

Patterns of Alcohol-Dependence Symptoms Using a Latent Empirical Approach: Associations With Treatment Usage and Other Correlates*

JEAN Y. KO, PH.D.,[†] SILVIA S. MARTINS, M.D., PH.D., S. JANET KURAMOTO, M.H.S., AND HOWARD D. CHILCOAT, SC.D.[†]

Department of Mental Health, Johns Hopkins Bloomberg School of Public Health, 624 North Broadway, 8th Floor, Baltimore, Maryland 21205-1900

ABSTRACT. Objective: The aim of this study was to understand the variation in response to alcohol use by identifying classes of alcohol users based on alcohol-dependence symptoms and to compare these classes across demographic characteristics, abuse symptoms, and treatment usage. **Method:** Data from combined 2002-2005 National Survey on Drug Use and Health identified 110,742 past-year alcohol users, age 18 years or older. Latent class analysis defined classes based on observed clustering of alcohol-dependence symptoms based on criteria from the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV). Chi-square statistics were used to test differences in sociodemographic and alcohol-abuse characteristics across classes. Multivariable latent class regressions were used to compare treatment usage across classes. **Results:** The four-class model had the best overall fit and identified classes that differed quantitatively and qualitatively, with

2.3% of the users in the most-severe class and 83.8% in the least-severe/not-affected class. These classes differed in a number of demographic characteristics and alcohol-abuse symptoms. All individuals in the most-severe class met DSM-IV criteria for alcohol dependence; 80% of this class had alcohol-abuse symptoms. Twenty-six percent of the moderate and 50% of the moderate-high class met dependence criteria. Approximately 19% of the most-severe class and less than 5% of the moderate and moderate-high class received treatment for alcohol in the past year. **Conclusions:** This study demonstrates that meeting dependence criteria only partially captures variations in responses to severity of alcohol problems. Although individuals in the most-severe class were more likely to perceive need and receive treatment, the percentage of individuals receiving treatment was low. (*J. Stud. Alcohol Drugs*, 71, 870-878, 2010)

ALCOHOL DEPENDENCE IS CONCEPTUALIZED as a combination of psychological and physiological processes that lead to a person's preoccupation with drinking, while he or she becomes increasingly unresponsive to adverse consequences (Edwards and Gross, 1976; Grant et al., 2007; Hasin et al., 2006). As a dichotomous diagnosis, alcohol dependence is specified by the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV; American Psychiatric Association, 1994), as a cluster of three or more of seven dependence symptoms within a 12-month period. Within this diagnostic categorization, individuals diagnosed with alcohol dependence could have significant heterogeneity with respect to clustering of symptoms. Reliance on the dichotomous DSM-IV approach not only masks the heterogeneity of dependence symptoms among individuals with alcohol dependence but also may exclude individuals with subthreshold dependence symptoms who may also benefit from treatment. It is beneficial to un-

derstand the full range of dependence symptomatology and associated features among those who drink.

Latent class analysis (LCA) has been used to understand the heterogeneity of alcohol use and problems related to its use. This approach empirically identifies distinct phenotypic groups or classes based on the probability of particular response patterns (McCutcheon, 1987). The use of LCA to categorize problematic alcohol use has yielded important findings, identifying either four or five subtypes of alcohol users by their abuse or dependence symptoms and numerous demographic characteristics associated with these subtypes (Bucholz et al., 1996; Delucchi et al., 2004; Lynskey et al., 2005; Moss et al., 2008; Nelson et al., 1998). Most existing LCA studies have included clinical or indicated samples (i.e., probands of alcoholics; Bucholz et al., 1996) or individuals enrolled in a dependency program (Delucchi et al., 2004). However, two studies have been based on data from community-based samples (Moss et al., 2008; Nelson et al.,

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[†]Correspondence may be sent to Jean Y. Ko at the above address or via email at: jyko@jhsph.edu. Howard D. Chilcoat is also with GlaxoSmithKline Worldwide Epidemiology, GlaxoSmithKline, Research Triangle Park, NC.

1998). Nelson et al. (1998) used lifetime measures of alcohol from the National Comorbidity Survey and included all individuals who reported drinking more than 12 drinks in any 12-month period of their life. Another community-based study by Moss et al. (2008) restricted their sample to individuals who met DSM-IV criteria for alcohol dependence. Although these studies have furthered our understanding of the heterogeneity of alcohol dependence, the quantitative and qualitative variation in dependence among current drinkers is still relatively unexplored.

Additionally, despite the utility of LCA to identify subtypes of alcohol users and the low prevalence of treatment among alcohol users (Cohen et al., 2007; Hasin et al., 2007; McLellan et al., 2000; Wu and Ringwalt, 2004), only one study has examined how treatment usage varies across subtypes of alcohol dependence (Moss et al., 2008). In this study by Moss and colleagues, treatment variation was related to the severity of the disorder, with the greatest likelihood of treatment observed among subtypes with the highest probability of endorsing DSM-IV dependence criteria. The lowest likelihood of treatment usage was among the most prevalent subtype, which was comprised of young adults who had moderate high levels of periodic heavy drinking. However, because this study was restricted to those meeting criteria for alcohol dependence, it did not examine treatment usage across the entire range of alcohol users who may not have met the alcohol-dependence criteria but who could have also benefited from treatment. The current study extends the work by Moss et al. by including all past-year alcohol users and their responses to alcohol via patterns of alcohol-dependence symptoms, using LCA to understand the variation of psychological and physiological symptomatology of alcohol dependence. Given this focus, symptoms of abuse (e.g., recurrent substance use resulting in a failure to fulfill major role obligations at work, school, home) are not included in the classification of subtypes, because they can also reflect the consequences of alcohol dependence (Grant et al., 2007; Hasin et al., 2006).

