20) ^c	2.18 (1.32, 3.60) ^b
Education				
Middle/High School vs. College (ref)	0.80 (0.57, 1.12)	0.61(0.41, 0.91) ^a	0.54 (0.36, 0.82) ^b	0.45 (0.28, 0.71) ^c
Unknown vs. College (ref)	0.74 (0.45, 1.23)	0.62 (0.35, 1.11)	0.89 (0.50, 1.60)	0.77 (0.41, 1.46)
Residential Location				
Urban vs. Rural (ref)	1.01 (0.78, 1.31)	0.97 (0.69, 1.35)	0.58 (0.42, 0.81) ^b	1.38 (0.92, 2.09)
Substance abuse-related Factors:				
Age of onset of substance use				
6 – 12 vs. >18 yrs (ref)	12.70 (7.94, 20.32) ^c	8.77(0.51, 14.98) ^c	2.57 (1.43, 4.62) ^b	2.27 (1.13, 4.52) ^a
13 – 17 vs. >18 yrs (ref)	5.21 (3.79, 7.17) ^c	3.41 (2.34, 4.98)	1.96 (1.37, 2.81) ^b	1.77 (1.15, 2.72) ^b
Number of substances used at admission				
Single illicit drug only vs. Alcohol only (ref)	0.21 (0.14, 0.32) ^c	0.24 (0.12, 0.46) ^c	0.52 (0.33, 0.82) ^b	0.80 (0.35, 1.81)
Multiple substances vs. Alcohol only (ref)	0.94 (0.67, 1.31)	0.50 (0.27, 0.93) ^a	0.59 (0.39,0.91) ^a	0.78 (0.34, 1.80)
Drug use reported at admission (No ref)				
Alcohol	0.31 (2.38, 4.09) ^c	1.36 (0.84, 2.20)	1.72 (1.23, 2.40) ^b	1.12 (0.57, 2.23)
Cocaine	0.88 (0.68, 1.14)	1.03 (0.67, 1.58)	0.65 (0.46, 0.92) ^a	0.52 (0.29, 0.94) ^a
Marijuana	2.76 (2.08, 2.65) ^c	2.36 (1.55, 3.58) ^c	1.62 (1.13, 2.32) ^b	1.51 (0.86, 2.65)
Opiates/ narcotics	0.59 (0.44, 0.81) ^c	1.05 (0.66, 1.66)	0.48 (0.31, 0.74) ^b	0.72 (0.37, 1.40)
Sedatives/hypnotics	0.76 (0.51, 1.12)	0.74 (0.45, 1.23)	0.61 (0.35,1.07)	0.86 (0.42, 1.78)
Stimulants/ amphetamines	0.68 (0.46, 1.02)	0.88 (0.51, 1.53)	0.35 (0.18, 0.69) ^b	0.49 (0.22, 1.08)
Hallucinogens	2.15 (0.43, 10.69)	1.36 (0.23, 8.09)	0.64 (0.27, 13.55)	2.21 (0.36, 18.64)
Other	2.84 (1.22, 6.58) ^a	3.43 (1.29, 9.15)	3.07 (1.17, 8.04) ^a	2.77 (0.90, 8.46) ^d
Primary treatment				
Substance abuse only vs. Substance abuse & Mental Health (ref)	0.96 (0.62, 1.48)	0.92 (0.55, 1.55)	0.84 (0.49, 1.46)	0.79 (0.43, 1.45)
Family History of Substance Use				
Parents abused substances	1.01(0.78, 1.30)	0.77 (0.56, 1.06)	0.78 (0.56, 1.09)	0.71 (0.48, 1.06) ^d
Sibling abused substances	0.96 (0.73, 1.26)	0.94 (0.68, 1.31)	0.88 (0.61, 1.26)	1.10 (0.73, 1.65)
Other relative abused substances	0.91 (0.70, 1.18)	0.85 (0.62, 1.16)	0.87 (0.61, 1.22)	0.84 (0.57, 1.24)

^ap<0.05; ^bp<0.01; ^cp<0.001; ^dp<0.10

Never-smokers vs. typical progressors

Similarly, several variables were significant in the adjusted model when comparing never smoker with typical progressors (see Table 2). Gender, residence, number of substances used at admission, and reported drug used at admission (i.e., alcohol, marijuana, opiates/narcotics, and “other drugs”) were not significant in the adjusted model. Ethnicity, education, age of onset of substance use, and cocaine remained significant. As shown in Table 2, African Americans were

twice (OR=2.18; 95% CI=1.32-3.60, p<0.01) as likely to report being a never-smoker, compared to whites. College-educated participants were more likely to be never-smokers (OR= 0.45; 95% CI=0.28 -0.71, p< 0.001). Individuals who began using substances, either before 12 years of age or between 13 to 17 years of age, were 2.27 and 1.77 times more likely to report being a never-smoker (OR=2.27; 95% CI=1.13-4.52, p<0.05 and (OR=1.77; 95% CI=1.15-2.72, p<0.01, correspondingly) compared to those who began after 18 years of age. Participants who reported cocaine use at admission were more likely

to report typical progression (OR=0.52; 95% CI=0.29-0.94, $p < 0.05$).

