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Validation of the Adolescent Substance Abuse Subtle Screening Inventory-3 (SASSI-A3)

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Abstract

The study objective was to develop a revision of the Substance Abuse Subtle Screening Inventory for Adolescents (SASSI-A2) to include new subtle and symptom-related identifiers of SUD in adolescents and new items to identify nonmedical use of prescription medications. Interview items, scales, decision rules, and enhanced question stems were also updated, to make the language more contemporary and understandable to present-day teens. This validation project was conducted to evaluate the instrument's psychometric properties and screening accuracy against a criterion of DSM-5 diagnosis for SUD. The responses of 1,065 participants were used to develop and examine various aspects of the Adolescent SASSI-A3. Clinical professionals from substance use treatment programs, criminal justice, and social service programs throughout the United States who used the SASSI Online screening tool submitted 515 completed administrations along with their independent DSM-5 diagnosis. The remaining 550 respondents constituted the normative sample collected via Knowledge Panel®, a probability-based web panel designed to be representative of the United States. Cross validation sample findings demonstrated SASSI-A3 sensitivity of 98%, specificity of 85%, and AUC 94%. Items added to identify adolescents who abused opioids or sedatives showed perfect sensitivity (100%), high specificity (98%), and high AUC (95%).

Keywords: Substance use disorders; DSM-5; Subtle screening; SASSI; Adolescent alcohol and drug screening, Prescription drug abuse

Introduction

Background and Significance

In 1990, The SASSI Institute released its first adolescent version of the Substance Abuse Subtle Screening Inventory (SASSI-A) [1]. The SASSI-A was developed in response to the growing need for a brief, objective, and accurate screening measure to identify adolescents in need of services for what was then referred to as "chemical dependence." At that time, there was an emphasis on drug-free schools; adolescents' easy access to drugs that cause addiction; and the greater recognition that addiction was not just a bad habit or a symptom of other psychiatric problems. An added concern was that many counselors and practitioners working with adolescents in social services, healthcare, juvenile justice, and educational settings had little background in addiction. These factors prompted the initial development of an adolescent-specific screening instrument using a reading grade level and item content that was appropriate for youth. Scoring rules yielded a screening accuracy rate of 83% against clinicians' judgments about whether the adolescent was chemically dependent. Unlike many screening instruments that rely exclusively on face-valid questions about alcohol and drug use, in addition to such items, the SASSI-A contained two features that facilitated the accurate identification of SUD even when adolescents denied or minimized their substance misuse. The SASSI-A included subtle items that were shown empirically to discriminate the presence and absence of chemical dependency [1], but did not include alcohol or drug content.

In 2001, research sources identified substance abuse as the number–one health concern in the United States [2]. To answer practitioners' demand to increase clinical utility of the instrument, The SASSI Institute developed a revision of the SASSI-A to validate the screening outcome against the American Psychiatric Associations (APA) diagnostic criteria, DSM-IV, for diagnosing both substance abuse and substance dependence disorders [3]. New scales to measure family and friends' risk, and attitudinal risk factors – two domains categorized as significant risk factors in adolescent substance abuse development and maintenance [4-7] and a measure of response invalidity – the "VAL Scale" was incorporated as well. The VAL scale (Validity Check) – was designed to identify individuals who may need further evaluation despite the SASSI indicating a low probability of a Substance Use Disorder [8]. This revised adolescent screening inventory, SASSI-A2 [8,9], demonstrated an overall accuracy rate of 94% in screening for substance abuse and substance dependence.

Response to a national crisis

Substance use disorder has continued to affect people of all ethnic, cultural groups and ages, and in recent years to a greater degree, adolescents. In 2005 nearly 50,000 adolescents (12-17 years old) presented to hospital emergency departments because of the nonmedical use of prescription painkillers [10]. Since that time, however, emergency room incidents for nonmedical use of prescription narcotic pain relievers have continually increased in people under age 21 [11]. The abuse of prescription medication is not the only grave concern here, however. Over the last few years, unintentional deaths, consequences, and related societal costs have escalated in other regards as well. National Center for Health Statistics data, for example, showed motor vehicle crashes as the leading cause of death for high school students, accounting for 73% of all unintentional deaths among 12-19 year olds [12]. Some years later, results from the Youth Risk Behavior Surveillance 2015 Prevention Status Reports [13] showed that in the 30

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days before the survey, 33% of high school students drank alcohol, 22% smoked marijuana, and 8% drove a vehicle after drinking [14]. Death by poisoning due to prescription overdoses is up 91% in less than a decade among adolescents aged 15 to 19 [15]. As a response, some states have instituted the use of the opioid antidote Narcan (naloxone) by emergency medical technician first responders in an attempt to stem the tide of overdose incidents and death.

