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ABSTRACT

To determine the dimensionality of items from the Composite International Diagnostic Interview—Substance Abuse Module (CIDI-SAM), responses to the 34 CIDI-SAM symptom items (17 each for alcohol and marijuana) obtained from 636 subjects who were alcohol and marijuana users from a representative community sample of young adults were subjected to factor analysis. Of the four factors extracted, one corresponded to alcohol dependence and another represented marijuana dependence. Alcohol and marijuana abuse items were not distinguished by substance, but rather by the domains of problems related to general substance abusing behavior. Within specific substances, dependence as measured by the CIDI-SAM appears to be a unidimensional construct. Conversely, abuse appears to be a multidimensional construct irrespective of the substance concerned.

Key words: CIDI, substance use disorder, exploratory factor analysis, confirmatory factor analysis

INTRODUCTION

Alcohol- and drug-related problems are among society's most pervasive health and social concerns (U.S. Department of Health and Human Services, 2000). Of all communicable and non-communicable diseases, alcohol dependence is estimated to become the fourth most debilitating disease in industrialized countries by 2020 (Murray & Lopez, 1996). Also, a report reveals that 36 percent of persons aged 12 years and older in the U.S. have used an illegal drug in their lifetime and 6.4 percent of the total population are current users of some illicit drug (U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, 1997). Understanding racial/ethnic differences in the prevalence of substance abuse is becoming increasingly important as the proportion of the U.S. population from racial/ethnic minority groups continues to increase (Office of Applied Studies, Substance Abuse and Mental Health Services Administration, 1998). Thus, achieving reliable estimates of variation in substance use disorders across racial/ethnic groups represents a significant scientific priority.

Ideally, diagnostic systems and diagnostic instruments should operate equivalently across sex, race/ ethnicity, cultures, and regions. The Composite International Diagnostic Interview ([CIDI]; World Health Organization [WHO], 1993) is the internationally standardized diagnostic interview, designed and constructed to provide comparable information about

mental disorders across populations. For this to be achieved, items/questions and operational criteria of the CIDI must be free from item- and diagnosis-level bias associated with exogenous variables such as sex and race/ethnicity (Robins *et al.*, 1988). Although some evidence supports the reliability and validity of the Substance Abuse Module of CIDI (CIDI-SAM) in a variety of cultural settings (Üstün *et al.*, 1997) and in comparisons among racial/ethnic groups (Horton, Compton, & Cottler, 2000), little is known about possible measurement bias at both item- and diagnosis-levels in cross-cultural and/or cross-racial/ethnic settings.

One of the scientifically-sound approach to this topic is an analysis of differential item functioning ([DIF]; Holland & Thayer, 1988) among groups. It is well known that a DIF analysis depends on the “unidimensionality” of the group of items intended to measure the latent continuum (Holland & Thayer, 1988; Swaminathan & Rogers, 1990), and thus, assessing the dimensional structure is an indispensable step toward DIF analysis (Mazor, Hambleton, & Clauser, 1998).

Muthén, Grant and Hasin (1993) have identified two factors, interpreted as alcohol abuse and dependence, in analyses of symptom items for alcohol problems utilizing the Diagnostic and Statistical Manual of Mental Disorders Fourth edition ([DSM-IV]; American Psychiatric Association, 1994) criteria. However, it is possible that this two-factor structure may have been artificially produced because the analysis was limited to only items for alcohol use problems; i.e., if either a group of items for abuse or that for dependence has larger correlations, such items would form a distinct factor and the remaining items might tend to constitute another factor. Therefore, both items for alcohol use problems and those for other substance use problems should be analyzed simultaneously. In addition, no prior research has addressed the dimensionality of CIDI-SAM, which includes similar items/questions of those of DSM-IV.

These provide the rationale to conduct the present study, which is the first report on the dimensionality of symptom items of the CIDI-SAM for alcohol and marijuana use problems simultaneously, using data collected in an epidemiologic community survey of young adults. Among 10 categories of substances investigated in the survey, alcohol and marijuana were selected for this report because they were by far the most commonly used substances in the sample (Turner & Gil, 2002), consistent with other U.S. data sets (U.S. Department of Health and Human Services, 1997).

