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Cross-cultural Validation of the Arizona Sexual Experience Scale (ASEX) in 42 Countries and 26 Languages

Rafael Ballester-Arnal · Marcel Elipe-Miravet · Jesús Castro-Calvo · Patricia Beltrán-Martínez · Léna Nagy · Mónika Koós, et al. ***[full author details at the end of the article]***

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Abstract

Introduction The Arizona Sexual Experiences Scale (ASEX) is a brief questionnaire that evaluates five major aspects of sexual function: sex drive, arousal, erectile function/vaginal lubrication, ability to reach orgasm, and satisfaction with orgasm. An advantage of the ASEX is its simplicity and brevity (five items), making it suitable for the screening of sexual function problems in healthcare contexts and large-scale studies. The main objective of this study was to examine the psychometric properties of the ASEX in a multi-national sample, as well as to explore sexual function according to countries, genders, and sexual orientations.

Methods The psychometric examination of the ASEX was conducted with a sample of 82,243 participants (women = 57.02%; men = 39.59%; gender-diverse = 3.38%; M_{age} = 32.39 years; SD = 12.52) from 42 different countries speaking 26 languages.

Results The CFA supported a one-factor solution. Multigroup CFAs supported configural, metric, partial scalar, and residual invariance across countries, languages, genders, and sexual orientations. Furthermore, the ASEX showed good internal consistency (ω = .85) and convergent validity (e.g., significant negative associations with masturbation and sexual intercourse frequency). Finally, individuals in Eastern countries, women, and asexual participants reported higher levels of sexual function issues.

Conclusions and Policy Implications The findings supported the use of the ASEX as a tool to screen for sexual function problems across diverse populations in multi-cultural settings. This scale may be used to improve our knowledge on the cross-cultural differences on the expression of sexual function, serving as the basis for the development of culturally tailored interventions for the improvement of this basic aspect of well-being.

Keywords Sexual Function · Assessment · International Sex Survey (ISS) · Validation · Cross-cultural · ASEX

Introduction

A fundamental aspect of an individual's sexuality is their sexual response or function, in which both organic and psychological factors are involved. Six decades ago, Masters and Johnson (1966) described a four-phase model of human sexual response: excitement, plateau, orgasm, and resolution. These phases have been a reference to design a nosology of sexual dysfunctions that are included in main diagnostic manuals such as the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5, American Psychiatric Association, 2013).

Sexual function problems (SFPs) are common among general populations. It is estimated that 31% of men and 43% of women may experience some kind of SFPs (Elnazer & Baldwin, 2020). However, it is important to bear in mind that when we are talking about SFP, we are not necessarily referring to problems with clinical relevance and entity, nor to clinical disorders that meet the criteria for a diagnosis of sexual dysfunction. In these cases, prevalence data would be much lower.

SFPs as well as sexual dysfunctions may be classified according to the phase of sexual response affected by the condition. Thus, SFPs may impact the desire phase, the arousal phase (i.e., erection problems for men and absent/reduced sexual excitement/pleasure in women), or the orgasm phase (i.e., premature/delayed/infrequent/absent

The Sungkyunkwan University research team includes Dr. Hyein Chang and Mr. Kyeongwoo Park.

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ejaculation in men and delayed/infrequent/absent orgasm in women).

Etiological and potential risk factors for the development and maintenance of SFPs encompass both psychological and physiological aspects. Age is positively related to the prevalence of SFPs (Mitchell et al., 2013). Among psychological factors, predisposing factors (e.g., religious upbringing, traumatic experiences in childhood), precipitating factors (e.g., relationship problems, depression) and maintenance factors (e.g., performance anxiety, anticipation of failure) relate to the risk of developing SFPs (Ballester-Arnal, 2020; Ciaccio & Di Giacomo, 2022; Tavares et al., 2020).

The connection between SFPs and mental health goes both ways. Having problems in sexual response can result in feeling anxious about intimacy, low self-esteem, and depression, but the reverse can also be true. Studies have shown that mental health conditions, such as schizophrenia, depression, eating disorders, or personality disorders also contribute to SFPs (Quinn & Browne, 2009) that can be aggravated by pharmacotherapy (Soldati, 2016; Zemishlany & Weizman, 2008).