In 2008, the National Center on Addiction and Substance Abuse (CASA) issued a report on Internet access to controlled substances [16]. Findings showed that 85% of websites selling federally controlled prescription medication such as OxyContin, Valium, Xanax, Vicodin, Ritalin, and Adderall did not require a prescription. In addition, the 2011 YRBS found that nearly 25% of students reported riding in a vehicle with a driver who had been drinking [17]. Moreover, approximately 40% of high school seniors reported that narcotics other than heroin were 'fairly easy' or 'very easy' to obtain; and 26% of high school students were offered, sold, or given an illegal drug on school property in the past 12 months [17]. The CDC reported national data from the Monitoring the Future (MTF) survey of eighth, tenth, and twelfth graders in the U.S. found, among high school seniors, nonmedical use of prescription drugs was the second most prevalent illicit drug use category after marijuana and alcohol [17]. In terms of access, there existed no evidence of regulatory mechanisms to block the sale of controlled substances to children, even when adolescents under study supervision entered their actual height, weight, and ages. Adolescents could order any number of prescription medications online and have them shipped in unmarked packaging. In addition to easy access via the internet, Ross-Durow, McCabe, & Boyd [18] found that the majority of adolescents prescribed opioid painkillers, stimulants, antianxiety medications or sedatives had unsupervised access to them at home, further increasing the likelihood of abuse. Follow-up studies demonstrate that by the time they are high school seniors, 64% of respondents have used alcohol, 45% marijuana, and nearly one out of every five acknowledged the nonmedical use of narcotics other than heroin [19]. More recently, and likely owing to the advances in social media, adolescent access to controlled substances and illegal international sources has increased dramatically [20].

Overall, since 2015, young drivers involved in fatal crashes rose by 3.6%, and the number of resulting deaths of drivers in this age group increased by 0.1%. Alcohol plays a significant role in these deaths—more than a third of fatal motor vehicle crashes among people aged 16–20 involve alcohol [21]. More recent data shows an even more alarming increase in this phenomenon [22,23]. While there are no specific statistics regarding teen use of prescription medications in combination with drinking and driving episodes, after marijuana and alcohol, prescription drugs are the most commonly abused substances by teens age 14 and older and sometimes in deadly combinations [19,24]**.** In 2016 the CDC's National Center for Injury Prevention and Control named alcohol-related harms, HIV, and prescription drug overdose as three of the top 10 public health concerns in states across the U.S. [13]. Such misuse is a major contributing factor in drug overdose deaths, rise in emergency room visits, drug-related emergency department incidents involving suicide attempts, and neonatal opioid withdrawal syndrome, among a host of other serious consequences [25-28].

The estimated costs of addressing alcohol and drug abuse in the U.S. currently exceed $415 billion [29]. Presently, the drug abuse and overdose epidemic, particularly as related to prescription opioids, is tearing apart America's families and devastating communities in such an alarming fashion that interventions have become a dire necessity on city, state, and now federal levels. The White House Office of National Drug Control Policy (ONDCP), on orders of The White House, stated that "It will require the resolve of our entire country" to provide the critically needed prevention, treatment, and recovery support services to adequately address this nationwide public health emergency [30]. Coupled with the adulteration of street heroin and other narcotics with extremely dangerous substances such as Fentanyl, Carfentanil, extremely high potency morphine and other opioids [31] and the recently cited dangers of the advent of Vaping, subsequent years have revealed even more alarming statistics [22,32].

Adolescent development - state of the science

Clearly, the costs and consequences of substance abuse are severe, particularly for adolescents who are still developing. In contrast to the understanding several decades ago that brain development was complete by adolescence [33], the current state of the science indicates that neurological development continues throughout adolescence and into young adulthood. Research has shown that the adolescent brain is primed neurologically to engage in new and risky behaviors and reward-seeking, while at the same time has not yet matured in the prefrontal development and cortical processes that control cognitive evaluations of risk and the ability to instigate cognitive controls over behavior. Thus, adolescence is a period of particular vulnerability to substance abuse – it is a novel and physiologically rewarding activity in persons who are ill-equipped to evaluate its risks [34,35].

The majority of alcohol and drug use is initiated in adolescence and all substances of abuse activate the brain's dopamine reward pathways, promoting continuation of the behavior [36,37] putting teens at increased risk of negative consequences from their substance use, including increased likelihood of developing a substance use disorder, damage to key brain circuits, and loss of motivation and ability to derive pleasure from natural rewards [38,39]. In addition to more obvious physical disorders, research on adolescent neurological impacts has shown alcohol and illicit drug abuse have detrimental effects on attention, memory and executive functioning, impairing the adolescent's ability to plan, reason, and control impulses [40]. Other research has shown neurocognitive deficits in visuospatial memory, attention, working memory, and information processing speed among adolescents with chronic exposure to alcohol or cannabis, even after long periods of abstinence [34,39]. Substance abuse in adolescence can also contribute to the development of adult health problems, such as heart disease, high blood pressure, and sleep disorders [41].

Further, this relationship between substance abuse and neuropsychological deficits may be implicated in the substance-abusing adolescent's greater involvement in other risky behaviors, both as perpetrators and victims of not just simple delinquent actions and behaviors, but far more serious gun violence, sexual assault, and other crime patterns [14,42]. A longitudinal study of 14-17-year old serious juvenile offenders for example, (felony-level violent crime, property, and drug offenses) found that the presence of a substance use disorder and the level of substance use at the juvenile's initial arrest both were significant predictors of increased subsequent arrests in the 7-year study period, including nondrug-related offenses; as compared with serious juvenile offenders without a substance use disorder [42].

Importance of Screening and Drug Abuse Assessment

Validated SUD screening instruments are integral to the work of substance use assessment professionals and treatment providers, as working with youth often requires a different approach to getting them engaged in the treatment process. For more than two decades

such tools have played a significant role in evaluations done in criminal justice, probation and reintegration programs [43,44]; interventions for domestic and teen dating violence [45,46]; treatment of patients with spinal cord and traumatic brain injuries [47,48]; identification of depression severity risk factors [49] and examining the development of the adolescent brain [39,50].