The objectives of this study are to (a) empirically examine the variation in response to alcohol use by identifying subtypes based on alcohol-dependence symptoms among *all past-year alcohol users* in the general adult population, (b) compare demographic characteristics and prevalence of alcohol-abuse symptoms across these groups, and (c) compare differences in treatment usage across these groups.

Method

Data source

We used combined data from the 2002-2005 National Survey on Drug Use and Health (NSDUH) public use data files (Substance Abuse and Mental Health Services Administration [SAMHSA], 2003, 2004, 2005, 2006). The NS-

DUH, sponsored by SAMHSA, is a series of cross-sectional surveys carried out regularly since 1971 and annually since 1990. The NSDUH is a nationally representative multistage cluster sampling of household populations age 12 years or older. In 2002-2005, certain subpopulations (e.g., youths and young adults) were oversampled so that the sample would have approximately equal distribution across three major age groups: 12-17, 18-25, and 26 years or older. The 2002-2005 surveys were administered via computer-assisted instruments, and all respondents were offered a \$30 incentive payment for their participation. The overall response rate was 91% for household screening for each year of 2002-2005 and 71%-79% for completed interviews across years (SAMHSA, 2003, 2004, 2005, 2006). Detailed information about the sampling and survey methodology in the NSDUH can be found elsewhere (SAMHSA, 2003, 2004, 2005, 2006).

Study participants

This study was restricted to adults age 18 years or older who reported using alcohol in the year preceding the survey, resulting in a sample size of 110,742 past-year alcohol users.

Measures

Past-year alcohol use, abuse, and dependence symptoms. The NSDUH includes separate sections about patterns of use on 12 drug classes. Past-year alcohol users were defined as respondents who consumed "a can or bottle of beer, a glass of wine or a wine cooler, a shot of liquor, or a mixed drink with liquor in it" (p. 26) and excludes occasions "of sip or two from drink" (SAMHSA, 2003; p. 29).

The seven symptoms of past-year alcohol dependence were assessed through 11 self-report items on the NSDUH (SAMHSA, 2006). Respondents were classified as alcohol dependent using the DSM-IV criteria if they reported having three of seven symptoms of dependence during the 12 months before the interview (American Psychiatric Association, 1994). The seven symptoms of dependence were the following: (a) great deal of time spent using/obtaining alcohol (salience); (b) alcohol is taken in larger amounts or over longer period than intended; (c) alcohol tolerance; (d) persistent desire or unsuccessful efforts to cut down or control alcohol use; (e) continued use of alcohol despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by alcohol; (f) giving up or reduction in social, occupational, or recreational activities; and (g) alcohol withdrawal. These seven symptoms were used as indicators of dependence in the LCA.

Seventeen items were used to assess four symptoms of alcohol abuse in the year before the interview: (a) recurrent substance use resulting in a failure to fulfill major role obligations at work, school, or home; (b) recurrent substance

use in situations in which it is physically hazardous; (c) recurrent substance-related legal problems; and (d) continued substance use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of the substance (American Psychiatric Association, 1994). For the purpose of this study, we categorized level of abuse as zero, one, and two or more symptoms.

Demographic measures. Information on substance use and demographic data was available for all respondents. Demographic variables selected for this study were age (18-25 years, 26-34 years, 35-49 years, 50 years or older), gender, race/ethnicity (non-Hispanic White, African American, Hispanic, and other), marital status (married or widowed, divorced or separated, and never been married), annual family income (less than \$20,000, \$20,000-49,999, \$50,000-74,999, \$75,000 or more), education (less than high school, completed high school, some college, college or more), and employment (employed full time, employed part time, unemployed, other including not in labor force). Type of health insurance was categorized as public (Medicaid, child state health insurance, Medicare, Tricare, Champus, Veterans Affairs, and/or military health but no private insurance), private (health insurance through employment and respondents who also reported public insurance), and no insurance.

Frequency and type of substance use. The frequency and type of substance use were assessed in the following ways: number of DSM-IV substance-dependence disorders for drugs other than alcohol (dependence on zero, one, or two or more of the following drugs: cocaine, heroin, analgesics, marijuana, sedatives, tranquilizers, stimulants, inhalants, hallucinogens), any drug use in the past year (including use of cocaine, heroin, analgesics, marijuana, sedatives, tranquilizers, stimulants, inhalants, hallucinogens), heavy episodic drinker (yes/no; defined in the NSDUH as "drinking 5 or more drinks on the same occasion on at least one day in the past 30 days"), and heavy drinker over five or more episodes (yes/no, defined in the NSDUH as "drinking 5 or more drinks on the same occasion on each of 5 or more days in the past 30 days" (SAMHSA, 2003; p. 182).