SFPs prevalence may vary across countries and cultures (Clayton & Valladares Juarez, 2019; Hald et al., 2019), with higher estimates observed in Asian countries compared to Western and Northern European countries (Koops & Briken, 2018; Lewis, 2011). The results of general population studies regarding the possible existence of gender differences in SFPs tend to coincide with a higher prevalence in women. For example, Ballester and Gil (1995) reported a prevalence estimate of 42% among Spanish women and 39% in men. Johnson et al. (2004) in a study with a US population reported a prevalence of 33% in women compared to 14% among men. And Ljungman et al. (2020) in a Swedish general population aged 19–40 years observed a SFPs prevalence of 53% among women compared to 31% among men. Regarding sexual orientation, bisexual (Björkenstam et al., 2020) and gay and lesbian (Waterhouse & Burkill, 2019) individuals may experience more SFPs and greater SFP-related distress than heterosexual people. Again, we must remember that we are talking about SFP that do not necessarily have clinical relevance and do not necessarily meet the criteria for a diagnosis of sexual dysfunction.

Considering the high prevalence estimates of SFPs both in the general population and in people with psychological disorders and medical problems (Ballester-Arnal et al., 2022), and the relevance of sexual well-being for quality of life, the importance of assessing these problems with valid and reliable scales is crucial. Over the years, several rating scales have been designed to assess different aspects of SFPs. Some of these scales have been designed to assess SFPs related to a specific phase of the sexual response and others evaluate problems in all the phases of it (for a review, see Grover & Shouan, 2020).

Some scales were specifically designed to assess sexual desire such as the Decreased Sexual Desire Screener (DSDS) (Clayton et al., 2009), Hurlbert Index of Sexual Desire (HISD) (Apt & Hurlbert, 1992), and Sexual Desire Inventory (SDI) (Spector et al., 1996). Among the scales that assess sexual arousal or erection in men, we have the International Index of Erectile Function (IIEF-EF) (Rosen et al., 1999), Erection Hardness Scale (EHS) (Mulhall et al., 2007), Sexual Encounter Profile (SEP) (Porst et al., 2003) and Erectile Dysfunction Inventory of Treatment Satisfaction (EDITS) (Althof et al., 1999). Scales developed to assess problems related to orgasm include the following: Orgasm Rating Scale (ORS) (Mah & Binik, 2002) and Female Orgasm Scale (Mcintyre-Smith & Fisher, 2010). Scales for assessment of ejaculatory dysfunction include Premature Ejaculation Profile (PEP) (Patrick et al., 2009), Index of Premature Ejaculation (IPE) (Althof, 2016), Premature Ejaculation Diagnostic Tool (PEDT) (Huang et al., 2014) and Arabic Index of Premature Ejaculation (AIPE) (Arafa & Shamloul, 2007). Finally, the Multidimensional Vaginal Penetration Disorder Questionnaire (MVPDQ) (Molaeinezhad et al., 2014), or Vaginal Penetration Cognition Questionnaire (VPCQ) (Klaassen & TerKuile, 2009) can be used for assessment of vaginismus.

These scales have the advantage of assessing a single dysfunction or problem of sexual function in a greater depth. However, they may be less useful when screening for possible impairment of different phases of sexual response in the shortest possible time. Therefore, several scales have been developed that assess all aspects of sexual function. Some of the commonly used scales include the Arizona Sexual Experience Scale (ASEX) (McGahuey et al., 2000), Sexual Evaluation Scale (SES) (Othmer & Othmer, 1987), International Index of Erectile Dysfunction (IIEF) (Rosen et al., 1997), Female Sexual Function Index (FSFI) (Rosen et al., 2000), Brief Index of Sexual Functioning for Women (BISF-W) (Mazer et al., 2000), Change in Sexual Functioning Questionnaire (CSFQ) (Clayton et al., 1997), Sexual Functioning Questionnaire (SFQ) (Krishna et al., 2014), Sexual Function Questionnaire (Quirk et al., 2002), and Derogatis Interview for Sexual Functioning (DISF) (Derogatis, 1997), and Golombok-Rust Inventory of Sexual Satisfaction (GRISS) (Rust & Golombok, 1985). Although all these scales have some advantages, they also have some limitations. For example, the 22-item BISF-W (Mazer et al., 2000) evaluates seven relevant dimensions of sexual function (i.e., thoughts/desires, arousal, frequency of sexual activity, receptivity/initiation, pleasure/orgasm, relationship satisfaction and problems affecting sexual function), but it is only applicable among women. The 15-item IIEF (Rosen et al., 1997) is only applicable for males in a heterosexual sexual relationship, while the 19-item FSFI (Rosen et al., 2000) was developed to examine women's sexual function. In sum, some of the aforementioned scales do not include

all aspects of SFPs, are only for use among men or women, specifically refer to a heterosexual sexual relationship, are only applicable by a clinician, or include a high number of items limiting their easy applicability in healthcare settings or large-scale studies with limited space.

