



Validation of screening instruments for alcohol and substance use disorders among men and women in Eastern Cape, South Africa

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ABSTRACT

Introduction: Valid Alcohol Use Disorder (AUD) and Substance Use Disorder (SUD) screeners are needed to identify and link people to services. We evaluated the performance of several AUD and SUD screeners in South Africa using the Mini International Neuropsychiatric Interview (MINI)-5 diagnostic gold standard.

Methods: Adults at primary and tertiary care facilities in Buffalo City Metro, South Africa, were screened by research assistants using the AUDIT and AUDIT-C (AUD), DAST-10 (SUD) and NIDA Quick Screen (AUD and SUD). Nurses administered the MINI-5 to identify AUD and SUD. We assessed the internal consistency, criterion validity, sensitivity and specificity of these tools, stratified by gender.

Results: Among 1885 participants, the prevalence of AUD and SUD were 9.5 % and 1.6 %, respectively. All tools demonstrated adequate internal consistency and criterion validity. A positive AUDIT screen (men: ≥ 8 ; women: ≥ 7) yielded sensitivity/specificity of 70.6/87.3 % (men: 78.7/82.6 %; women: 64.8/89.8 %). A positive AUDIT-C screen (men: ≥ 4 ; women: ≥ 3) yielded sensitivity/specificity of 66.1/82.0 % (men: 64.0/78.8 %; women: 67.6/81.3 %). Endorsing the NIDA alcohol use question yielded sensitivity/specificity of 71.1/68.1 % (men: 74.7/59.7 %; women: 68.6/72.5 %). Endorsing either NIDA substance use questions yielded sensitivity/specificity of 80.6/91.7 % (men: 80.8/89.0 %; women: 80.0/93.1 %). A DAST-10 cut-off of ≥ 3 yielded sensitivity/specificity of 71.0/96.0 % (men: 73.1/83.7 %; women 60.0/97.4 %).

Conclusions: The AUDIT and AUDIT-C performed similarly among men and women, although lower cut-offs may optimize performance among women. The low number of SUD cases hampered our ability to draw conclusions about the SUD screeners' performance.

1. Introduction

Unhealthy alcohol and substance use contributes significantly to the

global burden of disease, disproportionately impacting people in low- and middle-income countries (LMICs) (Degenhardt et al., 2018; Peacock et al., 2018). In South Africa alcohol consumption is high (Walls et al.,

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2020); a recent population-based survey found a 10.3 % prevalence of hazardous, harmful or dependent alcohol (16.5 % among men, 4.6 % among women) and a 8.6 % past 3-month prevalence of other substance use (13.3 % among men, 4.1 % among women) (Pengpid et al., 2021). The prevalence of alcohol use disorder (AUD) is approximately three times higher in South Africa relative to other African countries.(WHO, 2014) Furthermore, the prevalence of risky drinking patterns has been increasing in South Africa since the 1990s (Parry, 2005; Peltzer and Ramlagan, 2009). Unhealthy alcohol and substance use contributes to increases in injury, non-communicable disease, and infectious disease, and worsening social and health outcomes, particularly for those with conditions such as HIV or TB.(Probst et al., 2018a; Probst et al., 2018b; Walls et al., 2020) Moreover, there may be important gender differences in unhealthy alcohol and substance use, with a historically higher prevalence among men, (Peltzer and Pengpid, 2018; Peltzer and Phaswana-Mafuya, 2013) but with an increasing prevalence among women.(Lal et al., 2015; Nguyen et al., 2023; Slabbert et al., 2020)

Treatment for unhealthy alcohol and substance use in South Africa is limited, where there is limited psychiatric care, and the primary care system remains overburdened and under-resourced.(Matzopoulos et al., 2014) Alcohol and substance use services are often only available at private treatment centers, which are inaccessible to most South Africans (Parry, 2005) Given the shortage of psychiatric specialists, there is a need for valid, brief screening tools that can be integrated into primary care and used by non-specialists to facilitate treatment.(Collins et al., 2013) Tools such as the Alcohol Use Disorders Identification Test (AUDIT), the Drug Abuse Screening Test (DAST-10), and the NIDA Quick Screen are increasingly used to identify individuals with unhealthy alcohol or substance use.(Babor et al., 2001; Bradley et al., 2007; National Institute on Drug Abuse, 2012) However, these tools need to be psychometrically validated, with attention to translation and cross-cultural utility, to ensure the tools function effectively (Nadkarni et al., 2019; Yudko et al., 2007) Given the prevalence of AUD and SUD in South Africa, the need for screening is high, but few screeners have been translated or validated.

We aimed to evaluate the performance of the AUDIT, AUDIT-C, the NIDA quick screen, and the DAST-10 administered in English or isiXhosa among adults in Eastern Cape, South Africa against a diagnostic gold standard. As different cut-off scores are recommended on the AUDIT/AUDIT-C for men and women, (Chishinga et al., 2011; Hagman, 2016; Neumann et al., 2004) we assessed the sensitivity and specificity of these tools at standard cut-off scores and stratified by gender.

2. Methods

This study was part of a larger study validating mental health screeners.(Stockton et al., 2024)

2.1. Study Setting

Participants were recruited from government primary care clinics (n = 4) and tertiary facility (n = 1) within the Buffalo City Metro (BCM) Health District, Eastern Cape Province, South Africa in 2022.

2.2. Study population and eligibility

Adults 18 years or older, able to communicate in isiXhosa or English, and who were either seeking care for themselves or accompanying another person at a study facility were eligible to participate.

2.3. Measures

The AUDIT and AUDIT-C, the DAST-10, and the NIDA quick screen and Mini International Neuropsychiatric Interview (MINI)-5 diagnostic tool were translated into isiXhosa by the study coordinator (LM) in collaboration with two colleagues fluent in both isiXhosa and English.

Study staff then assessed the questions. The screeners were then back translated from isiXhosa into English by individuals unfamiliar with the study. The back-translation was approved by study team members (MAS, EWM, MLM) and study psychiatrist (CG).

2.3.1. Mental disorder diagnosis and classification

Current mental disorder diagnoses were made using the MINI-5, a structured diagnostic interview (Ali et al., 2016). We identified AUD (abuse and dependence) from the “Alcohol Abuse and Dependence” and SUD (abuse and dependence) from the “Non-alcohol Psychoactive Substance Use Disorders” modules, which included a list of drug categories - stimulants, cocaine, narcotics, hallucinogens, inhalants, marijuana, tranquilizers, miscellaneous - with common local terms included for each category (Annex 1). Additionally, current common mental disorders (CMD: Depression, Anxiety or PTSD), severe mental disorders (SMD: Psychosis, Hypomania or Mania) and low to high suicide risk (SR) were also diagnosed (Stockton et al., 2024).

2.3.2. Alcohol and substance use screeners

We administered the following alcohol and substance use screeners:

AUDIT: The AUDIT is a 10-item questionnaire that identifies hazardous and harmful patterns of alcohol consumption. The first eight questions ask about the frequency of different drinking behaviors and experiences on a five-point Likert scale (all scored 0–4) The last two questions ask about lifetime injury and suggestions to reduce drinking on a three-point Likert scale (scored 0, 2, or 4). The AUDIT scores range 0–40 (Babor et al., 2001). AUDIT scores of ≥ 7 for women or ≥ 8 for men and scores of ≥ 13 for women or ≥ 15 for men are indicative of unhealthy alcohol use (Nadkarni et al., 2019) and possible AUD,(Jonas and Garbutt, 2017) respectively.

AUDIT-C: The first three questions of the AUDIT focus on alcohol consumption patterns and are referred to as the AUDIT-C. The AUDIT-C scores range 0–12. An AUDIT-C score of ≥ 3 for women and ≥ 4 for men is indicative of hazardous or harmful alcohol use.(Bradley et al., 2007)

AUDIT Question 1: The first question of the AUDIT asks: “How often do you have a drink containing alcohol?” on a five-point Likert scale (scored 0–4). It is also the screening question for both the AUDIT-C and AUDIT, as participants who report “never” (scored 0) skip the remaining AUDIT-C questions and skip questions 2–8 on the AUDIT.

DAST-10: The DAST-10 is a ten-item screener that captures drug abuse problems that yields scores 0–10 (Skinner, 1982). Scores of 0, 1–2, 3–5, 6–8, and 9–10 are indicative of no, low, moderate, substantial and severe drug abuse problems, respectively. We added “excluding tobacco products and alcoholic beverages” to the introduction to the DAST-10, which then read: “These questions refer to drug use (excluding tobacco products and alcoholic beverages) in the past 12 months.”

NIDA Quick Screen: The NIDA Quick Screen includes four questions that ask about frequency of hazardous use of alcohol (question 1), tobacco products (question 2), prescription drugs for nonmedical reasons (question 3), and illegal drugs (question 4).(National Institute on Drug Abuse, 2012 Saitz et al., 2014) An endorsement of question 1 (score >0) is indicative of being an at-risk drinker. An endorsement of questions 3 or 4 (score >0) is indicative of hazardous drug use. The Questions 3 and 4 were adapted from a single-question screen for drug use in primary care.(Smith et al., 2010) and trigger further screening (National Institute on Drug Abuse, 2012).