Past-year treatment status and other treatment indicators. Respondents who reported lifetime substance use were asked whether they have "ever received treatment or counseling for use of alcohol or any drug, not counting cigarettes" (SAMHSA, 2003; coded yes/no having ever received treatment). Respondents who answered affirmatively were subsequently asked to specify if they received treatment or counseling for alcohol use in the past 12 months (yes/no received treatment for alcohol). The setting of the treatment received was categorized as inpatient only (hospital, inpatient rehabilitation facility, or emergency room), outpatient only (mental health center, outpatient rehabilitation facility, or doctor's office), other only (prison/jail and self-help groups), more than one location, or no treatment. Perceived need (felt need) for treatment in the past year was classified as yes if a respondent

answered yes to either "reported feeling a need for treatment for their specific substance use in past year" or "reported feeling a need for additional treatment for their specific substance use in the past year" (treatment for alcohol only, treatment for drug only, treatment for both alcohol and drug, or no need for treatment; SAMHSA, 2006; p. 424-425).

Statistical analyses

To derive empirically defined subgroups of alcohol users based on observed clustering of the seven DSM-IV symptoms of alcohol dependence, LCA was applied using Mplus software Version 4.21 (Muthén and Muthén, 2007) and was limited to the seven symptoms of alcohol dependence as indicator variables for the LCA. Additional covariates were not included in the LCA. To determine the best-fitting model, Bayesian Information Criteria (BIC) and class error indices were used (Magidson and Vermunt, 2004). Two sets of parameters are primarily of interest when conducting LCA: (a) the probability of being in each subgroup (or latent class), which also provides estimates of the prevalence of latent class membership, and (b) conditional response probabilities, or the probability of a particular response given membership in a specified class.

To test associations with latent class membership, respondents were assigned to their *most likely class* (i.e., modal class) using posterior probabilities. When observations are classified into classes using the modal class membership probabilities, a certain amount of misclassification error is present (in this case, 5.0%). As this misclassification error is low, it is of minimal concern for this study. Chi-square statistics were used to test differences in demographic characteristics and alcohol-abuse symptomatology across classes. Two separate latent class regression analyses were carried out using Stata 10.0 (StataCorp LP, College Station, TX) to examine the association between class membership with treatment reception and perceived need for alcohol treatment (outcome variables). Gender, race/ethnicity, age, education, marital status, number of other DSM-IV substance dependencies, type of health insurance, and alcohol-abuse symptoms were included as covariates in the adjusted models. All analyses included a weighting variable to account for the probability of sampling and used Taylor series expansion linearization to account for the complexity of the NSDUH survey design.

Results

Latent classes of past-year alcohol users

Model fit statistics are shown in Table 1. The four-class model was selected, because this model yielded distinct classes along with the best combination of greatest degrees of freedom and lowest BIC and sample-adjusted BIC sta-

TABLE 1. Latent class analysis: Model fit

Class number	LL	BIC (LL)	<i>n</i> adjusted BIC	<i>p</i> value of Vuong-Mendel-Rubin	Class error	Entropy	<i>df</i>
One-class model	-170,284.22	340,649.75	340,627.50	N.A.	0	N.A.	111
Two-class model	-143,452.93	287,080.08	287,032.41	.00	.01	.83	112
Three-class model	-141,948.69	284,164.53	284,091.44	.00	-.01	.76	104
Four-class model	-141,365.47	283,091.01	282,992.49	.00	.05	.82	96
Five-class model	-141,268.16	282,989.31	282,865.36	.17	-.05	.82	88
Six-class model	-141,184.82	282,915.54	282,766.17	.36	-.01	.81	80

Notes: LL = log-likelihood; BIC = Bayesian Information Criteria; N.A. = not applicable.

tistics. Although the model fit statistics were slightly better for the five-class model, the pattern of symptomatology of the fifth class did not differ substantially from those in the four-class model. Additionally, the entropy was similar, and the Vuong-Mendel Rubin test *p* value was nonsignificant, suggesting that the addition of the fifth class was not a significant improvement from the four-class model. Hence, the four-class model was selected over the five-class model. The conditional probabilities of dependence symptoms by the four latent classes are shown in Figure 1. Class 1 (nonsymptomatic class) included an estimated 83.3% of the past-year alcohol users, with very low probabilities (ranging from .001 to .05) of endorsing each of the seven symptoms of dependence. Contrary to the nonsymptomatic class, individuals classified to Class 2 (prevalence = 2.3%; high symptomatic class) had moderate to high probabilities of endorsing each of the seven symptoms of dependence (.43-.94). Both Class 3 (prevalence = 12.9%; moderate symptomatic) and Class 4 (prevalence = 1.6%; moderate-high symptomatic) had low probabilities of endorsing the following three symptoms: continued use despite problems, giving up or reducing important activities because of alcohol use, and withdrawal. In contrast to the moderate symptomatic class, the moderate-high symptomatic class had moderate to high probabilities of endorsing two symptoms: persistent desire/unsuccessful

efforts to cut down/control use and use in larger amounts or for longer periods than intended. Although the probabilities of endorsing each of the seven symptoms of dependence in the moderate symptomatic class were lower than probabilities in the high symptomatic class, the symptom profiles were almost parallel (Figure 1).

