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Alcohol and drug dependence symptom items as brief screeners for substance use disorders: results from the Clinical Trials Network

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Abstract

Aim—To address an urgent need for screening of substance use problems in medical settings, we examined substance-specific dependence criteria as potential brief screeners for the detection of patients with a substance use disorder (SUD).

Methods—The sample included 920 opioid-dependent adults who were recruited from outpatient treatment settings at 11 programs in 10 U.S. cities and who completed intake assessments of SUDs for a multisite study of the National Drug Abuse Treatment Clinical Trials Network (CTN003). Data were analyzed by factor analysis, item response theory (IRT), sensitivity, and specificity procedures.

Results—Across all substances (alcohol, amphetamines, cannabis, cocaine, sedatives), *withdrawal* was among the least prevalent symptoms, while *taking large amounts* and *inability to cut down* were among the most prevalent symptoms. Items closely related to the latent trait of a SUD showed good-to-high values of area under the receiver operating characteristic curve in identifying cases of a SUD; IRT-defined severe and less discriminative items exhibited low sensitivity in identifying cases of a SUD (*withdrawal* for all substances; *time using* for alcohol and sedatives; *giving up activities* for sedatives).

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Conclusions—Study results suggest that *withdrawal* and *time using* are much less reliable indicators for a SUD than *taking larger amounts than intended* and *inability to cut down* and should be studied further for consideration in developing a simplified tool for screening patients for SUDs in medical settings. These findings have implications for the use of common health indicators in electronic health records systems to improve patient care.

Keywords

clinical trials network; item response theory; receiver operating characteristic curve; brief screening; sensitivity; specificity; substance use disorders

1. Introduction

Effective screening and intervention for substance use disorders (SUDs) in health care settings constitute a national priority. The new National Drug Control Strategy, as well as the Patient Protection and Affordable Care Act (PPACA) of 2010, emphasize prevention and integration of SUD interventions and treatments into the mainstream health care system (Substance Abuse and Mental Health Services Administration [SAMHSA], 2010a; Office of National Drug Control Policy, 2010). Consequently, access to SUD treatments and the quality of care will likely be enhanced. However, primary care physicians are very busy and have many areas to assess in a relatively short time; thus, the potential benefits of integrating SUD prevention and treatment into primary care will not be realized unless procedures to screen for SUDs are identified that can easily fit into busy work schedules.

National data have shown that the vast majority of individuals with a SUD do not use any treatment in a 12-month period; financial (cost, insurance coverage) and psychological (stigma and denial) barriers are pervasive (SAMHSA, 2010b; Wu, 2010; Wu et al., 2007; Wu & Ringwalt, 2004; Wu et al., 2011), suggesting that routine screening for SUDs can be useful in promoting treatment use and reducing SUD-related problems (Madras et al., 2009; U.S. Preventive Services Task Force, 2004). The U.S. Preventive Services Task Force has recommended screening and intervention for alcohol use problems in primary care settings (U.S. Preventive Services Task Force, 2004). However, empirical data are limited to guide similar efforts for drug use problems, despite the fact that drug use is also a leading risk factor for the global burden of disability, increases health care costs, and can cause multiple medical illnesses and premature deaths (Brick, 2004; Tiet et al., 2008; World Health Organization, 2009). Lack of simplified and effective screening tools targeting drug use problems is clearly a hindrance to incorporating treatment for SUDs into routine care (Saitz et al., 2010; Tiet et al., 2008).

For practical and clinical considerations, a stepped strategy for screening, combining an initial “substance use” screen and successive “substance-related problem” screeners to detect SUDs for intervention, is recommended (Whitlock et al., 2004). For example, national survey data estimate that 9% of American adults aged 18 years or older have an alcohol or drug use disorder within a 12-month period (SAMHSA, 2011). In busy health care settings, it would be burdensome to screen all individuals for SUDs; instead, a more efficient practice would be to target the detection of SUDs at individuals who screen positive for substance use. This approach would facilitate timely intervention or treatment referral, especially among individuals in emergency room or psychiatric treatment settings where SUDs are comparatively prevalent but individuals are under-diagnosed or under-treated because SUDs have not been systematically assessed (Rockett et al., 2003; Tiet et al., 2008; Vinson et al., 2007).