Increasingly, screening for SUD has been advanced among best practices in primary healthcare settings, including healthcare provision to adolescents [23,51-53]; to facilitate access to substance use treatment for individuals who are deaf or hard of hearing [54] to inform individualized plans for employment for individuals receiving vocational rehabilitation services [55-57]; and in treatment of chronic pain [58-60]. During the recent overdose and prescription opioid epidemic, screening became an important tool to predict overdose risk using tools such as algorithms and machine learning [61] and addressing overdose risk more generally [62].

This third iteration of the adolescent SASSI screening questionnaire is timely, especially within the contexts of the prescription medication abuse crises and community responses across the country. It provides an accurate and efficient screening tool for providers to identify adolescents in need of further evaluation and possible treatment for substance use disorders related to the abuse of alcohol, illicit drugs, and now with added sensitivity to prescription drug abuse, vaping, and increasingly potent forms of marijuana. Making good choices about alcohol and drug use is ultimately up to the teen, but helping them see when poor choices are being made via early intervention is up to service providers.

Theoretical development and validation

When The SASSI Institute designed the second iteration of the SASSI adolescent instrument (SASSI-A2), the Indiana Division of Mental Health and Addiction Services (DMHA) gathered a group of experts to garner a large pool of questions from which we selected items to include in the SASSI-A2 questionnaire. In the last two years, when we gathered new items to include in the SASSI-A3 questionnaire, we updated items to reflect current teen drug-use language, while simultaneously consulting with several teen substance use disorder (SUD) treatment facilities. Clients in treatment for substance use disorders and control subjects answered the questions. We used statistical analyses to select questions that distinguished responses from individuals with a substance use disorder to those of control subjects. Using such descriptive interpretation, we determined that scores on the alcohol and drug frequency scales indicate the extent of usage that clients are willing to acknowledge. Examining the client's responses on these items helps form a picture of the individual's usage patterns and the consequences that potentially may follow.

Methods

Sampling procedures

The SASSI Institute engages in ongoing research to evaluate the psychometric properties of the SASSI substance use disorder screening inventories and to enhance their accuracy and clinical utility. This section reviews our sampling and analyses procedures for determining the accuracy of SASSI-A3 screening outcomes in identifying individuals who have a high or low probability of being diagnosed with a substance use disorder. We will discuss the efficacy of the SASSI-A3 in terms of six measures of accuracy: sensitivity, specificity, false negatives, false positives, positive predictive value, and negative predictive value (see further below for an explanation of these terms). Other research articles [23,63] present additional procedural and methodological discussions on the development and validation of the adult SASSI-4 and faking good research on the adolescent SASSI-A3 screeners.

As is the case with all empirically derived screening instruments, in order to understand the clinical significance of SASSI-A3 results, it is necessary to understand the criterion variable that was used to formulate and cross-validate it. The SASSI was developed to meet human service practitioners' need for an addictions-screening tool that does not rely on clients to be completely forthright in reporting relevant behaviors. That goal precludes use of a standardized diagnostic instrument that is based exclusively on research volunteers' self-reports of symptoms of substance misuse as the criterion variable. Rather, we designed the SASSI-A3 to match diagnoses formulated by clinicians during the process of assessing clients in actual human service settings. Clients often seek services as a culmination of personal, health, social, familial, financial, and legal problems, and clinicians have access to information about the presenting problem and collateral information. Since such information can enhance the ultimate clinical value of the diagnosis, it was considered a vital part of the criterion variable that formed the basis of the SASSI-A3. To that end, clinicians' diagnoses regarding the presence or absence of substance use disorders served as the criterion variable in validity analyses for SASSI-A3, with the provision that all such diagnoses also include specification of the DSM-5 [64] symptom criteria on which they were based. Thus, teens who are test positive on the SASSI-A3 are likely to be diagnosed as having a substance use disorder.

The SASSI Institute's ongoing Online Security Commitment ensures our systems and processes meet or exceed all state and federal regulations, including HIPAA, 42CFR, FERPA, and other regulations regarding confidential client data. We encrypted all data transmissions and de-identified client information so that all identifiable client information was maintained as encrypted data. We facilitated a separate research module on the SASSI Online platform in order to allow participating counselors to administer the research survey to participants. To protect the privacy of study participants and confidentiality of the study data, each administration of the screening survey was automatically assigned a SASSI Online platform-generated sequence of characters to readily and singularly identify each case for the duration of the study. No identifying fields were formatted for the research administrations that would allow counselors to enter participants' names, date of birth, or any other item of personally identifiable information about the participant. The DSM checklist for each participant was assigned the same sequence of characters as the survey; in this way the two sources of data for a case were both anonymous and paired. Each participating counselor created a master list to match the participant's study ID number to the participant's name so that the counselor knew the associated identity for each screening report. The master lists were not shared with the study investigators. In addition, participant responses on the screening survey consisted of true/false, categorical, and numerical responses, which were numerically coded. At all times, counselors retained the ability to opt out of providing a diagnostic evaluation for a case, and instead choose to use the SASSI Online platform for paid administrations of the screening questionnaire. Respondents were also given the option to discontinue their participation at any time or have their completed survey withdrawn from the study by informing their counselor. These procedures produced screening responses with a diagnostic criterion measure (DSM-5 diagnosis of substance use disorder) in anonymous clinical cases. The study data was stored on one of The SASSI Institute's HIPAA-compliant database servers and protected against unauthorized

access with firewall security and password-protected access issued only to authorized SASSI Institute staff. All recruitment procedures were reviewed and approved by the Advarra Institutional Review Board (IRB) to ensure that participants were treated in accordance with HIPAA guidelines and regulations.

