

Validation of the alcohol, smoking and substance involvement screening test (ASSIST)

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ABSTRACT

Aim The concurrent, construct and discriminative validity of the World Health Organization's Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) were examined in a multi-site international study. **Participants** One thousand and 47 participants, recruited from drug treatment ($n = 350$) and primary health care (PHC) settings ($n = 697$), were administered a battery of instruments. **Measurements** Measures included the ASSIST; the Addiction Severity Index-Lite (ASI-Lite); the Severity of Dependence Scale (SDS); the MINI International Neuropsychiatric Interview (MINI-Plus); the Rating of Injection Site Condition (RISC); the Drug Abuse Screening Test (DAST); the Alcohol Use Disorders Identification Test (AUDIT); the Revised Fagerstrom Tolerance Questionnaire (RTQ); and the Maudsley Addiction Profile (MAP). **Findings** Concurrent validity was demonstrated by significant correlations between ASSIST scores and scores from the ASI-Lite ($r = 0.76$ – 0.88), SDS ($r = 0.59$), AUDIT ($r = 0.82$) and RTQ ($r = 0.78$); and significantly greater ASSIST scores for those with MINI-Plus diagnoses of abuse or dependence ($P < 0.001$). Construct validity was established by significant correlations between ASSIST scores and measures of risk factors for the development of drug and alcohol problems ($r = 0.48$ – 0.76). Discriminative validity was established by the capacity of the ASSIST to discriminate between substance use, abuse and dependence. Receiver operating characteristic (ROC) analysis was used to establish cut-off scores with suitable specificities (50–96%) and sensitivities (54–97%) for most substances. **Conclusions** The findings demonstrated that the ASSIST is a valid screening test for identifying psychoactive substance use in individuals who use a number of substances and have varying degrees of substance use.

Keywords Alcohol, ASSIST, illicit drugs, psychometrics, screening test, tobacco, validation.

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INTRODUCTION

Problems associated with the use of psychoactive substances are prevalent world-wide, and are associated with significant morbidity and mortality. The World Health Organization (WHO) has identified alcohol, tobacco and illicit drugs as among the top 20 risk factors for ill-health [1]. A public health approach to screening for these substances has been adopted [2] and a reliable and valid screening instrument has been developed that can be used in primary care settings to identify people with both

moderate and severe substance use problems, and that is capable of detecting risky, hazardous or harmful substance use, where the level of risk can determine the most appropriate treatment for the individual.

The limitations of using existing screening tests in primary care settings have been described recently [3,4]. Some instruments, such as the Problem-Oriented Screening Inventory for Teenagers (POSIT) [5] or Addiction Severity Index (ASI) [6] are time-consuming to administer. Conversely, briefer instruments, such as the Cut-down, Annoyed, Guilt, Eye-opener (CAGE)—Adapted to

Include Drugs (CAGE-AID) [7] and the Drug Abuse Screening Test (DAST) [8] focus on dependence, which is less useful for detecting problematic or risky drug use in non-dependent people. Other tests, devoted exclusively to alcohol or tobacco, tend to have similar limitations. Moreover, the available self-report screening tests have not been developed or validated for international use [27]. Finally, biological tests designed to detect the presence of psychoactive substances are limited because of their cost and intrusiveness.

In 1982 the World Health Organization initiated a programme to develop an international screening test for hazardous and harmful alcohol use [9]. The resulting instrument, the Alcohol Use Disorders Identification Test (AUDIT), has been found to be reliable and valid in numerous studies [10] and is used widely throughout the world in primary and other health care settings as part of screening and brief intervention programmes [11,12]. The success of the AUDIT and brief intervention for alcohol led the WHO to consider developing a screening instrument suitable for all psychoactive substances.

Accordingly, in 1997 the WHO sponsored the development of the interviewer-administered Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) [2]. A test–retest study of the ASSIST conducted internationally demonstrated that the ASSIST items were reliable and that the ASSIST screening procedure was feasible in primary care settings in a number of cultures [2].

