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The eleven-item Alcohol, Smoking and Substance Involvement Screening Test (ASSIST-11): Cross-cultural psychometric evaluation across 42 countries

Chih-Ting Lee [a], Chung-Ying Lin [b,c,*], Mónika Koós [d,e], Léna Nagy [d,e], Shane W. Kraus [f], Zsolt Demetrovics [e,g], Marc N. Potenza [h,i], Rafael Ballester-Arnal [j], Dominik Batthyány [k], Sophie Bergeron [l], Joël Billieux [m,n], Julius Burkauskas [o], Georgina Cárdenas-López [p], Joana Carvalho [q], Jesús Castro-Calvo [r], Lijun Chen [s], Giacomo Ciocca [t], Ornella Corazza [u,v], Rita I. Csako [w], David P. Fernandez [x], Elaine F. Fernandez [y], Hironobu Fujiwara [z,aa], Johannes Fuss [ab], Roman Gabrhelík [ac,ad], Ateret Gewirtz-Meydan [ae], Biljana Gjoneska [af], Mateusz Gola [ag,ah], Joshua B. Grubbs [ai], Hashim T. Hashim [aj], Md. Saiful Islam [ak,al], Mustafa Ismail [aj], Martha Jiménez-Martínez [am,an], Tanja Jurin [ao], Ondrej Kalina [ap], Verena Klein [aq], András Költő [ar], Sang-Kyu Lee [as,at], Karol Lewczuk [au], Christine Lochner [av], Silvia López-Alvarado [aw], Kateřina Lukavská [ac,ax], Percy Mayta-Tristán [ay], Ionut Milea [az], Dan J. Miller [ba], Oľga Orosová [bb], Gábor Orosz [bc], Sungkyunkwan University's Research Team[bd,1], Fernando P. Ponce [be], Gonzalo R. Quintana [bf], Gabriel C.Quintero Garzola [bg,bh], Jano Ramos-Diaz [bi], Kévin Rigaud [bc], Ann Rousseau [bj], Marco De Tubino Scanavino [bk,bl], Marion K. Schulmeyer [bm], Pratap Sharan [bn], Mami Shibata [z], Sheikh Shoib [bo], Vera Sigre-Leirós [m,bp], Luke Sniewski [bq], Ognen Spasovski [br], Vesta Steibliene [o], Dan J. Stein [bt], Julian Strizek [bu], Berk C. Ünsal [d,e], Marie-Pier Vaillancourt-Morel [bv], Marie Claire Van Hout [bw], Beáta Bőthe [l]

[a] Department of Family Medicine, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan
[b] Institute of Allied Health Sciences, College of Medicine, National Cheng Kung University, Tainan, Taiwan
[c] Biostatistics Consulting Center, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan
[d] Doctoral School of Psychology, ELTE Eötvös Loránd University, Budapest, Hungary
[e] Institute of Psychology, ELTE Eötvös Loránd University, Budapest, Hungary
[f] Department of Psychology, University of Nevada, Las Vegas, Las Vegas, NV, USA
[g] Centre of Excellence in Responsible Gaming, University of Gibraltar, Gibraltar, Gibraltar
[h] Yale University School of Medicine, New Haven, CT, USA
[i] Connecticut Council on Problem Gambling, Wethersfield, CT, USA
[j] Departmento de Psicología Básica, Clínica y Psicobiología, University Jaume I of Castellón, Spain
[k] Institute for Behavioural Addictions, Sigmund Freud University Vienna, Austria
[l] Département de Psychologie, Université de Montréal, Montréal, Canada
[m] Institute of Psychology, University of Lausanne, Lausanne, Switzerland
[n] Center for Excessive Gambling, Addiction Medicine, Lausanne University Hospitals (CHUV), Lausanne, Switzerland
[o] Laboratory of Behavioral Medicine, Neuroscience Institute, Lithuanian University of Health Sciences, Lithuania
[p] Virtual Teaching and Cyberpsychology Laboratory, School of Psychology, National Autonomous University of Mexico, Mexico
[q] William James Center for Research, Departamento de Educação e Psicologia, Universidade de Aveiro, Aveiro, Portugal; CPUP: Center for Psychology at Porto University
[r] Department of Personality, Assessment, and Psychological Treatments, University of Valencia, Spain
[s] Department of Psychology, College of Humanity and Social Science, Fuzhou University, China
[t] Section of Sexual Psychopathology, Department of Dynamic and Clinical Psychology, and Health Studies, Sapienza University of Rome, Rome, Italy
[u] Department of Clinical, Pharmaceutical and Biological Sciences, University of Hertfordshire, United Kingdom
[v] Department of Psychology and Cognitive Science, University of Trento, Italy

* Corresponding author. Institute of Allied Health Sciences, Departments of Occupational Therapy and Public Health, and Biostatistics Consulting Center, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, 1 University Rd, Tainan 701401, Taiwan
E-mail address: cylin36933@gmail.com (C.-Y. Lin).

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[w] Department of Psychology and Neuroscience, Auckland University of Technology, Auckland, New Zealand
[x] Nottingham Trent University, United Kingdom
[y] HELP University, Malaysia
[z] Department of Neuropsychiatry, Graduate School of Medicine, Kyoto University, Kyoto, Japan
[aa] Decentralized Big Data Team, RIKEN Center for Advanced Intelligence Project, Tokyo, Japan
[ab] Institute of Forensic Psychiatry and Sex Research, Center for Translational Neuro- and Behavioral Sciences, University of Duisburg-Essen, Essen, Germany
[ac] Charles University, Department of Addictology, Prague, Czech Republic
[ad] General University Hospital in Prague, Department of Addictology, Czech Republic
[ae] School of Social Work, University of Haifa, Israel
[af] Macedonian Academy of Sciences and Arts, Macedonia
[ag] Institute of Psychology, Polish Academy of Sciences, Poland
[ah] Institute for Neural Computations, University of California San Diego, USA
[ai] Bowling Green State University, United States
[aj] University of Baghdad, College of Medicine, Iraq
[ak] Department of Public Health and Informatics, Jahangirnagar University, Savar, Dhaka, 1342, Bangladesh
[al] Centre for Advanced Research Excellence in Public Health, Savar, Dhaka, 1342, Bangladesh
[am] Universidad Pedagógca y Tecnológica de Colombia, Colombia
[an] Grupo de Investigación Biomédica y de Patología, Colombia
[ao] Department of Psychology, Humanities and Social Sciences, University of Zagreb, Croatia
[ap] Department of Educational Psychology and Psychology of Health, Pavol Jozef Safarik University in Kosice, Slovakia
[aq] School of Psychology, University of Southampton, United Kingdom
[ar] Health Promotion Research Centre, University of Galway, Ireland
[as] Department of Psychiatry, Hallym University Chuncheon Sacred Heart Hospital, South Korea
[at] Chuncheon Addiction Management Center, South Korea
[au] Institute of Psychology, Cardinal Stefan Wyszynski University, Warsaw, Poland
[av] SAMRC Unit on Risk & Resilience in Mental Disorders, Stellenbosch University, South Africa
[aw] University of Cuenca, Ecuador
[ax] Charles University, Department of Psychology, Prague, Czech Republic
[ay] Universidad Científica Del Sur, Lima, Peru
[az] Babeş-Bolyai University, Romania
[ba] James Cook University, Australia
[bb] Pavol Jozef Safarik University in Kosice, Department of Educational Psychology and Psychology of Health, Slovakia
[bc] Artois University, France
[bd] Department of Psychology, Sungkyunkwan University, South Korea
[be] Facultad de Psicología, Universidad de Talca, Chile
[bf] Departamento de Psicología y Filosofía, Universidad de Tarapacá, Arica, Arica y Parinacota, Chile
[bg] Florida State University, Panama
[bh] Sistema Nacional de Investigación (SNI), SENACYT, Panama
[bi] Universidad Privada Del Norte, Lima, Peru
[bj] Leuven School for Mass Communication, KU Leuven, Leuven, Belgium
[bk] Department of Psychiatry, Universidade de São Paulo, Brazil
[bl] Experimental Pathophisiology Post Graduation Program, Universidade de São Paulo, Brazil
[bm] Universidad Privada de Santa Cruz de la Sierra, Bolivia
[bn] Department of Psychiatry, All India Institute of Medical Sciences, New Delhi, 110029, India
[bo] Department of Psychology, Shardha University, India
[bp] Institute of Legal Psychiatry, Lausanne University Hospitals (CHUV), Lausanne, Switzerland
[bq] Auckland University of Technology, New Zealand
[br] University of Ss. Cyril and Methodius in Trnava, Slovakia
[bt] SAMRC Unit on Risk & Resilience in Mental Disorders, Dept of Psychiatry & Neuroscience Institute, University of Cape Town, South Africa
[bu] Austrian Public Health Institute, Austria
[bv] Département de Psychologie, Université Du Québec à Trois-Rivières, Trois-Rivières, Canada
[bw] Public Health Institute, Liverpool John Moores University, United Kingdom