To date, researchers have investigated a single-question screener for substance use in primary care (Smith et al., 2009; Smith et al., 2010), as well as a two-item screener for SUDs to facilitate detection of SUDs and treatment (Brown et al., 2001). The single-question screener identifies substance use (“How many times in the past year have you used an illegal drug or used a prescription medication for nonmedical reasons?”); a response of at least one time to the question is considered positive for drug use (Smith et al., 2010). This single screening question was found to have a high level of accuracy in identifying drug use in primary care patients, supporting its use as a brief screen (self-reported current drug use: sensitivity=92.9; specificity=94.1). The two-item screener includes questions similar to the *Diagnostic and Statistical Manual of Mental Disorders-IV* (DSM-IV) dependence criteria to identify individuals with a SUD (“In the last year, have you ever drunk or used drugs more than you meant to?” and “Have you felt you wanted or needed to cut down on your drinking or drug use in the last year?”). Brown et al. (2001) found that having at least one positive response to the two-item screener detected a current SUD with nearly 80% sensitivity and specificity in primary care settings, suggesting the feasibility of integrating the two dependence-related questions into a clinical interview. However, the two-item screen has not been continuously tested to further establish its utility. While the Drug Abuse Screening Test (DAST: 10-, 20-, 28-item) has been used for assessing or screening severity (low, medium, high) of drug use problems (Skinner, 1982; Yudko et al., 2007), its length has impeded widespread adoption in clinical practice. To be adopted for routine use, a short and simplified tool that is sensitive to drug use problems and useful for clinical decision-making, such as identifying those with a clinical diagnosis, is needed. Substance dependence symptoms are robust manifestations of compulsive drug use and less prone to measurement biases than abuse symptoms (Babor and Caetano, 2008; Koob and Le Moal, 2006); thus, they are good candidate screeners for detecting individuals with a high probability of having a SUD, as shown by Brown et al. (2001).

Implementation of the National Drug Control Strategy and current health care reform necessitates the expansion of screening for drug use problems to promote treatment of SUDs. To address this need, we examined substance dependence criteria as brief screeners for SUDs among 920 opioid-dependent adults. The data are drawn from an 11-site, randomized treatment trial for opioid dependence within the National Drug Abuse Treatment Clinical Trials Network (CTN). Data from this study include a geographically diverse sample of drug users with sufficient prevalences of substance-related problems that were assessed by the same diagnostic instrument so as to provide useful data about the relative values of screening items for alcohol and multiple drug use disorders commonly seen in clinical settings. In this study, we apply two-parameter item response theory (IRT), sensitivity, and specificity analyses to examine substance dependence criteria as potential screeners for SUDs. This IRT approach assumes that a latent severity trait underlies response patterns of SUDs measured by DSM-IV criteria, and recognizes item-level (criterion) variability in the discrimination and severity of the SUD severity continuum (Saha et al., 2006; Wu et al., 2009a; Wu et al., 2009b; Wu et al., 2009c). IRT analysis determines the unidimensional latent trait underlying criterion symptoms for each disorder (a one-factor syndrome), but also provides vital item-level discrimination and severity estimates for substance-specific criteria (Wu et al., 2009a; Wu et al., 2009b). IRT findings consistently show that dependence symptoms measure various ranges of a “similar” condition underlying SUD problems (Saha et al., 2006; Wu et al., 2009a; Wu et al., 2009b), indicating the presence of poor items and feasibility to identify “core” dependence items for use as a simplified screen for detecting individuals at risk for SUDs. Assuming that an IRT approach to SUDs is feasible, poorly performing items from IRT analysis (low discrimination, high severity) will have low sensitivity/specificity values in identifying individuals with a disorder; reliable items across multiple substances will be good indicators for problematic use that are likely to meet criteria for a SUD.

Specifically, here we 1) examine prevalences of substance dependence and substance-specific symptoms across multiple substances, 2) determine the unidimensionality of dependence criteria and item-level discrimination and severity estimates, and 3) calculate sensitivity, specificity, and area under the receiver operating characteristic curve (ROC-AUC) for each dependence criterion in opioid-dependent adults. ROC-AUC considers the trade-off between sensitivity and specificity values and indicates the level of accuracy in classifying cases and non-cases of a SUD according to the DSM-IV checklist (1.0=perfect classification). We hypothesize that items showing low discrimination and high severity estimates (low relevancy to the underlying trait of a disorder) will have comparatively low sensitivity/specificity (ROC-AUC) values in identifying cases of a SUD.