2.3.3. Demographic and general health measures

Participants provided socio-demographic information (age, gender, marital status, living situation, education, monthly household income, occupation, and race) and self-reported health history (prior diagnoses of chronic disease, mental disorders, HIV, and TB).

Responses were recorded via tablet using the Research Electronic Data Capture (REDCap) platform (Harris et al., 2009).

2.4. Data collection

Data collection took place in two separate pop-up tents, erected in private places at the study facilities. A team of research assistants and nurses screened and diagnosed participants, respectively. Research assistants conducted an eligibility screening, invited individuals to participate, and consented participants. The research assistants then screened consenting individuals with the AUDIT, the DAST-10, and then NIDA Quick Screen. Afterwards, nurses blinded to the screening administered the MINI-5. The research assistants used a targeted sampling strategy to ensure a gender balanced sample, which relied on an over-sampling of men given the predominance of women at the facilities.

MINI-5 diagnosed mental health disorders were managed according to facility policies. Namely, the study nurses referred cases to on-site psychiatric staff or used the African Adult Primary Care (APC) and the Integrated Chronic Disease Management (ICDM) manuals to link individuals to psychiatric services (Department of Health, 2014, 2019).

2.5. Statistical analysis

Participants with incomplete responses to the MINI-5 or screeners were excluded.

Cronbach's alpha and McDonald's omega were calculated with bootstrapped 95 % confidence intervals to assess the internal consistency of scales (AUDIT, AUDIT-C, and DAST-10) (Dunn et al., 2014; Hayes and Coutts, 2020) We repeated these analyses stratified by gender, HIV status, and lifetime TB history and then restricted to those screened in isiXhosa.

To assess criterion validity, we calculated total sum scores, representing the number and/or frequency of endorsed symptoms or behaviors for the AUDIT (Range 0–40), AUDIT-C (Range 0–12) and DAST (Range 0–10). We compared the sum scores to the MINI-5 diagnoses using a receiver operating characteristic curve (DeLong et al., 1988) and calculated the area under the curve (AUC) (Pence et al., 2005). We calculated the sensitivity and specificity for the standard cut-offs for each screener.

Finally, test characteristics (sensitivity, specificity and percent correctly classified) at every possible cut-off score for all screeners were calculated among the entire sample and then stratified by gender (RF Fletcher and Wagner, 1996). The cut-off scores with the optimal combined sensitivity and specificity were identified using the Youden's Index (Ruopp et al., 2008) and are presented in Annex 4.

2.6. Ethics

Participants provided written informed consent as approved by the New York State Psychiatric Institute (NYSPI) Institutional Review Board (Protocol #8272), the Foundation for Professional Development Research Ethics Committee (8/2021) and the Eastern Cape Provincial Department of Health Research Committee (EC_202110_015).

3. Results

3.1. Participant characteristics

A total of 1885 participants were screened and assessed with the MINI-5 (Table 1). Participants were aged 18–88 years (mean = 39; SD = 13.1). 34.5 % (n = 651) identified as men, 65.4 % (n = 1232) as women, and 0.1 % (n = 2) as trans or non-binary. Of the women, 7.3 % (n = 90) were currently pregnant, and 10.3 % (n = 127) had given birth in the last year. Nearly all participants (n = 1792; 95.1 %) were screened in isiXhosa. Only 10 % (n = 188) of participants reported a tertiary education and 58.6 % (n = 1104) reported unemployment. Most participants were seeking care themselves (n = 1364; 72.4 %).

Only 0.6 % (n = 12) of participants self-reported a prior diagnosis of

Table 1
Participant Characteristics (N = 1885), by Gender.

Mean (SD) or n (%)	Total (N = 1885)	Men (n = 651)	Women (n = 1232)
Age (Range:18–88)	39 (13.1)	39.4 (12.4)	38.9 (13.5)
Marital Status			
Single	1114 (59.1)	409 (62.8)	703 (57.1)
In a relationship/married	624 (33.1)	111 (17.1)	209 (17.0)
Separated, Divorce, Widowed	147 (7.8)	43 (6.6)	104 (8.4)
Language of mwTool–13			
Administration			
English	92 (4.9)	26 (4.0)	66 (5.4)
isiXhosa	1792 (95.1)	625 (96.0)	1165 (94.6)
Race			
White	17 (0.9)	7 (1.1)	10 (0.8)
Black	1834 (97.3)	634 (97.4)	1198 (97.2)
Indian	1 (0.1)	0 (0.0)	1 (0.1)
Colored	31 (1.6)	10 (1.5)	21 (1.7)
Other	2 (0.1)	0 (0.0)	2 (0.2)
Education			
Grade 7 (Primary) or Less	219 (11.6)	73 (11.2)	146 (11.9)
Grade 8–11 (before matric)	733 (38.9)	264 (40.6)	468 (38.0)
Grade 12 (Matric) or Tertiary	933 (49.5)	314 (48.2)	618 (50.2)
Residence			
Informal Dwelling	551 (29.2)	171 (26.3)	380 (30.8)
Formal House	1329 (70.5)	478 (73.4)	849 (68.9)
Other	5 (0.3)	2 (0.3)	3 (0.2)
Household Income (monthly)			
< R1000 (~57 USD)	1061 (56.3)	347 (53.3)	714 (58.0)
> R1000	824 (43.7)	304 (46.7)	518 (42.1)
Employment			
Unemployed	1104 (58.6)	369 (56.7)	735 (59.7)
Employed	532 (28.2)	190 (29.2)	340 (27.6)
Self-Employed, Volunteer, Student, Other	249 (13.2)	92 (14.1)	157 (12.7)
Health Seeking			
Seeking Care	1364 (72.4)	460 (70.7)	902 (73.2)
Accompanying	521 (27.6)	191 (29.3)	330 (26.8)
Prior Alcohol/Substance Abuse Diagnosis	12 (0.6)	9 (1.4)	3 (0.2)
Prior Mental Disorder Diagnosis*	259 (13.7)	128 (19.7)	131 (10.6)
Ever Diagnosed with TB	1601 (84.9)	520 (79.9)	1079 (87.6)
Diagnosed with HIV	487 (25.8)	119 (18.3)	366 (29.7)
Diagnosed with other Chronic Condition* *	577 (30.6)	176 (27.0)	401 (32.6)

Note: Two participants reported they were trans/non-binary for "gender" and were excluded from the gender-stratified analyses: *Depression, Anxiety, PTSD, Bipolar Disorder, Panic, Suicidality, or Schizophrenia. * *Hypertension, Heart Disease, Diabetes, Epilepsy, Asthma, Arthritis, Ulcers, Cancer, Headaches, and being "disabled."

alcohol or substance abuse. Fourteen percent (n = 259) self-reported a prior mental disorder diagnosis. Finally, 15.1 % reported ever having TB, 25.8 % an HIV diagnosis and 30.6 % reported another chronic condition.

3.2. Alcohol and substance use disorder

The proportion of participants with AUD was 9.5 % (n = 180), where 7.8 % (n = 147) met criteria for dependence and 1.8 % (n = 33) met criteria for abuse. (Table 2) The proportion of participants with SUD was 1.6 % (n = 31), where 1.3 % (n = 25) met criteria for dependence and 0.3 % (n = 6) met criteria for abuse. 205 participants (10.9 %) had AUD or SUD, whereas 6 participants (0.3 %) had both. Of note, 6 of the 31 participants with SUD also had AUD (19.3 %). Men were more likely than women to have AUD and/or SUD. With respect to psychiatric multimorbidity among those with AUD or SUD: 40.0 % (n = 82) reported at least one CMD, 40.0 % (n = 81) reported low to high suicide risk, and 14.6 % (n = 30) reported a SMD. Table 2 stratified by HIV status, TB history and healthcare seeking status is available in Annex 2.

Table 2
Current Alcohol and Substance Use and other Mental Health Disorders, by Gender.

Disorder	Total (N = 1885)	Gender	
		Men (n = 651)	Women (n = 1232)
AUD	180 (9.5)	75 (11.5)	105 (8.5)
Dependence	147 (7.8)	60 (9.2)	87 (7.1)
Abuse	33 (1.8)	15 (2.3)	18 (1.5)
SUD	31 (1.6)	26 (4.0)	5 (0.4)
Dependence	25 (1.3)	20 (3.1)	5 (0.4)
Abuse	6 (0.3)	6 (0.9)	0 (0.0)
AUD or SUD	205 (10.9)	97 (14.9)	108 (8.8)
Both	6 (0.4)	4 (0.6)	2 (0.2)
Mental Health			
CMD	458 (24.3)	107 (16.4)	350 (28.4)
SMD	152 (8.1)	78 (12.0)	74 (6.0)
SR	279 (14.8)	60 (9.2)	219 (17.8)

CMD=Depression, Anxiety, or PTSD; SMD=Psychosis, Hypomania or Mania; SR=low to high suicide risk; HIV Status excludes those who reported “don’t know” or “refused to answer.”