The ASSIST (version 2.0) has a number of attributes that make it suitable for use in primary care settings [2]. It is relatively brief, comprising eight questions or items, covering 10 substances: tobacco, alcohol, cannabis, cocaine, amphetamine-type stimulants (ATS), inhalants, sedatives, hallucinogens, opioids and ‘other drugs’. The ASSIST investigates frequency of use and associated problems for each substance. Following Q1 concerning life-time use of substances, Q2 asks about frequency of use during the prior 3 months. Responses for this question (and Q3, Q4 and Q5) are rated on a five-point Likert scale ranging from ‘never’ (in the past 3 months) to ‘daily or almost daily’. This question provides critical information about the substances most relevant to the respondent’s current health status. If there has been no substance use in the past 3 months, the interviewer can skip to the last three questions about problems and usage patterns prior in their life-time. If any substance has been used during the past 3 months Q3, Q4 and Q5 are asked, before concluding with Q6, Q7 and Q8. Q3 asks about compulsion to use substances in the previous 3 months. This is a measure of psychological dependence. Q4 asks about health, social, financial or legal problems associated with substance use that have occurred within the previous 3 months. This is a measure of harmful use. Q5

asks whether participants have failed to meet usual role obligations; Q6–Q8 ask about life-time and recent problems, including whether concern has been expressed by friends or relatives, prior failed attempts at controlling drug use and current or life-time injection of drugs.

The primary aim of the current project was to conduct an evaluation of the construct, concurrent and discriminative validity of the ASSIST at a number of diverse international sites. Validity refers typically to how well an instrument measures what it is said to be measuring. In this case a psychological test validation approach was employed [13], which involved comparison of the ASSIST with a battery of other standardized, internationally used assessments. The test battery was chosen for its ability to measure multiple assessment domains and outcome criteria [14]. Hair samples also were used to validate self-report of substance use, and were selected for this study because sampling is non-invasive and drugs and their metabolites remain in hair tissue indefinitely after use.

METHOD

Recruitment setting, procedure and criteria

The project was conducted at Clinical Research Units (CRUs) in seven countries selected to represent the broad range of cultures, political and economic systems in which substance-related problems are prevalent, and to enhance the cross-national generalizability of the findings. The sites were as follows. (i) Australia: Drug and Alcohol Services South Australia (also the Coordinating Centre); (ii) Brazil: Departamento de Psicobiologia, Universidade Federal de Sao Paulo, Sao Paulo and Departamento de Farmacologia, Universidade Federal do Parana Curitiba, Paraná; (iii) India: Department of Psychiatry, All India Institute of Medical Sciences, New Delhi; (iv) Thailand: Northern Dependence Treatment Centre, Mae Rim, Chiang Mai; (v) United Kingdom: National Addiction Centre, London; (vi) USA: UCLA Integrated Substance Abuse Programs, Los Angeles; and (vii) Zimbabwe: Department of Psychiatry, University of Zimbabwe Medical School, Harare.

Most sites had two to five tertiary-educated interviewers who were familiar with substance-use issues. The project coordinator in each site was responsible for training of interviewers, with additional oversight and monitoring provided by the coordinating centre. A detailed study manual and demonstration video served as the key training resources for delivery of the interviewer-administered schedules.

Each research centre recruited approximately 150 participants. Of these, two-thirds were recruited from primary health care (PHC) facilities, and the remaining

third were recruited from specialized drug treatment facilities in that country. This sampling procedure was used to ensure that participants exhibited a range of substance use, from dependent to occasional and non-problematic use, and also to establish three main reference groups: (i) current abstainers or non-problematic substance users who had never been treated for drug and alcohol problems representing those at low risk of developing harms associated with drug use; (ii) current substance users who, while not dependent, may have been at moderate risk of experiencing harms from their drug use either now or in the future, and who did not require specialized treatment although they may have sought treatment in the past; and (iii) high-level or dependent users, currently in treatment, representing those at high risk of harm, including frequent injection. The total sample size obtained from all sites combined was 1047 (697 from PHCs, 350 from specialized settings).

Suitable locations for recruiting the PHC sample focused upon those having an over-representation of substance users including sexually transmitted disease (STD) clinics, general medical in-patients and out-patients, community health centres and general practitioners. Participants from PHC settings were recruited by means of fliers placed in the waiting rooms of agencies. PHC respondents underwent preliminary screening to determine if they were suitable for the study, but were not relegated to reference group 1 (occasional use–low risk) or group 2 (regular use–moderate risk) until the completion of the interview when MINI-Plus scores were available.