Human rights protections and HIPAA adherence

Overall risk/Benefit assessment: This project entailed minimal risk to participants in that study participation consisted of providing anonymous responses on a screening survey regarding alcohol and drug-related experiences and attitudes. The risk of harm is no greater than would be encountered in standard psychological testing. In addition, clinical participants were invited to participate in the study by assessment professionals who use the SASSI screening survey in their practices and who have an established professional relationship with the respondent. Clinical licensure, certification, and code of ethics require that counselors consent their clients for treatment with full disclosure of expectations and rights in the client-counselor relationship, including the counselor's agreement to act in the best interest of the client. Further, both parents and teens decided whether to provide permission and assent to study participation. Standard of care for clinical participants was to answer the current version of the adolescent screening survey, SASSI-A2, as part of the clinical services their counselors presently provide. Adolescent study participants were asked to allow their anonymous responses to all of the questions on the current screener (SASSI-A2) as well as responses to 21 provisional screening questions we evaluated for possible inclusion in the final SASSI-A3 *prior* to their participation. We provided screening result reports only to counselors of clinical sample participants, and these were based only on the SASSI-A2 decision rules and survey questions, resulting in no change in the standard of care for clinical participants. As in other behavioral survey research, participants may, on occasion, feel uncomfortable answering some of the survey questions. But as further protection and to mitigate against these risks, we gave participants the option of skipping any question/s or withdrawing from study participation at any time without incurring any penalty or rescinding any rights to which they would otherwise be entitled.

SASSI-A3 Clinical data collection procedure

The clinical data set that was used to formulate and validate the SASSI-A3 consisted of 515 cases from teens ages 13-18, who were not in foster care, or detained by the courts in a locked treatment or detention facility. All cases were provided by clinicians working in service settings throughout the US Census Regions (Northeast, Midwest, South, and West). Professionals in 18 service organizations and private practices participated, providing assessments in a range of types of human service settings, including substance use treatment programs, criminal justice programs, community corrections, private clinical practices, behavioral health centers, and social service organizations. These professionals were qualified users of the SASSI, and the research version of the SASSI-A3 was administered via the SASSI Institute SUD web-based screening application. In appreciation of teenagers who participated, The SASSI Institute made a $5 donation to the teen's choice of a youth or pet charity.

We formulated and cross-validated the SASSI-A3 decision rules that yield the screening outcome on these cases. To be included, cases had to include both a completed, valid research version of the SASSI-A3, which included new items, and an independently derived diagnosis for substance use disorder with specification of DSM-5 symptom criteria. The sample of 515 cases was divided randomly into two subsamples, with the provision that the ratio of cases diagnosed as having and as not having substance use disorders, as well as the overall sample sizes, be approximately equal in both subsamples. One subsample served as the development group; that is, the set of cases used to derive new decision rules for SASSI-A3 scoring. We used the second subsample as an unexamined set of cases reserved for cross-validating the newly derived decision rules.

SASSI-A3 Stability sample and data collection procedure

In order to evaluate the retest reliability of the SASSI-A3 we collected a stability sample of participants (n=107) from community respondents ages 13-18, throughout all US Census Regions who were not in treatment for substance use disorders. Screening responses were collected by the contract research organization Ipsos Public Affairs (Ipsos) from their registered Knowledge Panel®, a probability-based web panel designed to be representative of the United States. Firms such as Ipsos allow for expedient, random, and representative normative samples to be collected in a much shorter time frame than if the investigative teams were to conduct these themselves. Upon first completion of the questionnaire, qualified parents of the teen completing the survey received a cash-equivalent incentive worth $5 to share with their teen. Respondents were mostly not employed (65%; n = 69), identified as mostly White (65%; n = 70), Hispanic (14%; n = 15), or Black / African American (8%; n = 8). Participants' levels of completed education ranged from 5th grade to some college with the majority completing 10th (23%; n = 25), 11th (18%; n = 19), or 9th (16%; n = 17) grades.

Our agreement with Ipsos stipulated that within a four-week period following survey completion, Ipsos would invite the participants who completed the initial survey to complete the questionnaire a second time, thus allowing us to analyze the temporal stability of SASSI-A3 scores. Ipsos distributed survey instructions that informed participants that the purpose of retaking the questionnaire was to see whether answers to questions about health-related attitudes and experiences, including those related to alcohol and drugs, change over time in teens within the community. Qualified retest survey parents received a cash-equivalent incentive worth $10 to share with their teen.

Measures

DSM-5

Diagnoses according to the DSM-5 were chosen as the criterion variable for the SASSI-A3. Specifiers for SUD severity are delineated by the number of symptoms evidenced: 2–3, mild; 4–5, moderate; 6 or more, severe. Counselors indicated the presence or absence of the 11 DSM-5 SUD symptom criteria and specified for which drug class the symptom was evidenced, within the time period (past 12 months, lifetime) for which they conducted each diagnostic evaluation. In addition to those with current SUDs, counselors also indicated diagnoses of any non-substance related psychological disorders.