2. Methods

2.1. Data source

The National Drug Abuse Treatment Clinical Trials Network (CTN) includes 13 nodes (research centers) allied with substance abuse treatment providers in 39 states across the United States, the District of Columbia, and Puerto Rico (Tai et al., 2011). For this study, analyses were performed on data from a large, multisite CTN study that evaluated two buprenorphine/naloxone taper schedules for opioid detoxification in 11 outpatient, community-based treatment programs (Ling et al., 2009). Eligible participants were at least 15 years of age and seeking treatment for opioid dependence at one of the participating treatment programs in 10 U.S. cities (Colorado, Connecticut, New York, North Carolina, Oregon, Virginia, and Washington). Recruitment methods included word of mouth, radio announcements, newspaper advertisements, and referrals from local opioid treatment and outreach programs, alcohol and drug abuse clinics, primary care providers, local mental health centers, crisis clinics, and hospital emergency rooms. The sample included 920 opioid-dependent adults from the intake assessment. Opioid-dependent adults who did not meet eligibility criteria were also included in the analysis, which both enabled us to ascertain whether substance use status differed by randomization status and provided a larger sample size for the analysis. The Duke University Institutional Review Board approved use of these data for this study.

2.2. Study variables

Demographics included age, sex, race/ethnicity, education, and employment status, which were assessed by the CTN common demographic form. Past-year substance use and disorders (abuse or dependence on alcohol, cannabis, cocaine, inhalants, amphetamines, sedatives, hallucinogens) were assessed by the DSM-IV Checklist (Hudziak et al., 1993). At intake, all participants were administered the DSM-IV Checklist by CTN-affiliated trained interviewers (research staff who completed training for administering the DSM-IV Checklist) to assess substance use in the past year. Participants who responded affirmatively to the initial substance use question ("Have you ever used [NAME OF THE SUBSTANCE] in the past 12 months?") then were assessed for seven substance-specific dependence criteria. Endorsement of at least three of the seven DSM-IV dependence criteria resulted in a dependence diagnosis (tolerance, withdrawal, substance often taken in large amounts/for longer periods of time, persistent desire or unsuccessful attempt to cut down, a great deal of time spent in activities necessary to get the substance, important activities given up, continued substance use despite knowledge of having recurrent physical or psychological problems). Following DSM-IV logic, individuals who did not meet the criteria for a SUD were then assessed for abuse.

The analysis focused on DSM-IV dependence criteria because dependence symptoms reflect physical and/or psychological dependence and a pattern of compulsive use, which are

directly related to the extent of substance use, while abuse symptoms (role interference, hazardous use, legal problems, relationship problems) concern social or legal consequences of drug use behaviors, which are more likely to be affected and biased by a user's age and environmental factors (Babor and Caetano, 2008). DSM-IV and the developing DSM-5 comprise the most widely used criteria for health statistics in the United States (American Psychiatric Association [APA], 2000); questions of dependence criteria, thus, are ideal candidates for brief screeners as clinicians already use the criteria and would not need to learn a new set of questions and rules.

2.3. Data analyses

Distributions of study variables and potential differences in sociodemographic and substance use status by the randomization status were examined by descriptive analyses. Prevalence rates of substance dependence in the total sample and among substance users (conditional rates of substance use disorders) then were calculated.

Among substance users, discrete factor analysis for categorical data was conducted using Mplus (v. 6; Muthén and Muthén, 2010) to describe factor loadings of dependence symptoms. The Tucker-Lewis index (TLI), comparative fit index (CFI), standardized root mean square residual (SRMR), and the root mean square error of approximation (RMSEA) were used to assess the model fit for a one-factor model, as substance dependence is generally considered a single factor (Edwards and Gross, 1976; Wu et al., 2009a; Wu et al., 2009b). A higher value of TLI and CFI (>0.94) and a lower value of SRMR (<0.8) and RMSEA (<0.07) indicate an excellent fit to the data (Browne and Cudeck, 1993; Hu and Bentler, 1999). The one-factor model for substance dependence also was assessed by the scree test (Cattell, 1966) and the ratio of the first to the second eigenvalues.

Two-parameter IRT analysis then was conducted to determine the unidimensionality (one factor) of each dependence, as well as item-level discrimination and severity (Edwards and Gross, 1976; Wu et al., 2009a). Seven substance-specific dependence criteria (dichotomous variables) among past-year users of the corresponding substance were analyzed; hallucinogen use (6.3% of the sample, $n=58$) and inhalant use (1.2%, $n=11$) were not examined. The two-parameter IRT model assumes that item responses are a function of discrimination and severity of the items included. Item *severity* (threshold) is defined by the location on a latent continuum at which an item has a 50% likelihood of being present; item *discrimination* measures the precision with which an item differentiates between individuals with levels of the latent trait above or below its severity level.