Overall, 7.2% of past-year alcohol users met DSM-IV criteria for past-year alcohol dependence. Among past-year alcohol users, individuals who met the DSM-IV dependence criteria were distributed across the three classes (43.3% in the high symptomatic class, 39.8% in the moderate symptomatic class, and 16.9% in the moderate-high symptomatic class). An examination of the prevalence of alcohol dependence by latent class (Table 2) shows that no individuals in the nonsymptomatic class met the DSM-IV criteria for alcohol dependence, whereas 100% of the high symptomatic class, 25.9% of the moderate class, and 49.9% of the moderate-high class met the criteria for alcohol dependence.

Distribution of alcohol-abuse symptoms by latent class

The vast majority (81.8%) of those in the high symptomatic class had alcohol-abuse symptoms in the past year (Table 2), whereas symptoms of abuse were unlikely (4.6%) among those in the nonsymptomatic class. The prevalence

TABLE 2. Prevalence of abuse symptoms and alcohol dependence by latent class membership among past-year alcohol users (*n* = 110,742), National Survey on Drug Use and Health, 2002-2005

Variable	Latent classes of past-year alcohol users			
	Class 1 Nonsymptomatic (<i>n</i> = 92,118) %	Class 2 High symptomatic (<i>n</i> = 3,221) %	Class 3 Moderate symptomatic (<i>n</i> = 13,501) %	Class 4 Moderate-high symptomatic (<i>n</i> = 1,902) %
Alcohol-abuse symptoms in the past year				
0 symptoms	95.4	18.2	59.2	60.6
1 symptom	4.1	25.7	26.6	27.3
≥2 symptoms	0.5	56.1	14.2	12.1
DSM-IV alcohol dependence				
Yes	0	100	25.9	49.9
No	100	0	74.1	50.1

Note: DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition.

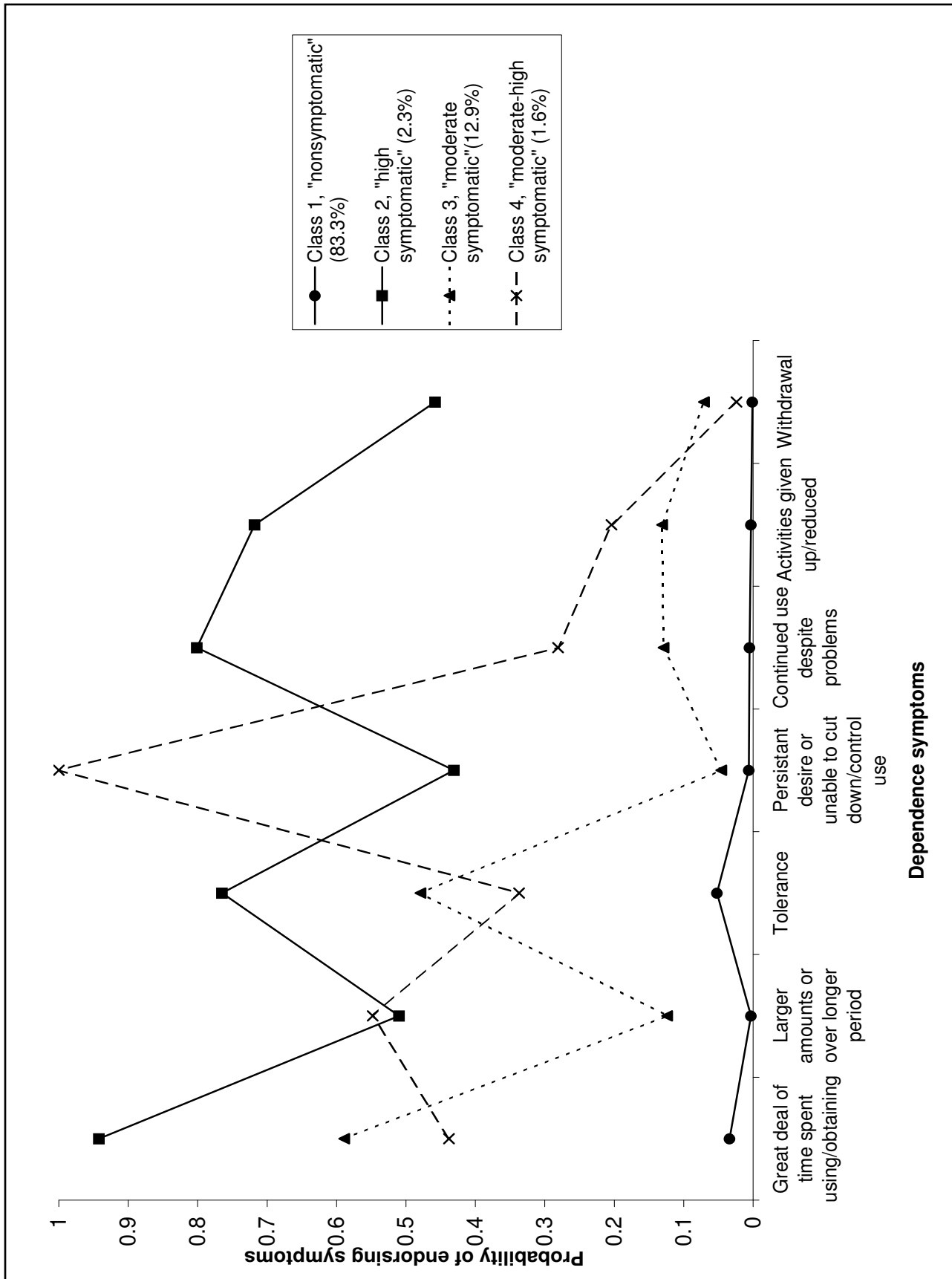


FIGURE 1. Weighted probability of endorsing dependence symptoms given latent class among all past-year alcohol users, National Survey on Drug Use and Health, 2002-2005