Programmes that specialized in substance abuse/dependence treatment served as the recruitment base for diagnosed dependent substance users and reference group 3 (dependent high risk). These sites included in-patient and out-patient drug treatment centres and in one country, psychiatric clinics. The recruitment procedure in the majority of clinics involved either advertising with fliers within the treatment setting, or direct canvassing of patients by the interviewer or treating clinician.

The following exclusion criteria were used to screen out inappropriate study participants: (i) communication difficulties or cognitive impairment; (ii) severe behavioural disturbances and/or mental health problems; (iii) drug and alcohol intoxication or severe withdrawal; (iv) recent long-term incarceration; (v) no substance use in the last three months; and (vi) aged over 45 or under 18 years.

A stratified sampling procedure was used to ensure recruitment was balanced with regards to gender and the following age groups: 18–25; 26–35; and 36–45 years. Most sites were able to recruit equal numbers of subjects within these age groups.

Measures

A comprehensive test battery lasting approximately 60–90 minutes was administered to all participants and questions were asked retrospectively for the period prior to treatment [14]. Instruments and documents were translated, where relevant, according to the WHO guidelines for translation and adaptation of instruments.

The test battery included a demographic profile, the ASSIST questionnaire and the following instruments: the Addiction Severity Index–Lite (ASI-Lite) [6]; the Severity of Dependence Scale (SDS) [15,16]; the MINI International Neuropsychiatric Interview (MINI-Plus), in which sections relating to drug and alcohol abuse and dependence and attention deficit/hyperactivity disorder (ADHD) and antisocial personality disorder (ASPD) were administered [17,18]; the Rating of Injection Site Condition (RISC) [19]; the Drug Abuse Screening Test (DAST) [8,20]; the Alcohol Use Disorders Identification Test (AUDIT) [9,21]; the Revised Fagerstrom Tolerance Questionnaire (RTQ) [22] and the Maudsley Addiction Profile (MAP) [23].

Several different domains can be derived from the ASSIST [14]. The ASSIST scores utilized for comparison were the:

- specific substance involvement score (ASSIST–SSI) for each substance (sum of response weights to Q2–Q7 within each of the substance classes);
- total substance involvement score (TSI, sum of response weights to Q1–Q8 across all substance classes);
- current frequency of substance use (item score for Q2 for each substance);
- ASSIST questions reflecting dependence (sum of Q1, 2, 3, 6 and 7 across all substances);
- ASSIST questions reflecting abuse (sum of Q1, 2, 4, 5 and 6 across all substances).

Participants from the treatment group also received an independent clinical evaluation (ICE) from a specialist addiction clinician who was blind to the findings of other tests. The purpose of the ICE was to determine diagnoses of current and life-time dependence on a range of substances and comprised a semistructured clinical interview based on DSM-IV criteria for dependence. The ICE was generally conducted within 24 hours of the test battery.

A 3-cm hair sample weighing approximately 20 mg (~50–100 strands of hair) was taken from the majority of subjects in all participating countries excluding the United Kingdom and Zimbabwe. Interviewers were trained in hair sample collection and storage procedures. All participants (from both PHC and drug treatment settings) were asked to provide a hair sample, following administration of the baseline assessment instruments.

Analysis of a selection of the samples (10%, $n = 110$) was conducted by the Forensic Science Laboratories of South Australia. Diagnostix™ enzyme-linked immunosorbent assay (ELISA) plate kits were used to confirm the self-reported presence of cocaine, ATS, benzodiazepines or opioids in hair according to a standard method [24].

Sample demographics

Of the total sample ($n = 1047$), 35% were aged 18–25, 35% were aged 26–35 and 30% were aged 36–45 years. The mean age of the total sample was 30.4 (8.2) years. The mean age of subjects across sites was comparable, ranging from 28.1 years in Thailand to 31.6 in the United Kingdom. Two-thirds (66%) of the sample were male (Australia 50%, Brazil 63%, India 96%, Thailand 69%, United Kingdom 67%, United States 43%, Zimbabwe 75%).

The majority of the sample (46%) had never been married or were currently married (31.3%). Just over one-half of the sample was currently employed (55.1%) in either full-time (40.6%) or part-time (14.6%) work. Participants had completed a mean of 11.5 [standard deviation (SD) = 4.0] years of schooling (range: 1–25 years).