With respect to past year substance use, 3.6 % (n = 68) of participants reported any drug use on the MINI-5; drug use was more common among men [7.2 % (n = 46)] than among women [1.8 % (n = 22)]. Marijuana was the most reported drug [2.6 % (n = 49)]; others reported using stimulants [0.9 % (n = 17)], narcotics [0.1 % (n = 1)], tranquilizers [0.2 % (n = 4)], and miscellaneous local drugs [0.5 % (n = 9)] such as: Woonga (heroin and antiretrovirals), Krokodil/Zombie Drug (desmorpine paint thinners or petrol), Nyope (heroin/cannabis), or Cat (tik and snuff). None of the participants reported using cocaine, hallucinogens, or inhalants and only one reported using narcotics.

3.3. Psychometric performance

3.3.1. Internal consistency

The AUDIT showed good internal consistency (Cronbach’s alphas and McDonald’s omegas 0.80–0.89) among the total sample and stratified by gender. (Table 5) The AUDIT-C showed acceptable internal consistency (Cronbach’s alpha 0.77 and McDonald’s omega 0.78) among the total sample, with lower internal consistency among women than men. The DAST-10 showed excellent internal consistency (Cronbach’s alphas and McDonald’s omegas >0.90) among the total sample, excellent internal consistency among men, and good internal consistency among women.

3.3.2. Criterion validity

The AUDIT, AUDIT-C, the NIDA substance use items (questions 3–4), and the DAST-10 all demonstrated good criterion validity (AUCs >0.8), with limited differences by gender. However, the NIDA question 1 (alcohol use) and the NIDA question 3 (prescription drug use) yielded

Table 3
Internal consistency, by gender.

	Cronbach’s α (95 %CIs)	McDonald’s ω_t (95 %CIs)
AUDIT Score (Range 0–40)		
Total Population	0.885 (0.864, 0.904)	0.849 (0.818, 0.867)
Men	0.833 (0.791, 0.864)	0.800 (0.767, 0.863)
Women	0.917 (0.891, 0.941)	0.880 (0.846, 0.897)
AUDIT-C Score (Range 0–12)		
Total Population	0.768 (0.729, 0.803)	0.775 (0.742, 0.821)
Men	0.773 (0.739, 0.807)	0.808 (0.757, 0.843)
Women	0.725 (0.655, 0.780)	0.727 (0.664, 0.775)
DAST Score (Range 0–10)		
Total Population	0.905 (0.883, 0.921)	0.911 (0.896, 0.928)
Men	0.913 (0.887, 0.932)	0.914 (0.900, 0.936)
Women	0.889 (0.871, 0.911)	0.903 (0.829, 0.924)

CI=Confidence Intervals

AUCs < 0.8. (Table 4)

3.3.3. Sensitivity and specificity at the standard cut-offs

Tables presenting the sensitivity and specificity for all tools at every cut-off among the total sample and stratified by gender are available in Annex 4. The sensitivity and specificity at standard cut-offs for AUD and SUD among the total population and stratified by gender are presented in Tables 5–7 and described in this section. Companion analyses restricted to those who were screened in isiXhosa, living with HIV, those with a lifetime history of TB, and those who were accompanying someone else seeking healthcare are available in Annex 3.

3.3.4. Audit

The first question of the AUDIT at a cut-off of ≥ 1 yielded 88.33 % sensitivity and 69.62 % specificity; performance did not vary by gender. (Table 5)

For the AUDIT-C, using the standard cut-off of ≥ 3 for women and ≥ 4 for men yielded 66.11 % sensitivity and 81.97 % specificity. Stratified by gender, these cut-offs yielded similar metrics for identifying AUD among both women and men. However, the cut-off scores that optimized the sensitivity and specificity trade-off were lower for women (≥ 1) than men (≥ 3). (Annex 4)

For the complete AUDIT, using the standard cut-off of ≥ 7 for women and ≥ 8 for men yielded 70.56 % sensitivity and 87.32 % specificity. Stratified by gender, these cut-offs yielded similar metrics for identifying AUD among both women and men. Across cut-off scores, sensitivity was lower among women than men, although the differences were not statistically significant. (Annex 4). Finally, the optimal cut-offs the AUDIT were lower for women (≥ 1) than men (≥ 9).

3.3.5. NIDA quick screen

Endorsing the NIDA Question 1 (score > 0) yielded 71.11 % sensitivity and 68.09 % specificity and performed similarly stratified by gender. (Table 6)

Recognizing that SUD was not common, endorsing either of the NIDA questions 3 or 4 (score > 0) yielded 80.65 % sensitivity and 91.69 % specificity, performing similarly among men and women. Examined individually, the NIDA question 3 (prescription drug use) yielded a much lower sensitivity than NIDA question 4 (illegal drug use); endorsing the NIDA question 3 (score > 0) yielded 12.90 % sensitivity,

Table 4

Area under the curve (AUC) and 95 % confidence intervals for each tool for alcohol and substance use disorder among the total population and stratified by gender.

Tool	Disorder	AUC (95 %CIs)		
		Total	Men	Women
AUDIT				
Q1	AUD	0.82 (0.79–0.85)	0.80 (0.76–0.84)	0.82 (0.78–0.86)
AUDIT-C	AUD	0.83 (0.80–0.86)	0.82 (0.78–0.86)	0.83 (0.79–0.87)
AUDIT	AUD	0.87 (0.84–0.90)	0.87 (0.83–0.91)	0.86 (0.83–0.90)
NIDA				
Q1	AUD	0.74 (0.70–0.78)	0.7(0.64–0.76)	0.75 (0.70–0.81)
Q3	SUD	0.54 (0.48–0.60)	0.54 (0.47–0.60)	0.58 (0.37–0.78)
Q4	SUD	0.86 (0.77–0.94)	0.86 (0.77–0.94)	0.79 (0.54–1.00)
Q3–4	SUD	0.88 (0.81–0.96)	0.87 (0.79–0.96)	0.89 (0.68–1.00)
DAST–10				
DAST–10	SUD	0.88 (0.81–0.95)	0.88 (0.81–0.96)	0.79 (0.54–1.00)

AUD=Alcohol Use Disorder; SUD=Substance Use Disorder

Table 5

Sensitivity and specificity at standard cut-off scores for the AUDIT among the total population and by gender.

Tool (cut-off score)	# Screen Positive	Sensitivity (95 % CI)	Specificity (95 % CI)
Total (N = 1885; 180 AUD cases)			
Q1 (>0)	677	88.33 (82.72–92.63)	69.62 (67.37–71.80)
AUDIT-C (≥3 W; ≥4 M*)	426	66.11 (58.70–72.99)	81.97 (80.06–83.77)
AUDIT (≥7 W; ≥8 M*)	343	70.56 (63.32–77.10)	87.32 (85.64–88.86)
AUDIT (≥13 W; ≥15 M*)	147	46.67 (39.21–54.24)	96.30 (95.29–97.15)
Women (n = 1232; 105 AUD cases)			
Q1 (>0)	386	84.76 (76.44–91.03)	73.65 (70.97–76.20)
AUDIT-C (≥3 W)	256	67.62 (57.79–76.43)	83.58 (81.29–85.70)
AUDIT (≥7 W)	184	64.76 (54.83–73.84)	89.71 (87.78–91.42)
AUDIT (≥13 W)	88	49.52 (39.62–59.45)	96.81 (95.60–97.75)
Men (n = 651; 75 AUD cases)			
Q1 > 0	289	93.33 (85.12–97.8)	61.98 (57.87–65.96)
AUDIT-C (≥4 M)	170	64.00 (52.09–74.77)	78.82 (75.25–82.09)
AUDIT (≥8 M)	159	78.67 (67.68–87.29)	82.64 (79.29–85.65)
AUDIT (≥15 M)	59	42.67 (31.31–54.62)	95.31 (93.25–96.89)

W=Women; M=Men; CI=Confidence Intervals; *Excludes those who identified a nonbinary or transgender; AUD=Alcohol Use Disorder

while endorsing the NIDA question 4 (score > 0) yielded 74.19 % sensitivity.

3.3.6. DAST 10

For the DAST-10, using a standard cut-off of ≥ 3 yielded 70.97 % sensitivity and 95.95 % specificity. (Table 7) A standard cut-off of ≥ 3 yielded higher sensitivity for men than women, but the differences were not statistically significant. The optimal cut-off score for the DAST-10 was ≥ 2 among the total population (≥2 for men and ≥5 for women). (Annex 4)

4. Discussion

Though the AUDIT is widely used in LMICs, it has not been well validated, particularly in sub-Saharan Africa, (Pengpid et al., 2021) and many different cut-offs are recommended.(Nadkarni et al., 2019) In Zambia, AUDIT scores of 20–24 (sensitivity 50–60 %) and AUDIT-C scores ≥ 3 (sensitivity >80 %) are recommended (Chishinga et al., 2011; Inoue et al., 2021). Conversely, in Mozambique AUDIT cut-off of ≥ 6 (sensitivity: 68.8 %; specificity 92.0 %) and AUDIT-C cut-off of ≥ 3 (sensitivity: 56.3 %; specificity: 90.7 %) are recommended for identifying for alcohol dependence (Atkins et al., 2021). In this study, using the standard AUDIT-C cut-off of ≥ 3 for women and ≥ 4 for men yielded sub-optimal sensitivity (66 %) and acceptable specificity (82 %) and using the standard AUDIT cut-off of ≥ 7 for women and ≥ 8 for men yielded adequate sensitivity 71 % and good specificity 87 %. Participants were potentially reluctant to report alcohol use and related harms, and lower cut-off scores could improve the performance of the tool. Future research that includes cognitive interviewing to understand how questions are understood is warranted, as is further investigation of social desirability in reporting substance use.