Discussion

This study examined cigarette smoking initiation patterns among a substance abuse treatment population. Two important findings emerged: First, the high prevalence of cigarette smoking among this substance abuse treatment population (82%), regardless of whether or not it was a gateway substance, supports the critical need to provide smoking cessation intervention among these individuals. Second, a sizable proportion of participants reported deviations from the GH (66%: 48% atypical progressors and 18% never-smokers), which is a larger percentage than reported from the general population [12,29,30]. Since the GH is only able to accommodate cigarette smoking progression in about one-third of this subpopulation, particularly among non-Hispanic whites and participants with less than a high school education, the GH framework is seemingly insufficient for explaining the progression of substance abuse among the majority of those with serious substance abuse problems when considering cigarettes as the gateway substance. Other studies have also noted the non-existent effect of alcohol as a gateway substance among substance use treatment clients [31].

The current study explored some of the factors –specifically, socio-demographics and substance abuse-related factors- that characterize those who diverge from the sequential, gateway pattern of progression (i.e., typical progression). The final models revealed demographic and substance abuse-related similarities when comparing typical progressors to both atypical progressors and never-smokers. Both adjusted models found that substance users who reported either being atypical progressors or never-smokers were more likely to have been African American and college-educated. The ethnicity-atypical/never-smoker association parallels other studies involving substance use participants [25,32,33]. Ethnicity seems to be a well-studied variable, though education level does not, which is surprising given it has been purported to be the strongest demographic determinant for increased cigarette smoking [34]. The initiation of cigarette smoking, on the other hand, may differ with respect to the social surroundings and/or risk perception of college-educated substance abusers. For instance, being an atypical progressor may reflect the wide availability of other substances on college campuses for those who begin experimenting with drugs in college. A systematic review revealed that prior illicit drug use increases the likelihood of cigarette smoking initiation among college students, especially when their social groups accept cigarette smoking as a normative or safe behavior [35]. However, the college-educated participants who were identified as never-smokers may be more inclined to view tobacco as a taboo or risky/unhealthy practice and, in turn, use a more socially acceptable drug such as alcohol or even marijuana.

Several substance abuse-related factors were significant and varied based on the absence or presence of cigarette smoking. When comparing the younger age ranges for substance use onset (i.e., 6 to 12 years and 13 to 17 years old) to the older age range for substance use onset (i.e., 18 or older), individuals who initiated licit or illicit drug use at an earlier age were more likely to be either atypical progressors or never-smokers than typical progressors. Given the high prevalence of an early age of onset of substance use among all participants and the increased likelihood among atypical progressors

and never-smokers, prevention efforts should focus on general substance use among individuals well before age 17, especially in high school. Also, assessing the initial preference for or the availability of a particular drug used and reported at admission may aid in explaining the varying progression patterns. In fact, marijuana was statistically significant for predicting atypical progressors. These findings concur with mounting evidence, which supports the notion that marijuana may be becoming customary for substance use onset and in turn, a problematic substance behavior. Unlike marijuana, reported cocaine use at admission was less likely to deviate in drug progression.

This study is not without limitations. First, the study participants were not randomly selected, so the study findings cannot be generalized. Second, the accuracy of retrospective reports may be questionable. However, previous studies have shown that age of onset has decent reliability. Recollection of age tends to shift upward as participant age increases. Regardless, the data were derived from participants' self-reports, which could be subject to this bias. Third, only participants who consented to participate in the study at substance abuse treatment intake and who could also be reached six months after admission were interviewed, which excluded persons who could not be reached by phone. Also, substance abuse participants who are treated in state-funded facilities are a specific subset of substance abusers seeking treatment. While two thirds of problematic substance use participants enroll in publicly-funded treatment facilities, future research should still explore a variety of treatment facilities [25]. Furthermore, problematic substance users currently not in treatment should be included in the future studies; however, this subset of abusers is relatively difficult to access.

In spite of these limitations, the implications of the findings are compelling. First, the prevalence of smoking, regardless of whether or not it was a “gateway” among substance abuse participants, supports the need to include role of smoking in future studies in this population. Second, the increased prevalence of atypical progressors and never-smokers suggests that the GH is an insufficient theory, especially among problematic substance users. This study highlights the necessary addition and exploration of other social and cognitive/affective variables known to influence problematic substance use behavior, to aid in the development of targeted substance use prevention programs [2,36]. Exploring the variables associated with problematic behavior may begin to provide a more comprehensive understanding of the etiologic factors on substance use, progression, and predisposition. Likewise, research should evaluate polydrug vs. single use of each of the “softer” drug (i.e., tobacco, alcohol, and marijuana), and other illicit drugs (e.g., cocaine and opiates), among both problematic and experimental substance users to identify potential drug-specific etiologic variability. Other factors such as problematic behavior and social determinants should be assessed among substance abusers to elucidate the etiologic pathways for patterns of cigarette smoking initiation. The findings from this comparison may enable the development of tailored preventative programs for those at greatest risk with strategies to ward off problematic use of gateway substances preceding substance abuse and/or dependence.

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