Lastly, we calculated sensitivity (the proportion of individuals with a substance-specific SUD according to the DSM-IV Checklist who had a positive response to the item), specificity (the proportion of individuals without a substance-specific SUD according to the DSM-IV Checklist who had a negative response to the item), and the ROC-AUC for each item. A high ROC-AUC value indicates a high level of accuracy in classifying cases versus non-cases of a SUD according to the DSM-IV Checklist (1.0=perfect classification; <0.7 =poor discrimination) (Hanley and McNeil, 1982).

3. Results

3.1. Selected characteristics of opioid-dependent adults

Of the 920 opioid-dependent adults, 55.9% were randomized patients (Table 1). The randomized group was slightly younger (mean age: 35.5 vs. 36.9 years, $p=0.04$) and included more employed individuals (55.0% vs. 41.5%, $p<0.001$) than the non-randomized group (opioid-dependent adults who either did not meet the full inclusion/exclusion criteria or who met the full criteria but did not continue for personal reasons). The groups did not

differ in sex, race/ethnicity, years of education, marital status, and past-year alcohol or drug use. Overall, 67.1% were men, 31.2% were nonwhite (13.0%, African-American; 10.0%, Hispanic; 8.2%, other), 46.1% received some post-secondary education, and 45.7% were never married.

3.2. Past-year substance use and dependence among opioid-dependent adults

Past-year use of alcohol (73.0%), cocaine (65.8%), cannabis (54.0%), and sedatives (45.5%) was more prevalent than use of amphetamines (17.0%), hallucinogens (6.3%), or inhalants (1.2%). Overall, 22.7% met criteria for cocaine dependence, and lower proportions met criteria for dependence on alcohol (8.5%), cannabis (6.0%), amphetamines (3.9%), sedatives (3.5%), hallucinogens (0.2%), and inhalants (0%). Among the subset that used the substance in the past year (Table 2), conditional rates of substance-specific dependence were higher among cocaine (34.6%) and amphetamine (23.1%) users than among alcohol (11.6%), cannabis (11.1%), sedative (7.6%), or hallucinogen (3.5%) users.

3.3. Exploratory factor analysis of dependence symptom items

Across five substances (Fig. 1), *withdrawal* (3.4–12.8%) and *time using* (2.6–22.2%) were among the least prevalent symptoms among substance users; *taking large amounts* (10.5–45.8%) and *inability to cut down* (14.8–37.6%) were comparatively prevalent. Hallucinogens and inhalants were dropped from further analysis because of low prevalence. CFI, TLI, RMSEA, and the ratio of the first to the second eigenvalues from factor analyses (Table 3) indicated one dependence factor for each substance examined (factor loadings: alcohol, 0.76–0.95; amphetamines, 0.76–0.93; cannabis, 0.54–0.96; cocaine, 0.75–0.93; sedatives, 0.75–0.93). *Withdrawal* had the lowest value of factor loadings (0.54) for cannabis dependence.

3.4. IRT analysis and ROC-AUC of dependence symptom items

As shown in item characteristic curves (ICCs) that considered item-level discrimination and severity estimates simultaneously (Fig. 2a–2e), *withdrawal* (particularly for cannabis and cocaine dependence) and *time using* were among the most severe symptoms of the IRT-defined latent trait problems (shifted to right side); *taking larger amounts* was among the least severe indicators and was accompanied by a high level of discrimination estimates for all substances (steep lines).

To explore whether the IRT item-level estimates suggested similar information as sensitivity/specificity analyses (Table 4), ROC-AUC was calculated (Fig. 3). ROC-AUC considers sensitivity and specificity together; a value of 1.0 (100%) indicates that the item accurately classifies cases of a SUD defined by the DSM-IV Checklist. Consistent with IRT results, items that shifted to the severe ends on ICCs (Fig. 2a–2e) showed low ROC-AUC values (≤ 0.70): *withdrawal* for alcohol, cannabis, cocaine, and sedatives; *time using* for alcohol and sedatives; and *giving up activities* for sedatives (Fig. 3). *Taking larger amounts* (high discrimination, low-to-medium severity on ICCs) demonstrated good-to-excellent levels of classification (ROC-AUC > 0.80), especially for alcohol (ROC-AUC = 0.91) and cannabis (ROC-AUC = 0.90); *tolerance* (high discrimination, medium severity on ICCs) showed an excellent classification (ROC-AUC = 0.93) for sedatives.