In the current study, we chose to validate the Arizona Sexual Experiences Scale (ASEX) (McGahuey et al., 2000) in a multi-cultural setting among diverse participants as it evaluates the main dimensions of sexual function (i.e., drive, arousal, penile erection/vaginal lubrication, ability to reach orgasm and satisfaction with orgasm) in a comprehensive, yet brief way (i.e., five items), making it appropriate to be used in different settings (e.g., research studies with limited space, or in busy healthcare settings). It can also be self-administered or administered by a clinician, among partnered and single individuals, and among individuals with different sexual orientations as well. The ASEX was developed to improve the assessment of SFPs in both community and clinical samples. This instrument has been shown to have a one-dimensional structure and demonstrated excellent reliability ($\alpha = 0.906$; test–retest among patients [$r = 0.801$, $p < 0.01$] and among controls [$r = 0.892$, $p < 0.01$]) as well (McGahuey et al., 2000). Its validity has also been demonstrated in previous studies, showing positive correlations with the Brief Index of Sexual Functioning (BISF) (McGahuey et al., 2000), psychiatrists' assessment of the presence of sexual dysfunction ($r = 0.53$, $p < 0.001$) (Soykan et al., 2004), or the Dickson Glazer Scale for the assessment of Sexual Function Inventory (DGSFI) (Dickson & Glazer, 2000; Nunes et al., 2009), among others. The ASEX has already been translated into several languages and showed excellent psychometric properties in these studies as well (Jannini et al., 2022; Jitkritsadakul et al., 2014; Sánchez-Fuentes et al., 2019; Santos-Iglesias et al., 2016). In these adaptation studies, the ASEX had a one-dimensional factor structure, was reliable, and its validity was further corroborated. Besides its use in general populations, the ASEX appears to be useful in a range of clinical situations including patients with primary sexual dysfunction, specific psychiatric disorders, specific physical illnesses, and treatment-emergent sexual dysfunction (Elnazer & Baldwin, 2020).

Despite the advantages of the ASEX such as its brevity and the evaluation of different dimensions of SFPs, its psychometric properties have not been concurrently examined across multiple countries, languages, genders (especially among gender-diverse individuals) and sexual orientations (especially among sexually diverse individuals), generating a knowledge gap and limiting the utility of the scale in underserved and underrepresented populations. Therefore, the present study has the following objectives:

- to examine the psychometric properties of the ASEX, as a main objective.
- to measure invariance across languages, countries, genders and sexual orientations.
- to evaluate the validity of the ASEX.
- to explore the scores differences in ASEX across languages, countries, genders and sexual orientations.

Method

Participants

Participants in this study were drawn from the International Sex Survey (ISS), a pre-registered study aimed to provide sound cross-cultural data on different domains of sexuality[1] (for a complete description of the study protocol, see Bothe et al., 2021). Once the data were cleaned according to the preregistered criteria,[2] a total sample of 82,243 participants, with a mean age of 32.39 years ($SD = 12.52$) were included in the present study. Concerning gender, 32,549 participants were men (39.59%), 46,874 were women (57.02%) and 2,783 were gender-diverse individuals (3.38%). Regarding sexual orientation, 68.24% of participants were heterosexual ($n = 56{,}125$), 9.35% were bisexual (7,688), 5.6% were gay or lesbian (4,607), 2.39% were pansexual (1,969) and the other 14.14% reported other orientations, such as queer (1.16%), asexual (1.29%), or questioning (2.37%), among others. Regarding educational level, 74.06% of participants ($n = 60{,}896$) completed university studies (tertiary education), 24.71% high school ($n = 20{,}325$), and 1.22% primary school ($n = 1{,}002$). About relationship status, 62.97% of participants were in a relationship or married ($n = 51{,}778$), 33.49% were single ($n = 27{,}541$), and 3.01% divorced ($n = 2{,}472$). For additional sociodemographic characteristics (such as country of origin or language), see Table 1.

Procedure

For the ASEX, the original questionnaire (in English) was translated into 25 other languages based on the 42[3] ISS participating countries' official languages, following

[1] https://osf.io/uyfra/?view_only=6e4f96b748be42d99363d58e32d511b8

[2] https://doi.org/10.17605/OSF.IO/DK78R

[3] Egypt, Iran, Pakistan, and Romania were included in the study protocol paper as collaborating countries (Bothe 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, Koós, et al., 2021) as it joined the study after publishing the study protocol. Therefore, instead of the planned 45 countries (Bothe et al., 2021), 42 individual countries are considered in the present study, see details at https://osf.io/n3k2c/.

