

Construct and Differential Item Functioning in the Assessment of Prescription Opioid Use Disorders Among American Adolescents

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ABSTRACT

Objective: To examine the psychometric properties of diagnostic criteria for prescription analgesic opioid use disorders (OUDs) and to identify background predictors of a latent continuum for OUD liability. **Method:** Data were drawn from the adolescent sample of the 2006 National Survey of Drug Use and Health. Item response theory (IRT) and multiple indicators–multiple causes methods were used to examine *DSM-IV* criteria for OUDs in a subsample of adolescents who reported nonmedical prescription opioid use in the past year ($N = 1,290$). **Results:** Among nonmedical users of prescription opioids, the criteria of OUDs were arrayed along a single continuum of severity. All abuse criteria were endorsed at a severity level higher than D1 (tolerance) and D5 (time spent) but lower than D3 (taking larger amounts) and D4 (inability to cut down). Differential item functioning in reports of dependence symptoms across adolescents' sex and race/ethnicity were identified: withdrawal, time spent, and continued use despite medical or psychological problems. Adjusting for the effects of differential item functioning and the demographic variables examined, female subjects were more likely than male subjects to exhibit a higher level of OUD liability. **Conclusions:** Study findings do not support the *DSM-IV*'s current hierarchical distinction between abuse of and dependence on prescription opioids. Abuse symptoms in adolescents are not necessarily less severe than those of dependence. There is evidence of some differential item functioning in the assessment of OUDs. *J. Am. Acad. Child Adolesc. Psychiatry*, 2009;48(5):563–572. **Key Words:** *DSM-IV*, item response theory, nosology, opioid use disorders.

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According to the *DSM-IV*,¹ an abuse diagnosis is limited to individuals who do not meet criteria for a drug dependence diagnosis and is defined only by the harmful consequences of repeated use.¹ The *dependence syndrome* was first introduced by Edwards and Gross,² who posited that the unidimensionality of a set of behavioral, cognitive, and physiological components constituted a clinical syndrome for alcoholism. This syndrome was considered distinct from the consequences of heavy drinking (e.g., social or legal problems),³ and this biaxial conceptualization guides the separation of dependence and abuse for alcohol and drug use disorders in *DSM-III-R*⁴ and *DSM-IV*. Dependence is described as unidimensional in nature and noncategorical,² but because of considerations of clinical practice, it was dichotomized at a threshold of three or more criteria. The validity of the distinction between dependence and abuse is controversial, as some studies have suggested that dependence and abuse constitute a single construct.⁵ The present

relative positions of dependence and abuse along a continuum of severity are of concern because the manner in which a given disorder is defined directly affects prevalence estimates of the disorder and its needs for treatment.

To date, little is known about whether the distinction between abuse and dependence is applicable to adolescents who have opioid use disorders (OUDs). Data from the 2007 National Survey on Drug and Health (NSDUH) revealed that OUDs constitute the second most prevalent nonalcohol drug use disorder,⁶ following only marijuana use disorders. Analgesic opioids have become one of the most commonly used drugs by new drug users and also are much more likely to be used nonmedically than all other abusable psychotherapeutic drugs considered in aggregate.⁶ Among American adolescents aged 12 to 17 years, approximately 1 in 10 has used analgesic opioids nonmedically.⁷ Hydrocodone, propoxyphene, and codeine are the opioids of choice among adolescents.⁷

A recent study of a national sample of adolescents further revealed that at least one third of nonmedical users of prescription opioids manifest OUD symptoms.⁸ Among adolescents who reported nonmedical opioid use in the previous year, 7% and 9% met *DSM-IV* criteria for opioid abuse and dependence, respectively. An additional 20% of the sample was classified as *diagnostic orphans* (endorsing one to two dependence criteria and no abuse). Although diagnostic orphans are not currently captured by *DSM-IV*, they also exhibited elevated odds of depression, alcohol use disorders, and polydrug use. Furthermore, symptoms of opioid dependence among adolescents are twice as prevalent as those of opioid abuse (24% versus 12%), and dependence on opioids can occur in the absence of abuse.⁸ This finding implies that dependence may not be more severe than abuse as suggested by *DSM-IV*.¹ Together, recent findings show not only that the nonmedical use of opioids poses a threat to the nation's youth but also that *DSM-IV*'s criteria may be inadequate in classifying OUDs in adolescents. Given that the valid classification of OUDs is fundamental to estimating the populations' needs for prevention and treatment, it is important to investigate the validity of the hierarchical distinction between dependence and abuse for OUDs.