3.5. Sensitivity and specificity of dependence symptom items

To help evaluate ROC-AUC estimates, sensitivity and specificity estimates are presented in Fig. 4a and 4b. All items exhibited good-to-excellent levels of specificity (0.79–1.0), indicating that individuals who did not endorse the item were unlikely to have a SUD. However, Fig. 4a shows that three items had low-to-poor sensitivity (*withdrawal* and *time*

using for all five substances; *giving up activities* for cannabis and sedatives), indicating many individuals with a SUD did not endorse the items.

4. Discussion

4.1. Main findings

To address the urgent need for brief screening tools in keeping with the national priority to improve screening and treatment for SUDs (SAMHSA, 2010a; Office of National Drug Control Policy, 2010), we evaluated item-level psychometric (IRT) and classification (ROC-AUC) information of substance-specific dependence questions for five SUDs in a large sample of treatment-seeking, opioid-dependent adults. Across five substances, *withdrawal* was among the least prevalent symptoms, while *taking large amounts* and *inability to cut down* were among the most prevalent symptoms. IRT analysis provided support for the concept that items closely related to the underlying latent trait of a SUD showed good-to-high ROC-AUC values in identifying cases of SUDs (*taking large amounts*, *inability to cut down*, *tolerance*, *medical/psychological problems*), and severe and less discriminative items exhibited low sensitivity and a fair ROC-AUC in identifying a SUD (*withdrawal* for all substances; *time using* for alcohol and sedatives; *giving up activities* for sedatives). These results demonstrate the feasibility of applying IRT and ROC-AUC procedures to select dependence symptom items to develop an efficient, reasonably sensitive, and simplified tool to screen for SUDs in medical settings. Findings also add to the evidence for single-item screeners for “alcohol or drug use” that have shown good sensitivity and specificity in primary care settings (Smith et al., 2009; Smith et al., 2010). Therefore, expanding prior research on the two-item screener for SUDs (Brown et al., 2001), these combined results from IRT and ROC-AUC analyses suggest the value of using *taking large amounts* and *inability to cut down* as part of a simplified screener to facilitate detection of problematic substance users with a high probability for having a SUD (National Institutes of Health, 2011).

4.2. IRT and ROC-AUC indicate similar item-level results across substances

Due to competing priorities and time constraints in medical settings, brevity is crucial for incorporating a screen into routine clinical practice; the need for a brief tool for identifying SUDs has been emphasized (Bush et al., 1998; Tiet et al., 2008; Vinson et al., 2007). For instance, Brown et al. (2001) compared five screening questions for alcohol and/or drug use disorders (*blackouts*, *use alcohol/drugs more than intended*, *use for feelings*, *need to cut down*, *regret*). *Use more than intended* and *need to cut down* showed higher sensitivity than the others; both were then combined into a two-question screener for SUDs. When one positive response was taken as a positive result, the two-question screener yielded sensitivity and specificity of 79% and 78%, respectively, for identifying a SUD thus suggesting its utility in clinical practice (Brown et al., 2001). The two-question screener, however, does not distinguish between alcohol and drug use, and its generalizability to the range of drug use disorders is unclear (Brown et al., 2001).

To address this gap, we examined substance-specific screening questions and observed somewhat consistent findings across SUDs. IRT analysis revealed that severe items—such as *withdrawal* and *time using*, and to a lesser extent, *giving up activities*—had low sensitivity in identifying a SUD, suggesting that use of these items as brief screeners may disproportionately miss cases of SUD (false negative). For example, sensitivity for *withdrawal* ranged from 0.22–0.53, indicating that about 47–78% of individuals who met criteria for a SUD in this sample did not endorse *withdrawal*, which can be explained partly by its low prevalence (3.4–12.8%); this low rate indicated severe (more rare) items in IRT analysis. On the other hand, *taking large amounts*, *inability to cut down*, *tolerance*, and

medical/psychological problems showed good-to-high discrimination values and clustered at the low-to-medium end of the IRT-defined SUD problems. These comparatively prevalent items demonstrated good-to-high ROC-AUC values in specifying cases of a SUD. For instance, sensitivity for *taking larger amounts* was 0.91 for alcohol, indicating that 91% of alcohol users with alcohol abuse or dependence responded affirmatively to this item. Given the consistency across SUDs, these items can be studied further for use as brief screening items for SUDs, as a positive response to one identified a high proportion of individuals with a SUD in this sample. Thus, IRT and ROC-AUC complement one another by demonstrating that poorly performing items are less reliable indicators for a SUD.