METHODS

1 Study design and participants

The participants are 1,803 young men and women, with 93% being between the ages of 19 and 21, randomly selected from a larger representative cohort while they attended Miami-Dade County Public Schools, Florida, U.S.A., during 1990 through 1993 (Vega & Gil, 1998). The original participants included a

representative sample of middle school boys in the Miami-Dade public school system of South Florida. A small group of girls were also studied at that time and additional females, drawn from the same schools and of the same ages as the original male sample, were added to ensure roughly equal sex representation in the sample (952 men, 851 women). Details on the survey protocol and participants have been reported elsewhere (Iwata, Turner & Lloyd, 2002; Johnson, Turner & Iwata, 2003; Turner & Lloyd, 2004).

Written informed consent was obtained for face-to-face interviews, and verbal informed consent was obtained for telephone interviews (interview mode was determined by subjects' availability and preferences). Racial/ethnic identification by subject's report was categorized into five groups: non-Hispanic whites (Whites: N = 463), African-Americans (N = 434), Hispanics born in the U.S. (US-born Hispanics: N = 493), Hispanics born outside the U.S. (Immigrant Hispanics: N = 395), and others. The 18 subjects who were categorized as "others" were excluded from the analyses.

2 Diagnostic Interview for Substance Use Disorders

Data were obtained through computer assisted personal interviews utilizing a DSM-IV version of the Michigan revision of the CIDI, a structured interview designed to be administered by non-clinicians trained in its use (Robins et al., 1988). Each interviewer completed four days of training. The CIDI-SAM, a module focused on substance use disorders, expands on the WHO-CIDI (Cottler, Robins, & Helzer, 1989). There are no early skip outs in the CIDI-SAM, so respondents who reach a certain threshold of use of any substance are required to answer questions across the entire range of symptoms rather than just screening questions (Cottler & Compton, 1993). The threshold for the administration of alcohol use disorder questions was 12 drinks in the respondent's lifetime; the threshold for the administration of marijuana use disorder question was use more than five times. For a diagnosis of alcohol or marijuana dependence, CIDI-SAM includes seven symptoms measured by 10 items. For a diagnosis of alcohol or marijuana abuse, CIDI-SAM includes four symptoms measured by seven items. Analyses included all response data in a lifetime frame to cover the broad range of diagnostic symptoms.

3 Statistical analyses

Exploratory factor analysis (EFA) followed by the promax rotation (Hendrickson & White, 1964) was conducted to explore the dimensional structure of the 34 items measuring alcohol and marijuana use disorders. Responses of the 636 subjects who reported more than 12 drinks and more than five occasions of marijuana use in their lifetime were analyzed. Since the CIDI items were scored as dichotomous variables, we calculated the tetrachoric correlation for each pair of items, and constructed the matrix for the dimensionality analyses. In an initial EFA, factor loading of 0.40 or above was regarded as meaningful. As a second step, confirmatory factor analysis (CFA) was used to ascertain the factor structure. Both EFA and CFA were conducted using the Mplus statistical program (Muthén & Muthén, 1998).

Table 1. Promax Rotated Factor Loadings of CIDI Items for Diagnostic Criteria of the DSM-IV Alcohol and Marijuana Use Disorders