TABLE 3. Distribution of sociodemographic, past-year substance use, and treatment characteristics by latent class membership for past-year alcohol users (*n* = 110,742), National Survey on Drug Use and Health (NSDUH), 2002-2005

Variable	Latent classes of past-year alcohol users Adult alcohol users (<i>n</i> = 110,742)								<i>p</i> ^a
	Class 1		Class 2		Class 3		Class 4		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Gender									
Males	42,719	50	1,979	67	8,110	65	1,125	60	<.001
Females	49,399	50	1,242	33	5,391	35	777	40	
Race									
White non-Hispanic	66,048	75	2,200	69	9,092	65	1,397	79	<.001
African American	9,491	9	307	13	1,393	13	184	9	
Hispanic	10,835	11	450	15	1,920	16	197	8	
Other ^b	5,744	5	264	4	1,096	6	124	4	
Age									
18-25 years	44,635	15	1,957	26	9,945	38	992	17	<.001
26-34 years	14,950	18	481	22	1,623	22	310	20	
35-49 years	21,633	33	652	36	1,508	25	442	35	
≥50 years	10,900	35	131	15	425	15	158	29	
Education									
Less than high school	13,157	12	744	23	2,566	19	266	11	<.001
High school	29,986	30	1,124	33	4,614	34	526	24	
Some college	27,297	27	968	28	4,509	29	580	27	
College or more	21,678	31	385	15	1,812	18	530	38	
Marital status									
Married or widowed	39,224	63	593	30	2,313	35	555	48	<.001
Divorced or separated	8,673	13	426	23	1,004	14	176	16	
Never been married	44,221	24	2,202	47	10,184	52	1,171	36	
Employment									
Full time	54,074	61	1,691	57	7,164	60	1,117	66	<.001
Part time	16,876	13	633	15	2,980	16	378	16	
Unemployed	4,777	3	327	9	1,050	6	124	4	
Other (incl. not in labor force)	16,391	22	570	19	2,307	17	283	15	
Income, in U.S. \$									
<\$20,000	20,669	14	1,168	32	4,658	26	525	16	<.001
\$20,000-\$49,999	34,553	35	1,201	37	4,843	39	681	35	
\$50,000-\$74,999	16,398	20	410	14	1,804	15	288	17	
≥\$75,000	20,498	31	442	17	2,196	20	408	31	
Any illegal drug use in past year									
Yes	22,138	15	2,186	58	7,455	42	939	38	<.001
No	69,980	85	1,035	42	6,046	58	963	62	
No. of other DSM-IV substance dependence									
None	89,686	99	2,402	80	12,031	92	1,749	94	<.001
One	2,173	1	572	14	1,264	7	126	5	
Two or more	259	<1	247	6	206	1	27	1	
Type of health insurance									
Public	1,390	12	447	16	9,220	9	118	5	<.001
Private	8,813	65	1,783	56	66,059	78	1,326	77	
No insurance	3,298	24	991	29	16,839	13	458	18	
Received treatment									
Yes, treatment received	1,185	1	558	19	681	5	82	3	<.001
No treatment	90,933	99	2,663	81	12,820	95	1,820	97	
Location of received treatment									
Inpatient only	58	<1	33	1	48	<1	6	<1	<.001
Outpatient only	243	<1	71	2	133	<1	22	<1	
Other only	485	<1	146	5	268	2	38	1	
More than one location	547	<1	363	13	313	3	25	1	
No treatment	90,785	99	2,608	79	12,739	95	1,811	97	
Felt need for treatment for alcohol in past year									
Yes	88	<1	415	14	174	2	45	2	<.001
No	92,030	99	2,806	86	13,327	99	1,857	98	
Heavy episodic drinker ^c									
Yes	33,961	29	2,720	81	10,743	75	1,546	76	<.001
No	58,157	71	501	20	2,758	26	356	24	
Heavy drinker over ≥5 episodes ^d									
Yes	8,206	7	1,765	51	5,456	35	824	38	<.001
No	83,912	93	1,456	49	8,045	65	1,078	62	

Notes: Incl. = including; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition. ^aChi-square statistics; ^bincludes Asians, Native Americans, Hawaiians, and Pacific Islanders; ^cdefined in NSDUH as drinking five or more drinks on the same occasion on at least one day in the past 30 days (Substance Abuse Mental Health Services Administration [SAMHSA], 2003); ^ddefined in NSDUH as drinking five or more drinks on the same occasion on each of 5 or more days in the past 30 days (SAMHSA, 2003).