Table 1 Participants' sociodemographic characteristics

Variables	N = 82,243	%
Country of residence		
Algeria	24	0.03
Australia	639	0.78
Austria	746	0.91
Bangladesh	373	0.45
Belgium	644	0.78
Bolivia	385	0.47
Brazil	3,579	4.35
Canada	2,541	3.09
Chile	1,173	1.43
China	2,428	2.95
Colombia	1,913	2.33
Croatia	2,390	2.91
Czech Republic	1,640	1.99
Ecuador	276	0.34
France	1,706	2.07
Germany	3,271	3.98
Gibraltar	64	0.08
Hungary	11,200	13.62
India	194	0.24
Iraq	99	0.12
Ireland	1,702	2.07
Israel	1,334	1.62
Italy	2,401	2.92
Japan	562	0.68
Lithuania	2,015	2.45
Malaysia	1,170	1.42
Mexico	2,137	2.60
New Zealand	2,834	3.45
North Macedonia	1,251	1.52
Panama	333	0.40
Peru	2,672	3.25
Poland	9,892	12.03
Portugal	2,262	2.75
Slovakia	1,134	1.38
South Africa	1,849	2.25
South Korea	1,464	1.78
Spain	2,327	2.83
Switzerland	1,144	1.39
Taiwan	2,668	3.24
Turkey	820	1.00
United Kingdom	1,412	1.72
United States of America	2,398	2.92
Other	1,177	1.78
Language		
Arabic	142	0.17
Bangla	332	0.40
Croatian	2,522	3.07
Czech	1,583	1.92
Dutch	518	0.63
English	13,994	17.02
French	3,941	4.79
German	3,494	4.25
Hebrew	1,315	1.60

Table 1 (continued)

Variables	N = 82,243	%
Hindi	17	0.02
Hungarian	10,937	13.30
Italian	2,437	2.96
Japanese	466	0.57
Korean	1,437	1.75
Lithuanian	2,094	2.55
Macedonian	1,301	1.58
Mandarin – simplified	2,474	3.01
Mandarin – traditional	2,685	3.26
Polish	10,343	12.58
Portuguese – Brazil	3,650	4.44
Portuguese – Portugal	2,277	2.77
Romanian	75	0.09
Slovak	2,118	2.58
Spanish – Latin America	8,926	10.85
Spanish – Spain	2,312	2.81
Turkish	853	1.04
Sex assigned at birth		
Male	33,245	40.43
Female	48,987	59.57
Gender (original answer options in the survey)		
Masculine/Man	32,549	39.59
Feminine/Woman	46,874	57.02
Indigenous or other cultural gender minority identity (e.g., two-spirit)	166	0.20
Non-binary, gender fluid, or something else (e.g., genderqueer)	2,315	2.81
Other	302	0.37
Gender (categories used in the analyses)		
Men	32,549	39.59
Women	46,874	57.02
Gender-diverse individuals	2,783	3.38
Trans status		
No, I am not a trans person	79,280	96.43
Yes, I am a trans man	357	0.43
Yes, I am a trans woman	295	0.36
Yes, I am a non-binary trans person	881	1.07
I am questioning my gender identity	1,137	1.38
I don't know what it means	269	0.33
Sexual orientation (original answer options in the survey)		
Heterosexual/Straight	56,125	68.24
Gay or lesbian or homosexual	4,607	5.60
Heteroflexible	6,200	7.54
Homoflexible	534	0.65
Bisexual	7,688	9.35
Queer	957	1.16
Pansexual	1,969	2.39
Asexual	1,064	1.29
I do not know yet or I am currently questioning my sexual orientation	1,951	2.37
None of the above	807	0.98
I don't want to answer	308	0.37
Sexual orientation (categories used in the analyses)		
Heterosexual	56,125	68.52
Gay or lesbian	4,607	5.62
Bisexual	7,688	9.38
Queer and pansexual	2,926	3.57

Table 1 (continued)