The percentage of subjects who received a positive score on the ASSIST (i.e. scoring between 1 and 20, or between 1 and 16 for tobacco) by substance was as follows: alcohol 87%; tobacco 75%; cannabis 38%; ATS 25%; opioids 22%; sedatives 18%; cocaine 15%; hallucinogens 8% and inhalants 5%. The ASSIST took an average of 8.7 (SD = 4.6) minutes to administer to participants (range: 1–30 min, $n = 1023$).

Data analysis

Data were analysed using SPSS for Windows, version 10.1 (SPSS). To compensate for the increased likelihood of type 1 error caused by multiple comparisons, the alpha level was adjusted so that $P < 0.01$ was required for statistical significance.

Concurrent validity

Concurrent validity of the ASSIST was investigated by comparing domain scores obtained from the ASSIST with scores obtained from similar measures and assessments (ASI, SDS, AUDIT, RTQ, MINI-Plus) using two-tailed Pearson's correlation. Two-tailed independent t -tests were also used to compare ASSIST scores which had been divided into two groups according to the presence or absence of MINI-Plus diagnoses of current or life-time abuse or dependence. Finally, self-report of cocaine, amphetamines, benzodiazepines and opioids in the last 3 months (ASSIST Q2) was compared with the pres-

ence or absence of the drug in participants' hair and χ^2 comparisons were used to determine true-positive and true-negative fractions (sensitivity and specificity) accordingly.

Construct validity

Cronbach's α was used to determine the internal consistency of ASSIST–SSI and TSI scores.

The ASSIST constructs of 'abuse' and 'dependence' were investigated by comparison with MINI-Plus severity of abuse and dependence using two-tailed Pearson's correlation. MINI-Plus severity of abuse and dependence was derived by summing responses to individual items recording current or life-time abuse or dependence respectively, including alcohol and the four most problematic drugs other than alcohol (if relevant).

The construct validity of an instrument also concerns circumstantial evidence for the constructs it is said to measure. In this case, TSI scores were correlated with measures thought to be indirect indicators of substance problems such as physical and psychological health (MAP), injecting behaviour (RISC) and psychiatric disorders (MINI-Plus diagnoses of ADHD and ASPD) [25]. The first two constructs were investigated using two-tailed Pearson's correlation. Two-tailed independent t -tests were used to compare ASSIST scores, which had been divided into two groups according to the presence or absence of ADHD and ASPD.

Discriminative validity

The ASSIST was investigated for its ability to discriminate between three groups—non-problematic use (low risk), abuse (moderate risk) and dependence (high risk). Risk status was considered to be proportional to the ASSIST score achieved and participants recruited from specialist treatment settings comprised the dependent high-risk group. Participants recruited from PHCs were classified into two groups according to the presence (moderate risk) or absence (low risk) of current MINI-Plus diagnoses for abuse. TSI scores were compared using independent groups analysis of variance (ANOVA) with Scheffé's *post-hoc* test as classified by the above groupings. The same groupings were also used to perform receiver operating characteristic (ROC) analysis in order to obtain further information concerning the ability of the ASSIST to discriminate between groups and to determine cut-off scores for moderate and high risk, and the sensitivity and specificity of the cut-off scores. Similar analyses were performed for ASSIST–SSI scores using ICE diagnoses of specific substance dependence to determine membership of the high-risk dependent group.

Table 1 Comparison of mean (standard deviation) Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) version 2.0 scores divided according to the presence or absence of MINI International Neuropsychiatric Interview (MINI-Plus) current or life-time diagnoses of abuse or dependence for each substance.