As demonstrated by recent studies,^{9–11} item response theory (IRT)¹² modeling constitutes an appropriate method to evaluate the latent construct underlying

DSM-IV criteria for abuse and dependence. It assumes that a single construct is tapped by a set of items or criteria and can be used to evaluate the psychometric properties of each constituent indicator for a disorder. Item response theory uses information from each item and item endorsement patterns to estimate the level of severity that each item assesses along the latent trait severity of the OUD liability construct as measured by the 11 criteria (i.e., item severity). It also provides estimates to describe how precisely each item discriminates among users at different risk for OUDs (i.e., item discrimination). An item with a low discrimination value would suggest low precision (i.e., higher measurement error). Low discrimination could indicate that the indicator is unrelated to the underlying construct of OUD risk or the indicator is poorly defined.¹³

Recent IRT studies have found that *DSM-IV* criteria for alcohol and specific drug use disorders in adult samples reflect a single continuum of severity.^{9,10} Among adolescents, *DSM-IV* criteria for alcohol and marijuana use disorders have also yielded a single dimensional construct.^{11,14,15} These studies demonstrate that *DSM-IV* criteria for abuse and dependence may represent only one condition and not the two specified by *DSM-IV*.¹ Whereas a unidimensional construct of *DSM-IV* criteria for alcohol and drug use disorders is consistently observed, IRT studies also reveal substance-specific variations in item-level contributions to the underlying construct.^{9,11,14,15} For example, two abuse criteria (social problems and role interference) and one dependence criterion (time spent) were found to indicate the lowest severity levels on the marijuana use disorder continuum,¹⁴ whereas tolerance and social problems tapped the lowest level on the alcohol use disorder continuum.¹⁵ The study of adolescent marijuana users further revealed that several criteria exhibited comparatively low levels of precision in distinguishing among problematic users (e.g., items measuring continued use despite reporting resulting problems and an inability to cut down).¹⁴ It has been suggested that the *DSM-IV* criteria are developed mainly from studies of adult samples and that they may be less reliable in assessing adolescent drug use disorders.¹⁶

Furthermore, recent studies have found differential item functioning (DIF)—differential reporting of criterion symptoms of alcohol and marijuana use disorders—by sex and race/ethnicity,^{14,17} which indicates that the severity level of certain criteria along the

latent continuum may vary by these characteristics. An ideal criteria set would show no evidence of DIF because its presence could lead to errors in comparing the disorder across groups, if these differences were not controlled statistically.¹⁸ This issue has important implications for risk factor assessments of substance use disorders because traditional epidemiological studies have often not taken DIF into account, and the resulted associations between two groups could be confounded by differential reporting across groups (e.g., measurement artifact). We are not aware of any studies of predictors of OUDs or risk among adolescents that take DIF into account.

Taken together, recent findings emphasize the need to move from a reliance on generic IRT analyses to a more in-depth investigation of psychometric performance of each item used to determine a given disorder. This investigation should be performed for each substance of use, given the variability in pharmacological effects. Specifically, a greater level of understanding of the contributions of specific item-level variations to the latent construct of each substance use disorder is needed, and DIF across key demographic groups should be elucidated to inform revisions of the *DSM* criteria. Given increased rates of nonmedical opioid use and related disorders,^{6–8} it is also critically important to identify subgroups that exhibit a high risk for the disorder using a regression framework that controls for the potentially confounding effects of DIF in reports of diagnostic criteria.

To date, criteria for current OUDs in adolescents have yet to be subjected to IRT analysis. Whereas recent IRT analyses of the latent construct of alcohol and marijuana use disorders among adolescents have used IRT,^{11,14,15} we apply both IRT and multiple indicators–multiple causes (MIMIC) methods to examine *DSM-IV* criteria and DIF. Importantly, MIMIC modeling can detect the DIF of criteria for multiple demographic variables while controlling for the overall level of OUD liability (as measured by the 11 criteria of OUDs). It also facilitates the statistical adjustment for DIF in the analysis of predictors of the latent construct within a regression framework, thereby reducing the potential for distortion of the risk factor assessment.^{17,18}

To reflect latent variable modeling, we use the term *OUD liability* to describe the latent trait severity of the OUD construct. This investigation relies on newly released data from the 2006 NSDUH,¹⁹ which

constitutes the largest nationally representative sample of American adolescents. We examine DIF by participants' sex, age, and race/ethnicity because these characteristics are associated with nonmedical use of opioids⁸ and because prevalence estimates of substance use disorders are often disaggregated by these variables to reflect disparities in problems and to guide health policies related to treatment and research.^{19,20}

This study addresses the following questions:

- Do the criteria of OUDs form a single continuum of severity (one factor)?
- If so, where along this continuum does each criterion lie, relative to the others (item severity or what level of severity does each assess)?
- How well does each criterion perform, or discriminate, relative to the others (item discrimination)?
- Does the probability of endorsing the criteria of OUDs at any given level of severity differ across sex, age, and race/ethnicity (DIF)?
- What demographic subgroups manifest a comparatively high severity along the OUD continuum?