4.3. Implications for SUD screening and use of electronic health records (EHR)

These results have timely implications for the development of EHR systems and collection of “common data elements” or health indicators for SUD screening and intervention to improve patient care (Brown et al. 2001; Ghitza et al., 2011a; Ghitza et al., 2011b). Current practices generally rely on a two-step strategy (Whitlock et al., 2004). Individuals are assessed initially by a single-item screener for either alcohol or drug use status; the subset of users then is screened for SUD-related problems (e.g., CAGE, Alcohol Use Disorders Identification Test [AUDIT], DAST). However, in addition to screening for substance use and SUDs, a long list of health conditions has been recommended for screening and intervention by the U.S. Preventive Services Task Force. These competing priorities, plus the complexity of patients’ conditions, constitute barriers to screening completely for various conditions as each screener takes time to complete. Therefore, brevity and accuracy in detecting SUDs are critical considerations for adoption, as seen in the Health Information Technology for Economic & Clinical Health Act and the PPACA, which encourage the development and meaningful use of EHR to improve patient care (i.e., collections of standardized, patient-reported health indicators or common data elements) (Ghitza et al., 2011b; National Institutes of Health, 2011). Common data elements should include validated or standardized items, with brevity as a primary consideration (e.g., use of a minimal number of screening questions, combining screening items for alcohol and drugs) (Ghitza et al., 2011b).

Presently, single-item screeners for “substance use” have been identified (Smith et al., 2009; Smith et al., 2010), but simplified screeners for SUDs are lacking. Our results suggest that several dependence criteria are candidate common data elements that can be used to that end as they not only meet the principles of brevity and standardization but also distinguish between cases and non-cases of a SUD (abuse or dependence). For example, regardless of substance, a positive response to a dependence criterion (e.g., *taking large amounts*, *inability to cut down*, *tolerance*, *medical/psychological problems*) detected a high proportion of substance users with a SUD (abuse or dependence). The consistency in results and high levels of specificity support use for assessing SUDs. The next step would be to identify a brief set of dependence items (with or without combining alcohol and drugs) that can be used to screen for that diagnosis in health care settings, particularly emergency rooms and mental health settings where SUDs are comparatively prevalent but under-detected and undertreated (Rockett et al., 2003; Tiet et al., 2008; Vinson et al., 2007).

Lastly, cocaine dependence was the most prevalent comorbid SUD in this sample. Co-abuse of opioids and cocaine can increase drug-related adverse effects and poses a unique treatment challenge (Leri et al., 2003; Mello and Negus, 2007). These data suggest that *taking large amounts* and *inability to cut down* are useful items for detecting patients with cocaine use disorders to facilitate treatment management.

4.4. Limitations and strengths

These results are based on treatment-seeking, opioid-dependent adults, and the sample is not necessarily representative of all adults with a SUD. Treatment-seeking individuals may have different characteristics than persons who are being screened in primary care settings but who do not present seeking care for SUDs. While our results are consistent across substance classes, replication among substance users in different settings, including non-opioid dependent individuals, is needed. Another limitation is reliance on participants' self-reports, which are subject to reporting bias; however, biomarkers are not available for SUD screening and diagnosis. Because assessments of SUDs rely on self-reports, IRT analysis can provide independent, psychometric evaluation for self-reported measures (Wu et al., 2009a; Wu et al., 2010). Lastly, the small sample size of hallucinogen (n=58) or inhalant (n=11) users precluded detailed analysis and interpretation of results.

Strengths include the rigorous conduct of the original trial (standardized assessments, comprehensive research staff training, protocol monitoring, regulatory control); geographic diversity (from 11 cities across the nation); and inclusion of all opioid-dependent participants from study intake in the analysis, thus making the sample more heterogeneous than that found at a single site. All participants were assessed for substance-specific SUDs using the same instrument, allowing for comparisons of all dependence criteria across various substances. Such comparisons provide vital information regarding whether a similar set of questions can apply to alcohol and various drugs, as prior research has focused on two dependence-related questions and combined alcohol and drug use into a single question (Brown et al., 2001). Another strength is the assessment of the *withdrawal* criterion for cannabis, hallucinogen, and inhalant use disorders, permitting comparison of this criterion with others. *Withdrawal* is not considered present for these SUDs in the DSM-IV (APA, 2000), but data are needed to evaluate its inclusion in DSM-5 with regards to prevalence and screening efforts.