MINI-plus current or life-time diagnosis of abuse or dependence	ASSIST Specific Substance Involvement Score		
	Diagnosis present	Diagnosis absent	t-value (P-value)
Alcohol	7.9 (5.3)	2.4 (2.7)	-17.2 ($P < 0.001$)
Cannabis	7.6 (5.8)	0.9 (2.5)	-25.9 ($P < 0.001$)
Cocaine	8.9 (6.9)	0.3 (1.4)	-32.4 ($P < 0.001$)
Amphetamine-type stimulants	8.9 (6.9)	0.4 (1.6)	-32.6 ($P < 0.001$)
Inhalants	6.7 (7.7)	0.1 (0.6)	-25.1 ($P < 0.001$)
Sedatives	10.0 (6.5)	0.6 (2.2)	-29.3 ($P < 0.001$)
Hallucinogens	2.8 (4.1)	0.1 (0.7)	-12.6 ($P < 0.001$)
Opioids	13.2 (6.2)	0.2 (1.0)	-58.3 ($P < 0.001$)

Determination of weighted scoring

For the purposes of the present validity study, the ASSIST was scored using simple Likert scoring categories which were weighted identically for similar questions. Additional analyses were conducted to determine if the frequency (category) scores on individual items could be weighted and recoded according to how much they contribute to the risk of an individual. Principal components analysis (PCA) was used with all 31 components from within the item pool to determine if category items correlated around a central single factor and the weighting that would best reflect the centrality of each category item. The resulting weighted scores were based on optimal scaling of the categories using the correlations within the data. Cut-off scores were determined using ROC analysis as per the calculation of discriminative validity of the ASSIST.

RESULTS

Concurrent validity of the ASSIST

Comparison with the Addiction Severity Index

There were significant positive correlations ($r = 0.76$ – 0.88 ; $P < 0.001$; $n = 1047$) between Q2 ASSIST current frequency of substance use for alcohol, cannabis, cocaine, amphetamines, sedatives and opioids and corresponding items on the ASI.

Comparisons with MINI-plus

Participants recording current or life-time abuse or dependence diagnoses on the MINI-Plus had significantly higher ASSIST–SSI scores for all substances compared with participants for whom the same diagnosis was absent (Table 1). TSI was correlated significantly with the total number of diagnoses recorded on the MINI-Plus by participants ($r = 0.76$, $n = 1047$, $P < 0.001$). The total

number of MINI-Plus diagnoses comprised the sum of current and life-time diagnoses of abuse and dependence for alcohol and a maximum of four drugs.

Comparisons with the SDS, RTQ and AUDIT

TSI was correlated significantly with the score obtained on the SDS ($r = 0.59$, $P < 0.001$). Furthermore, the ASSIST–SSI scores for tobacco and alcohol were correlated significantly positively with the RTQ total score ($r = 0.78$, $P < 0.001$) and AUDIT score ($r = 0.82$, $P < 0.001$), respectively.

Hair analysis

Q2 ASSIST self-reported measures of cocaine, ATS, benzodiazepines and opioid use in the last 3 months was comparable with the presence of these drugs in hair samples. Table 2 shows the sensitivity and specificity of the ASSIST for each of these substances.

Construct validity of the ASSIST

Internal consistency

The calculation of Cronbach's α demonstrated good inter-item correlation for TSI (0.89) and for ASSIST–SSI scores as follows; tobacco (0.80), alcohol (0.84), cannabis (0.86), cocaine (0.93), ATS (0.94), inhalants (0.93), sedatives (0.89), hallucinogens (0.77) and opioids (0.94).

Comparisons with MINI-Plus diagnoses of ADHD and ASPD

TSI scores were significantly higher for participants diagnosed with ADHD than those not diagnosed with the disorder (49.4 (SD = 22) versus 26.2 (SD = 18.8), respectively, $t = -8.8$, $P < 0.01$). Similarly, TSI scores were significantly higher for participants diagnosed with

Table 2 Self-reported use of substances compared with presence in hair over the last 3 months.

	Cocaine	ATS	Benzodiazepines	Opioids
TPF percentage (sensitivity)	82%	66%	73%	91%
TNF percentage (specificity)	91%	73%	75%	80%

ATS: amphetamine-type stimulants; TPF: true positive fraction, TNF: true negative fraction. $n = 110$ for each substance group.

Table 3 Discrimination between use and abuse; abuse and dependence using analysis of variance (ANOVA) and receiver operating characteristic (ROC) analysis.