METHOD

Study Sample

This study used data from the subsample of adolescents reporting the nonmedical use of prescription opioids ($N = 1,290$) in the public use file of the 2006 NSDUH.¹⁹ The NSDUH is the only ongoing survey that provides estimates of substance use and related disorders in the U.S. population. The survey's sampling frame covers approximately 98% of the total U.S. population aged 12 years or older and uses multistage area probability sampling methods to select a representative sample of the civilian noninstitutionalized population (i.e., household residents; U.S. residents of shelters, rooming houses, and group homes; residents of Alaska and Hawaii; civilians residing on military bases). As described elsewhere, the NSDUH uses methods that ensure that each cross-sectional sample is representative of the U.S. general population aged 12 years and older.

Participants were interviewed in private at their places of residence. They were assured that their names would not be recorded and that their responses would be kept strictly confidential. All field interviewers signed a confidentiality agreement, and consent forms explaining data collection procedures and protections were carefully administered. The NSDUH uses a combination of computer-assisted personal interviewing and audio computer-assisted self-interviewing methodologies to increase the validity of participants' reports of substance use and sensitive behaviors.²¹ Demographic items were administered by the field interviewer via computer-assisted personal interviewing. The interview was then conducted via audio computer-assisted self-interviewing, which provided participants with a highly private and confidential setting in which to answer sensitive questions (e.g., use of alcohol and other drugs). Questions were shown on a computer screen and administered orally through headphones to participants, who then

entered responses directly into a computer. The weighted response rate of interviewing for adolescents aged 12 to 17 years was 85.5%. Of all adolescents aged 12 to 17 years ($N = 18,314$), 52% were female subjects, and 40% were nonwhite.

Study Variables

Nonmedical use of opioids was defined as any self-reported use of prescription pain relievers that were not prescribed for the participant or that the participant took only for the experience or feeling they caused.⁸ Participants were read the following statement: "These questions are about prescription pain reliever use. We are not interested in your use of 'over-the-counter' pain relievers such as aspirin, Tylenol, or Advil that can be bought in drug stores or grocery stores without a doctor's prescription." The survey then used a series of discrete questions to assess each participant's history of nonmedical use of prescription pain relievers (e.g., Vicodin, Lortab, Darvocet, codeine, Percocet, Tylox, hydrocodone, and OxyContin).⁷

Past-year abuse of and dependence on prescription pain relievers were specified by *DSM-IV* criteria.¹ Four *abuse* criteria included (A1) serious problems at home, work, or school; (A2) regular consumption that put the user in physical danger; (A3) repeated use that led to trouble with the law; and (A4) problems with family or friends caused by continued use. Seven *dependence* criteria included (D1) tolerance; (D2) withdrawal; (D3) more frequent use than intended or inability to maintain limits on use; (D4) inability to reduce or stop use; (D5) spending a great deal of time over a period of a month using or getting over the effects of the pain relievers; (D6) reduced involvement or participation in important activities because of use; and (D7) continued use despite related problems with emotions, nerves, or mental or physical health. Detailed questions are reported elsewhere.⁸

Demographic variables examined included participants' age, sex, race/ethnicity, and family income. The selection of these variables

was based on their previously reported associations with nonmedical opioid use from this dataset.⁸ Family income was included as a potential confounder of our analysis of the race/ethnicity variable.

Data Analysis

We first identified the subset of adolescents who reported any non-medical use of prescription opioids and used SUDAAN²² to assess the distributions of study variables. All the subsequent factor, IRT, and MIMIC analyses were conducted by Mplus²³ and were based on this subsample of past-year nonmedical opioid users ($N = 1,290$). Factor analysis for binary data was conducted using a weighted least squares estimation procedure to examine IRT's assumption of unidimensionality,¹² which is established by demonstrating that a single factor model provides the most parsimonious fit to the data. We assessed the number of factors to be retained by means of a scree plot of eigenvalues²⁴ and the ratio of the first to the second eigenvalue.

A two-parameter IRT model was conducted to examine the relation between participants' response to an item and their level on the OUD liability continuum, which is described by a monotonically increasing S-shaped *item characteristic curve* (ICC).¹² An ICC is characterized by item severity and discrimination parameters. An item *severity* parameter indicates the position of the ICC in relation to the latent continuum, typically ranging from -3 to $+3$ standardized units below and above the mean score of zero. The severity parameter represents the location along the latent trait of OUD liability, in which a respondent has a 50% probability for endorsing any given criterion. Higher severity values indicate that the criterion is associated with a higher risk for OUD. The item *discrimination* parameter measures the degree of precision with which a criterion discriminates among participants with levels of OUD liability above and below the criterion's level of severity.²⁵ The higher a discrimination value, the more useful the item is for discriminating OUD liability levels among drug users along the continuum.