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ABSTRACT

The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) is an instrument to screen substance-use-related health risks. However, little is known whether the ASSIST could be further shortened while remaining psychometrically sound across different countries, languages, gender identities, and sexual-orientation-based groups. The study aimed to validate a shortened 11-item ASSIST (ASSIST-11). Using the International Sex Survey data, 82,243 participants ($M_{age} = 32.39$ years) across 42 countries and 26 languages completed questions from the ASSIST-11 regarding gender identity, sexual orientation, and other information. Confirmatory factor analysis (CFA) and multigroup CFA (MGCFA) evaluated the ASSIST-11's structure and tested measurement invariance across groups. Cronbach's α and McDonald's ω were used to examine the internal consistency. Cohen's d and independent *t*-tests were used to examine known-group validity. The ASSIST-11 was unidimensional across countries, languages, age groups, gender identities (i.e., men, women, and gender-diverse individuals), and sexual orientations (i.e., heterosexual and sexual minority individuals). Cronbach's α was 0.63 and McDonald's ω was 0.68 for the ASSIST-11. Known-group validity was supported by Cohen's d (range between 0.23 and 0.40) with significant differences (p-values<0.001). The ASSIST-11 is a modified instrument with a unidimensional factor structure across different languages, age groups, countries, gender identities, and sexual orientations. The low internal consistency of the ASSIST-11 might be acceptable as it assesses a broad concept (i.e., use of several different substances). Healthcare providers and researchers may use the ASSIST-11 to quickly

[1] The Sungkyunkwan University's research team includes Dr. Hyein Chang and Mr. Kyeongwoo Park.

assess substance-use information from general populations and evaluate the need to follow up with more detailed questions about substance use.

1. Introduction

Use of licit (e.g., cigarette and alcohol) and illicit substances (e.g., heroin or marijuana) is an internationally relevant public health issue (Chang et al., 2022a; Chen et al., 2022). People who use substances often experience poor sleep, low quality of life, behavioral problems, and other stress-related concerns (Chang and Lin, 2015; Chang et al., 2014; Fan et al., 2022; Gjoneska et al., 2022; Lin et al., 2016; Saffari et al., 2022a). They may also encounter stigma, which may reduce motivation to seek professional treatment (Chang et al., 2019b, 2020, 2022b; Cheng et al., 2019). Thus, healthcare systems may experience burdens relating to addressing substance-related health concerns (Ryan and Rosa, 2020). However, early interventions could help reduce healthcare costs (Chang et al., 2017, 2019a). The World Health Organization (WHO) developed the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) to assist with early identification of substance-use related health risk and substance use disorders (SUDs) in primary and other healthcare settings (WHO ASSIST Working Group, 2002).

The ASSIST was developed partly due to the successful experience of another screening tool developed by the WHO: the Alcohol Use Disorders Identification Test (AUDIT), developed in 1982 (Allen et al., 1997). The AUDIT focuses on alcohol and is valid, psychometrically-sound, and widely used in healthcare settings worldwide (Allen et al., 1997; Babor and Higgins-Biddle, 2000; Gecaite-Stonciene et al., 2021). Although some instruments assessing different types of psychoactive substances (e.g., Addiction Severity Index, Substance Abuse Module of the Composite International Diagnostic Interview, and CAGE-Adapted to Include Drugs) have been developed with satisfactory psychometric properties (Brown and Rounds, 1995; Cottler et al., 1989; McLellan et al., 1985), they are limited by the following: (i) being lengthy and time-consuming; (ii) having a focus on dependence and not less consumption patterns; and (iii) often lacking cross-cultural validation (Khan et al., 2011; Basedow et al., 2021).

After the ASSIST was initially developed in 2002 (WHO ASSIST Working Group, 2002), its feasibility has been evaluated across multiple populations, including children and adolescents (Friso et al., 2021; Källmén et al., 2019; Kane et al., 2016), university students (Christoff et al., 2016; Mostardinha et al., 2019; Onifade et al., 2014; Tiburcio Sainz et al., 2016), older people (Khan et al., 2012), clinical populations with or without psychotic disorders (Henrique et al., 2004; Hides et al., 2009; Humeniuk et al., 2008; Johnson et al., 2015; Khan et al., 2011; Kumar et al., 2016; O'Grady et al., 2016; López-Lazcano et al., 2022; McNeely et al., 2014, 2016; Rubio Valldolid et al., 2014; Sun et al., 2010; van der Westhuizen et al., 2016; Yee et al., 2016), and general populations (Altin and Coşkunol, 2020; Muhamad et al., 2018; Newcombe and Tanielu, 2016; Soto-Brandt et al., 2014). The ASSIST appears to be a psychometrically sound instrument for assessing SUDs across these populations. Although the ASSIST assesses the frequency of an individual using different types of substances (including tobacco, alcohol, cannabis, cocaine, amphetamines, inhalants, sedatives, hallucinogens, opioids, and others), previous research has demonstrated that the ASSIST has a unidimensional structure (Khan et al., 2012), potentially reflecting polysubstance use (Kluwe-Schiavon et al., 2022), which could contribute to its low internal consistency.

The ASSIST contains eight items, each having sub-items. Specifically, the first item asks about the use of 10 different substances; then, subsequent questions addresss details regarding such use. Therefore, responses to and scoring of the ASSIST are complex. Thus, shortening the ASSIST to ask about the frequency of use of the 10 different substances with one open question as supplement may reduce administration time and provide a simpler scoring method. Therefore, we tested an 11-item version (ASSIST-11).

The ASSIST has been validated in different languages (e.g., English [O'Grady et al., 2016], French [Khan et al., 2011], Turkish [Altin and Coşkunol, 2020], Malay [Yee et al., 2016], Chinese [Sun et al., 2010], and Spanish [Rubio Valldolid et al., 2014]). Here, we tested the ASSIST-11 in various languages and cultures, including new, underserved, and underrepresented populations. Multi-language cross-cultural investigations are important given worldwide concerns related to substance use. A large-scale study involving different countries may test the instrument across cultures and aid in healthcare provision broadly.