4.5. Conclusions

While IRT analysis has played a key role in the psychometric evaluation of health-related item banks for the Patient-Reported Outcomes Measurement Information System (PROMIS), it generally has not been used in research on screeners for SUDs to support the underlying construct of patient-reported measures. This paper demonstrates the unique value of IRT analysis in determining the underlying trait of a set of measures and elucidating item-level psychometric information to help interpret results of sensitivity and specificity. As a sound measure of patient-reported items is fundamental to assessing health conditions like SUD (Wu et al., 2009a), researchers should consider incorporating IRT approaches into their analysis plans to support the psychometric quality of patient-reported items. Finally, across five substances, two DSM-IV dependence items (*taking large amounts, inability to cut down*) are good candidates for harmonized common data elements in SUD screening in this large treatment-seeking sample, while *withdrawal* and *time-spent in using the substance* are poor candidates as they miss many cases of SUDs.

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Fig. 1. Past-year prevalence (%) of substance-specific dependence symptoms among substance users in a sample of treatment-seeking, opioid-dependent adults (N=920).

2c

2d

2e

Fig. 2.

Fig. 2a. An item response analysis of alcohol dependence symptoms among 672 alcohol users in a sample of treatment-seeking, opioid-dependent adults.

Fig. 2b. An item response analysis of amphetamine dependence symptoms among 156 amphetamine users in a sample of treatment-seeking, opioid-dependent adults.

Fig. 2c. An item response analysis of cannabis dependence symptoms among 497 cannabis users in a sample of treatment-seeking, opioid-dependent adults.

Fig. 2d. An item response analysis of cocaine dependence among 609 cocaine users in a sample of treatment-seeking, opioid-dependent adults.

Fig. 2e. An item response analysis of sedative dependence symptoms among 419 sedative users in a sample of treatment-seeking, opioid-dependent adults.

Fig. 3. Area under the receiver operating characteristic curve (ROC-AUC) for classifying cases versus non-cases of a substance use disorder, by substance-specific dependence symptoms. Lines extending from bars indicate 95% confidence intervals of the estimates.

4a

4b

Fig. 4.

Fig. 4a. Sensitivity of classifying cases versus non-cases of a substance use disorder, by substance-specific dependence symptoms. Lines extending from bars indicate 95% confidence intervals of the estimates.

Fig. 4b. Specificity of classifying cases versus non-cases of a substance use disorder, by substance-specific dependence symptoms. Lines extending from bars indicate 95% confidence intervals of the estimates.

Table 1

Demographic characteristics of opioid-dependent adults by randomization status (N = 920)

Demographic, column %	Overall	Randomized group	Non-randomized group	χ^2 (df) <i>p</i>
Sample size, N	920	515	405	
Age, years, mean (SD)	36.1 (10.1)	35.5 (10.5)	36.9 (10.6)	$p=0.04^a$
Sex, %				
Male	67.1	67.2	66.9	NS
Female	32.9	32.8	33.1	
Race/ethnicity, %				
White, non-Hispanic	68.8	71.1	65.9	NS
African-American	13.0	11.3	15.3	
Hispanic	10.0	9.1	11.1	
Other	8.2	8.5	7.7	
Years of education, %				
0–12	15.4	15.8	15.1	NS
12	38.5	41.2	35.1	
12+	46.1	43.1	49.9	
Marital status, %				
Married/cohabitating	29.6	30.3	28.6	NS
Separated/divorced/widowed	24.8	23.5	26.4	
Never married	45.7	46.2	44.9	
Past-month employment, %				
Employed	49.0	55.0	41.5	16.46 (1)
Not employed	51.0	45.0	58.5	<0.001
Substance use in the past year, %				
Alcohol	73.0	74.0	71.9	NS
Amphetamines	17.0	17.3	16.5	NS
Cannabis	54.0	55.7	51.9	NS
Cocaine	65.8	64.3	67.7	NS
Sedatives ^b	45.5	45.8	45.2	NS
Hallucinogens	6.3	7.6	4.7	NS
Inhalants	1.2	1.2	1.2	NS

^aT-test.^bSedatives included benzodiazepines.SD: standard deviation. NS: $P > 0.05$.