The AUDIT and AUDIT-C have performed differently among men and

Table 6

Sensitivity and specificity at standard cut-off scores for the NIDA Quick Screen among the total population and by gender.

Tool (cut-off score)	# Screen Positive	Sensitivity (95 %CI)	Specificity (95 %CI)
Total (N = 1885; 180 AUD cases, 31 SUD cases)			
NIDA Q1 (>0)	672	71.11 (63.9–77.61)	68.09 (65.82–70.30)
NIDA Q3 (>0)	99	12.90 (3.63–29.83)	94.88 (93.77–95.83)
NIDA Q4 (>0)	141	74.19 (55.39–88.14)	93.64 (92.43–94.70)
NIDA Q3–4 (>0)	179	80.65 (62.53–92.55)	91.69 (90.34–92.91)
Women (n = 1232; 105 AUD cases, 5 SUD cases)			
NIDA Q1 (>0)	382	68.57 (58.78–77.28)	72.49 (69.79–75.08)
NIDA Q3 (>0)	66	20.00 (0.51–71.64)	94.70 (93.30–95.89)
NIDA Q4 (>0)	65	60.00 (14.66–94.73)	94.95 (93.57–96.10)
NIDA Q3–4 (>0)	89	80.00 (28.36–99.49)	93.07 (91.51–94.43)
Men (n = 651; 75 AUD cases, 26 SUD cases)			
NIDA Q1 (>0)	288	74.67 (63.3–84.01)	59.72 (55.59–63.76)
NIDA Q3 (>0)	33	11.54 (2.45–30.15)	95.20 (93.22–96.74)
NIDA Q4 (>0)	76	76.92 (56.35–91.03)	91.04 (88.52–93.16)
NIDA Q3–4 (>0)	90	80.77 (60.65–93.45)	88.96 (86.24–91.31)

CI=Confidence Intervals; AUD=Alcohol Use Disorder; SUD=Substance Use Disorder;

Table 7

Sensitivity and specificity at standard cut-off scores for the DAST-10 among the total population and by gender.

Tool (cut-off score)	# Screen Positive	Sensitivity (95 % CI)	Specificity (95 % CI)
Total (N = 1885; 31 SUD cases)			
DAST–10 (≥ 3)	97	70.97 (51.96–85.78)	95.95 (94.96–96.81)
DAST–10 (≥ 6)	35	38.71 (21.85–57.81)	98.76 (98.14–99.21)
Women (n = 1232; 5 SUD cases)			
DAST–10 (≥ 3)	35	60.00 (14.66–94.73)	97.39 (96.34–98.21)
DAST–10 (≥ 6)	9	40.00 (5.27–85.34)	99.43 (98.83–99.77)
Men (n = 651; 26 SUD cases)			
DAST–10 (≥ 3)	62	73.08 (52.21–88.43)	83.74 (80.78–86.41)
DAST–10 (≥ 6)	26	38.46 (20.23–59.43)	97.44 (95.88–98.53)

CI=Confidence Intervals; SUD=Substance Use Disorder;

women,(Chishinga et al., 2011; Hagman, 2016; Levola and Aalto, 2015; Neumann et al., 2004) in alignment with differing global guidance on unhealthy alcohol use for men and women.(Patel and Balasanova, 2021) While differences between men and women were not significant in this study, our data suggest a lower cut-off for women than men could optimize sensitivity and specificity. For example, in our study AUDIT-C cut-offs of ≥ 3 for men and ≥ 1 for women and AUDIT cut-offs ≥ 9 for men and ≥ 1 for women optimized the sensitivity-specificity tradeoff. Of

note, another study in South Africa also recommended higher cut-off for men (≥ 10 , sensitivity: 81 %; specificity: 77 %) compared to women (≥ 7 , sensitivity: 82 %; specificity: 82 %) (Saal et al., 2020). In Zambia, one study recommended a higher AUDIT cut-off for men than women, (Chishinga et al., 2011) while another recommended the same AUDIT-C cut-off for both men and women (Inoue et al., 2021). In South Africa, social factors may result in gendered differences in alcohol use that have important health implications. (Peltzer and Pengpid, 2018; Peltzer and Phaswana-Mafuya, 2013; Pretorius et al., 2009) As socially acceptable alcohol use changes over time, research into alcohol use behaviors with attention to differences by gender, life stage, context and culture is warranted. Recognizing that this manuscript used a gender-binary framework to examine potential differences between men and women, in practice alcohol use screeners need to use gender-inclusive language and cut-offs and be assessed among gender-minority populations (Dermody et al., 2023; Gilbert et al., 2018).

Regarding the performance of the NIDA Quick Screen questions, Question 1 (alcohol use) performed well, and yielded adequate sensitivity and specificity for AUD. Questions 3 (prescription drug use) and question 4 (illegal drug use) together performed well, yielding high sensitivity and specificity for SUD, although question 3 on its own yielded low sensitivity. Further, question 4 on its own yielded very similar sensitivity and specificity to Questions 3 and 4 together. The NIDA Quick Screen has not been widely validated globally, or in the region (Coleman-Cowger et al., 2019; Harris et al., 2014) However, the original validation of the single item “How many times in the past year have you used an illegal drug or used a prescription medication for nonmedical reasons?” (a combination of questions 3 and 4) yielded 100 % (90.6 %–100 %) sensitivity and 73.5 % (67.7 %–78.6 %) specificity for detecting drug use disorder in the United States (Smith et al., 2010). Our analysis suggests questions 3 and 4 could potentially be combined as they were in the original single-item screener, or conversely, question 3 could be dropped in a low prescription drug use setting. It is worth noting that the term “illegal” can affect cross-cultural performance, given that “illegality” is not uniform, despite similar addictive liability. Regardless, our analysis suggests the translated, ultra-brief NIDA Quick Screen will function well as a first step in identifying unhealthy substance use behaviors in South Africa.

Using a standard DAST-10 cut-off of ≥ 3 (indicative of a moderate to severe drug use problems) yielded adequate sensitivity and high specificity for SUD among the total population, while performing similarly stratified by gender. The DAST-10 has also not been widely validated globally, (Yudko et al., 2007) or in sub-Saharan Africa. While the DAST-10 psychometrics have been assessed in China, (Chen et al., 2020; Lam et al., 2015) Turkey, (Evren et al., 2014) Saudi Arabia, (Murad et al., 2022) Iran, (Shirinbayan et al., 2020) US (in English and Spanish), (Bedregal et al., 2006; Gerke et al., 2018; Goldmann et al., 2021) and India, (Carey et al., 2003) few studies have assessed the DAST-10 against a diagnostic gold standard. Of the studies that used a diagnostic gold standard, low cut-off scores (1–4) were recommended to achieve adequate sensitivity and an optimal sensitivity/specificity trade-off. (Chen et al., 2020; Evren et al., 2014; Lam et al., 2015; Murad et al., 2022) This study demonstrates the isiXhosa DAST-10 performs similarly.

Recognizing the need for brevity in low-resource settings, ultra-brief, one- to three-item screeners may offer substantial utility as a first step towards identifying individuals who need further assessment (Basaraba et al., 2023) Prioritizing high sensitivity and improved sensitivity/specificity trade-off, our analysis suggests that for AUD, the first question of the AUDIT may perform better than the first question of the NIDA Quick Screen. Comparing the three-item AUDIT-C to the full ten-item AUDIT, the AUDIT-C performed comparably and thus may be a more efficient screener in this setting. With respect to SUD screening, the two NIDA Quick Screen questions performed comparably to the ten DAST-10 questions, suggesting the NIDA Quick Screen may be a much more efficient screener in this setting. Other studies have similarly found that single-item screeners may perform comparably and be more efficient

than the DAST-10 (Hearon et al., 2015; Smith et al., 2010) It is worth considering this recommendation in light of the very low proportion of the sample who met criteria for SUD, which hampers our ability to draw conclusions about the performance of the DAST-10 or the NIDA substance use items, particularly among women. Ultimately, the decisions around which questions and cut-offs to use should consider the trade-off between sensitivity and specificity and be guided by the aims of the research or program.