Psychometric properties of the ASSIST remain insufficiently explored across sex and gender. Biological, epidemiological, and treatment-related differences exist between genders/sexes in SUDs, with more research needed (McHugh et al., 2018). To aid future studies examining sexuality/gender-related differences in SUDs, it is important to have a valid instrument for assessing SUDs without potential sexuality-/gender-related bias. Minority stress related to sexual orientation may contribute to different levels of substance use. For example, adolescents who report sexual-minority status are particularly likely to use substances (Corliss et al., 2010; Költő et al., 2019). As a result, we examined whether the ASSIST-11 assessed SUDs across gender-identity and sexual-orientation groups similarly.

The present study had the following research aims. First, we examined whether the modified ASSIST-11 had a unidimensional factor structure with satisfactory internal consistency in the total sample. Second, we conducted measurement invariance tests to examine if the ASSIST-11 was invariant across language, country, age, gender-identity, and sexual-orientation groups. Third, we tested known-group validity via several items assessing potential addictive behaviors. We hypothesized that (i) the ASSIST-11 would have a unidimensional factor structure; (ii) the unidimensional factor structure would be invariant across language, age, country, gender-identity, and sexual-orientation groups; and (iii) participants with more severe addictive behaviors would have higher ASSIST-11 scores than those with less severe addictive behaviors.

2. Methods

2.1. Procedure and participants

Forty-two countries[2] followed the International Sex Survey (ISS) guidelines to conduct an online survey using a cross-sectional study design described by Bőthe et al. (2021) (details of the preregistered study methods can be found here: https://osf.io/uyfra/?view_only=6e4f96b748be42d99363d58e32d511b8). For the present study validating the ASSIST-11 across countries, the non-English-speaking collaborating countries initially translated the ISS English survey battery into local languages with a robust translation procedure proposed by Beaton et al. (2000). Then, the collaborating countries obtained local ethics approval from their institutions (https://osf.io/n3k2c/?view_only=838146f6027c4e6bb68371d9d14220b5). Subsequently, the online survey

[2] Egypt, Iran, Pakistan, and Romania were included in the study protocol paper as collaborating countries (Bőthe et al., 2021); however, it was not possible to get ethical approval for the study in a timely manner in these countries. Chile was not included in the study protocol paper as a collaborating country (Bőthe et al., 2021) as it joined the study after publishing the study protocol. Therefore, instead of the planned 45 countries (Bőthe et al., 2021), only 42 individual countries are considered in the present study; see details at https://osf.io/n3k2c/.

(via the Qualtrics Research Suite) commenced simultaneously in all countries and data collection was conducted between October 2021 and May 2022. All procedures in the ISS survey were conducted in accordance with the Helsinki Declaration. On average, it took about 25–70 min for participants to complete the anonymous survey. There were no specific exclusion criteria; however, the participants needed to have been of a legal age to provide consent for participation. Therefore, the minimal age for participation depended on the laws of each country (e.g., participants needed to be aged 20 years or above in Taiwan). The list of related publications using the ISS dataset is uploaded on the OSF (journal publications: https://osf.io/jb6ey/?view_only=0014d87bb2b546f7a2693543389b934d; conference publications: https://osf.io/c695n/?view_only=7cae32e642b54d049e600ceb8971053e).

2.2. Measures

2.2.1. Background information

Sociodemographic information (e.g., biological sex, gender identity, sexual orientation, age, and level of education) and sexuality-related questions were queried as described in https://osf.io/jcz96/?view_only=9af0068dde81488db54638a01c8ae118 (Bőthe et al., 2021). Moreover, as described in the study protocol (Bőthe et al., 2021), several questions were used to assess mental health/emotional problems (without a timeframe), traditional gambling experiences (timeframes of ever or the past year), online gambling experiences (timeframes of ever or the past year), and seeking professional help for self-perceived uncontrolled sexual urges/behaviors (timeframe of current or the past year).

2.2.2. Eleven-item Alcohol, Smoking and Substance Involvement Screening Test (ASSIST-11)

The ASSIST-11 screens for substance use. The ASSIST was developed by the WHO (Humeniuk et al., 2010; WHO ASSIST Working Group, 2002) with validations in self-administered forms (Lopez-Rodriguez and Rubio Valladolid, 2018; Tiburcio Sainz et al., 2016). A unidimensional factor structure has been supported (Khan et al., 2012). The first 10 ASSIST-11 items ask if a respondent has used specific types of substances *in a time frame of last three months*: (item 1) tobacco, (item 2) alcohol, (item 3) cannabis, (item 4) cocaine, (item 5) amphetamine, (item 6) inhalants, (item 7) sedatives, (item 8) hallucinogens, (item 9) opioids, and (item 10) others. Examples of each type of substance (except "others") are given (e.g., cigarettes for tobacco). The last item in the ASSIST-11 is an open-ended question to specify other substances as indicated. All ASSIST-11 items (except for item 11) are rated using a five-point Likert scale ranging from 0 (never), 1 (once or twice), 2 (monthly), 3 (weekly), and 4 (daily or almost daily), all in the last three months. Because item 11 was supplementary to the 10 items, item 11 was not used in psychometric testing here. Using the first 10 items, the ASSIST-11 total score ranged between 0 and 40. Moreover, the timeframe of the ASSIST-11 follows that of the original ASSIST (i.e., in the past three months) to maintain consistency. The translations of the ASSIST-11 are available at https://osf.io/th4j6.

2.3. Statistical analysis

Statistical analyses involved four main steps: (i) descriptive statistics with normality checks (using IBM SPSS software); (ii) factor structure and internal consistency tests (using *lavaan* and *psych* packages in R software); (iii) measurement invariance tests across languages, countries, age, gender identities, and sexual orientations (using the *lavaan* package in R software); (iv) known-group validity tests (using the *effectsize* package in R software). The detailed analytic plan was preregistered (https://doi.org/10.17605/OSF.IO/DK78R).

2.3.1. Descriptive statistics and normality checks

Descriptive statistics summarized participants' characteristics (e.g., age, gender) and properties of ASSIST-11 items. Apart from means, standard deviations (SDs), frequencies, and percentages, skewness and kurtosis were used to check normality of each ASSIST-11 item, with normal distributions having absolute values of skewness smaller than 3 and kurtosis smaller than 10 (Kline, 2011).

2.3.2. Factor structure and internal consistency

Similar to most factor structure validation studies (Chen et al., 2023; Hu et al., 2022; Wu et al., 2023), confirmatory factor analysis (CFA) with a diagonally weighted least squares (DWLS) estimator was used to evaluate whether the ASSIST-11 would yield a one-factor structure. The use of DWLS is an appropriate estimator for Likert-type scales (Finney and DiStefano, 2013). If ASSIST-11 data fit well to a one-factor structure, the CFA fit indices should have comparative fit indices (CFIs) of >0.9; Tucker-Lewis indices (TLIs) of >0.9; root mean square errors of approximation (RMSEAs) of <0.08; and standardized root mean square residuals (SRMRs) of <0.08 (Browne and Cudeck, 1993). Two methods testing internal consistency (Cronbach's α and McDonald's ω) were used.

2.3.3. Measurement invariance test

Multigroup CFA (MGCFA) with the DWLS estimator examined measurement invariance across subgroups based on language, age, country, gender identity, and sexual orientation. Each subgroup needed a minimum of 560 participants, according to Monte Carlo simulations (see: https://doi.org/10.17605/OSF.IO/DK78R). The grouping rationale is reported at https://doi.org/10.17605/OSF.IO/DK78R. To overcome convergence problems in measurement invariance tests, the following grouping methods were used. The original 26 language subgroups were regrouped into two subsets according to the alphabetical order of the name of the language in English; the original 42 country-based subgroups were regrouped into two subsets according to the countries' English name in alphabetical order; the age subgroups were the following: young adults (aged below 30 years), early middle-aged adults (aged between 30 and 44.99 years), older middle-aged adults (aged between 45 and 59.99 years), and older adults (aged 60 years or above); the original five gender identity subgroups were regrouped into three groups (men, women, and gender-diverse individuals). The original eight sexual orientation subgroups were regrouped into two (heterosexual and sexual minority individuals), see https://doi.org/10.17605/OSF.IO/DK78R.