Variables	N = 82,243	%
Homo- and hetero-flexible identities	6,734	8.22
Asexual	1,064	1.29
Questioning	1,951	2.38
Other	807	0.98
Highest level of education		
Primary (e.g., elementary school)	1,002	1.22
Secondary (e.g., high school)	20,325	24.71
Tertiary (e.g., college or university)	60,896	74.06
Currently being in education		
Not being in education	49,802	60.58
Being in primary education (e.g., elementary school)	64	0.08
Being in secondary education (e.g., high school)	1,571	1.91
Being in tertiary education (e.g., college or university)	30,762	37.42
Work status		
Not working	20,853	25.36
Working full time	42,981	52.27
Working part-time	11,356	13.81
Doing odd jobs	7,029	8.55
Socioeconomic status		
My life circumstances are among the worst	227	0.28
My life circumstances are much worse than average	773	0.94
My life circumstances are worse than average	4,232	5.15
My life circumstances are average	26,742	32.52
My life circumstances are better than average	31,567	38.38
My life circumstances are much better than average	14,736	17.92
My life circumstances are among the best	3,957	4.81
Residence		
Metropolis (population is over 1 million people)	26,441	32.15
City (population is between 100,000–999,999 people)	29,920	36.38
Town (population is between 1,000–99,999 people)	21,103	25.66
Village (population is below 1,000 people)	4,764	5.79
Relationship status		
Single	27,541	33.49
In a relationship	27,440	33.37
Married or common-law partners	24,338	29.60
Widow or widower	428	0.52
Divorced	2,472	3.01
Having children		
No	57,909	70.64
Yes, 1	8,417	10.26
Yes, 2	10,353	12.62
Yes, 3	3,843	4.68
Yes, 4	1,014	1.23
Yes, 5	290	0.35
Yes, 6–9	125	0.15
Yes, 10 or more	24	0.03
	Mean	*SD*
Age	32.39	12.52

Percentages might not add up to 100% due to missing data. *SD* standard deviation

a pre-established procedure for cross-cultural studies.[4] Data collection occurred between October 2021 and May 2022. Participants were recruited online (advertisements and websites forums) and anonymously completed the survey on Qualtrics. Information on countries involved in the cross-sectional study, the translation and data collection procedures, and eligibility criteria can be found in the study protocol (Bothe et al., 2021). The study procedures were conducted in accordance with the Declaration of Helsinki. Furthermore, each collaborating country obtained ethical approval from their respective Institutional Review Boards or were deemed exempt.[5] For the sake of transparency, the complete list of publications (including scientific articles and presentations) derived from the ISS is available in the Open Science Framework (OSF).[6,7]

Measures

Several sociodemographic questions (e.g., age, gender, sexual orientation, country of residence, language, educational level, work status, socioeconomic status, residence, and relationship and family status) were evaluated. The wording of each response option can be seen in Table 1.

Arizona Sexual Experiences Scale (ASEX, McGahuey et al., 2000). This scale consists of five items that evaluate sexual functioning according to the following dimensions: sexual drive (i.e., "*How strong is your sex drive?"*); sexual arousal (i.e. "*How easily are you sexually aroused (turned on)?"*); vaginal lubrication (i.e. "*How easily does your vagina become moist or wet during sex?"*) or penile erection (i.e. "*Can you easily get and keep an erection?"*); ability to reach orgasm (i.e. "*How easily can you reach an orgasm?"*); and satisfaction with orgasm (i.e. "*Are your orgasms satisfying?"*). These questions are answered on a scale ranging from 1 (hyperfunction) to 6 (hypofunction), with answer options adjusted to each item content. The original reliability of this scale was $\alpha = 0.91$. The male and female anatomy versions differ for the third question, as described above.[8] All translations of the ASEX can be found on the project's OSF page.[9]

Statistical Analyses

Study analyses followed a preregistered analytical plan.[10] This plan included the following: (1) descriptive statistics; (2) dimensionality tests (in particular, confirmatory factor analysis [CFA]); (3) measurement invariance (in particular, multi-group CFAs according to four variables of interest [country, language, gender, and sexual orientation]); (4) reliability tests (i.e., Cronbach's alpha [α] and McDonald's omega [ω]); and (5) validity tests. Analytic software included the SPSS statistical package (version 28) and R (version 4.1.3). Missing values on the ASEX ranged between 0.8%-1.2% (i.e., almost negligible) and, according to Little's Missing Completely at Random Test (MCAR), were not missing completely at random ($\chi^2 = 742.02$, $df = 50$, $p < 0.001$). Although the preregistered analytic approach planned the use of the Full Information Maximum Likelihood (FIML) method to handle missing values, this was not available in lavaan's CFA function. Instead, as the rate of missing data was almost negligible, we used the WLMSV estimator and lavaan's default listwise deletion method.