4.1. Limitations

There are several limitations to this study. We did not conduct cognitive interviews to assess the translated items. We used a targeted sampling strategy, thus inflating the proportion of the sample who met criteria for each disorder. As such, the proportions of the sample with AUD and SUD are not generalizable and should not be interpreted as prevalence estimates. The study population was recruited from health care facilities, and largely consisted of healthcare seeking individuals (e.g. a potentially “sick” population). However, when restricted to those who were accompanying others (e.g. not “sick” or healthcare seeking) we found that the tools performed similarly (Annex 3). We identified a very small proportion of participants who met the MINI criteria for SUD, and among women, a small proportion of both AUD and SUD. This may be due to under-reporting or reflect the 17.6 % of women in the perinatal period. However, the low numbers of AUD or SUD cases ultimately hampered our ability to assess the SUD screeners and examine differences by gender. As such, we recommend future assessment of these tools among populations with a higher prevalence of both AUD and SUD. We also did not randomize the order the screening tools were delivered nor did we randomize the administration of the screening vs diagnostic assessment, which may have impacted participants responses. Finally, we lacked a large enough sample screened in English ($n = 92$) to separately validate the tool in both isiXhosa and English. Due to the ethnic and linguistic diversity of South Africa, we chose to allow participants to decide the screening language as well as to vacillate between languages. Thus, this study generated real-world, multi-lingual validation data. However, the analyses restricted to those that were screened only in isiXhosa suggests the isiXhosa versions of the tools perform comparably.

5. Conclusion

In this cross-sectional validation study, we evaluated the psychometric performance of the AUDIT, AUDIT-C, DAST-10 and NIDA Quick Screen among adults in Eastern Cape Province, South Africa against a diagnostic gold standard and examined differences by gender. All the tools demonstrated at least adequate criterion validity. While the performance of the AUDIT and AUDIT-C did not significantly differ by gender, lower optimal cut-offs for women should be considered. The NIDA Quick Screen alcohol question performed adequately, although the first question of AUDIT may present a better single-item screening option. The NIDA Quick Screen substance use questions performed well together, although question 3 (about prescription drug use) appeared to have limited utility. Finally, the DAST-10 performed acceptably using a standard cut-off of ≥ 3 , but the low prevalence of SUD, particularly among women, hampered our ability to draw conclusions about its performance. In South Africa, very few alcohol or substance use screeners have been translated into isiXhosa or validated. This study helps fill that gap by translating the AUDIT, DAST-10 and NIDA Quick Screen into isiXhosa and validating these tools against a diagnostic gold standard. As efforts in South Africa have already begun to show the acceptability and feasibility of using lay health workers to administer the AUDIT, (Goldschmidt et al., 2023) future effectiveness-implementation trials are needed to understand how to use valid, translated tools for the continued expansion of alcohol and substance use services.

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Contributors

MAS designed the study, analyzed the results, and drafted the manuscript. EWM and LM lead the study staff training and help develop data collection protocols, with support from KN, NN, ACS, PN, CB and CG. CG lead the clinical training and provided clinical oversight throughout the course of the study. CB and MMW provide statistical expertise and consultation. CB developed the data collection system. MLW, AM, and PN provided senior leadership and oversight. All authors contributed to and approved this manuscript.

CRedit authorship contribution statement

Nogemane Kwanda: Writing – review & editing, Project

Annex 1. : MINI “Non-Alcohol Psychoactive Substance Use Disorder” Section opening question, with complete list of street drugs and medications

Opening Question: *Now I am going to show you / read to you a list of street drugs or medicines. In the past 12 months, did you take any of these drugs more than once, to get high, to feel better, or to change your mood?*

STIMULANTS: Methamphetamine (Tik, Tyhf, qapapa, qukala, vaccine, xhash xhash) amphetamines, speed, crystal meth, crank, rush, Dexedrine, Ritalin, diet pills, CAT (methcathione), etc.

COCAINE: Ntash, Neus Kos, Snorting, IV, freebase, crack, speedball, etc.

NARCOTICS: Stipaine, Adco-Doll, codeine, heroin, morphine, opium, opioids, OxyContin, methadone, etc.

HALLUCINOGENS: LSD (acid), mescaline, peyote, PCP (angel dust, peace pill), psilocybin, "mushrooms", "ecstasy", E's, MDA, MDMA, ketamine ("special K"), etc.

INHALANTS: "glue", ethyl chloride, "rush", nitrous oxide ("laughing gas"), amyl or butyl nitrate ("poppers"), etc.

MARIJUANA: Cannabis (dagga, hashish, hash, THC, pot, grass, weed", "reefer", skunk, boom, blunt, kush), etc.

TRANQUILIZERS: Methaqualone (Mandrax, Mercedes, Adidas, mdozolo, ndanda, white pipe, gholf or buttons), Valium, Xanor, Librium, Ativan, "Roofies", barbiturates etc.

MISCELLANEOUS: Woonga (heroin and ARV's), Krokodil/Zombie Drug (desmorpine paint thinners or petrol), Nyope (heroin/cannabis), Cat (tik and snuff)

Annex 2. : Prevalence of Current MINI-diagnosed Mental and Substance Use Disorders, by HIV status, TB history, and healthcare seeking status

Disorder n(%)	Total (N = 1885)	HIV Status		TB History		Healthcare Seeking	
		Positive (n = 487)	Negative (n = 1195)	Ever (n = 284)	Never (n = 1601)	Seeking (n = 1364)	Accompanying (n = 521)
AUD	180 (9.5)	70 (14.4)	92 (7.7)	46 (16.2)	134 (8.4)	143 (10.5)	37 (7.1)
Dependence	147 (7.8)	56 (11.5)	74 (6.2)	35 (12.3)	112 (7)	122 (8.9)	25 (4.8)
Abuse	33 (1.8)	14 (2.9)	18 (1.5)	11 (3.9)	22 (1.4)	21 (1.5)	12 (2.3)
SUD	31 (1.6)	7 (1.4)	19 (1.6)	11 (3.9)	20 (1.2)	26 (1.9)	5 (1)
Dependence	25 (1.3)	7 (1.4)	13 (1.1)	9 (3.2)	16 (1)	22 (1.6)	3 (0.6)
Abuse	6 (0.3)	0 (0)	6 (0.5)	2 (0.7)	4 (0.2)	4 (0.3)	2 (0.4)
A/SUD	205 (10.9)	76 (15.6)	107 (9)	53 (18.7)	152 (9.5)	164 (12)	41 (7.9)
Both	6 (0.4)	1 (0.2)	4 (0.3)	2 (0.1)	4 (1.4)	5 (0.4)	1 (0.2)
Other							
CMD	458 (24.3)	154 (31.6)	249 (20.8)	73 (25.7)	386 (24.1)	369 (27.1)	89 (17.1)
SMD	152 (8.1)	30 (6.2)	103 (8.6)	14 (4.9)	138 (8.6)	137 (10)	15 (2.9)
SR	279 (14.8)	107 (22)	145 (12.1)	52 (18.3)	227 (14.2)	97 (7.1)	17 (3.3)

CMD=Depression, Anxiety, or PTSD; SMD=Psychosis, Hypomania or Mania; SR=low to high suicide risk; AUD=Alcohol Use Disorder (dependence or abuse); SUD=Substance Use Disorder (dependence or abuse); HIV Status excludes those who reported “don’t know” or “refused to answer;” Those with a lifetime history of TB includes those who currently have TB, had TB within the last two years, and had TB more than two years ago;

Annex 3: Tables for sensitivity and specificity for each screening tool using standard cut-off points restricted to sub-populations

These are the companion tables to [Tables 5–7](#).

Annex Table 3.1: Sensitivity and specificity at standard cut-off points for each screening tool, among the total population and by gender

Tool	Total		Women		Men	
	Sensitivity (95 %CI)	Specificity (95 %CI)	Sensitivity (95 %CI)	Specificity (95 %CI)	Sensitivity (95 %CI)	Specificity (95 %CI)
AUDIT						
Q1	88.33 (82.72–92.63)	69.62 (67.37–71.8)	84.76 (76.44–91.03)	73.65 (70.97–76.2)	93.33 (85.12–97.8)	61.98 (57.87–65.96)
AUDIT-C ≥ 3 W; ≥ 4 M*	66.11 (58.70–72.99)	81.97 (80.06–83.77)	67.62 (57.79–76.43)	83.58 (81.29–85.7)	64.00 (52.09–74.77)	78.82 (75.25–82.09)
AUDIT ≥ 8	68.89 (61.58–75.57)	88.21 (86.59–89.7)	61.90 (51.91–71.21)	91.13 (89.31–92.72)	78.67 (67.68–87.29)	82.64 (79.29–85.65)
AUDIT ≥ 16	36.11 (29.10–43.59)	97.3 (96.42–98.02)	33.33 (24.43–43.2)	97.96 (96.95–98.7)	40.00 (28.85–51.96)	96.01 (94.07–97.45)
AUDIT ≥ 7 W; ≥ 8 M*	70.56 (63.32–77.10)	87.32 (85.64–88.86)	64.76 (54.83–73.84)	89.71 (87.78–91.42)	78.67 (67.68–87.29)	82.64 (79.29–85.65)
AUDIT ≥ 13 W; ≥ 15 M*	46.67 (39.21–54.24)	96.3 (95.29–97.15)	49.52 (39.62–59.45)	96.81 (95.6–97.75)	42.67 (31.31–54.62)	95.31 (93.25–96.89)
NIDA						
Q1 > 0	71.11 (63.9–77.61)	68.09 (65.82–70.3)	68.57 (58.78–77.28)	72.49 (69.79–75.08)	74.67 (63.3–84.01)	59.72 (55.59–63.76)
Q3 > 0	12.90 (3.63–29.83)	94.88 (93.77–95.83)	20.00 (0.51–71.64)	94.7 (93.3–95.89)	11.54 (2.45–30.15)	95.2 (93.22–96.74)
Q4 > 0	74.19 (55.39–88.14)	93.64 (92.43–94.7)	60.00 (14.66–94.73)	94.95 (93.57–96.1)	76.92 (56.35–91.03)	91.04 (88.52–93.16)
Q3-4 > 0	80.65 (62.53–92.55)	91.69 (90.34–92.91)	80.00 (28.36–99.49)	93.07 (91.51–94.43)	80.77 (60.65–93.45)	88.96 (86.24–91.31)
DAST						
DAST ≥ 3	70.97 (51.96–85.78)	95.95 (94.96–96.81)	60.00 (14.66–94.73)	97.39 (96.34–98.21)	73.08 (52.21–88.43)	83.74 (80.78–86.41)
DAST ≥ 6	38.71 (21.85–57.81)	98.76 (98.14–99.21)	40.00 (5.27–85.34)	99.43 (98.83–99.77)	38.46 (20.23–59.43)	97.44 (95.88–98.53)