In the MGCFA, nested models testing for configural invariance (Model 0), metric invariance (Model 1), scalar invariance (Model 2), and residual invariance (Model 3) were compared. Model 0 examined if the subgroups shared the same one-factor model. Model 1 constrained the factor loadings being equal across subgroups. Model 2 additionally constrained item intercepts as being equal across subgroups. Model 3 additionally constrained residuals as being equal across subgroups. For metric, scalar, and residual invariance, invariances were first examined if full invariance was achieved using the following indices: ΔCFI (i.e., CFI between every two nested modes) > -0.010, ΔTLI > -0.010, ΔRMSEA <0.03 (for metric invariance) or < 0.015 (for scalar and residual invariance), and ΔSRMR <0.03 (Chen, 2007; Cheung and Rensvold, 2002; Rutkowski and Svetina, 2013). When full invariance was not achieved for any of the metric, scalar, or residual invariance, partial invariance that relaxed constraints of factor loadings, item intercepts, or residuals were also tested (Milfont and Fischer, 2010). Following the MGCFA, latent mean differences were computed to explore if different demographic groups had different latent scores on the ASSIST-11. The statistical analysis for the latent mean differences anchored a subgroup to have a latent of 0. Then, the other groups' latent means were checked to see their values differed from 0. This difference was used as an effect size indicator. In this regard, the latent mean difference at 0.2 indicated a small effect in difference, 0.5 a moderate effect

in difference, and 0.8 a large effect in difference.

2.3.4. Known-group validity testing

Known-group validity was examined using Cohen's d with independent samples *t*-tests. Participants with (versus without) substance-use problems were compared on ASSIST-11 total scores: having mental health/emotional problems, ever having traditional gambling experiences, past-year traditional gambling experiences, ever having online gambling experiences, past-year online gambling experiences, ever seeking professional help for self-described uncontrolled sexual urges/behaviors, and currently seeking professional help for self-described uncontrolled sexual urges/behaviors. These variables were chosen for known-group validity as we considered that people having high total ASSIST-11 scores would be more likely to have these other behaviors/concerns. The magnitude of effect size was considered small for 0.2 Cohen's d; moderate for 0.5 Cohen's d; and large for 0.8 Cohen's d (Cohen, 1988).

3. Results

Most participants (N = 82,243; mean $_{age}$ = 32.39 years) self-identified as women (*n* = 46,874; 57.0%), followed by men (*n* = 32,549; 39.6%), non-binary individuals (*n* = 2,315; 2.8%), and individuals identifying with other gender identities (*n* = 468; 0.6%), with 40.3% being biologically male (n = 33245). Nearly three-fourths of participants had the highest education as tertiary (*n* = 60,896; 74.0%) and nearly one-fourth had secondary education (*n* = 20,325; 24.7%). Detailed sociodemographic characteristics by country can be found at https://osf.io/n3k2c/?view_only=838146f6027c4e6bb68371d9d14220b5. All ASSIST-11 items, except for items 1 and 2 (skewness = 1.32 and 0.26; kurtosis = −0.01 and −1.31) violated normal distributions (skewness = 2.65 to 12.52; kurtosis = 6.58 to 184.92). In general, most items had floor effects (Table 1). There were some missing data (<10%) in the present study. Thus, subsequent analyses were conducted using a pairwise method to handle missing data.

CFA results of the ASSIST-11 are reported in Table 2. A one-factor structure of the ASSIST-11 was supported by fit indices: CFI = 0.936; TLI = 0.917; RMSEA (90% CI) = 0.030 (0.028, 0.031); and SRMR = 0.080. However, standardized factor loadings derived from the CFA were acceptable for items 1 to 5 (range between 0.306 and 0.628) but not for items 6 to 10 (range between 0.062 and 0.273). Moreover, the CFA fit indices were acceptable or nearly acceptable for most of the countries (CFI = 0.852 to 1.000, TLI = 0.810 to 1.123, and RMSEA = 0.000 to 0.042), except for the SRMR (ranged between 0.046 and 0.289; for detailed information, please see Appendix Table S1). The internal consistency was poor with McDonald's ω at 0.68 and Cronbach's α at 0.63. Corrected item-total correlations showed relatively low correlations for items 6, 7, 9, and 10 (range between 0.068 and 0.194). Appendix Table S2 reports internal consistency for each language version.

The MGCFA examined measurement invariance of the ASSIST-11 across languages, age groups, countries, gender identities, and sexual orientations (Table 3). In the MGCFA, the unidimensional structure was used because, although low factor loadings were observed in the baseline model in the case of some items, the fit indices supported the unidimensional structure, and the ASSIST-11 is a screening tool with a clear rationale for a one-factor structure. Regarding language-based measurement invariance tests, configural invariance (CFI = 0.937; TLI = 0.919; RMSEA = 0.029; SRMR = 0.074), full metric invariance (ΔCFI = −0.015; ΔTLI = −0.008; ΔRMSEA = 0.001; ΔSRMR = 0.002), full scalar invariance (ΔCFI = −0.017; ΔTLI = −0.008; ΔRMSEA = 0.002; ΔSRMR = 0.002), and partial residual invariance with residuals of items 2 and 3 relaxed (ΔCFI = −0.016; ΔTLI = −0.007; ΔRMSEA = 0.001; ΔSRMR = 0.030) were achieved.

Regarding country-based measurement invariance tests, configural invariance (CFI = 0.936; TLI = 0.918; RMSEA = 0.030; SRMR = 0.074), full metric invariance (ΔCFI = −0.005; ΔTLI = 0.004; ΔRMSEA =

Table 1
Participants' characteristics and descriptive statistics for the 11-item Alcohol, Smoking and Substance Involvement Screening Test (ASSIST-11) (N = 82,243).

	Mean (SD)	n (%)	Min	Max	Skewness	Kurtosis
Age	32.39 (12.52)	82,230 (99.98)	18	99	1.18 (0.01)	0.97 (0.02)
Age groups						
Young adult (younger than 30 years)		43,424 (52.8)				
Early middle-aged adult (30–44.99 years)		24,826 (30.2)				
Older middle-aged adult (45–59.99 years)		10,787 (13.1)				
Older adults (60 years or above)		3206 (3.9)				
Gender						
Man		32,549 (39.6)				
Woman		46,874 (57.0)				
Non-binary individuals		2,315 (2.8)				
Individuals identifying with other genders		468 (0.6)				
Biological sex						
Male		33,245 (40.3)				
Female		48,987 (59.7)				
Educational level						
Primary school		1,002 (1.2)				
Secondary school		20,325 (24.7)				
Tertiary school		60,896 (74.0)				
Sexual orientation						
Heterosexual		56,125 (68.2)				
Gay or lesbian		4,607 (5.6)				
Bisexual		7,688 (9.3)				
Queer and pansexual		2,926 (3.6)				
Homo- and hetero-flexible identities		6,734 (8.2)				
Asexual		1,064 (1.3)				
Questioning		1,951 (2.4)				
Other		807 (1.0)				
Language						
Arabic		142 (0.2)				
Bangla		332 (0.4)				
Croatian		2,522 (3.1)				
Czech		1,583 (1.9)				
Dutch		518 (0.6)				
English		13,994 (17.0)				