Research version of the SASSI-A3

The SASSI-A2 consists of 72 true-false items that identify SUD through obvious and subtle content. The instrument also includes 28 face valid alcohol and other drug frequency items. Face valid and subtle items are organized into nine scales that are utilized in a series of decision rules to produce a dichotomous SUD screening classification. The nine scales consist of the following: FVA (Face-Valid Alcohol) – acknowledged consequences of alcohol use, motivation and consequences of usage, and loss of control; FVOD (Face-Valid Other

Drugs) – acknowledged consequences of other drug use, motivation, and consequences of usage; FRISK (Family and Friends Risk) – part of a family/social system that is likely to enable substance misuse; ATT (Attitudes toward Substance Use) – attitudes and beliefs regarding substance use; SYM (Symptoms of Substance Misuse) – consequences of substance misuse and loss-of-control in usage; OAT (Obvious Attributes) – extent to which the individual is aware of, and able and willing to acknowledge, some behavioral characteristics that may accompany substance misuse; SAT (Subtle Attributes) – helps identify individuals who lack awareness and insight into the nature of their substance misuse and other related problems they may have; DEF (Defensiveness) – identifies defensive responding and lack of forthright disclosure not necessarily related to substance use; SAM (Supplemental Addiction Measure) – supplements other scales in some decision rules. An additional scale is used to refine test classifications: VAL (Validity Check) – identifies some individuals for whom further evaluation may be of value, even though they are classified as having a low probability of an SUD. The instrument also includes a COR (Correctional) scale but is not used in test classification. It provides information pertaining to the possibility that the individual may have a relatively high risk of experiencing legal problems.

Twenty-one new items were added to the research version of the SASSI-A3 to assess their accuracy in identifying persons with SUDs based on subtle identifiers, nonmedical use of prescription drugs, and symptom criteria for a DSM-5 diagnosis of SUD (e.g., craving for a substance).

Participants

Table 1 displays the demographic characteristics of the development and cross-validation samples. Note the general equivalence between the development and cross-validation samples regarding each of the variables presented in the table. The clinical sample included participants from a variety of settings, with the majority coming from substance use treatment centers (82.33%; n= 424). Participants had a range of diagnoses with the largest group having a severe diagnosis (35.76%; n=179) and the second largest having no diagnosis (33.00%; n=170). Additionally, 39.81% (n=205) of participants had a co-occurring disorder and 7.39% (n=38) had an opioid or sedative use disorder. The stability sample was mostly unemployed (64%; *n*-69) and white (65%; n=70) with the second largest racial/ethnic group identifying as Hispanic (14%; n=15). On average, participants were in the 5th grade (SD=1.82).

Data analyses

In order to assess the accuracy of the added items and how they affected instrument accuracy we focused on the following four elements in addition to other measures of accuracy described below:

Item analyses: We conducted discriminant function analyses on responses in the development sample to identify survey items that effectively discriminate between SUD criterion groups at the 95% confidence level. We eliminated items that were not significant predictors of criterion group membership from the candidate pool for SASSI-A3 scoring. We retained significant predictor items and added them to newly compiled scales based on internal consistency analyses of SASSI-A3 scale scores. Furthermore, to establish whether participant characteristics affected accuracy, we compiled a logistic regression with the following participant demographics: years of education, employment, ethnicity, gender, age, and clinical setting.

Test retest reliability, raw score stability, internal consistency, and resistance to response minimization: We used Spearman,

Characteristic	Development (n=257)%	Cross-validation (n=258)%
Data Source		
Criminal Justice Programs	2.33	4.65
Social Services Programs	3.89	5.43
Substance Use Treatment	85.99	78.68
Other	7.78	11.24
Clinical Diagnosis		
Mild Substance Use Disorder	17.9	17.44
Moderate Substance Use Disorder	17.51	11.63
Severe Substance Use Disorder	31.91	37.6
Criterion Negative	32.68	33.33
Gender		
Male	68.87	62.02
Female	31.12	37.98
Missing	0	0
Employment Status		
Employed/Full-time	0.78	1.55
Employed/Part-time	11.67	13.95
Not employed	87.55	81.78
Volunteer	0	2.71
Missing	0	0
Race/Ethnicity		
Black or African American	15.95	18.6
American Indian or Alaska Native	0.39	1.55
Asian, Hawaiian or Pacific Islander	0.39	1.55
Hispanic	40.08	19.77
White or Caucasian	38.52	48.84
Multiracial	3.89	7.75
Other/Unknown	0.78	1.94
Living Situation		
Parents	66.93	53.88
Other Relatives	8.56	6.98
Friends	0.39	0.39
Group Home	0.39	3.1
Residential	10.51	20.54
Other/Unknown	13.23	15.12
Trouble with the law		
Yes	97.28	96.9
No	2.72	3.1
Missing	0	0
Education (years)		
M	8.69	8.69
SD	1.58	1.58
Age (years)		
M	15.38	15.43
SD	1.47	1.37
Note: Some totals may not equal 100 due to rounding.		

Tables 1: Participant characteristics of SASSI-A3 development, and cross-validation samples

Pearson, and Tetrachoric correlation methods to calculate test-retest reliability. To assess raw score stability, we conducted paired Mcnemar, Wilcoxon, and t-tests to evaluate raw score change to provide evidence of score stability [63]. We also calculated omega to provide evidence of internal consistency given it relaxes the constant item variance assumption Cronbach's Alpha makes [63,65]. Consistent with Lazowski & Geary [63] internal consistency was analyzed with the clinical sample while all other reliability analyses were conducted with the stability sample. In a separate study, we evaluated the SASSI's performance when participants were "faking good" [23].