ASSIST domain	ROC (AUC)	ROC sensitivity (%)	ROC specificity (%)	ASSIST cut-off score	ANOVA Mean diff ($P \leq 0.001$)*
TSI					
Use/abuse	0.84	80	71	14.5	15.5
Abuse/depend	0.73	73	66	28.5	14.3
SSI score for alcohol					
Use/abuse	0.87	83	79	5.5	6.2
Abuse/depend	0.70	67	60	10.5	3.4
SSI score for cannabis					
Use/abuse	0.96	91	90	1.5	8.1
Abuse/depend	0.62	57	61	10.5	2.2
SSI score for cocaine					
Use/abuse	0.95	92	94	0.5	5.4
Abuse/depend	0.84	70	77	8.5	7.4
SSI score for amphetamines					
Use/abuse	0.96	97	87	0.5	7.5
Abuse/depend	0.77	72	68	11.5	5.7
SSI score for sedatives					
Use/abuse	0.96	94	91	0.5	11.1
Abuse/depend	0.45	54	50	10.5	-1.1 ^{NS}
SSI score for opioids					
Use/abuse	0.97	94	96	0.5	11.9
Abuse/depend	0.74	76	65	14.5	4.2

SSI: Specific Substance Involvement score; Depend: dependence. Participants in the dependence group met independent clinical evaluation (ICE) criteria for current dependence; participants in the abuse group met MINI International Neuropsychiatric Interview (MINI-Plus) criteria for current abuse. NS: not significant. *All analyses significant at $P \leq 0.001$ with the exception of abuse versus dependence for sedatives. Too few cases to undertake analysis for inhalants and hallucinogens. No information available for tobacco. ASSIST: Alcohol, Smoking and Substance Involvement Screening Test; AUC: area under the curve; TSI Total Substance Involvement.

ASPD (48.9 (SD = 24.2) versus 24.1 (SD = 16.6), respectively, $t = -15.3$, $P < 0.01$) than those not diagnosed with the disorder.

Comparisons with MINI-Plus derived scores of dependence and abuse

There was a significant and positive correlation between ASSIST scores reflecting dependence and the MINI-Plus derived severity of dependence score ($r = 0.76$, $P < 0.001$, $n = 1047$). Similarly, there was a significant and positive correlation between ASSIST scores reflecting abuse, and the MINI-Plus derived severity of abuse score ($r = 0.75$, $P < 0.001$, $n = 1047$).

Comparison with the MAP and the RISC

The TSI score was correlated significantly with the sum of physical and psychological health problems as measured

by the MAP ($r = 0.57$, $P < 0.01$, $n = 1044$), and with frequency of recent injecting behaviour as measured by the RISC ($r = 0.48$, $P < 0.01$, $n = 1045$).

Discriminative validity of the ASSIST

Table 3 shows that there were significant differences in TSI scores between 'use' (low risk) and 'abuse' (moderate risk) groups ($P \leq 0.001$) and ASSIST-SSI scores for alcohol, cannabis, cocaine, ATS, sedatives and opioids (all $P \leq 0.001$). There also were significant differences between 'abuse' (moderate risk) and 'dependence' (high risk) groups for TSI ($P \leq 0.001$) and ASSIST-SSI scores for alcohol, cannabis, cocaine, ATS and hallucinogens (all $P \leq 0.001$), but not for sedatives. There were insufficient cases to undertake analyses for hallucinogens and inhalants.

ROC analysis showed that the ASSIST was able to discriminate between 'use' and 'abuse' (i.e. low risk versus moderate risk), and 'abuse' and 'dependence' (i.e. moderate risk versus high risk) for each substance (ASSIST-SSI) and for TSI. Cut-off scores that separate groups most effectively, and their respective sensitivities and specificities, are presented in Table 3. Area under the ROC curve (AUC) is also presented in the table and group disparity increases as AUC approaches 1. In general, AUCs were higher for 'use' and 'abuse' comparisons than for 'abuse' versus 'dependence' comparisons.

DISCUSSION

The results of this study indicate that the ASSIST is a valid screening test for psychoactive substances in individuals who use a number of different substances and have varying degrees of substance involvement in the cross-national sample in which it was tested.

Concurrent validity is evident by the significant positive correlations obtained between ASSIST scores and a range of scores from other instruments, such as the ASI, SDS, MINI-Plus, AUDIT and RTQ, which provide collateral validation of substance use, abuse and dependence. For example, the significant correlation between Total Substance Involvement and the score derived from the SDS suggests that the ASSIST is a valid measure of severity of dependence for the substance that was most problematic for the person concerned. Moreover, ASSIST-SSI scores were significantly greater for those participants who received a diagnosis of abuse or dependence on the MINI-Plus, indicating that the ASSIST-SSI scores reflect problematic substance use accordingly. Analysis of hair samples was also indicative of the concurrent validity of the ASSIST, and demonstrates that self-reported drug use as recorded by the ASSIST is a sensitive and specific way of identifying drug use.