(continued on next page)

Table 1 (*continued*)

	Mean (SD)	n (%)	Min	Max	Skewness	Kurtosis
French		3,941 (4.8)				
German		3,494 (4.2)				
Hebrew		1,315 (1.6)				
Hindi		17 (<0.1)				
Hungarian		10,937 (13.3)				
Italian		2,437 (3.0)				
Japanese		466 (0.6)				
Korean		1,437 (1.7)				
Lithuanian		2,094 (2.5)				
Macedonian		1,301 (1.6)				
Mandarin-simplified characters		2,474 (3.0)				
Mandarin-traditional characters		2,685 (3.3)				
Polish		10,343 (12.6)				
Portuguese-Brazil		3,650 (4.4)				
Portuguese-Portugal		2,277 (2.8)				
Slovak		2,118 (2.6)				
Spanish-Latin America		8,926 (10.9)				
Spanish-Spain		2,312 (2.8)				
Turkish		853 (1.0)				
Country						
Algeria		24 (<0.1)				
Australia		639 (0.8)				
Austria		746 (0.9)				
Bangladesh		373 (0.5)				
Belgium		644 (0.8)				
Bolivia		385 (0.5)				
Brazil		3,579 (4.4)				
Canada		2,541 (3.1)				
Chile		1,173 (1.4)				
China		2,428 (3.0)				
Colombia		1,913 (2.3)				
Croatia		2,390 (2.9)				
Czechia		1,640 (2.0)				
Ecuador		276 (0.3)				
Egypt		54 (0.1)				
France		1,706 (2.1)				
Germany		3,271 (4.0)				
Gibraltar		64 (0.1)				
Hungary		11,200 (13.6)				
India		194 (0.2)				
Iraq		99 (0.1)				
Ireland		1,702 (2.1)				
Israel		1,334 (1.6)				
Italy		2,401 (2.9)				
Japan		562 (0.7)				
Lithuania		2,015 (2.5)				
Malaysia		1,170 (1.4)				
Mexico		2,137 (2.6)				
New Zealand		2,834 (3.4)				
North Macedonia		1,251 (1.5)				
Panama		333 (0.4)				
Peru		2,672 (3.2)				
Poland		9,892 (12.0)				
Portugal		2,262 (2.8)				
Slovakia		1,134 (1.4)				
South Africa		1,849 (2.2)				
South Korea		1,464 (1.8)				
Spain		2,327 (2.8)				
Switzerland		1,144 (1.4)				
Taiwan		2,668 (3.2)				
Turkey		820 (1.0)				
United Kingdom		1,412 (1.7)				
United States of America		2,398 (2.9)				
Other		1,123 (1.4)				
ASSIST1: tobacco	0.91 (1.52)	74,181	0	4	1.32 (0.009)	−0.01 (0.018)
ASSIST2: alcohol	1.47 (1.33)	74,191	0	4	0.26 (0.009)	−1.31 (0.018)
ASSIST3: cannabis	0.39 (0.91)	74,167	0	4	2.65 (0.009)	6.58 (0.018)
ASSIST4: cocaine	0.04 (0.26)	74,147	0	4	7.69 (0.009)	72.22 (0.018)
ASSIST5: amphetamine	0.06 (0.32)	74,166	0	4	7.12 (0.009)	61.98 (0.018)
ASSIST6: inhalants	0.02 (0.19)	74,148	0	4	12.27 (0.009)	184.92 (0.018)
ASSIST7: sedatives	0.13 (0.56)	74,141	0	4	5.13 (0.009)	28.12 (0.018)
ASSIST8: hallucinogens	0.04 (0.24)	74,150	0	4	6.88 (0.009)	59.47 (0.018)
ASSIST9: opioids	0.02 (0.22)	74,046	0	4	12.52 (0.009)	184.60 (0.018)
ASSIST10: others	0.03 (0.31)	74,065	0	4	11.81 (0.009)	142.87 (0.018)

Table 2
Confirmatory factor analysis (CFA) and internal consistency results of the 11-item Alcohol, Smoking and Substance Involvement Screening Test (ASSIST-11).

Item level statistics	Standardized factor loading	Item-total correlation
ASSIST1	0.628	0.436
ASSIST2	0.544	0.405
ASSIST3	0.544	0.417
ASSIST4	0.306	0.302
ASSIST5	0.308	0.312
ASSIST6	0.132	0.148
ASSIST7	0.212	0.194
ASSIST8	0.273	0.307
ASSIST9	0.119	0.154
ASSIST10	0.062	0.068
Scale level statistics		Fit indices
McDonald's ω		0.68
Cronbach's α		0.63
χ^2 (df)/p-value in CFA		2186.57 (35)/ <0.001
Comparative fit index (CFI)		0.936
Tucker-Lewis index (TLI)		0.917
RMSEA (90% CI)		0.030 (0.028, 0.031)
SRMR		0.080

Notes. RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

−0.001; ΔSRMR = 0.001), full scalar invariance (ΔCFI = −0.008; ΔTLI = −0.001; ΔRMSEA = 0.000; ΔSRMR = 0.001), and full residual invariance (ΔCFI = −0.009; ΔTLI = 0.000; ΔRMSEA = 0.000; ΔSRMR = 0.006) were achieved.

Regarding age-based measurement invariance tests, configural invariance (CFI = 0.941; TLI = 0.924; RMSEA = 0.029; SRMR = 0.075), full metric invariance (ΔCFI = −0.012; ΔTLI = −0.001; ΔRMSEA = 0.000; ΔSRMR = 0.001), partial scalar invariance with item intercept of item 2 relaxed (ΔCFI = −0.011; ΔTLI = 0.000; ΔRMSEA = 0.000; ΔSRMR = 0.000), and partial residual invariance with residuals of items 1, 2, 3, and 8 relaxed (ΔCFI = −0.005; ΔTLI = 0.002; ΔRMSEA = 0.013; ΔSRMR = 0.023) were achieved.

Regarding gender-identity-based measurement invariance tests, configural invariance (CFI = 0.938; TLI = 0.920; RMSEA = 0.029; SRMR = 0.074), full metric invariance (ΔCFI = −0.006; ΔTLI = 0.005; ΔRMSEA = −0.001; ΔSRMR = 0.000), full scalar invariance (ΔCFI = −0.013; ΔTLI = −0.003; ΔRMSEA = 0.001; ΔSRMR = 0.001), and partial residual invariance with the residual of item 2 relaxed (ΔCFI = −0.008; ΔTLI = −0.002; ΔRMSEA = −0.001; ΔSRMR = 0.016) were achieved.

Regarding sexual-orientation-based measurement invariance tests, configural invariance (CFI = 0.939; TLI = 0.922; RMSEA = 0.028; SRMR = 0.073), full metric invariance (ΔCFI = −0.019; ΔTLI = −0.013; ΔRMSEA = 0.003; ΔSRMR = −0.001), partial scalar invariance with item intercept of item 3 relaxed (ΔCFI = −0.014; ΔTLI = −0.007; ΔRMSEA = 0.001; ΔSRMR = −0.001), and partial residual invariance with residuals of items 2 and 3 relaxed (ΔCFI = −0.017; ΔTLI = −0.007; ΔRMSEA = 0.001; ΔSRMR = 0.041) were achieved.