TABLE 1

Selected Socioeconomic Characteristics of Adolescent Participants Aged 12 to 17 Years Who Reported Nonmedical Use of Prescription Analgesic Opioids in the Past Year ($N = 1,290$)

Weighted Proportion, %	All Users	Users Without Abuse and Dependence	Users With Opioid Abuse	Users With Opioid Dependence
Sample size	$N = 1,290$	$n = 1,104$	$n = 97$	$n = 89$
Sex				
Male	47.9	49.5	47.9	30.2 ^a
Female	52.1	50.3	52.1	69.8
Age group, y				
12–13	14.7	14.7	20.3	9.6
14–15	33.5	31.8	42.9	42.6
16–17	51.8	53.5	36.8	47.8
Race/ethnicity				
White	66.8	66.8	59.3	73.1
African American	11.6	12.0	10.6	9.1
Hispanic	14.7	14.7	23.0	9.2
Other	6.9	6.7	7.1	8.5
Family income				
<\$40,000	41.8	41.4	47.0	41.8
\$40,000–\$74,999	31.0	31.9	30.9	22.0
≥\$75,000	27.1	26.8	22.1	36.2

^a $\chi^2 = 7.94, p = .02$; all of the other comparisons are not significant ($p > .5$).

TABLE 2
Item Response Theory Analysis of *DSM-IV* Criteria of Prescription Opioid Use Disorders Among Nonmedical Users Aged 12 to 17 years (*N* = 1,290)

Criteria for Abuse and Dependence	Percentage ^a	Factor Loadings			Discrimination (SE)			Item Severity (SE)		
		Abuse/ Dependence ^b	Abuse ^c	Dependence ^d	Abuse/ Dependence ^b	Abuse ^c	Dependence ^d	Abuse/ Dependence ^b	Abuse ^c	Dependence ^d
A1: Role interference	7.3	0.83	0.87	—	1.49 (0.22)	1.76 (0.28)	—	1.76 (0.14)	1.68 (0.13)	—
A2: Hazardous use	6.9	0.81	0.82	—	1.39 (0.19)	1.41 (0.26)	—	1.83 (0.14)	1.82 (0.15)	—
A3: Problems with the law	2.1	0.85	0.92	—	1.58 (0.44)	2.41 (1.25)	—	2.42 (0.25)	2.21 (0.23)	—
A4: Relationship problems	3.1	0.90	0.92	—	2.09 (0.45)	2.39 (0.78)	—	2.06 (0.17)	2.02 (0.17)	—
D1: Tolerance	19.7	0.78	—	0.80	1.24 (0.16)	—	1.33 (0.20)	1.09 (0.10)	—	1.07 (0.10)
D2: Withdrawal	8.0	0.64	—	0.66	0.84 (0.13)	—	0.89 (0.14)	2.19 (0.24)	—	2.12 (0.22)
D3: Taking larger amounts	2.2	0.50	—	0.54	0.58 (0.13)	—	0.64 (0.15)	4.02 (0.81)	—	3.74 (0.74)
D4: Inability to cut down	2.5	0.42	—	0.44	0.46 (0.14)	—	0.49 (0.14)	4.68 (1.20)	—	4.47 (1.05)
D5: Time spent using	16.9	0.85	—	0.89	1.63 (0.31)	—	1.92 (0.42)	1.12 (0.09)	—	1.08 (0.09)
D6: Giving up activities	6.4	0.79	—	0.79	1.27 (0.19)	—	1.28 (0.21)	1.94 (0.16)	—	1.94 (0.17)
D7: Continued use despite medical/psychological problems	4.5	0.88	—	0.89	1.85 (0.40)	—	1.95 (0.51)	1.93 (0.16)	—	1.91 (0.17)

^aPrevalence of symptoms.

^bThe model included all 11 abuse and dependence criteria: Comparative Fit Index = 0.987; Tucker-Lewis Index = 0.989; Root Mean Square Error of Approximation = 0.012.

^cThe model included the four abuse criteria only: Comparative Fit Index = 1.00; Tucker-Lewis Index = 1.00; Root Mean Square Error of Approximation ≤ 0.001.

^dThe model included the seven dependence criteria only: Comparative Fit Index = 0.996; Tucker-Lewis Index = 0.996; Root Mean Square Error of Approximation = 0.007.