Similarly, there is substantial evidence for the construct validity of the ASSIST. Cronbach's α calculated for each domain showed good internal validity and in most cases alpha levels were above 0.80, thereby suggesting that the items had good internal consistency in measuring the same constructs. Construct validity also was investigated by comparing ASSIST scores with measures that provide circumstantial evidence for substance abuse and dependence. As expected, the relationships between ASSIST scores and other measures were not as strong as those found with concurrent validity. Nevertheless, there were significant, albeit modest, positive correlations between ASSIST scores and associated risk factors including recent injecting behaviour and physical, psychological or social problems. Furthermore, the finding that participants diagnosed with either ADHD and/or ASPD had significantly higher ASSIST scores is

further evidence for the construct validity of the ASSIST.

It was demonstrated that the ASSIST can discriminate between low-, moderate- and high-risk substance use, and thus has good discriminative validity, particularly for alcohol, cannabis, ATS, opioid and cocaine use. This was evidenced by both the ROC analysis and ANOVA with *post-hoc* testing. The ANOVA indicated significant differences between all three groups for all substances with the exception of sedatives, for which no difference was found between moderate and high-risk groups. Overall, it appears that the ASSIST discriminates more effectively between low and moderate risk than between moderate- and high-risk use. ROC analysis demonstrated that the AUC was modest to strong and also was able to provide a series of cut-off scores with acceptable sensitivities and specificities for most substance types.

It is intended that use, abuse and dependence be interpreted by health care workers as low, moderate and high risk, although clinical judgement should also be exercised by health care workers, particularly with regard to discriminating between moderate and high risk for which the discriminative validity evidence is relevant, albeit less strong.

As an addendum to this study, PCA was used to weight and recode frequency (category) scores on individual questions (items) according to how much they contribute to the risk of the individual. For practical purposes, the resulting version of the ASSIST (version 3.0) has established cut-offs that are the same for all substances with the exception of alcohol. The weighting of ASSIST version 2.0 item and category scores has resulted in a more accurate screening instrument and consequently the ASSIST version 3.0, which now contains the weighted scoring, and should be used in any subsequent research and clinical work. An electronic copy of version 3.0 and guidelines for use [26] can be found at http://www.who.int/substance_abuse/activities/assist/en/index.html. In brief, the revised cut-offs for version 3.0 are scores ≥ 4 (alcohol ≥ 10) reflect moderate risk, and high risk is commensurate with scores ≥ 27 [14,26].

The use of a reliable and valid screening instrument is considered a key aspect of a public health approach to early intervention for drug-related problems [2] and an appropriate response to the burden of disease created by substance use world-wide. Previous work has already established that the scores derived from the ASSIST are reliable and that it is feasible to use the ASSIST in a variety of settings and cultures [2]. The current study provides evidence of the validity of the ASSIST in a cross-national sample, and in particular shows that the instrument has the potential to be a low-cost tool for detecting drug-related problems in PHCs. Nevertheless, this conclusion should be tempered by recognition of the

limitations of test validation procedures that rely on self-report measures with overlap between the new test and the criterion measure.

While redundancy could have optimized the correlations between the ASSIST and some of the criterion measures, it is worth noting that our approach employed multiple methods to compensate for this problem, including an independent clinical evaluation and biological markers. With this initial demonstration of the validity of the ASSIST, additional research attention should be devoted to further testing in different settings and populations. Another important step is to the clinical usefulness of the ASSIST screening in relation to a therapeutic intervention, in the form of a brief intervention that can be administered in primary care settings.

In conclusion these findings suggest, with few minor discrepancies, that the ASSIST is capable of obtaining accurate information concerning the use of a number of substances and the level of risk associated with that substance use. Overall, the ASSIST shows good concurrent, construct and discriminative validity and can screen adequately for low-, moderate- and high-risk substance use for most substances. The results suggest that the ASSIST could be used as part of a more general public health approach to the identification and management of psychoactive substance use in primary care and other settings.

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