In the measurement invariance testing, latent mean differences of the ASSIST-11 across the demographics were: −0.29 in the two language subgroups, from −0.12 to 0.82 in the four age subgroups (the highest latent mean in the early middle-aged adult subgroup and the lowest latent mean in the older adult subgroup), −0.08 in the two country subgroups, from −0.01 to 0.11 in the three gender identity subgroups (the highest latent mean in the gender-diverse individual subgroup and the lowest latent mean in the woman subgroup), and −0.23 in the two sexual orientation subgroups (Table 3).

Known-group validity was next examined using measures of mental health problems, gambling behaviors and problematic sexual behaviors, using individuals without these characteristics as comparator groups. Participants reporting mental health problems had higher total ASSIST-11 scores, with a small to moderate effect size (Cohen's d = 0.32; $p < 0.001$). Participants reporting traditional gambling had higher total ASSIST-11 scores, with small to moderate effect sizes (Cohen's d = 0.25 and 0.24; $p < 0.001$). Participants reporting online gambling had higher total ASSIST-11 scores, with small to moderate effect sizes (Cohen's d = 0.24 and 0.23; $p < 0.001$). Participants reporting having sought professional help for sexual urge problems had higher total ASSIST-11 scores, with small to moderate effect sizes (Cohen's d = 0.30 and 0.40; $p < 0.001$) (Table 4).

4. Discussion

The present study shows that the ASSIST-11 (a shortened ASSIST) is a unidimensional instrument in a large-scale cross-sectional investigation across 40+ countries and 20+ languages. The unidimensional factor structure was invariant across country, age, language, gender identity (three subgroups of men, women, and gender-diverse individuals), and sexual orientation (two subgroups of heterosexual and sexual minority individuals) groups. However, items 2 and 3 needed to be relaxed in their item intercepts (sexual-orientation groups) or residuals (language, gender-identity, and sexual-orientation groups) to achieve full invariance. Moreover, some items (i.e., items 6, 7, 9, and 10) had relatively low factor loadings. Nevertheless, the known-group validity supported the entire ASSIST-11 score to distinguish people reporting (versus not) potentially addictive behaviors.

The unidimensional factor structure noted in the present sample is consistent with prior ASSIST studies (Khan et al., 2012). The online survey mode in the present cross-cultural study (i.e., the ISS) corroborates prior evidence that the ASSIST may be completed in a self-administered manner (Lopez-Rodriguez and Rubio Valladolid, 2018; Tiburcio Sainz et al., 2016) in addition to the original interview-based format (Humeniuk et al., 2010; WHO ASSIST Working Group, 2002). Thus, the feasibility and efficiency of using the ASSIST-11 were also supported. Healthcare providers, policymakers, and researchers may consider using the ASSIST-11 to quickly evaluate or screen whether an individual may have substance-use problems.

However, the internal consistency of the ASSIST-11 was somewhat low, and this could be due to some items having low factor loadings (i.e., items 6 [inhalants], 7 [sedatives], 9 [opioids], and 10 [others]) and/or a broader concept in the ASSIST-11. A possible explanation for low factor loadings is that inhalants, sedatives, and other substances (those not listed in the ASSIST-11) have low usage prevalence estimates (Chang et al., 2022a; United Nations Office on Drugs and Crime, 2015). Indeed, items 6 related to inhalants use (mean score = 0.02; skewness = 12.27; kurtosis = 184.92), 7 related to sedatives use (mean score = 0.02; skewness = 12.52; kurtosis = 184.60), and 10 to other addictive substances (mean score = 0.03; skewness = 11.81; kurtosis = 142.87) had the lowest scores and largest skewness and kurtosis values.

Speculatively, the low factor loading of item 9 assessing opioid use may reflect methadone maintenance treatment for patients who are treated for opioid use disorder (Chang et al., 2014; Chang and Lin, 2015; Lin et al., 2016). A considerable portion of people reporting opioid use received methadone maintenance treatment (Chang et al., 2014; Chang and Lin, 2015; Lin et al., 2016), and they might have different interpretations regarding whether they have used opioids (e.g., using opioids as a pharmacological treatment for pain). Some may consider that they did not use it because of receiving methadone, while some may consider methadone as opioid use. Therefore, different interpretations may have confounded the item assessing opioid use and resulted in low factor loading.

Nevertheless, the low internal consistency and factor loadings were deemed to be acceptable due to several reasons. First, when a broad concept (i.e., different substances) is measured using a limited number of items (i.e., 10 items in the ASSIST-11), constructing them into one factor is often considered more reasonable than constructing them into

Table 3
Measurement invariance of the 11-item Alcohol, Smoking and Substance Involvement Screening Test (ASSIST-11).

Fit indices	Model					
Group	M0 Configural	M1 Metric	M2 Scalar	M2P[a] Partial scalar	M3 Residual	M3P[a,b,c,d] Partial residual
Language (latent means: 0.00 [first subgroups] vs. -0.29 [second subgroup])						
χ^2 (df) or $\Delta\chi^2$ (Δdf)	2164.67 (70)	483.64 (9)	565.47 (9)	–	1199.90 (10)	556.30 (8)
p-value	<0.001	<0.001	<0.001	–	<0.001	<0.001
CFI or ΔCFI	0.937	−0.015	−0.017	–	−0.039	−0.016
TLI or ΔTLI	0.919	−0.008	−0.008	–	−0.023	−0.007
RMSEA or ΔRMSEA	0.029	0.001	0.002	–	0.003	0.001
SRMR or ΔSRMR	0.074	0.002	0.002	–	0.033	0.030
Age groups (latent means: 0.00 [older middle-aged adults], 0.82 [early middle-aged adults], 0.27 [young adults], and -0.12 [older adults])						
χ^2 (df) or $\Delta\chi^2$ (Δdf)	2244.53 (140)	462.01 (27)	1023.60 (27)	409.59 (24)	–	202.59 (18)
p-value	<0.001	<0.001	<0.001	<0.001	–	<0.001
CFI or ΔCFI	0.941	−0.012	−0.028	−0.011	–	−0.005
TLI or ΔTLI	0.924	−0.001	−0.015	0.000	–	0.002
RMSEA or ΔRMSEA	0.029	0.000	0.003	0.000	–	0.013
SRMR or ΔSRMR	0.075	0.001	0.000	0.000	–	0.023
Country (latent means: 0.00 [first subgroup] vs. -0.08 [second subgroup])						
χ^2 (df) or $\Delta\chi^2$ (Δdf)	2223.21 (70)	170.46 (9)	287.56 (9)	–	305.90 (10)	–
p-value	<0.001	<0.001	<0.001	–	<0.001	–
CFI or ΔCFI	0.936	−0.005	−0.008	–	−0.009	–
TLI or ΔTLI	0.918	0.004	−0.001	–	0.000	–
RMSEA or ΔRMSEA	0.030	−0.001	0.000	–	0.000	–
SRMR or ΔSRMR	0.074	0.001	0.001	–	0.006	–
Gender identity (latent means: 0.00 [man], -0.01 [woman], and 0.11 [gender-diverse individual])						
χ^2 (df) or $\Delta\chi^2$ (Δdf)	2212.45 (105)	212.78 (18)	468.14 (18)	–	1063.80 (20)	289.44 (18)
p-value	<0.001	<0.001	<0.001	–	<0.001	<0.001
CFI or ΔCFI	0.938	−0.006	−0.013	–	−0.031	−0.008
TLI or ΔTLI	0.920	0.005	−0.003	–	−0.016	−0.002
RMSEA or ΔRMSEA	0.029	−0.001	0.001	–	0.003	−0.001
SRMR or ΔSRMR	0.074	0.000	0.001	–	0.017	0.016
Sexual orientation (latent means: 0.00 [sexual minority] vs. -0.23 [heterosexual])						
χ^2 (df) or $\Delta\chi^2$ (Δdf)	2058.52 (70)	638.56 (9)	698.88 (9)	481.26 (8)	–	553.93 (8)
p-value	<0.001	<0.001	<0.001	<0.001	–	<0.001
CFI or ΔCFI	0.939	−0.019	−0.021	−0.014	–	−0.017
TLI or ΔTLI	0.922	−0.013	−0.012	−0.007	–	−0.007
RMSEA or ΔRMSEA	0.028	0.003	0.002	0.001	–	0.001
SRMR or ΔSRMR	0.073	−0.001	−0.001	−0.001	–	0.041