*Excludes those who identified a nonbinary or transgender

Annex Table 3.4, Sensitivity and specificity for each screening tool using standard cut-off points restricted to those who received the screening tools in isiXhosa (n = 1792)

Tool	Disorder	Total Population (N = 1885)		Received in isiXhosa (n = 1792)	
		Sensitivity (95 %CI)	Specificity (95 %CI)	Sensitivity (95 %CI)	Specificity (95 %CI)
AUDIT					
Q1	AUD	88.33 (82.72–92.63)	69.62 (67.37–71.8)	88.95 (83.29–93.22)	69.63 (67.33–71.86)
AUDIT-C ≥ 3 W; ≥ 4 M*	AUD	66.11 (58.70–72.99)	81.97 (80.06–83.77)	66.28 (58.69–73.30)	82.14 (80.18–83.98)
AUDIT ≥ 8	AUD	68.89 (61.58–75.57)	88.21 (86.59–89.7)	69.19 (61.71–75.99)	88.46 (86.8–89.97)
AUDIT ≥ 16	AUD	36.11 (29.10–43.59)	97.3 (96.42–98.02)	36.05 (28.88–43.70)	97.22 (96.3–97.97)
AUDIT ≥ 7 W; ≥ 8 M*	AUD	70.56 (63.32–77.10)	87.32 (85.64–88.86)	70.93 (63.53–77.59)	87.52 (85.81–89.09)
AUDIT ≥ 13 W; ≥ 15 M*	AUD	46.67 (39.21–54.24)	96.3 (95.29–97.15)	47.09 (39.45–54.84)	96.17 (95.11–97.05)
NIDA					
Q1 > 0	AUD	71.11 (63.9–77.61)	68.09 (65.82–70.3)	72.09 (64.76–78.65)	68.64 (66.32–70.9)
Q3 > 0	SUD	12.90 (3.63–29.83)	94.88 (93.77–95.83)	12.90 (3.63–29.83)	95.34 (94.25–96.28)
Q4 > 0	SUD	74.19 (55.39–88.14)	93.64 (92.43–94.7)	74.19 (55.39–88.14)	94.09 (92.89–95.15)
Q3-4 > 0	SUD	80.65 (62.53–92.55)	91.69 (90.34–92.91)	80.65 (62.53–92.55)	92.33 (90.99–93.53)
DAST					
DAST ≥ 3	SUD	70.97 (51.96–85.78)	95.95 (94.96–96.81)	70.97 (51.96–85.78)	96.02 (95–96.89)
DAST ≥ 6	SUD	38.71 (21.85–57.81)	98.76 (98.14–99.21)	38.71 (21.85–57.81)	98.75 (98.11–99.22)

*Excludes those who report transgender or non-binary; W=Women; M=Men; AUD=Alcohol Use Disorder (dependence or abuse); SUD=Substance Use Disorder (dependence or abuse)

Annex Table 3.5, Sensitivity and specificity for each screening tool using standard cut-off points, restricted to those with a lifetime history of TB (n = 284)

Tool	Disorder	Total Population (N = 1885)		Lifetime history of TB (n = 284)	
		Sensitivity (95 %CI)	Specificity (95 %CI)	Sensitivity (95 %CI)	Specificity (95 %CI)
AUDIT					
Q1	AUD	88.33 (82.72–92.63)	69.62 (67.37–71.8)	93.48 (82.1–98.63)	56.3 (49.75–62.7)
AUDIT-C ≥ 3 W; ≥ 4 M*	AUD	66.11 (58.70–72.99)	81.97 (80.06–83.77)	73.91 (58.87–85.73)	70.17 (63.92–75.91)
AUDIT ≥ 8	AUD	68.89 (61.58–75.57)	88.21 (86.59–89.7)	76.09 (61.23–87.41)	79.83 (74.17–84.74)
AUDIT ≥ 16	AUD	36.11 (29.10–43.59)	97.3 (96.42–98.02)	45.65 (30.9–60.99)	95.8 (92.41–97.97)
AUDIT ≥ 7 W; ≥ 8 M*	AUD	70.56 (63.32–77.10)	87.32 (85.64–88.86)	78.26 (63.64–89.05)	78.99 (73.26–83.99)
AUDIT ≥ 13 W; ≥ 15 M*	AUD	46.67 (39.21–54.24)	96.3 (95.29–97.15)	58.7 (43.23–73)	94.54 (90.84–97.06)
NIDA					
Q1 > 0	AUD	71.11 (63.9–77.61)	68.09 (65.82–70.3)	71.74 (56.54–84.01)	65.55 (59.13–71.57)
Q3 > 0	SUD	12.90 (3.63–29.83)	94.88 (93.77–95.83)	18.18 (2.28–51.78)	93.77 (90.22–96.33)
Q4 > 0	SUD	74.19 (55.39–88.14)	93.64 (92.43–94.7)	81.82 (48.22–97.72)	93.41 (89.78–96.05)
Q3-4 > 0	SUD	80.65 (62.53–92.55)	91.69 (90.34–92.91)	90.91 (58.72–99.77)	90.11 (85.94–93.38)
DAST					
DAST ≥ 3	SUD	70.97 (51.96–85.78)	95.95 (94.96–96.81)	72.73 (39.03–93.98)	95.24 (91.99–97.44)
DAST ≥ 6	SUD	38.71 (21.85–57.81)	98.76 (98.14–99.21)	36.36 (10.93–69.21)	97.07 (94.31–98.73)

Those with a lifetime history of TB includes those who currently have TB, had TB within the last two years, and had TB more than two years ago; *Excludes those who report transgender or non-binary; W=Women; M=Men; AUD=Alcohol Use Disorder (dependence or abuse); SUD=Substance Use Disorder (dependence or abuse)

Annex Table 3.6, Sensitivity and specificity for each screening tool using standard cut-off points, restricted to those living with HIV (n = 487)

Tool	Disorder	Total Population (N = 1885)		Living with HIV (n = 487)	
		Sensitivity (95 %CI)	Specificity (95 %CI)	Sensitivity (95 %CI)	Specificity (95 %CI)
AUDIT					
Q1	AUD	88.33 (82.72–92.63)	69.62 (67.37–71.8)	90 (80.48–95.88)	60.19 (55.31–64.92)
AUDIT-C ≥ 3 W; ≥ 4 M*	AUD	66.11 (58.70–72.99)	81.97 (80.06–83.77)	64.29 (51.93–75.39)	76.87 (72.51–80.84)
AUDIT ≥ 8	AUD	68.89 (61.58–75.57)	88.21 (86.59–89.7)	65.71 (53.4–76.65)	85.61 (81.87–88.84)
AUDIT ≥ 16	AUD	36.11 (29.10–43.59)	97.3 (96.42–98.02)	40 (28.47–52.41)	96.64 (94.43–98.15)
AUDIT ≥ 7 W; ≥ 8 M*	AUD	70.56 (63.32–77.10)	87.32 (85.64–88.86)	68.57 (56.37–79.15)	84.1 (80.22–87.48)
AUDIT ≥ 13 W; ≥ 15 M*	AUD	46.67 (39.21–54.24)	96.3 (95.29–97.15)	48.57 (36.44–60.83)	95.42 (92.94–97.22)
NIDA					
Q1 > 0	AUD	71.11 (63.9–77.61)	68.09 (65.82–70.3)	72.86 (60.9–82.8)	68.11 (63.4–72.56)
Q3 > 0	SUD	12.90 (3.63–29.83)	94.88 (93.77–95.83)	28.57 (3.67–70.96)	97.29 (95.41–98.55)
Q4 > 0	SUD	74.19 (55.39–88.14)	93.64 (92.43–94.7)	71.43 (29.04–96.33)	95.63 (93.39–97.27)
Q3–4 > 0	SUD	80.65 (62.53–92.55)	91.69 (90.34–92.91)	85.71 (42.13–99.64)	94.17 (91.68–96.09)
DAST					
DAST ≥ 3	SUD	70.97 (51.96–85.78)	95.95 (94.96–96.81)	71.43 (29.04–96.33)	98.13 (96.47–99.14)
DAST ≥ 6	SUD	38.71 (21.85–57.81)	98.76 (98.14–99.21)	28.57 (3.67–70.96)	98.96 (97.59–99.66)