Table 2

Past-year prevalence of substance dependence symptoms and dependence among past-year users of the corresponding substance

Substance-specific dependence symptoms	Users of the corresponding substance: Prevalence %						
	Alcohol	Amphet- amines	Cannabis	Cocaine	Sedatives ^a	Halluci- nogens	Inhalants
Sample size, n	671	156	497	604	419	58	11
D1: Tolerance	14.6	16.7	13.1	29.5	11.2	7.0	0
D2: Withdrawal	4.9	12.8	3.4	10.6	5.3	0	0
D3: Taking larger amounts	19.1	29.5	12.5	45.8	10.5	12.1	0
D4: Inability to cut down	19.1	19.9	21.5	37.6	14.8	5.2	9.1
D5: Time spent using	4.6	14.1	8.7	22.2	2.6	3.5	0
D6: Giving up activities	8.0	20.5	7.4	27.3	2.6	5.2	0
D7: Medical/psychological problems	12.4	22.4	10.1	31.8	7.4	1.7	0
Substance-specific dependence among users	11.6	23.1	11.1	34.6	7.6	3.5	0
Substance-specific dependence in the total sample ^b	8.5	3.9	6.0	22.7	3.5	0.2	0

^a Sedatives included benzodiazepines.

^b Sample size=920.

Table 3

Exploratory factor analysis (EFA) of dependence symptoms among past-year users of the corresponding substance

EFA ^a of dependence symptoms: Factor loading	Users of the corresponding substance: Factor loading				
	Alcohol	Amphetamines	Cannabis	Cocaine	Sedatives ^b
Sample size, n	671	156	497	604	419
D1: Tolerance	0.81	0.76	0.78	0.75	0.93
D2: Withdrawal	0.92	0.93	0.54	0.88	0.76
D3: Taking larger amounts	0.89	0.77	0.96	0.79	0.80
D4: Inability to cut down	0.76	0.88	0.59	0.79	0.75
D5: Time spent using	0.81	0.90	0.78	0.93	0.86
D6: Giving up activities	0.95	0.88	0.77	0.93	0.79
D7: Medical/psychological problems	0.88	0.90	0.76	0.83	0.86
CFI	0.99	0.99	0.99	0.99	0.99
TLI	0.99	0.99	0.99	0.99	0.99
RMSEA	0.03	0.05	0.02	0.05	0.03
SRMR	0.04	0.07	0.06	0.05	0.08
First/second eigenvalues	5.41/0.53	5.27/0.74	4.27/0.91	51.9/0.62	4.88/0.78

^aUsing weighted least-squares approach.

^bSedatives included benzodiazepines.

CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

Item response theory (IRT) analysis of dependence symptoms and area under the receiver operating characteristic curve (ROC-AUC) among past-year users of the corresponding substance

Table 4

Users of the corresponding substance															
IRT ^a of dependence symptoms	Alcohol			Amphetamines			Cannabis			Cocaine			Sedatives ^b		
	Discrimination	Severity	ROC-AUC	Discrimination	Severity	ROC-AUC	Discrimination	Severity	ROC-AUC	Discrimination	Severity	ROC-AUC	Discrimination	Severity	ROC-AUC
Sample size, N	671			156			497			604			419		
Discrimination/severity															
D1: Tolerance	1.40	1.31	0.87	1.21	1.27	0.74	1.33	1.43	0.79	1.20	0.71	0.80	2.37	1.34	0.93
D2: Withdrawal	2.18	1.86	0.70	3.12	1.18	0.76	0.81	3.01	0.60	1.21	1.64	0.64	1.32	2.07	0.69
D3: Taking larger amounts	1.96	0.98	0.91	1.27	0.70	0.81	2.96	1.24	0.90	1.90	0.14	0.86	1.47	1.54	0.85
D4: Inability to cut down	1.07	1.21	0.84	1.91	0.97	0.80	0.71	1.36	0.77	1.31	0.41	0.85	1.17	1.39	0.79
D5: Time spent using	1.47	2.09	0.65	2.05	1.20	0.77	1.33	1.74	0.76	2.84	0.82	0.80	1.97	2.18	0.64
D6: Giving up activities	2.82	1.51	0.81	1.67	0.97	0.84	1.41	1.81	0.73	2.69	0.66	0.84	1.52	2.35	0.64
D7: Medical/psychological problems	1.78	1.34	0.86	2.55	0.83	0.88	1.20	1.70	0.77	1.55	0.58	0.81	1.99	1.64	0.80

^aUsing maximum likelihood parameter estimates.

^bSedatives included benzodiazepines.

Boldface: estimates ≤0.70 or poor-to-fair ranges.