TABLE 4. Odds of receiving treatment and perceived need for treatment by class membership of all past-year alcohol users ($n = 110,742$), National Survey on Drug Use and Health, 2002-2005

Class membership	Model 1: Received treatment ^a		Model 2: Felt need for treatment ^b	
	AOR	95% CI	AOR	95% CI
Class 1: Nonsymptomatic	1.0	—	1.0	—
Class 2: High symptomatic	10.7	[8.68, 13.30]	184.9	[117.51, 290.76]
Class 3: Moderate symptomatic	3.2	[2.62, 3.85]	21.0	[13.23, 33.22]
Class 4: Moderate-high symptomatic	3.0	[1.95, 4.69]	28.7	[15.82, 52.18]

Notes: AOR = adjusted odds ratio; CI = confidence interval. ^aModel 1: adjusted odds for receiving treatment, after accounting for class membership, gender, race, age, education, marital status, type of health insurance, and number of other DSM-IV substance dependence; ^bModel 2: adjusted odds for felt need for treatment, after accounting for class membership, gender, race, age, education, marital status, type of health insurance, and number of other DSM-IV substance dependences.

of abuse symptoms was nearly identical for those in the moderate and moderate-high symptomatic classes. Further, more than half (56.1%) in the high symptomatic class had at least two abuse symptoms, compared with 14.2% and 12.1% in the moderate and moderate-high symptomatic classes, respectively.

Demographic and other correlates across the latent classes of past-year alcohol users

Demographic and substance-use characteristics of the four latent classes of past-year alcohol users are shown in Table 3. Although the moderate-high symptomatic class endorsed greater symptoms than the nonsymptomatic class, they were similar in a few demographic characteristics, including income, race, and education. The moderate symptomatic class tended to be younger and had lower income, somewhat paralleling the demographic characteristics of the high symptomatic class. The affected classes (moderate, moderate-high, and high symptomatic classes) had similar prevalences of heavy episodic drinking; however, the prevalence of heavy drinking over five or more episodes was higher in the high symptomatic class (51.3%) than in the moderate (35.4%) or moderate-high class (38.1%).

Treatment for alcohol problems

The majority of individuals in the affected classes did not receive or perceive a need for treatment. Even among the most affected group (high symptomatic class), fewer than 20% received treatment for alcohol in the past year (Table 3). The proportion of individuals receiving treatment was much lower in the moderate and moderate-high symptomatic classes ($\leq 5\%$). Furthermore, few individuals ($\leq 2\%$) in the moderate and moderate-high symptomatic classes perceived a need for alcohol treatment in the past year (Table 3). Approximately 14% of the high symptomatic class reported perceiving a need for treatment in the past year.

After adjusting for demographics and other covariates, the high symptomatic class was almost 11 times more likely

to receive treatment (odds ratio [OR] = 10.7, 95% CI [8.7, 13.3]) than the nonsymptomatic class (Table 4; Model 1). In a supplementary analysis comparing the high symptomatic class to other affected classes, the odds of receiving treatment for the high symptomatic class were 3.4 times greater (OR = 3.4, 95% CI [2.7, 4.3]) than the moderate class and 3.6 times greater (OR = 3.6, 95% CI [2.3, 5.6]) than the moderate-high class (not shown in table).

After adjusting for demographics and other covariates, the affected classes were more likely to perceive a need for treatment than the nonsymptomatic class (Table 4; Model 2). The odds of perceiving a need for treatment for the high symptomatic class were almost nine times greater than the odds for the moderate class (OR = 8.8, 95% CI [6.4, 12.1]) and approximately six times greater than odds for the moderate-high symptomatic class (OR = 6.4, 95% CI [3.8, 10.9]; not shown in table).

Discussion

The LCA of an epidemiological household sample of U.S. alcohol-consuming adults yielded a four-class model as the overall best fitting model. The four-class model identified one nonsymptomatic class and three affected classes, with differing symptom profiles. The classes were distinguished by several demographic and drug-use characteristics. Although treatment usage was low across all of the affected groups, the high symptomatic group was most likely to receive and perceive a need for treatment, whereas the moderate-high and moderate classes had a similar likelihood of receiving treatment.

The results of this study using LCA have identified significant heterogeneity in regards to alcohol-dependence symptomatology among those who have used alcohol in the past year. Our finding of four different classes of past-year alcohol users from the LCA is in agreement with studies by Nelson et al. (1998), who also found four classes (one asymptomatic class and three progressively more serious symptomatic classes) using retrospective data from the National Comorbidity Survey. In addition, a study on 2,551

relatives of alcoholic participants also observed similar four classes of alcohol users (1 = nonproblem drinkers, 2 = mild alcoholics, 3 = moderate alcoholics, and 4 = severely affected alcoholics) (Bucholz et al., 1996). Results from this study lend further support to the notion that there is heterogeneity among alcohol users. Unlike previous studies, inclusion of current alcohol users residing in the community and use of past-year alcohol symptomatology in this study captures all types of current alcohol users. Thus, although a majority of alcohol users are generally not affected, this study estimated that approximately one fifth of the alcohol users are affected by alcohol, as evidenced by a significant level of dependence symptoms. Further, we estimated associations of class membership with a variety of characteristics, including demographics, abuse symptoms, drinking behaviors, and treatment involvement.