Finally, MIMIC modeling was conducted to examine DIF for each criterion by sex, age, and race/ethnicity. This analysis involved sequential tests of DIF by participants' background variables. The results reported here were based on the model that had detected DIF. Participants' family income was included as a control variable.⁷ The Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA) were all used to assess model fit. Values of TLI and CFI above 0.95 and values of RMSEA below 0.06 indicate an excellent fit of the model to the data;^{26,27} the closer these values are to 1.00 and 0, respectively, the better the fit. All results reported here are weighted estimates; only sample sizes are unweighted.

RESULTS

Nonmedical Opioid Users

Among the sample of adolescents aged 12 to 17 years, 7% ($N = 1,290$) reported nonmedical opioid use in the past year. Within this subsample, 15.1% met *DSM-IV* criteria either for opioid abuse (7.4%) or dependence (7.7%) in the past year. As shown in Table 1, 52% were female, and 67% were white.

Types of Opioids Used

Propoxyphene, hydrocodone, oxycodone, and codeine products were more commonly used than the other types of opioids: Vicodin, Lortab, Lorcet, or Lorcet Plus (for which lifetime use was reported by 52% of users);

Darvocet, Darvon, or Tylenol with codeine (48%); Percocet, Percodan, or Tylox (20%); generic hydrocodone (20%); OxyContin (17%); generic codeine (17%); morphine (9%); methadone (8%); and Demerol (4%). The rate of use of other prescription pain relievers was low.

Factor Analysis

The scree plot and the ratio of the first eigenvalue to the second ($6.31/1.05 = 6.0$) indicated that a one-factor model accommodated all 11 criteria for OUDs well (CFI = 0.987, TLI = 0.989, RMSEA = 0.012). The two-factor model also fit the data well (CFI = 0.998, TLI = 0.998, RMSEA = 0.005). However, the abuse factor (measured by the four abuse criteria) and the dependence factor (measured by the seven dependence criteria) were highly correlated (correlation = 0.86). The high level of correlation between the two factors and excellent fit indices from the one-factor model indicated evidence of unidimensionality to allow IRT modeling.

IRT Modeling

Table 2 summarizes IRT estimates for item severity and discrimination. The ICCs that relate the probability of endorsing each criterion (discrimination) to the level of OUD liability (severity) are shown in Figure 1. Here, item

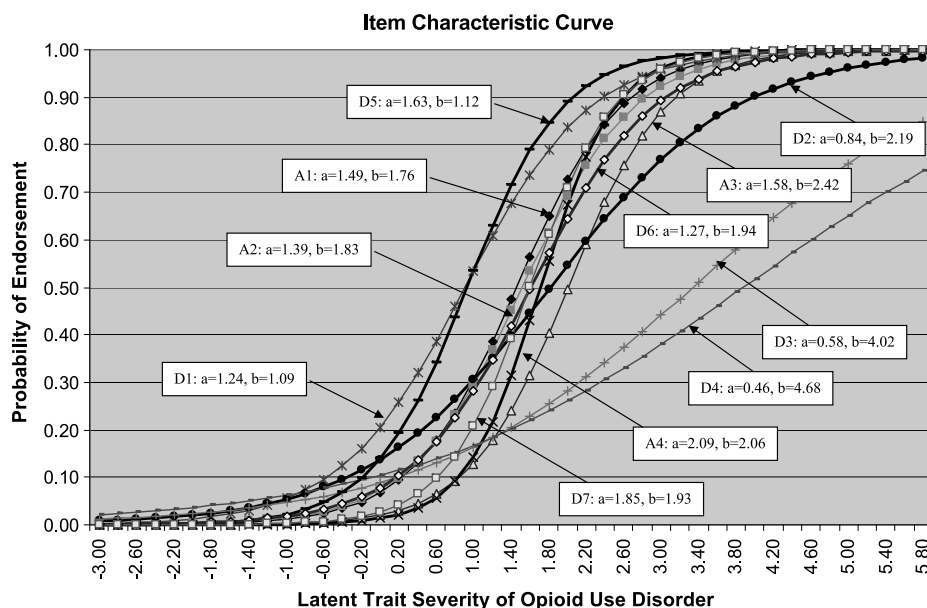


Fig. 1 Item characteristic curves (ICCs) for *DSM-IV* criteria of prescription opioid use disorders among nonmedical users aged 12 to 17 years ($N = 1,290$). A1 = role interference; A2 = hazardous use; A3 = problems with the law; A4 = relationship problems; D1 = tolerance; D2 = withdrawal; D3 = taking larger amounts; D4 = inability to cut down; D5 = time spent using; D6 = giving up activities; D7 = continued use despite medical or psychological problems.