CIDI-SAM Items	Two-Factor Structure		Three-Factor Structure			Four-Factor Structure				
	F1	F2	F1	F2	F3	F1	F2	F3	F4	
	Alcohol related Problems	Marijuana related Problems	Alcohol related Problems	Marijuana related Problems	Social Problems	Alcohol Dependence	Marijuana Dependence	Social Problems	Behavior under the influence	
Alcohol Dependence Criteria										
AD1 Tolerance to a substance	.59	-.16	.68	-.04	-.24	.68	-.02	.28	.07	
AD2a Withdrawal symptoms	.61	.04	.55	.06	.13	.76	.25	-.01	-.22	
AD2b Use to relieve withdrawal	.73	.07	.60	.03	.31	.69	.15	-.23	-.07	
AD3 Using more than intended	.74	-.19	.78	-.09	-.12	.77	-.05	.17	.06	
AD4a Tried to control/cut down but could not	.64	.03	.45	-.10	.54	.55	.07	-.47	-.16	
AD4b Persistent desire to control/cut down to drink	.58	-.09	.49	-.11	.22	.61	.06	-.15	-.18	
AD5 Too much time involved in drinking alcohol	.74	-.10	.76	-.01	-.08	.68	-.05	.10	.19	
AD6 Giving up activities to obtain/use alcohol	.71	.14	.63	.15	.19	.57	.12	-.16	.18	
AD7a Continued use despite physical/mental problems	.51	.27	.54	.35	-.08	.48	.26	.10	.25	
AD7b Continued use while taking medicine	.47	.15	.51	.22	-.09	.23	-.05	.03	.55	
Alcohol Abuse Criteria										
AA1a Impaired role performance	.52	.21	.54	.28	-.07	.25	-.01	.01	.59	
AA1b Failure to fulfill role obligations	.59	.00	.48	-.04	.27	.19	-.27	-.37	.45	
AA1c Expelled from school/work due to alcohol	.38	.13	.06	-.18	.99	.03	-.10	-1.03	-.09	
AA2a Physically risk-taking behavior while using alcohol	.49	.11	.51	.18	-.04	.20	-.11	-.03	.57	
AA2b Continued after physical accident due to alcohol	.55	-.10	.47	-.11	.18	.47	-.05	-.15	-.01	
AA3 Recurrent substance-related legal problems	.47	.06	.34	-.02	.36	.24	-.06	-.37	.16	
AA4 Continued use despite social/interpersonal problems	.43	.04	.28	-.07	.42	.15	-.14	-.46	.17	

-- Continued --

Table 1. – Continued --

Marijuana Dependence Criteria										
MD1	Tolerance to a substance	-.03	.54	.07	.61	-.21	.10	.54	.25	.18
MD2a	Withdrawal symptoms	-.09	.69	-.09	.64	.08	.08	.73	.01	-.07
MD2b	Use to relieve withdrawal	.01	.68	-.06	.59	.26	.13	.71	-.17	-.11
MD3	Using more than intended	-.04	.61	.03	.66	-.13	.11	.64	.20	.10
MD4a	Tried to control/cut down but could not	-.07	.68	-.20	.54	.41	-.04	.64	-.34	-.11
MD4b	Persistent desire to control/cut down to use	-.18	.50	-.18	.47	.05	.04	.62	.05	-.21
MD5	Too much time involved in using a substance	.00	.55	.05	.58	-.09	.01	.45	.10	.26
MD6	Giving up activities to obtain/use a substance	.17	.70	.16	.68	.08	.11	.55	-.05	.31
MD7a	Continued use despite physical/mental problems	.01	.68	.08	.73	-.12	.09	.63	.16	.24
MD7b	Continued use while taking medicine	.36	.28	.42	.36	-.13	.02	-.05	.03	.79
Marijuana Abuse Criteria										
MA1a	Impaired role performance	.14	.50	.18	.55	-.09	-.16	.17	.01	.73
MA1b	Failure to fulfill role obligations	.12	.64	.06	.57	.22	-.17	.31	-.29	.51
MA1c	Expelled from school/work due to a substance	.11	.46	-.09	.29	.56	-.13	.25	-.57	.11
MA2a	Physically/risk-taking behavior while using a substance	.02	.59	.11	.67	-.20	-.23	.28	.13	.75
MA2b	Continued after physical accident due to a substance	.33	.34	.23	.28	.26	.20	.25	-.24	.15
MA3	Recurrent substance-related legal problems	-.11	.54	-.27	.39	.46	-.23	.39	-.43	.03
MA4	Continued use despite social/interpersonal problems	.13	.38	.07	.32	.19	-.01	.22	-.21	.22
Interfactor Correlations										
F2		.44		.35			.20			
F3				.29			-.30			
F4							.42			
										-.30

Loadings greater than 0.400 (absolute value) have been boldfaced.