It is clear that patients with a high level of dependence symptomatology will be readily identified using the DSM-IV diagnostic threshold based on the number of symptoms endorsed. However, LCA has identified individuals with significant levels of dependence symptoms who do not meet DSM-IV criteria of dependence (i.e., individuals in moderate and moderate-high classes) but who could benefit from intervention to prevent escalation to higher levels of dependence. The similarities in the dependence profile patterns and demographic characteristics between the high symptomatic and moderate symptomatic class also deserve further attention. Future longitudinal studies may aid in early identification of those who are most at risk for transitioning into the high symptomatic class. Further, identification of relatively homogeneous subgroups might indicate the need for different therapeutic approaches or endpoints across these groups.

Examination of alcohol-abuse symptoms across these groups offers further support that abuse symptoms are not necessarily present among dependent individuals and may not represent the severity of dependence (Hasin and Paykin, 1999; Hasin et al., 1990). Furthermore, results from this study support the conceptual and etiologic distinction between alcohol abuse and alcohol dependence. This is best observed in the high symptomatic class, in which approximately one fifth of individuals reported no alcohol-abuse symptoms in the past year, even though all members of this class met DSM-IV criteria for alcohol dependence and had a high number of dependence symptoms. Although alcohol abuse has been used as a screener for alcohol dependence in a number of national and international surveys, including the National Comorbidity Survey Replication (Kessler et al., 2005), these results do not support the use of alcohol abuse to screen for dependence. There is evidence that the use of abuse as a screener yields lower prevalence estimates of alcohol and drug dependence (Grant et al., 2007).

This study provided additional evidence of the general lack of treatment among symptomatic alcohol users. Past-year alcohol users were separated into homogeneous groups

using LCA to further understand treatment usage with respect to variations in response to alcohol. This approach has demonstrated that the likelihood of receiving treatment among alcohol users with high numbers of dependence symptoms is alarmingly low (20% in the high symptomatic class). Likewise, many individuals in the moderate and moderate-high classes, who may benefit from treatment, did not receive or perceive a need for treatment. Interestingly, although the moderate and moderate-high classes differed in severity (26% versus 50% met dependence criteria), the likelihood of treatment was similar between the classes.

The strengths of this study include the population-based sample of past-year alcohol users, the ability to generalize findings to the U.S. household population, and the availability of past-year measures of alcohol-dependence symptoms. The large sample size resulting from the combination of surveys from 3 recent years has allowed for the observation of heterogeneity among alcohol users using an empirically validated approach. The examination of past-year alcohol users from such a large population sample enabled us not only to capture treatment use among alcohol-dependent individuals but also among individuals who have not met criteria for alcohol dependence and are exhibiting a pattern of symptoms of alcohol dependence. The availability of data on recent (past-year) alcohol-dependence symptoms is an important strength of this study. Past-year measures are useful because they characterize the potential burden of "active" drug users requiring intervention or treatment (Anthony and Helzer, 2002). By focusing on past-year users, the possibility of recall bias, which is often associated with lifetime measures, is lessened (Desai and Potenza, 2008; Grant et al., 2004).

The interpretations of these findings are limited because of the study's cross-sectional design. The use of modal probabilities to assign class membership could result in misclassification, which would generally bias the associations toward the null; however, the degree of misclassification was low and unlikely to affect these results. The surveys were also based on self-reports. However, use of a computerized reporting system, an audio computer-assisted self-interview (ACASI), increases the confidence that social desirability bias was kept to a minimum and that data are internally consistent and complete (Chromy et al., 2002; Turner et al., 1998).

This study highlights the heterogeneity of response to alcohol and the distinct conceptual and diagnostic differences between alcohol abuse and dependence. The findings of this study do not support the use of alcohol abuse as a method to screen individuals for alcohol dependence. The lack of treatment among individuals who are moderately and severely affected by alcohol dependence is alarming. These findings call for efforts to understand transitions across these subgroups and to increase treatment usage.