Descriptive Analyses

First, descriptive statistics (i.e., percentages) are presented for each country, language, gender, sexual orientation, education, work status, place of residence, relationship status, and family status (i.e., number of children). Next, ASEX items' descriptive analyses were conducted (i.e., mean, standard deviation, skewness, and kurtosis values). Finally, means, standard deviations, and minimum and maximum values were calculated for each language, country, gender, and sexual orientation (see supplemental materials).

Dimensionality Tests

CFA was conducted to examine the factor structure of the ASEX in the total sample. The CFA was then conducted for all countries, languages, genders, and sexual orientations. The CFA models were evaluated using common goodness-of-fit (GOF) indices (Browne & Cudeck, 1993; Marsh et al.,

[4] https://osf.io/xcgzf?view_only=6e4f96b748be42d99363d58e32d511b8

[5] https://osf.io/e93kf?view_only=838146f6027c4e6bb68371d9d14220b5

[6] https://osf.io/jb6ey/?view_only=0014d87bb2b546f7a2693543389b934d

[7] https://osf.io/c695n/?view_only=7cae32e642b54d049e600ceb8971053e

[8] Participants reporting a different gender identity than their sex assigned at birth, being non-binary, and/or being trans persons were provided a question concerning whether they would like to receive the male-bodied or the female-bodied sexual function scale, or whether they would prefer to skip this entire scale.

[9] https://osf.io/jcz96/?view_only=9af0068dde81488db54638a01c8ae118

[10] https://doi.org/10.17605/OSF.IO/DK78R

2005; Schermelleh-Engel et al., 2003): Comparative Fit Index (CFI; ≥ 0.90 adequate; ≥ 0.95 good), Tucker-Lewis Index (TLI; ≥ 0.90 adequate; ≥ 0.95 good), and Root-Mean-Square Error of Approximation with its 90% confidence interval (RMSEA;0.10 ≤ acceptable. ≤ 0.08 adequate, and ≤ 0.05 good). The weighted least square mean- and variance-adjusted (WLSMV) estimation method was used, given that it is indicated for ordered categorical variables (Savalei & Rhemtulla, 2013). The lavaan package from R software was used for all analyses (Rosseel, 2012).

Measurement Invariance Tests

To ensure that comparisons were meaningful and to reduce the possibility of measurement biases and invalid comparisons between groups (Millsap, 2011; Vandenberg & Lance, 2000), tests of measurement invariance were conducted using country, language, gender, and sexual orientation as grouping variables. Based on Monte Carlo simulations,[11] a minimum of 310 participants per group were required to be included in the CFA and measurement invariance analyses. For this reason, Algeria, Ecuador, Gibraltar, India, Iraq and Bangladesh were excluded from analysis. Thus, 36 countries were included in the measurement invariance analyses. Similarly, Arabic, Romanian, Hindi and Bangla languages were also excluded. Thus, 22 languages were retained for analyses. All genders and sexual orientations were included in analyses. However, the large number of subgroups in the country-based analyses required us to conduct invariance tests dividing the countries into two independent datasets (18 countries in both datasets based on the countries' names in English, following an alphabetical order) to prevent convergence problems. Information on the creation of the analysis groups can be found in the preregistration document.[12]

Invariance was evaluated on six increasingly constrained levels: configural, metric, scalar, residual, latent mean, and latent variance models were evaluated, using partial invariance analysis in cases when it was deemed necessary. The fit of the different invariance models was evaluated using the aforementioned GOF indices. A decrease ≥ 0.010 in the CFI and an increase ≥ 0.015 in the RMSEA indicated a significant decrease in the model fit when testing for measurement invariance (Chen, 2007; Cheung & Rensvold, 2002; Morin et al., 2016). For metric invariance, a more relaxed criterion (i.e., decreases ≥ 0.020 in the CFI and increases ≥ 0.030 in the RMSEA) was considered acceptable (Rutkowski & Svetina, 2014). Following the preregistration plan, in case models were not fully invariant at the first four measurement levels (i.e., configural, metric, scalar, and residual) that were used to identify potential measurement biases, we tested partial measurement invariance (i.e., models in which a subset of parameters was allowed to vary across groups). The selection of the parameters to be freed in these analyses was based on the examination of the modification indices and the resulting changes in X^2 (conducted using the *R* function «*lavTestScore*»). The *lavaan* package was also used for all measurement invariance analyses (Rosseel, 2012).

Group Differences

In order to compare the ASEX mean differences between country, gender, and sexual orientation groups, we used Kruskal–Wallis tests and eta-squared effect sizes. Eta-squared effect sizes were calculated for group comparisons, with benchmarks defined as small ($\eta^2 = 0.01$), medium ($\eta^2 = 0.06$), and large ($\eta^2 = 0.14$) by Cohen (1988).