Screening accuracy (conducted with cross-validation sample):

Overall Screening Accuracy: We evaluated the SASSI-A3 against DSM-5 diagnoses of SUD for the clinical sample for sensitivity = true positive / (true positive / false negative); specificity = true negative / (true negative + false positive); positive predictive value (PPV) = true positive / (true positive + false positive); NPV = true negative / (true negative + false negative); accuracy = (true positive + true negative) / (true positive + true negative + false positive + false negative). Additionally, we developed Receiver Operating Characteristic (ROC) curves to calculate the Area Under the Curve (AUC), providing another indication of agreement between test and criterion [63].

Co-occurring screening accuracy: To provide further evidence of construct validity, we conducted analyses to evaluate the accuracy of SASSI-A3 SUD screening outcomes in a sample of individuals who had co-occurring psychiatric disorders (i.e., dual diagnoses for SUD and one or more psychiatric disorders such as anxiety, depression, post-traumatic stress disorder, etc.) and a sample of individuals who were diagnosed as not having a substance use disorder but who did have one or more non-SUD related diagnoses (i.e., were criterion negative for SUD).

Opioid and sedative screening accuracy: Practitioners were asked to specify the class or classes of drugs associated with each client's specific SUD symptoms and were required to indicate the specific drugs of abuse within each criterion positive drug class. As opioids and sedatives are among the most widely abused prescription medications, we employed diagnoses of opioid or sedative related SUD as the criterion variable for assessing the accuracy of the SASSI-A3 Rx prescription drug abuse screening outcomes. A score of 2 or higher on the SASSI prescription medication abuse screener indicated a high probability of opioid or sedative use disorder. Individuals diagnosed with opioid or sedative related substance use disorders served as the criterion positive sample, and individuals diagnosed without any type of SUD served as the criterion negative sample.

SASSI-A3 Robustness to defensiveness: Additionally, although the SASSI-A3 is designed to identify people who respond to the questionnaire in a less than candid manner, we would expect defensive responding to reduce SASSI-A3 accuracy, as would be the case with any screening or assessment tool. The SASSI-A3 contains a measure of defensiveness (DEF scale) that can be used to identify individuals who defensively responded to the instrument. While defensiveness itself does not discriminate against the presence or absence of SUD, it was utilized in combination with other SASSI-A3 scale scores in the decision rules to yield the overall SUD screening outcome. The items on the DEF scale were selected because they were found to discriminate between responses given under standard instructions to answer honestly, versus instructions to try to hide signs of personal shortcomings and substance misuse [23]. Therefore, scores on the DEF scale can be used as an index of client's unwillingness or inability to acknowledge personal flaws and problems. This index can be used to examine the impact of defensive responding on the correspondence between SASSI- A3 screening results and clinical SUD diagnoses. These analyses were conducted with the cross-validation sample.

Incremental accuracy: We evaluated the incremental contribution to screening accuracy attributable to scoring rules based on subtle screening items (i.e., items with content that does not directly refer to alcohol or drug use), relative to accuracy based only on face-valid scales related to alcohol and drug use and consequences. These analyses provide us empirical estimates of the benefit to screening accuracy afforded by the inclusion of subtle items on the screening instrument to overcome respondent's attempts to minimize their self-reports of substance abuse [23,63,66]. These analyses were conducted with the cross-validation sample.

Results

Item analysis

A discriminant function analysis with the development sample in which all the items were entered as predictor variables of the presence or absence of a substance use disorder revealed a correct classification rate of 84%. Additionally, analyses of the frequency of cases using Fisher's exact test in the development versus the cross-validation sample as a function of age, sex, ethnicity, total arrests, prior treatment, referral, client setting found no differences (p-value> .01); however, we did find statistically significant differences in mandated (% mandated cross-validation = 61%; % mandated development=75%; p-value = <.001) and referral (% SASSI Online Demonstration cross-validation = 42%; % SASSI Online Demonstration development = 61%; p-value <.001). Finally, no predictors were statistically significantly related to accuracy at the .01 alpha level.

Score reliability, raw score stability, internal consistency, and resistance to response minimization

In Table 2, we present one to eight-week (M=15 days, SD=3.5) Spearman, Pearson, and Tetrachoric test-retest stability coefficients obtained with a sample of 107 participants randomly selected from the normative sample. The overall SASSI construct showed moderate test-retest reliability (tau=.83). The test-retest reliability across all other constructs are all statistically significant, ranging from .83 to .35. For raw score stability, only symptoms, defensiveness, and corrections had statistically significantly different distributions at time points one and two, providing evidence of stability reliability across the majority of constructs. In 98% of the cases, the results of the SASSI-A3 Decision Rule did not change between the first and second administrations. The Prescription Drug Abuse scale, which is not part of the Decision Rule, yielded a low reliability coefficient (.35). However, only 8% of the cases in the normative stability sample had a high probability of having a SUD; therefore, a higher prevalence rate of SUD is likely needed to obtain more accurate estimates of test-retest reliability. Findings for internal consistency indicated an overall coefficient omega of .88, indicating good internal consistency among the items used to screen for SUD. Coefficient omega statistics corresponding to each scale of the SASSI-A3 inventory also are presented in Table 2. Finally, a previous study with a smaller subset of this sample who were asked to "fake good" achieved an 86% sensitivity [23]. Additionally, of the 14 individuals the SASSI-A3 incorrectly classified, 13 of them had elevated DEF or VAL scores [23].

Overall screening accuracy

Table 3 results show an overall accuracy of 93% with high levels of sensitivity (98%) and moderate levels of specificity (85%).