Notes.
CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.
M0 = configural model; M1 = model with factor loadings constrained equal across groups; M2 = model with factor loadings and item intercepts constrained equal across groups; M2P = M2 with relaxed items in intercept across groups; M3 = model with factor loadings, item intercepts, and residual constrained equal across groups; M3P = M3 with relaxed items in intercept across groups.
For the language-based measurement invariance tests, the languages were regrouped into two subsets according to the languages' names in English following alphabetical order. For the country-based measurement invariance tests, countries were regrouped into two subsets according to the countries' English name following alphabetical order in English. For gender-identity-based measurement invariance tests, participants were regrouped into three groups (man, woman, and gender-diverse individuals). For sexual-orientation-based measurement invariance tests, participants were regrouped into two groups (heterosexual and sexual minority individuals).
[a] Relaxed the item intercept for ASSIST3 in the sexual orientation-based measurement invariance test and relaxed the item intercept for ASSIST2 in the age group measurement invariance test.
[b] Relaxed the residuals for ASSIST2 and ASSIST3 in the language-based measurement invariance test and sexual orientation-based measurement invariance test.
[c] Relaxed the residuals for ASSIST2 in the gender identity-based measurement invariance test.
[d] Relaxed the residuals for ASSIST1, ASSIST2, ASSIST3, and ASSIST8 in the age group measurement invariance test.

different factors (Khan et al., 2012). Second, the unidimensional factor structure of the ASSIST-11 has theoretical support with clinical relevance (Humeniuk et al., 2010; WHO ASSIST Working Group, 2002). Third, the fit indices derived from the CFA findings in the present study were acceptable for a unidimensional factor structure.

The unidimensional factor structure of the ASSIST-11 was found to be invariant (mostly full invariance with some partial invariance) across different groups based on country, language, gender identity, and sexual orientation. The measurement invariance findings indicate that using the ASSIST-11 to assess substance use across these groups is acceptable because the false implications related to measurement biases and invalid comparisons may be minimal (Jeong and Lee, 2019). Moreover, partial invariance was found mostly at the level of residual invariance, and full invariance was supported for metric and scalar invariance in almost all groups, suggesting that comparing means across these groups is meaningful. Specifically, residual invariance suggests the errors (i.e., the variance or residuals not captured by the latent concept) are invariant across groups, and this type of invariance does not influence the test of mean differences because residuals are not part of the latent factor (Putnick and Bornstein, 2016; Vandenberg and Lance, 2000).

Following invariance testing, our MGCFA showed that the latent mean scores of the ASSIST-11 were not substantially different in different countries (when grouping the countries into two), gender identities, and sexual orientations. This indicates that substance use problems could be similar across countries, gender identities, and sexual orientations. However, large effects were found in the latent mean differences between different age subgroups: early middle-aged adults had the highest latent mean (0.82 as compared with older middle-aged adults) and followed by young adults (0.27 as compared with older middle-aged adults); while older adults had the lowest latent means (−0.12 as compared with older middle-aged adults). Early middle-aged adults as compared with individuals in other age groups might have the highest levels of craving and abilities to obtain different substances, which might explain why this group had the highest ASSIST-11 latent

Table 4
Known-group validity of the 11-item Alcohol, Smoking and Substance Involvement Screening Test (ASSIST-11).

	Mean (SD)	Cohen's d (95% CI)	t (*p*-value)
Currently having mental health/ emotional problems		0.32 (−0.33, −0.29)	36.56 (<0.001)
Yes	3.86 (3.76)		
No	2.81 (3.11)		
Having engaged in traditional gambling (ever)		0.25 (−0.27, −0.24)	33.88 (<0.001)
Yes	3.60 (3.45)		
No	2.75 (3.24)		
Having engaged in traditional gambling (past year)		0.24 (−0.26, −0.22)	22.69 (<0.001)
Yes	3.80 (3.63)		
No	3.00 (3.29)		
Having engaged in online gambling (ever)		0.24 (−0.25, −0.22)	24.05 (<0.001)
Yes	3.77 (3.56)		
No	2.98 (3.29)		
Having engaged in online gambling (past year)		0.23 (−0.25, −0.20)	18.33 (<0.001)
Yes	3.80 (3.63)		
No	3.05 (3.31)		
Having sought professional help for self-described uncontrolled sexual urges/ behaviors (past year)		0.30 (−0.35, −0.25)	9.77 (<0.001)
Yes	4.11 (4.06)		
No	3.11 (3.34)		
Having sought professional help for self-described uncontrolled sexual urges/ behaviors (currently)		0.40 (−0.49, −0.32)	6.91 (<0.001)
Yes	4.48 (4.48)		
No	3.13 (3.35)		

mean scores. Therefore, special attention may need to be paid to this age group to prevent potential problems in their substance use.

Apart from the factor structure of the ASSIST-11, the present findings demonstrated that the ASSIST-11 had satisfactory known-group validity. The timeframes between the ASSIST-11 (three months) and the variables for known-group validity differed (e.g., no specific timeframe for mental health/emotional problems; past year for traditional gambling experiences, online gambling experiences, and seeking professional help for self-perceived uncontrolled sexual urges/behaviors) . It is unclear how the different timeframes may have impacted the findings, and the possible influences of timeframes should be examined directly in future studies. However, the ASSIST-11 may efficiently distinguish people potentially having addictive behaviors (including traditional gambling, online gambling, and compulsive sexual behaviors) from those not having these potential addictive behaviors. The present findings and prior evidence (Burleigh et al., 2019) suggest that substance use and other potentially addictive behaviors co-occur. Moreover, the known-group validity of the ASSIST-11 indicates that people with mental health/emotional problems had higher ASSIST-11 scores than those without such problems. These results resonate with prior data that people with versus without SUDs have worse mental health, with findings extending to substance use behaviors (Connery et al., 2020).

There are study limitations warranting mention. The general limitations in the entire ISS are documented online: https://osf.io/6kscb?view_only=838146f6027c4e6bb68371d9d14220b5. Additionally specific limitations for the present study are listed below. First, some important psychometric properties such as test-retest and responsiveness of the ASSIST-11 were not examined. Future studies are warranted to examine these properties using large-scale samples across different countries. Second, the present sample did not examine individuals with diagnosed SUDs (i.e., a clinical sample), as reflected in attenuated ranges for many reported substances. Therefore, the present study cannot determine whether the ASSIST-11 can accurately differentiate people with and without diagnosed SUDs, and this needs direct examination. Third, all gender-diverse and sexual minority individuals were collapsed into a same gender identity and sexual orientation group, respectively. Future studies are thus needed to examine and replicate the examination of measurement invariance of ASSIST across different groups of gender identities and sexual orientations.