severity is defined as the point on the latent continuum of OUD liability at which the probability of endorsing a specific item is 50%. It describes at what severity level of OUD liability the symptom is most informative or useful in scaling those with less severe or more severe risk for OUD. Item discrimination represents an item's ability to discriminate between drug users with the level of OUD liability above and below that item's severity level. Discrimination and severity parameters are similar to factor loadings and threshold parameters in a dichotomous factor analysis.²⁸

Discrimination. Comparatively poorer discrimination power (0.46–0.84) was noted for D2 (withdrawal), D3 (taking larger amounts), and D4 (unable to cut down). All the other criteria exhibited a good discriminatory power (1.27–2.09) in distinguishing between users at

middle-to-high severity levels of OUD liability (severity: 1.12–2.42).

Severity. Item severity parameters ranged from 1.09 (D1: tolerance) to 4.68 (D4: inability to cut down). The high severity parameter estimates (>4.0) of D3 (taking larger amounts) and D4 (inability to cut down) suggest that only participants with a severe level of OUD liability endorsed them (shifted to the right end of Fig. 1). However, their high SEs suggest that the number of participants with only high levels of risk was limited. All abuse criteria were endorsed at a severity level higher than D1 (tolerance) and D5 (time spent) but lower than D3 (taking larger amounts) and D4 (inability to cut down).

Individual Item Information and Precision. Item-level variations in the amount of psychometric information or the degree of precision that each criterion contributes to

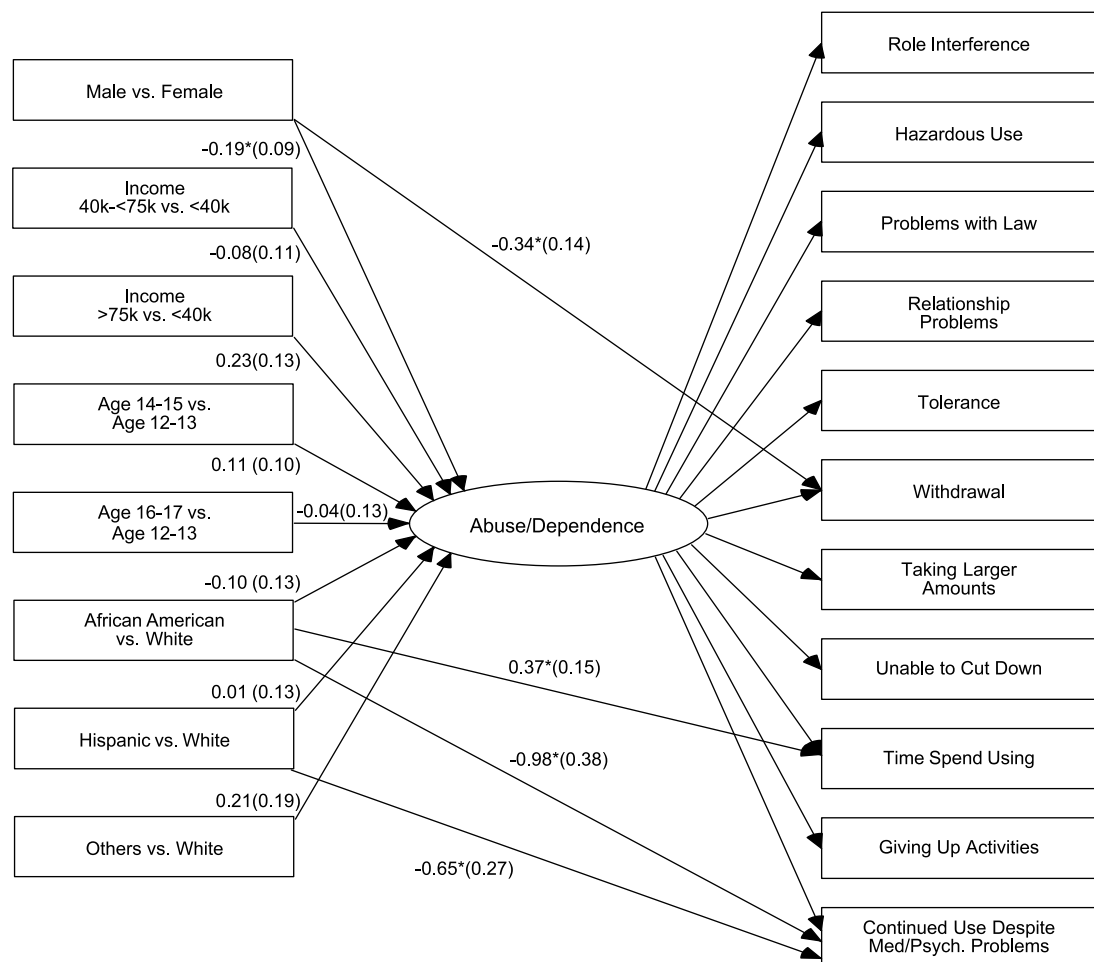


Fig. 2 The MIMIC model of DSM-IV criteria of prescription opioid use disorders among nonmedical users aged 12 to 17 years ($N = 1,290$). MIMIC = multiple indicators–multiple causes regression coefficients (SE); * $p < .05$.