Tests of Reliability and Validity

Cronbach's alphas and McDonald's omegas were calculated to assess the internal consistency of the scale (McDonald, 1970; Nunnally, 1978). The analysis was conducted within the *psych* package, with the *alpha* and *omega* functions (Revelle and Revelle, 2015).

The convergence validity analysis was examined by assessing the correlations between the ASEX and several sexuality-related descriptive items (e.g., total number of sexual partners; past-year sexual frequency; number of past-year sexual partners; past-year casual sexual frequency; and past-year masturbation frequency). Correlations around |.10| were considered weak, |.20| moderate, |.30| strong, and 0.40 very strong (Savalei & Rhemtulla, 2013). All analyses were conducted using R software (*psych* package).

Results

Descriptive Statistics

Descriptive statistics for each ASEX item and for the total score are presented in Table 2. The five items had means around 3, except for item 5, which had the lowest (suggesting high sexual functioning) score. All items had close to normal skewness (between 0.33 and 1.19) and kurtosis values (between 2.78 and 4.59), with the total scale demonstrating a normal distribution.

[11] https://doi.org/10.17605/OSF.IO/DK78R
[12] https://doi.org/10.17605/OSF.IO/DK78R

CFAs and Internal Consistency of the ASEX

CFA results from the total sample are presented in Table 3. CFA supported a one-dimensional scale structure, with excellent values for the CFI (0.966) and the TLI (0.933), and an acceptable value for the RMSEA (0.089 [90% CI = 0.087 to 0.092]). The standardized factor loadings ranged between 0.55 and 0.80. Finally, ordinal Cronbach's α (0.79) and McDonald's omega (0.85) exceeded the criterion of 0.70 as a minimum acceptable value for good internal consistency (Hunsley & Mash, 2008).

Measurement Invariance Analyses of the ASEX

We first conducted a multi-group CFA analysis, across country-, language-, gender- and sexual-orientation-based subgroups (Tables 4 5, 6, and 7). To conduct country-based measurement invariance tests, we divided all countries into two datasets (see Table 4). Results for both datasets were similar: configural, metric, partial scalar, and partial residual invariances showed good GOF indices, yet differences between pairs of nested models indicated a significant worsening of the model fit after partial residual invariance (i.e., Δ CFI $\geq$ 0.010 and Δ RMSEA $\geq$ 0.015). This means that our analysis did not support latent variance and latent mean invariance across the groups (see Table 4).

According to language (see Table 5), configural, metric, partial scalar, and partial residual variances showed good GOF indices. However, latent variance and latent mean invariance demonstrated CFI values higher than the cut-off (see Table 5). So, considering the Δ GOF and the $\chi 2$ value, we concluded that partial residual invariance was established, given that the Δ CFI and Δ RMSEA are under the limits.

Regarding gender (see Table 6), the GOF indices were appropriate in men and gender-diverse individuals, yet beyond the threshold in women (specifically, in RMSEA values). Differences between pairs of nested models supported configural, metric, scalar and partial residual invariance, but latent variance and latent mean invariance were not achieved.

Finally, for sexual orientation (see Table 7), RMSEA values were above the cut-off score among bisexual, queer, pansexual, asexual, and questioning groups. According to the differences between pairs and nested models, configural, metric, scalar, and residual invariance were met, but not latent variance and mean invariance.

Table 2 Descriptive statistics of the items of the Arizona sexual experience scale (ASEX)

Items	Range	*M*	*SD*	Skew	*SE*	Kurt	*SE*
Sexual Experience (i.e., total score)	5–30	14.15	4.30	0.78	0.03	4.23	0.04
1. How strong is your sex drive?	1–6	3.07	1.16	0.39	0.01	3.07	0.01
2. How easily are you sexually aroused (turned on)?	1–6	2.86	1.03	0.33	0.01	3.28	0.01
3. How easily does your vagina become moist or wet during sex?	1–6	2.62	1.16	0.57	0.01	3.14	0.01
3. Can you easily get and keep an erection?							
4. How easily can you reach an orgasm?	1–6	3.10	1.23	0.38	0.01	2.78	0.01
5. Are your orgasms satisfying?	1–6	2.49	1.20	1.19	0.01	4.59	0.01

M mean, *SD* standard deviation, *Skew* skewness, *SE* standard error, *Kurt* kurtosis

Table 3 Standardized factor loadings in the confirmatory factor analysis, reliability indices and overall confirmatory factor analysis of the Arizona sexual experience scale (ASEX) on the total sample