5. Conclusion

In conclusion, the present study showed that the shortened ASSIST (i.e., ASSIST-11) is an instrument with a unidimensional factor structure and works similarly across different languages, countries, age groups, gender identities, and sexual orientations. Although the entire internal consistency of the ASSIST-11 was lower than some acceptable cutoffs, we consider this as acceptable because the ASSIST-11 assesses a broad concept (i.e., including a variety of substances). Apart from the low internal consistency, the ASSIST-11 showed good known-group validity as it distinguished people with and without reported non-substance addictive behaviors. Moreover, the current findings support the use of ASSIST-11 in general populations across more than 40 countries. Therefore, the potential practice and research implications of the present findings is to make the ASSIST-11 available in at least 20 languages, including non-WEIRD (Western, Educated, Industrialized, Rich, and Democratic) countries. Given that most research in the field of addiction focuses on WEIRD countries (Baxter et al., 2013; Brady et al., 2018; Cheon et al., 2020; Degenhardt et al., 2011; Tindle, 2021), the present findings extend the use of ASSIST-11 to non-WEIRD countries. Nevertheless, future studies using other psychometric testing methods such as Rasch analysis and network analysis (Li et al., 2022; Saffari et al., 2022b) are encouraged to further corroborate the psychometric robustness of the ASSIST-11.

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Conceptualization: C.-T.L., C.-Y.L., M.K., L.N., S.W.K., Z.D., M.N.P., and B.B., Data curation: C.-T.L., C.-Y.L., M.K., L.N., S.W.K., Z.D., M.N.P., R.B.-A., D.B., S.B., J. Billieux, J. Burkauskas, G.C.-L., J.C., J.C.-C., L.C., G.C., O.C., R.I.C., D.P.F., E.F.F., H.F., J.F., R.G., A.G.-M., B.G., M.G., J.B. G., H.T.H., M.S.I., M.I., M.J.-M., T.J., O.K., V.K., A.K., S.-K.L., K. Lewczuk, C.L., S.L.-A., K. Lukavská, P.M.-T., I.M., D.J.M., O.O., G.O., K.P., F. P.P., G.R.Q., G.C.Q.G., J.R.-D., K.R., A.R., M.D.T.S., M.K.S., P.S., M.S., S. S., V.S.-L., L.S., O.S., V.S., D.J.S., J.S., B.C.Ü., M.-P.V.-M., M.C.V.H., and B.B., Formal analysis: C.-Y.L., Funding acquisition: C.-Y.L., M.K., L.N., S. W.K., Z.D., S.B., H.F., R.G., M.G., K. Lewczuk, C.L., K.P., K.R., D.J.S., and B.B.,Investigation: C.-T.L., C.-Y.L., M.K., L.N., S.W.K., Z.D., M.N.P., R.B.-A., D.B., S.B., J. Billieux, J. Burkauskas, G.C.-L., J.C., J.C.-C., L.C., G.C., O.C., R.I.C., D.P.F., E.F.F., H.F., J.F., R.G., A.G.-M., B.G., M.G., J.B.G., H. T.H., M.S.I., M.I., M.J.-M., T.J., O.K., V.K., A.K., S.-K.L., K. Lewczuk, C. L., S.L.-A., K. Lukavská, P.M.-T., I.M., D.J.M., O.O., G.O., K.P., F.P.P., G. R.Q., G.C.Q.G., J.R.-D., K.R., A.R., M.D.T.S., M.K.S., P.S., M.S., S.S., V.S.-L., L.S., O.S., V.S., D.J.S., J.S., B.C.Ü., M.-P.V.-M., M.C.V.H., and B.B., Methodology: C.-T.L., C.-Y.L., M.K., L.N., S.W.K., Z.D., M.N.P., and B.B., Project administration: C.-Y.L., M.K., L.N., S.W.K., Z.D., and B.B., Resources: C.-Y.L., M.K., L.N., S.W.K., Z.D., R.B.-A., S.B., J. Burkauskas, G. C.-L., J.C., J.C.-C., J.F., R.G., A.G.-M., B.G., M.G., J.B.G., H.T.H., M.S.I., M.I., M.J.-M., O.K., V.K., S.-K.L., K. Lewczuk, K. Lukavská, P.M.-T., O.O., K.P., G.C.Q.G., A.R., O.S., V.S., B.C.Ü., M.-P.V.-M., M.C.V.H., and B.B., Software: C.-T.L. and C.-Y.L., Supervision: C.-Y.L., S.W.K., Z.D., M.N.P., R.B.-A., D.B., S.B., J. Billieux, J. Burkauskas, G.C.-L., J.C., J.C.-C., L.C., G.C., O.C., R.I.C., D.P.F., E.F.F., H.F., J.F., R.G., A.G.-M., B.G., M.G., J.B.G., H.T.H., M.S.I., M.I., T.J., O.K., V.K., A.K., G.C.Q.G., M.-P.V.-M., and B.B., Validation: C.-T.L., C.-Y.L., M.K., L.N., S.W.K., Z.D., M.N.P., P.S., and B.B., Visualization: C.-T.L., C.-Y.L., S.B., R.G., and M.G., Writing - original draft: C.-T.L. and C.-Y.L., Writing - review & editing: C.-Y.L., M. K., L.N., S.W.K., Z.D., M.N.P., R.B.-A., D.B., S.B., J. Billieux, J. Burkauskas, G.C.-L., J.C., J.C.-C., L.C., G.C., O.C., R.I.C., D.P.F., E.F.F., H.F., J.F., R.G., A.G.-M., B.G., M.G., J.B.G., H.T.H., M.S.I., M.I., M.J.-M., T.J., O.K., V.K., A.K., S.-K.L., K. Lewczuk, C.L., S.L.-A., K. Lukavská, P.M.-T., I. M., D.J.M., O.O., G.O., K.P., F.P.P., G.R.Q., G.C.Q.G., J.R.-D., K.R., A.R., M.D.T.S., M.K.S., P.S., M.S., S.S., V.S.-L., L.S., O.S., V.S., D.J.S., J.S., B.C. Ü., M.-P.V.-M., M.C.V.H., and B.B.

Ethical standards

The collaborating countries applied for ethics approval and obtained the approval in their local sites (https://osf.io/n3k2c/?view_only=838146f6027c4e6bb68371d9d14220b5). All procedures in the ISS survey were conducted in accordance with the Helsinki Declaration.

Transparency and openness

Materials and analysis code for this study are available by emailing the corresponding author. The International Sex Survey (ISS) follows open sciences practices (Bőthe et al., 2021). Forty-two countries followed the International Sex Survey (ISS) guidelines to conduct an online survey using a cross-sectional study design (see preregistered study: https://osf.io/uyfra/?view_only=6e4f96b748be42d99363d58e32d511b8). Collaborating countries obtained local ethical approval from their institutions (https://osf.io/n3k2c/?view_only=838146f6027c4e6bb68371d9d14220b5). The list of related publications using the ISS dataset is uploaded to the OSF (journal publications: https://osf.io/jb6ey/?view_only=0014d87bb2b546f7a2693543389b934d; conference publications: https://osf.io/c695n/?view_only=7cae32e642b54d049e600ceb8971053e). Sociodemographic information (e.g., biological sex, gender identity, sexual orientation, age, and level of education) and sexuality-related questions were queried as described in https://osf.io/jcz96/?view_only=9af0068dde81488db54638a01c8ae118.

The translations of the ASSIST-11in 26 languages can be found at https://osf.io/jcz96/?view_only=9af0068dde81488db54638a01c8ae118.

The detailed analytic plan was preregistered (https://doi.org/10.17605/OSF.IO/DK78R).

Detailed sociodemographic characteristics by country can be found at https://osf.io/n3k2c/?view_only=838146f6027c4e6bb68371d9d14220b5.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2023.06.033.

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