ODL liability at each severity level are shown as item information curves. An item measures the level of severity on the continuum with greatest precision at or near the peak of the item's severity parameter. The amount of item information decreases as the severity level departs from the item's severity parameter. D3 (taking larger amounts) and D4 (inability to cut down) were least reliable in assessing ODL liability (low information and high measurement error). (Item information curves can be found in the supplemental digital content [online-only] material at <http://admin.links.lww.com/A895>.)

For purposes of comparison, Table 2 also includes IRT analyses of the four abuse criteria only (CFI = 1.00, TLI = 1.00, RMSEA <0.01) and of the seven dependence criteria only (CFI = 0.997, TLI = 0.996, RMSEA <0.01). Each discrete IRT model also exhibited an excellent fit to the data and yielded a single dimensional construct.

MIMIC Modeling

The MIMIC model (Fig. 2) fit the data well (CFI = 0.988, TLI = 0.988, RMSEA = 0.019). This model incorporates a measurement component of the 11 criteria (on the right side of Fig. 2) and regression analyses of predictors (on the left side of Fig. 2) and DIF (a direct relation between a demographic variable and an ODL indicator). It enabled us to estimate DIF of each criterion and predictors of ODL liability measured by the criteria simultaneously.

Differential Item Functioning. Differential item functioning analysis showed that the male subjects were less likely than the female subjects to endorse "withdrawal" (regression coefficient or $\beta = -.34$, $p = .01$), even after holding constant participants' level of ODL liability and demographic characteristics. At the equivalent level of ODL liability and as compared with whites, African Americans were more likely to endorse "time spent using" ($\beta = .37$) but less likely to endorse "continued use despite problems" ($\beta = -.98$), and Hispanics were less likely to report "continued use despite problems" ($\beta = -.65$).

Background Predictors of ODL Liability. The MIMIC model, which statistically adjusted for DIF as well as participants' age, race/ethnicity, and family income, showed a lower level of ODL liability among the male subjects than the female subjects ($\beta = -.19$). We explored the impact of DIF on regression coefficients of predictors of ODL liability by comparing the model with and without DIF. We found a 14% change in the

regression coefficient of the sex variable (reduced from -0.22 to -0.19 after DIF was adjusted in the model). There were also some changes in the regression coefficient for African American versus white (from -0.07 to -0.10) and for Hispanic versus white (from -0.09 to 0.01).

DISCUSSION

In this nationally representative sample of adolescent nonmedical opioid users, the criteria of ODLs were arrayed along a single continuum of severity. All abuse criteria were endorsed at a severity level higher than D1 (tolerance) and D5 (time spent) but lower than D3 (taking larger amounts) and D4 (inability to cut down). The abuse indicators clustered well with three dependence criteria (withdrawal, giving up activities, and continued use despite problems). These findings provide compelling evidence of a single dimensional construct for ODL liability and thus replicate previous studies of other substance use disorders in adult and adolescent samples. These studies have also found that abuse symptoms are not necessarily located on a less severe end of the continuum than dependence symptoms and have concluded that abuse and dependence may not represent two distinct conditions.^{9-11,14,15} The present findings further extend earlier work by applying MIMIC modeling to examine DIF and demonstrate differential symptoms endorsement in a risk factor analysis of the ODL construct in adolescents.

This investigation is one of few studies to focus specifically on all 11 *DSM-IV* criteria as applied over a 12-month period.¹⁰ Previous IRT analyses have typically examined *lifetime DSM-IV* symptoms that may have occurred sporadically over a longer period of time.^{9,14,15,29} The lack of similar studies of the ODL construct in adolescents constrains our ability to compare our findings with those of other studies. Nonetheless, our results are commensurate with previous IRT modeling of *DSM* criteria both for specific substance use disorders in adults^{9,10,29} and for alcohol or marijuana use disorders in adolescents,^{11,14,15} which have all revealed that criteria for abuse and dependence collectively reflect a unidimensional latent trait of severity. Abuse criteria may thus not necessarily be located lower than dependence criteria on a continuum of severity.