	Test-retest		Internal Consistency	
	Reliability Coefficients[a]		Reliability Coefficients[b]	
Scale	**Correlation**	**95% CI**	**Correlation**	**95% CI**
SASSI-A3 overall[cd]	0.83		0.88	[.86, .89]
Face Valid Alcohol	0.61	[.37, .80]	0.93	[.91, .95]
Face Valid Other Drug	0.73	[.54, .88]	0.95	[.94, .96]
Friends-Family Risk	0.62	[.45, .75]	0.68	[.56, .77]
Attitudes	0.73	[.63, .83]	0.71	[.67, .75]
Symptoms	0.62	[.45, .77]	0.87	[.86, .89]
Obvious Attributes	0.75	[.64, .83]	0.7	[.66, .74]
Subtle Attributes	0.74	[.62, .83]	0.69	[.65, .73]
Defensiveness[e]	0.8	[.72, .86]	0.71	[.67, .75]
Supplemental Addiction Measure	0.74	[.62, .83]	0.71	[.68, .75]
Correctional[e]	0.68	[.55, .79]	0.81	[.79, .83]
Prescription Drug Abuse[ef]	0.35	[.57, .61]	0.82	[.79, .86]

Note: CI = confidence interval.

[a]N = 107. [b]N = 515.

[c]Spearman correlation used unless otherwise specified for reliability coefficients.

[d]Analysis includes only items utilized in the SASSI-A3 SUD screening outcomes. Tetrachoric correlation was used given the data were binary and 95% is not available from the tetrachoric function in the psych package.

[e]Pearson correlation was used given the data were approximately normally distributed.

[f]Scale is used to screen for prescription drug abuse.

Table 2: Test-Retest Reliability and Internal Consistency Reliability Estimates for the SASSI-A3

Criterion Status	Prev*	AUC [95% CI]	Sens	Spec	PPV	NPV	% CC
SASSI	67	.94 [.91, .97]	98	85	93	95	93
SUD Severity (*n = 258*)							
Mild (*n = 45*)	17	.85 [.79, .92]	91	85	76	95	87
Moderate (*n = 30*)	12	.85 [.78, .92]	100	85	70	100	88
Severe (*n = 97*)	38	.94 [.91, .97]	100	85	88	100	93
No SUD (*n = 86*)	33						
Other Mental Health							
Diagnoses (*n = 136*)							
Co-occurring SUD (n = 113)	83	.94 [.87, 1]	98	83	97	90	96
Non Substance Related Disorder (n = 23)	17						
Rx Screen (*n = 104*)							
Opioid or Sedative							
SUD (*n = 18*)	17	.95 [.88, 1]	100	98	90	100	98
No SUD (*n = 86*)	83						

Note: All figures other than AUC are percentages.

Prev* = Prevalence of SUD within the diagnostic category;

AUC = Area under the curve;

CI = Confidence Interval;

Sens = Sensitivity;

Spec = Specificity;

PPV = Positive Predictive Value;

NPV = Negative Predictive Value;

% CC = percent correctly classified (i.e., accuracy);

SUD = substance use disorder;

Rx Screen = SASSI-A3 prescription drug abuse scale.

Table 3: Validation Sample Estimates of SASSI-A3 Screening Accuracy by DSM-5 Diagnostic Features

Additionally, the PPV is 93%, the NPV is 95%, and the AUC is 94%. Of the 17 incorrect classifications, 2 (12%) had DEF scores at or above 9, indicating a high probability of defensiveness.

Screening accuracy with clients with co-occurring disorders and opioid or sedative use

Findings indicated a high SASSI-A3 screening sensitivity (98%) and moderate sensitivity (83%) in detecting SUD in clients with co-occurring disorders. For the opioid or sedative sample, the SASSI-A3 classified 98% of clients correctly with high sensitivity (100%) and high specificity (98%), and a high AUC (95%). Thus, our findings provide evidence of construct validity and the precision of the SASSI-A3 in identifying likely SUD specifically, rather than identifying individuals who may require treatment for life stressors, poor adjustment, and functioning, or other psychological health issues.

Incremental Accuracy Contributed by the Subtle SASSI-A3 Scales

Overall accuracy based exclusively on face-valid scale scores is 89%, which is a 4% loss to the 93% overall accuracy obtained when using the full set of decision rules. When including the subtle scales, the SASSI-A3 correctly classified an additional 12 participants. Additionally, the sensitivity of the face valid scales alone is 87% versus the 98% sensitivity afforded by the full set of SASSI-A3 decision rules, including the subtle scales - an 11% improvement in sensitivity. The inclusion of the subtle scales also improved the NPV by 17% (face valid only = 78%; full SASSI-A3 = 95%).

SASSI-3 Robustness to defensiveness

Overall SASSI-A3 screening accuracy was 94% with a sensitivity and specificity of 98%, 85% respectively for cases where participants' DEF scores were one standard deviation above the normative sample DEF scale mean score or lower (DEF cut off=9, n=482). When DEF scores were elevated (one or more above the DEF of 9), results indicated an overall screening accuracy rate of 88% with a sensitivity of 100% and a specificity of 86% (n=34).