To evaluate the overall fit of the measurement models, two criteria were used: (1) a χ^2 to degree of freedom ratio of less than 5.0 (Bollen, 1989) and (2) the Comparative Fit Index (CFI). The CFI is an incremental fit index derived by comparing the predicted covariation in the hypothesized model to that of the null model (i.e., specifying no associations), with values greater than .90 indicating a good fit of the model to these data. To examine model fit, χ^2 , the goodness of fit index ([GFI]; Jöreskog & Sörbom, 1984) and the root mean square error of approximation ([RMSEA]; Browne & Cudeck, 1993) were used.

RESULTS

1 Exploratory Factor Analysis of the CIDI-SAM Items on Alcohol and Marijuana

The initial EFA revealed that eigenvalues of 11 factors were greater than 1.0; eigenvalues (and proportion of variance explained) of the first factor was 9.95 (29.3%), and those of the subsequent 10 factors were 3.64 (10.7%), 2.67 (7.9%), 2.45 (7.2%), 2.03 (6.0%), 1.69 (5.0%), 1.48 (4.4%), 1.40 (4.1%), 1.21 (3.6%), 1.12 (3.3%), and 1.07 (3.2%), respectively. Based on the scree plot, two and four factors appeared reasonable to extract; thus, the promax rotation was conducted for two through five factors to examine the divergence of factors extracted.

The two-factor solution (first two columns of Table 1) grouped items according to the target substance: “Alcohol-related problems” and “Marijuana-related problems.” Loadings below the threshold (0.400) were found for an alcohol abuse (AA1c), a marijuana dependence (MD7b) and two marijuana abuse items (MA2b, MA4). Interfactor correlation of 0.437 corresponded to an angle of 64° between two factor axes, and suggested that they did not exist independently.

The four-factor solution grouped all but two dependence items (AD7b, MD7b) into two factors, F1 (Alcohol Dependence) and F2 (Marijuana Dependence). AA2b did not load on any abuse-related factor (F3 or F4) but on F1. F3, “Social Problems (as outcomes of usage),” included the corresponding an abuse item (A1c) for both substances, an alcohol abuse item (AA4), and a marijuana abuse item (MA3). An alcohol dependence item (AD4a) also showed duplicate allocation to F3. F4, “Behavior under the influence,” consisted of eight items, the corresponding four items for both alcohol and marijuana: one dependence (D7b) and three abuse items (A1a, A1b, A2a). Of the 34 items, AA3, MA2b, and MA4 did not show “significant” loading on any of these factors.

Interfactor correlations indicated that “Alcohol Dependence” existed rather independently of “Marijuana Dependence” (0.196: factor axes angle of 79°). All negative interfactor correlations of “Social Problems” were due to the negative direction of this factor (all “significant” loadings were negative).

2 Confirmatory Factor Analysis of the CIDI-SAM Items on Alcohol and Marijuana

The two measurement models based on EFA and three other hypothetical models were subjected to CFA. Figure 1 displays the models assessed, except for the one-factor (F1) model: in the F1 model, all items loaded on one global latent variable; in two-factor models, items loaded on two latent variables according to the target substance (F2-A) or according to the symptom category (F2-B); in four-factor models, items loaded on four latent variables according to the target substance and symptom category (F4-A) or according to the four-factor structure from EFA (F4-B).

Table 2 shows fit indices of the models and their comparisons. The model fit indices in general are sensitive to the sample size, so every χ^2 reached a significant level and GFI did not reach the criterion of 0.85 or greater (Jöreskog & Sörbom, 1993). Also, the CFI values of all these models did not reach 0.90.