Several other findings also emerged from our study. Most individual criteria, except for D3 (taking large

amounts) and D4 (inability to cut down), seem to differentiate in a similar manner among participants with moderate-to-high levels of OUD liability, as shown by the clustering of several criteria from item characteristic curves. In addition, items D3 and D4 measure the most severe level of OUD liability, but their low discriminatory power (discrimination values <1.0) may be due to measurement error because of the few participants at this range of severity. Items D1 (tolerance) and D5 (time spent using) indexed lower levels of OUD liability relative to other symptoms. All abuse criteria were found to represent the moderately high to high severity levels on the OUD continuum (severity: 1.76–2.06). Because abuse symptoms are not less severe than those of dependence on the OUD continuum, our data did not empirically support *DSM-IV*'s hierarchical distinction between the two constructs.

We used MIMIC modeling to further investigate whether OUD criteria are equivalent statistically across adolescents with diverse demographic characteristics. Study results suggest that, at the equivalent level of OUD liability, the male subjects were less likely than the female subjects to endorse “withdrawal,” suggesting a higher threshold or severity level of this criterion in the male subjects. Additionally, African Americans and Hispanics, relative to whites, were less likely to endorse “continued use despite problems,” and African Americans were more likely to endorse “time spent.” These findings indicate some subgroup differences in adolescents' tendency to endorse dependence symptoms, given their overall level of OUD liability (i.e., differential item severity). Previous research of alcohol and marijuana users has also found DIF by sex and race/ethnicity.^{14,17} Therefore, these two variables should be included in future risk factor analyses for OUDs. This finding is potentially important because the presence of DIF may confound the OUD-related risk scores of particular groups if DIF is not controlled statistically. It would also be helpful to explore how cultural factors and sex-related psychological factors influence adolescents' interpretations of diagnostic questions.

Finally, results from MIMIC modeling found that the female subjects had a higher level of OUD liability than did the male subjects. Similarly, a recent study of adolescent nonmedical users of opioids that used logistic regression procedures reported greater odds of *DSM-IV* opioid dependence (≥ 3 dependence criteria) among the female subjects than the male subjects.⁸ In the MIMIC

model, the latent OUD liability was measured by all 11 abuse and dependence criteria, and it reflected an increased level of severity. In this regard, MIMIC modeling revealed that the female subjects exhibit higher severity levels of OUD liability than the male subjects and that this association persisted after the effects of DIF for certain OUD symptoms were controlled statistically. These results have important implications for prevention and research because several factors may place the young female subjects at particular risk for using opioids both medically and nonmedically. These factors include greater access to opioids, sharing medications within social networks, and nonprescribed use of these medications to treat physical discomfort (e.g., menstrual cramps) or emotional distress.^{8,30,31}

These findings should be interpreted with some caution. The NSDUH relies on participants' self-reports of substance use behaviors and thus may be subject to memory errors or biases (e.g., social desirability). This is a common limitation in national surveys. Study findings also are not representative of the approximately 2% of adolescents who are incarcerated, institutionalized, or homeless and are not included in the NSDUH. For example, adolescents who were in residential treatment for substance use at the time of survey were not included. This is potentially an important limitation because these adolescents may represent the most severe end of the severity spectrum. Another limitation concerns *DSM-IV* criteria of OUDs. This study examined the structure of *DSM-IV* criteria for OUDs used by NSDUH. However, it cannot address the adequacy of the criteria as a means to address OUDs.

The NSDUH data also have several noteworthy strengths not found in other surveys. The survey is currently the only national study that collects the diagnostic information needed to address the questions raised by this investigation. Its response rate is impressive, and the sample is representative of all noninstitutionalized American adolescents and thus has a high level of external validity. The survey also uses the most advanced technology available to increase participants' reporting of socially stigmatized or sensitive drug use behaviors.²¹

In conclusion, results from this IRT modeling of criteria for current OUDs in adolescents indicate a single dimension of risk for this construct. All abuse criteria are endorsed between moderately high to high severity levels of the OUD liability continuum and are clustered with the three dependence criteria. Thus, they suggest

empirically that opioid abuse is neither distinct from, nor less severe than, opioid dependence and that the *DSM-IV*'s hierarchical distinction for OUDs in adolescents is spurious. For the next *DSM*, a single diagnostic category for OUDs in adolescents can be considered. A categorical diagnosis may be made by considering all abuse and dependence criteria together and by dichotomizing adolescents at a threshold of one or more criterion, which will eliminate the present group of *diagnostic orphans*.⁸ Additional diagnostic subgroups using a higher threshold (e.g., 3–5 and 6+ criteria) to distinguish among adolescents by the extensiveness of symptoms affected by opioid use may be considered and studied for clinical use.

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