*Excludes those who report transgender or non-binary; W=Women; M=Men; AUD=Alcohol Use Disorder (dependence or abuse); SUD=Substance Use Disorder (dependence or abuse);

Annex Table 3.7, Sensitivity and specificity for each screening tool using standard cut-off points, restricted to those who were accompanying someone seeking healthcare (n = 521)

Tool	Disorder	Total Population (N = 1885)		Accompaniers (n = 521)	
		Sensitivity (95 %CI)	Specificity (95 %CI)	Sensitivity (95 %CI)	Specificity (95 %CI)
AUDIT					
Q1	AUD	88.33 (82.72–92.63)	69.62 (67.37–71.8)	83.78 (67.99–93.81)	71.07 (66.81–75.08)
AUDIT-C ≥ 3 W; ≥ 4 M*	AUD	66.11 (58.70–72.99)	81.97 (80.06–83.77)	59.46 (42.1–75.25)	82.64 (78.97–85.91)
AUDIT ≥ 8	AUD	68.89 (61.58–75.57)	88.21 (86.59–89.7)	67.57 (50.21–81.99)	89.26 (86.15–91.87)
AUDIT ≥ 16	AUD	36.11 (29.10–43.59)	97.3 (96.42–98.02)	35.14 (20.21–52.54)	97.52 (95.71–98.71)
AUDIT ≥ 7 W; ≥ 8 M*	AUD	70.56 (63.32–77.10)	87.32 (85.64–88.86)	67.57 (50.21–81.99)	88.64 (85.47–91.32)
AUDIT ≥ 13 W; ≥ 15 M*	AUD	46.67 (39.21–54.24)	96.3 (95.29–97.15)	40.54 (24.75–57.9)	96.9 (94.94–98.26)
NIDA					
Q1 > 0	AUD	71.11 (63.9–77.61)	68.09 (65.82–70.3)	64.86 (47.46–79.79)	64.88 (60.44–69.13)
Q3 > 0	SUD	12.90 (3.63–29.83)	94.88 (93.77–95.83)	0 (0–52.18)	93.99 (91.58–95.88)
Q4 > 0	SUD	74.19 (55.39–88.14)	93.64 (92.43–94.7)	80 (28.36–99.49)	93.8 (91.36–95.72)
Q3–4 > 0	SUD	80.65 (62.53–92.55)	91.69 (90.34–92.91)	80 (28.36–99.49)	91.47 (88.72–93.74)
DAST					
DAST ≥ 3	SUD	70.97 (51.96–85.78)	95.95 (94.96–96.81)	80 (28.36–99.49)	96.71 (94.78–98.07)
DAST ≥ 6	SUD	38.71 (21.85–57.81)	98.76 (98.14–99.21)	20 (0.51–71.64)	99.81 (98.92–100)

*Excludes those who report transgender or non-binary; W=Women; M=Men; AUD=Alcohol Use Disorder (dependence or abuse); SUD=Substance Use Disorder (dependence or abuse);

Annex 4. : Alcohol and substance use disorder tables for sensitivity and specificity for each screening tool every cut-off points, among the total population and stratified by gender

Annex 4, Table 1: AUDIT Question 1 Sensitivity, Specificity, and Percent Correctly Classified (% CC) at every cut-off point for Alcohol Use Disorder among the Total Population and Stratified by Gender

	Total (N=1885), 180 Cases			Men (n=651), 75 Cases			Women (n=1232), 105 Cases		
	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC
≥0 “Never”	100.00	0.00	9.55	100.00	0.00	11.52	100.00	0.00	8.52
≥1 “Monthly or Less”	88.33	69.62	71.41	93.33	61.98	65.59	84.76	73.65	74.59
≥2 “2-4 times a month”	48.33	88.04	84.24	56.00	80.73	77.88	42.86	91.84	87.66
≥3 “2-3 times a week”	36.67	91.26	86.05	42.67	85.24	80.34	32.38	94.41	89.12
≥4 “4 or more times a week”	14.44	99.12	91.03	14.67	98.44	88.79	14.29	99.47	92.21
>4 “4 or more times a week”	0.00	100.00	90.45	0.00	100.00	88.48	0.00	100.00	91.48

Shaded blue area represents cut-point where tradeoff between sensitivity and specified is optimized by Youden’s Index

Shaded blue area represents cut-point where tradeoff between sensitivity and specified is optimized by Youden’s Index

Annex 4, Table 2: AUDIT-C Sensitivity, Specificity, and Percent Correctly Classified (% CC) at every cut-off point for Alcohol Use Disorder among the Total Population and Stratified by Gender

Cut-off	Total Population (N=1885), 180 Cases			Men (n=651), 75 Cases			Women (n=1232), 105 Cases		
	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC
≥0	100.00	0.00	100.00	100.00	0.00	11.52	100.00	0.00	8.52
≥1	88.33	69.62	88.33	93.33	61.98	65.59	84.76	73.65	74.59
≥2	81.67	74.37	81.67	86.67	67.71	69.89	78.10	77.91	77.92
≥3	73.89	80.23	73.89	82.67	73.78	74.81	67.62	83.58	82.22
≥4	60.00	85.28	60.00	64.00	78.82	77.11	57.14	88.64	85.96
≥5	53.89	90.32	53.89	61.33	83.68	81.11	48.57	93.79	89.94
≥6	44.44	91.91	44.44	54.67	86.11	82.49	37.14	94.94	90.02
≥7	30.56	94.49	30.56	34.67	89.06	82.80	27.62	97.34	91.40
≥8	26.67	95.01	26.67	33.33	90.10	83.56	21.90	97.60	91.15
≥9	20.56	97.01	20.56	25.33	93.75	85.87	17.14	98.76	91.80
≥10	10.56	98.18	10.56	13.33	96.53	86.94	8.57	99.11	91.40
≥11	5.00	99.71	5.00	6.67	99.13	88.48	-	-	-
≥12	3.33	99.77	3.33	2.67	99.31	88.17	3.81	100.00	91.80
>12	0.00	100.00	0.00	0.00	100.00	88.48	0.00	100.00	91.48

Shaded blue area represents cut-point where tradeoff between sensitivity and specificity is optimized by Youden's Index

Shaded blue area represents cut-point where tradeoff between sensitivity and specificity is optimized by Youden's Index

Annex 4, Table 3: AUDIT Sensitivity, Specificity, and Percent Correctly Classified (% CC) at every cut-off point for Alcohol Use Disorder among the Total Population and Stratified by Gender

Cut-off	Total Population (N=1885), 180 Cases			Men (n=651), 75 Cases			Women (n=1232), 105 Cases		
	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC
≥0	100.00	0.00	9.55	100.00	0.00	11.52	100.00	0.00	8.52
≥1	91.11	68.39	70.56	94.67	60.42	64.36	88.57	72.58	73.94
≥2	85.00	72.61	73.79	89.33	65.28	68.05	81.90	76.49	76.95
≥3	81.11	77.01	77.40	89.33	69.79	72.04	75.24	80.75	80.28
≥4	78.33	79.59	79.47	85.33	72.74	74.19	73.33	83.14	82.31
≥5	75.56	82.76	82.07	84.00	75.87	76.80	69.52	86.34	84.90
≥6	74.44	84.63	83.66	81.33	77.95	78.34	69.52	88.11	86.53
≥7	71.11	86.69	85.20	80.00	80.90	80.80	64.76	89.71	87.58
≥8	68.89	88.21	86.37	78.67	82.64	82.18	61.90	91.13	88.64
≥9	66.11	90.85	88.49	74.67	86.81	85.41	60.00	92.99	90.18
≥10	63.33	92.43	89.66	69.33	89.58	87.25	59.05	93.97	90.99
≥11	58.33	93.67	90.29	65.33	91.15	88.17	53.33	95.03	91.48
≥12	53.33	94.78	90.82	56.00	92.36	88.17	51.43	96.01	92.21
≥13	48.89	95.66	91.19	48.00	93.40	88.17	49.52	96.81	92.78
≥14	43.33	96.48	91.41	42.67	94.62	88.63	43.81	97.43	92.86
≥15	40.00	96.77	91.35	42.67	95.31	89.25	38.10	97.52	92.45
≥16	36.11	97.30	91.46	40.00	96.01	89.55	33.33	97.96	92.45
≥17	29.44	97.54	91.03	30.67	96.53	88.94	28.57	98.05	92.13
≥18	26.11	97.71	90.88	25.33	96.88	88.63	26.67	98.14	92.05
≥19	22.78	98.06	90.88	21.33	97.05	88.33	23.81	98.58	92.21
≥20	21.11	98.24	90.88	21.33	97.22	88.48	20.95	98.76	92.13
≥21	17.78	98.59	90.88	13.33	97.74	88.02	20.95	99.02	92.37
≥22	16.11	98.77	90.88	10.67	97.92	87.86	20.00	99.20	92.45
≥23	15.00	98.94	90.93	10.67	98.26	88.17	18.10	99.29	92.37
≥24	13.89	99.24	91.09	-	-	-	17.14	99.56	92.53
≥25	12.78	99.30	91.03	9.33	98.61	88.33	15.24	99.65	92.45
≥26	11.11	99.35	90.93	8.00	98.78	88.33	13.33	99.65	92.29
≥27	10.00	99.53	90.98	5.33	99.13	88.33	-	-	-
≥28	9.44	99.53	90.93	4.00	99.13	88.17	13.33	99.73	92.37
≥29	7.78	99.71	90.93	-	-	-	11.43	99.82	92.29
≥30	6.11	99.71	90.77	2.67	99.48	88.33	8.57	99.82	92.05
≥31	-	-	-	0.00	99.48	88.02	7.62	99.91	92.05
≥32	4.44	99.77	90.66	-	-	-	-	-	-
≥33	3.89	99.82	90.66	0.00	99.65	88.17	6.67	99.91	91.96
≥34	3.33	100.00	90.77	0.00	100.00	88.48	5.71	100.00	91.96
≥35	-	-	-	-	-	-	-	-	-
≥36	2.78	100.00	90.72	-	-	-	4.76	100.00	91.88
≥37	2.22	100.00	90.66	-	-	-	3.81	100.00	91.80
≥38	1.67	100.00	90.61	-	-	-	2.86	100.00	91.72
≥39	-	-	-	-	-	-	-	-	-
≥40	0.56	100.00	90.50	-	-	-	0.95	100.00	91.56
>40	0.00	100.00	90.45	-	-	-	0.00	100.00	91.48