References

- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.
- Anthony, J. C., & Helzer, J. (2002). Epidemiology of drug dependence. In: M. T. Tsuang & M. Tohen (Eds.), *Textbook in psychiatric epidemiology* (2nd ed.). New York: Wiley-Liss.
- Bucholz, K. K., Heath, A. C., Reich, T., Hesselbrock, V. M., Kramer, J. R., Nurnberger, J. I., Jr., & Schuckit, M. A. (1996). Can we subtype alcoholism? A latent class analysis of data from relatives of alcoholics in a multicenter family study of alcoholism. *Alcoholism: Clinical and Experimental Research*, 20, 1462-1471.
- Chromy, J., Davis, T., Packer, L., & Gfroerer, J. (2002). Mode effects on substance use measures: Comparison of 1999 CAI and PAPI measures. In L. Gfroerer, E. Eyerman, & J. Chromy (Eds.), *Redesigning an ongoing national household survey: Methodological issues* (DHHS Publication No. SMA 03-3768). Rockville, MD: Office of Applied Studies, Substance Abuse and Mental Health Services Administration.
- Cohen, E., Feinn, R., Arias, A., & Kranzler, H. R. (2007). Alcohol treatment utilization: Findings from the National Epidemiologic Survey on Alcohol and Related Conditions. *Drug and Alcohol Dependence*, 86, 214-221.
- Delucchi, K. L., Matzger, H., & Weisner, C. (2004). Dependent and problem drinking over 5 years: A latent class growth analysis. *Drug and Alcohol Dependence*, 74, 235-244.
- Desai, R. A., & Potenza, M. N. (2008). Gender differences in the associations between past-year gambling problems and psychiatric disorders. *Social Psychiatry and Psychiatric Epidemiology*, 43, 173-183.
- Edwards, G., & Gross, M. M. (1976). Alcohol dependence: Provisional description of a clinical syndrome. *British Medical Journal*, 1, 1058-1061.
- Grant, B. F., Compton, W. M., Crowley, T. J., Hasin, D. S., Helzer, J. E., Li, T.-K., . . . Woody, G. E. (2007). Errors in assessing DSM-IV substance use disorders. *Archives of General Psychiatry*, 64, 379-380.
- Grant, B. F., Dawson, D. A., Stinson, F. S., Chou, S. P., Dufour, M. C., & Pickering, R. P. (2004). The 12-month prevalence and trends in DSM-IV alcohol abuse and dependence: United States, 1991-1992 and 2001-2002. *Drug and Alcohol Dependence*, 74, 223-234.
- Grant, B. F., Harford, T. C., Muthén, B. O., Yi, H., Hasin, D. S., & Stinson, F. S. (2007). DSM-IV alcohol dependence and abuse: Further evidence of validity in the general population. *Drug and Alcohol Dependence*, 86, 154-166.
- Hasin, D. S., Grant, B., & Endicott, J. (1990). Natural history of alcohol abuse: Implications for definitions of alcohol use disorders. *American Journal of Psychiatry*, 147, 1537-1541.
- Hasin, D., Hatzenbuehler, M. L., Keyes, K., & Ogburn, E. (2006). Substance use disorders: Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) and International Classification of Diseases, tenth edition (ICD-10). *Addiction*, 101 (Suppl. 1), 59-75.
- Hasin, D., & Paykin, A. (1999). Alcohol dependence and abuse diagnoses: Concurrent validity in a nationally representative sample. *Alcoholism: Clinical and Experimental Research*, 23, 144-150.
- Hasin, D. S., Stinson, F. S., Ogburn, E., & Grant, B. F. (2007). Prevalence, correlates, disability, and comorbidity of DSM-IV alcohol abuse and dependence in the United States: Results from the national epidemiologic survey on alcohol and related conditions. *Archives of General Psychiatry*, 64, 830-842.
- Kessler, R. C., Chiu, W. T., Demler, O., Merikangas, K. R., & Walters, E. E. (2005). Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, 62, 617-627.
- Lynskey, M. T., Nelson, E. C., Neuman, R. J., Bucholz, K. K., Madden, P. A., Knopik, V. S., . . . Heath, A. C. (2005). Limitations of DSM-IV operationalizations of alcohol abuse and dependence in a sample of Australian twins. *Twin Research and Human Genetics*, 8, 574-584.
- Magidson, J., & Vermunt, J. K. (2004). Latent class models. In D. Kaplan (Ed.), *The Sage Handbook of Quantitative Methodology for the Social Sciences* (pp. 175-198). Thousand Oaks, CA: Sage.
- McCutcheon, A. L. (1987). *Latent class analysis*. Sage University Paper Series on Quantitative Applications in the Social Sciences (No 07-064). Thousand Oaks, CA: Sage.
- McLellan, A. T., Lewis, D. C., O'Brien, C. P., & Kleber, H. D. (2000). Drug dependence, a chronic medical illness: Implications for treatment, insurance, and outcomes evaluation. *Journal of the American Medical Association*, 284, 1689-1695.
- Moss, H. B., Chen, C. M., & Yi, H. Y. (2008). DSM-IV criteria endorsement patterns in alcohol dependence: Relationship to severity. *Alcoholism: Clinical and Experimental Research*, 32, 306-313.
- Muthén, L. K., & Muthén, B. O. (1998-2007). *Mplus users guide* (version 5). Los Angeles, CA: Muthén and Muthén.
- Nelson, C. B., Heath, A. C., & Kessler, R. C. (1998). Temporal progression of alcohol dependence symptoms in U.S. household population: Results from the National Comorbidity Survey. *Journal of Consulting and Clinical Psychology*, 66, 474-483.
- Substance Abuse and Mental Health Services Administration (Office of Applied Studies). (2003). *National Household Survey on Drug Abuse: 2002 public use file and codebook*. Rockville, MD: Author.
- Substance Abuse and Mental Health Services Administration (Office of Applied Studies). (2004). *National Household Survey on Drug Abuse: 2003 public use file and codebook*. Rockville, MD: Author.
- Substance Abuse and Mental Health Services Administration (Office of Applied Studies). (2005). *National Household Survey on Drug Abuse: 2004 public use file and codebook*. Rockville, MD: Author.
- Substance Abuse and Mental Health Services Administration (Office of Applied Studies). (2006). *National Household Survey on Drug Abuse: 2005 public use file and codebook*. Rockville, MD: Author.
- Turner, C. F., Ku, L., Rogers, S. M., Lindberg, L. D., Pleck, J. H., & Sonenstein, F. L. (1998). Adolescent sexual behavior, drug use, and violence: Increased reporting with computer survey technology. *Science*, 280, 867-873.
- Wu, L. T., & Ringwalt, C. L. (2004). Alcohol dependence and use of treatment services among women in the community. *American Journal of Psychiatry*, 161, 1790-1797.