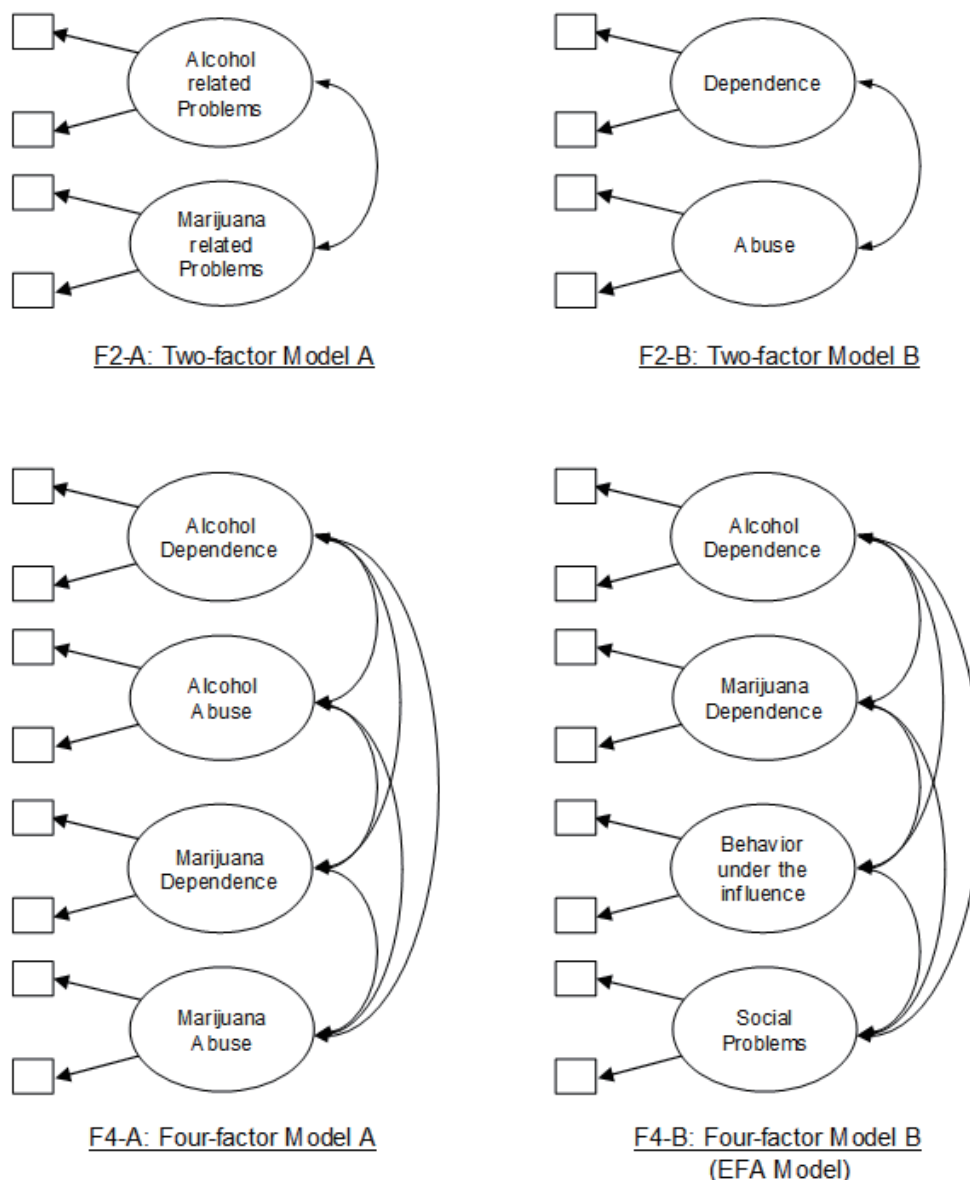


Figure 1. Measurement Models of Diagnostic Symptoms for Alcohol/Marijuana Use Disorders

In contrast, RMSEA for F2-A, F4-A, and F4-B models indicated relatively good fit (Browne & Cudeck, 1993). F2-A model better represented the actual data than F2-B model by means of a difference of χ^2 value ($\Delta\chi^2$) as compared to F1 model. F4-A and F4-B models better represented the data than did F2-A model. Furthermore, F4-B model showed significantly better fit than F4-A model. F4-A and F4-B models generally corresponded in assignment of items to Alcohol Dependence and Marijuana Dependence factors, but differed in assignment of abuse items. These results suggest that substance dependence items form distinct

unidimensional groups for each substance; however, substance abuse items do not appear distinct for alcohol and marijuana nor unidimensional across items.