Shaded blue area represents cut-point where tradeoff between sensitivity and specified is optimized by Youden's Index

Shaded blue area represents cut-point where tradeoff between sensitivity and specified is optimized by Youden's Index

Annex 4, Table 4: NIDA Question 1 Sensitivity and Specificity, and Percent Correctly Classified (% CC) at every cut-off point for Alcohol Use Disorder among the Total Population and Stratified by Gender

	Total (N=1885), 180 Cases			Men (n=651), 75 Cases			Women (n=1232), 105 Cases		
	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC
≥0 “Never”	100.00	0.00	9.55	100.00	0.00	11.52	100.00	0.00	8.52
≥1 “Once or twice”	71.11	68.09	68.38	74.67	59.72	61.44	68.57	72.49	72.16
≥2 “Monthly”	52.78	87.98	84.62	54.67	77.43	74.81	51.43	93.43	89.85
≥3 “Weekly”	33.33	92.02	86.42	38.67	85.94	80.49	29.52	95.21	89.61
≥4 “Daily or almost daily”	7.22	99.24	90.45	5.33	98.26	87.56	8.57	99.73	91.96
>4 “Daily or almost daily”	0.00	100.00	90.45	0.00	100.00	88.48	0.00	100.00	91.48

Shaded blue area represents cut-point where tradeoff between sensitivity and specified is optimized by Youden’s Index

Shaded blue area represents cut-point where tradeoff between sensitivity and specified is optimized by Youden’s Index

Annex 4, Table 5: NIDA Question 3 Sensitivity and Specificity, and Percent Correctly Classified (% CC) at every cut-off point for Substance Use Disorder among the Total Population and Stratified by Gender

	Total (N=1885), 31 Cases			Men (n=651), 26 Cases			Women (n=1232), 5 Cases		
	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC
≥0 “Never”	100.00	0.00	1.64	100.00	0.00	3.99	100.00	0.00	0.41
≥1 “Once or twice”	12.90	94.88	93.53	11.54	95.20	91.86	20.00	94.70	94.40
≥2 “Monthly”	9.68	99.35	97.88	7.69	99.52	95.85	20.00	99.27	98.94
≥3 “Weekly”	6.45	99.62	98.09	3.85	99.68	95.85	20.00	99.59	99.27
≥4 “Daily or almost daily”	6.45	99.84	98.30	3.85	99.84	96.01	20.00	99.84	99.51
>4 “Daily or almost daily”	0.00	100.00	98.36	0.00	100.00	96.01	0.00	100.00	99.59

Shaded blue area represents cut-point where tradeoff between sensitivity and specified is optimized by Youden’s Index

Shaded blue area represents cut-point where tradeoff between sensitivity and specified is optimized by Youden’s Index

Annex 4, Table 6: NIDA Question 4 Sensitivity and Specificity, and Percent Correctly Classified (% CC) at every cut-off point for Substance Use Disorder among the Total Population and Stratified by Gender

	Total (N=1885), 31 Cases			Men (n=651), 26 Cases			Women (n=1232), 5 Cases		
	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC
≥0 “Never”	100.00	0.00	1.64	100.00	0.00	3.99	100.00	0.00	0.41
≥1 “Once or twice”	74.19	93.64	93.32	76.92	91.04	90.48	60.00	94.95	94.81
≥2 “Monthly”	70.97	97.57	97.14	73.08	95.36	94.47	60.00	98.70	98.54
≥3 “Weekly”	67.74	98.33	97.82	69.23	96.00	94.93	60.00	99.51	99.35
≥4 “Daily or almost daily”	61.29	98.76	98.14	61.54	96.96	95.55	60.00	99.67	99.51
>4 “Daily or almost daily”	0.00	100.00	98.36	0.00	100.00	96.01	0.00	100.00	99.59

Shaded blue area represents cut-point where tradeoff between sensitivity and specified is optimized by Youden’s Index

Shaded blue area represents cut-point where tradeoff between sensitivity and specified is optimized by Youden’s Index

Annex 4, Table 7: NIDA Question 3–4 Sensitivity and Specificity, and Percent Correctly Classified (% CC) at every cut-off point for Substance Use Disorder among the Total Population and Stratified by Gender

Cut-off	Total (N=1885), 31 Cases			Men (n=651), 26 Cases			Women (n=1232), 5 Cases		
	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC
≥0	100.00	0.00	1.64	100.00	0.00	3.99	100.00	0.00	0.41
≥1	80.65	91.69	91.51	80.77	88.96	88.63	80.00	93.07	93.02
≥2	74.19	94.55	94.22	73.08	92.80	92.01	80.00	95.44	95.37
≥3	74.19	97.57	97.19	73.08	95.20	94.32	80.00	98.78	98.70
≥4	67.74	98.49	97.98	65.38	96.64	95.39	80.00	99.43	99.35
≥5	-	-	-	-	-	-	-	-	-
≥6	3.23	99.89	98.30	-	-	-	0.00	99.84	99.43
≥7	-	-	-	-	-	-	-	-	-
≥8	3.23	99.95	98.36	3.85	100.00	96.16	0.00	99.92	99.51
>8	0.00	100.00	98.36	0.00	100.00	96.01	0.00	100.00	99.59

Shaded blue area represents cut-point where tradeoff between sensitivity and specified is optimized by Youden’s Index

Shaded blue area represents cut-point where tradeoff between sensitivity and specified is optimized by Youden’s Index

Annex 4, Table 8: DAST Sensitivity and Specificity, and Percent Correctly Classified (% CC) at every cut-off point for Substance Use Disorder among the Total Population and Stratified by Gender

Cut-off	Total (N=1885), 31 Cases			Men (n=651), 26 Cases			Women (n=1232), 5 Cases		
	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC	Sensitivity	Specificity	% CC
≥0	100.00	0.00	1.64	100.00	0.00	3.99	100.00	0.00	0.41
≥1	100.00	0.32	1.96	100.00	0.32	4.30	100.00	0.33	0.73
≥2	80.65	92.50	92.31	84.62	88.96	88.79	60.00	94.30	94.16
≥3	70.97	95.95	95.54	73.08	93.12	92.32	60.00	97.39	97.24
≥4	58.06	97.25	96.60	57.69	95.20	93.70	60.00	98.29	98.13
≥5	54.84	98.38	97.67	53.85	96.96	95.24	60.00	99.10	98.94
≥6	38.71	98.76	97.77	38.46	97.44	95.08	40.00	99.43	99.19
≥7	25.81	99.19	97.98	23.08	98.24	95.24	40.00	99.67	99.43
≥8	12.90	99.51	98.09	11.54	99.04	95.55	-	-	-
≥9	6.45	99.62	98.09	3.85	99.36	95.55	20.00	99.76	99.43
≥10	3.23	100.00	98.41	0.00	100.00	96.01	20.00	100.00	99.68
>10	0.00	100.00	98.36	-	-	-	0.00	100.00	99.59

Shaded blue area represents cut-point where tradeoff between sensitivity and specified is optimized by Youden’s Index

Shaded blue area represents cut-point where tradeoff between sensitivity and specified is optimized by Youden’s Index

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