Discussion

Our primary goal/s were to develop appropriate, timely, effective, and efficient screening measures to facilitate adolescent assessments of the opioid and prescription medication crises that are sweeping the country. The adolescent SASSI-3 now includes revised subtle items (i.e., items that do not reference alcohol or drugs) that have been shown empirically to accurately discriminate the presence of a substance use disorder even when the individual attempts to minimize acknowledgment of alcohol or drug abuse on face-valid questions [1,9,63,66]. In order to evaluate these subtle items, we conducted assessments of the SASSI screener's utility in identifying "fake-good" response patterns, (i.e., respondents' attempts to minimize or deny acknowledgment of alcohol or drug abuse) by comparing screening outcomes when respondents were instructed to answer honestly based on their own experiences and when they are instructed to try to hide signs of substance abuse, i.e., fake-good. Providing assessment professionals a scale score to identify profiles in which the client is responding defensively, informs subsequent clinical interviews and treatment planning. In depth methodological considerations and findings of this portion of the overall study are reported more extensively elsewhere [23].

Although the SASSI-A3 is designed to identify people who respond to the questionnaire in a less than candid manner, we would expect defensive responding to reduce SASSI-A3 accuracy, as would be the case with any screening or assessment tool. The SASSI-A3 contains a measure (DEF) that can be used to identify individuals who respond to the instrument in a defensive manner. The items on the DEF scale were selected because they were found to discriminate between responses given under standard instructions to answer honestly, versus instructions to try to hide signs of personal shortcomings and substance misuse. Therefore, scores on the DEF scale can be used as an index of clients' unwillingness or inability to acknowledge personal flaws and problems. This index can be used to examine the impact of defensive responding on the correspondence between SASSI- A3 screening results and clinical SUD diagnoses.

The Lexile® Framework for Reading was used to assess readability of the questionnaire [67]. The Lexile® Measure for the SASSI-A3 instrument is 760L, which corresponds to the reading text complexity for 4th grade students [68,69].

Limitations

It's important to acknowledge that the SASSI-A3 is an alcohol and drug screening instrument. It is designed to be used in a prediagnostic fashion as an additional source of information to identify teens in need of further evaluation for the presence of an SUD and the potential need for treatment.

With respect to reliability overall, some measures for individual SASSI-A3 scales are in the low range suggesting that the scale may not consistently measure the underlying construct. Scale items were not chosen on the basis of their ability to consistently measure to a unitary construct but rather to identify persons with SUD. Thus, the coefficient omega and test-retest statistics for individual SASSI scale scores can be seen as less important for evaluating their reliability than are measures of raw score stability, which were generally not statistically significantly different over time.

Data used to validate the screening instrument were submitted by practitioners engaged in ongoing programs of substance use screening with teens. Teens who were incarcerated or in Foster Care were not included in the data due to IRB regulations; therefore, future research in settings that serve those populations is needed to extend the generalizability of the current findings.

Conclusions

The SASSI-A3 validation study indicates high screening accuracy in identifying individuals diagnosed with and without a substance use disorder according to the most recent and widely used diagnostic standards for SUD, the DSM-5. For the cross-validation sample, the SASSI-A3 has an overall accuracy of 93% with high levels of sensitivity (98%) and moderate levels of specificity (85%). Additionally, the PPV is 93%, the NPV is 95%, and the AUC is 94%.

Among the most frequently abused prescription medications are opioid pain medications and sedatives prescribed for anxiety and sleep disorders. Inclusion of a new SASSI-A3 prescription drug abuse scale, Rx, to specifically identify adolescents likely to be abusing prescription drugs was aimed at extending the clinical utility of the instrument by providing practitioners a measure of prescription medication abuse, in addition to the overall screening outcome for likely substance use disorder. The current findings indicate that overall, the SASSI-A3 prescription drug screening outcome is an effective tool for accurate identification of clients in need of specific evaluation and treatment planning related to opioid or sedative-related substance use disorders.

As demonstrated in Table 3, under the heading "Rx Screen," screening accuracy findings for the SASSI-A3 Rx scale indicated strong correspondence between the prescription drug scale screening classification and clinicians' diagnoses.

Individuals who are screened for substance use disorders often have presenting complaints related to other psychological and medical health issues, in addition to difficulty in functioning and adjustment in other life domains (e.g., home, work, school). It is important, therefore, that a screening instrument used to identify individuals in need of further evaluation for substance use disorders is able to discriminate between SUD and other mental health issues or poor adjustment and functioning. The SASSI-A3 demonstrated excellent sensitivity in identifying SUD in individuals experiencing co-occurring psychiatric disorders, and also demonstrated high specificity for individuals without SUD, who instead were experiencing cognitive, mood, somatic, or related impairments associated with other psychiatric disorders.

We also evaluated the data to determine whether accuracy was impacted by the type of assessment setting in which clients were screened, or by client demographic characteristics, including education, employment status, ethnic group membership, gender, age, and clinical setting. We conducted a thorough logistic regression analysis using type of assessment setting, together with all client demographic variables as predictors of screening accuracy; these analyses showed no significant effect on accuracy, concurring with our previous research. In addition to the overall screening outcome for alcohol or illicit drug related SUDs, the SASSI-A3 provides an accurate screen that identifies individuals likely to be abusing prescription medications.

Forthcoming articles will describe geographic substance use patterns and how these might be affected by global events such as the COVID-19 Pandemic. A similar study by Tiburcio, Twiggs & Dunlap on environmental conditions, (in this case Hurricane Katrina in Houston and New Orleans), investigated the large degree these disruptions had on changing substance use disorder usage and acquisition patterns in communities, counties and entire cities. The newly revised features of the SASSI-A3, including: the Rx scale, the overall SUD screening outcome, a scale to indicate profile validity and the inclusion of a measure of defensive responding, afford assessment professionals a concise and accurate tool to facilitate identification of SUD and clinical issues in need of further evaluation and treatment planning.

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