DISCUSSION

This study was the first to investigate the dimensionality of symptom items for alcohol use problems and those for other substance use problems of the CIDI-SAM simultaneously. Our sample consisted of representative community dwelling young adults. The dimensional structure of items for alcohol and marijuana use disorders did not necessarily correspond to diagnostic categories: i.e., although two factors could reflect independently alcohol and marijuana dependence, abuse items were grouped not by substance category but rather by the nature of problems of substance misuse (Table 1). This observation was initially derived via EFA, and was subsequently confirmed via CFA, which allowed us to conduct a more rigorous comparison (Figure 1 and Table 2).

Some prior researches support a unidimensionality of the 11 DSM-IV criteria (e.g., Dawson et al., 2010; Rose et al., 2012) for alcohol use problems based both on EFA and CFA. In addition, Rose and her colleagues (2012) mentioned that CFA specifying 2 separate factors for dependence and abuse criteria did not fit the data any better than the one factor model, providing further support for a single underlying alcohol use problem factor. In contrast, Muthén and his colleagues (1993) have identified two factors, interpreted as alcohol abuse and dependence. Thus, the previous findings on the dimensionality of the symptoms for dependence and abuse have been contradictory.

If alcohol use symptoms could be underlying a unidimensional construct as some US researchers have reported (e.g., Dawson et al., 2010; Rose et al., 2012), and marijuana use symptoms as well, our F2-A model should be the best among the five models examined here. However, the present study revealed that the majority of the common variance in the 34 items for CIDI-SAM symptoms on alcohol and marijuana use explained by four factors, i.e., alcohol dependence, marijuana dependence, behavior under the influence, and social problems, while these were slightly to moderately correlated. This type of analytic design used in this study seems the first attempt to investigate the dimensionality of these substance use-related symptoms. Thus,

Table 2. Measures of Model Fit for Each Model by a CFA and Comparisons of Models

Dimensionality Models		χ^2	<i>df</i>	χ^2/df	GFI	RMSEA	Comparison of Models	$\Delta\chi^2$	Δdf
One-Factor	Model (F1)	2853.86	527	5.42	.774	.083	F1 vs F2-A	375.25	1
Two-Factor	Model A (F2-A)	2478.60	526	4.71	.809	.076	F1 vs F2-B	120.94	1
	Model B (F2-B)	2732.92	526	5.20	.778	.081	F2-A vs F4-A	182.09	5
Four-Factor	Model A (F4-A)	2296.52	521	4.41	.822	.073	F2-A vs F4-B	227.85	6
	Model B (F4-B)	2250.75	520	4.33	.827	.072	F4-A vs F4-B	45.76	1

GFI: Goodness-of-Fit Index, RMSEA: Root Mean Square Error of Approximation.

All the models and comparisons of models are statistically significant ($p < .001$).

the difference between these findings might be in part attributable to that we analyzed response data on both alcohol and marijuana use simultaneously.

Nevertheless, if we assume symptoms of substance use disorders are of dimensional nature, at least based on the present study, substance dependence can be expressed by a unidimensional construct. In contrast, substance abuse appears to be a multidimensional or non-dimensional construct. One exception to the unidimensionality of substance dependence was item D7b (“continued use while taking medicine”), which was allocated to the “Behavior under the influence” factor along with some abuse items. Considering its content, this allocation pattern does not seem unreasonable for young subjects, but may not hold for older subjects. A further investigation on older subjects is warranted in this regard.

CONCLUSION

By analyzing the responses to the 34 CIDI-SAM symptom items (17 each for alcohol and marijuana) obtained from 636 subjects who were alcohol and marijuana users from a representative community sample of young adults, the four factors were extracted; two represented alcohol dependence and marijuana dependence, and another two corresponded to behavior under the influence and social problems, respectively. Alcohol and marijuana abuse items were not distinguished by substance, but rather by the domains of problems related to general substance abusing behavior. Within specific substances, dependence as measured by the CIDI-SAM appears to be a unidimensional construct. Conversely, abuse appears to be a multidimensional construct irrespective of the substance concerned.

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