Items	λ	α	ω	WLSMV χ^2	df	CFI	TLI	RMSEA	90% CI
Total score		0.79	0.85	3226.367	5	0.966	0.933	0.089	0.087- 0.092
1. How strong is your sex drive?	0.65								
2. How easily are you sexually aroused (turned on)?	0.80								
3. How easily does your vagina become moist or wet during sex? (female)	0.67								
3. Can you easily get and keep an erection? (male)									
4. How easily can you reach an orgasm?	0.59								
5. Are your orgasms satisfying?	0.55								

All factor loadings and correlations were statistically significant at $p < .001$; *λ* standardized factor loading, *α* Cronbach's alpha, *ω* McDonald's omega, *WLSMV* weighted least squares mean- and variance-adjusted estimator, χ^2 Chi-square, *df* degrees of freedom, *CFI* comparative fit index, *TLI* Tucker-Lewis index, *RMSEA* root-mean-square error of approximation, *90% CI* 90% confidence interval of the RMSEA

Table 4 Country-based confirmatory factor analyses and tests of invariance on the Arizona sexual experience scale (ASEX)

Model	WLSMV $\chi 2$	df	CFI	TLI	RMSEA	90% CI	Comp	Δdf	ΔCFI	ΔTLI	ΔRMSEA
Set 1											
Australia	23.895*	5	0.973	0.946	0.078	0.048–0.110	—	—	—	—	—
Austria	36.104*	5	0.950	0.901	0.092	0.065–0.121	—	—	—	—	—
Belgium	24.771*	5	0.972	0.944	0.079	0.050–0.111	—	—	—	—	—
Bolivia	18.117	5	0.963	0.926	0.083	0.044–0.126	—	—	—	—	—
Brazil	156.415*	5	0.963	0.926	0.092	0.080–0.105					
Canada	144.833*	5	0.949	0.898	0.106	0.091–0.121	—	—	—	—	—
Chile	31.845*	5	0.980	0.960	0.068	0.047–0.092	—	—	—	—	—
China	50.576*	5	0.990	0.979	0.062	0.047–0.078	—	—	—	—	—
Colombia	78.962*	5	0.972	0.943	0.089	0.072–0.107	—	—	—	—	—
Croatia	155.256*	5	0.940	0.879	0.113	0.099–0.129	—	—	—	—	—
Czech Republic	24.181*	5	0.992	0.984	0.049	0.030–0.069	—	—	—	—	—
France	89.248*	5	0.951	0.902	0.100	0.083–0.119	—	—	—	—	—
Germany	97.068*	5	0.970	0.939	0.075	0.063–0.089	—	—	—	—	—
Hungary	313.529*	5	0.971	0.942	0.075	0.068–0.082	—	—	—	—	—
Ireland	101.922*	5	0.952	0.905	0.107	0.090–0.126	—	—	—	—	—
Israel	66.381*	5	0.959	0.917	0.097	0.077–0.118	—	—	—	—	—
Italy	177.427*	5	0.926	0.853	0.121	0.106–0.136	—	—	—	—	—
Japan	51.866*	5	0.923	0.847	0.130	0.100–0.164	—	—	—	—	—
Set 2											
Lithuania	68.823*	5	0.970	0.940	0.080	0.064–0.097	—	—	—	—	—
Malaysia	29.817*	5	0.990	0.981	0.066	0.044–0.090	—	—	—	—	—
Mexico	143.632*	5	0.938	0.877	0.115	0.099–0.132	—	—	—	—	—
New Zealand	96.542*	5	0.973	0.946	0.081	0.067–0.096	—	—	—	—	—
North Macedonia	38.005*	5	0.981	0.962	0.073	0.053–0.096	—	—	—	—	—
Panama	9.755	5	0.989	0.978	0.054	0.000–0.104	—	—	—	—	—
Peru	129.136*	5	0.956	0.911	0.097	0.083–0.112					
Poland	644.347*	5	0.934	0.868	0.114	0.107–0.122	—	—	—	—	—
Portugal	144.329*	5	0.936	0.872	0.112	0.097–0.128	—	—	—	—	—
Slovakia	32.616*	5	0.972	0.944	0.071	0.049–0.095	—	—	—	—	—
South Africa	103.688*	5	0.956	0.912	0.105	0.088–0.123	—	—	—	—	—
South Korea	75.507*	5	0.971	0.942	0.099	0.080–0.119	—	—	—	—	—
Spain	123.223*	5	0.949	0.898	0.101	0.086–0.117	—	—	—	—	—
Switzerland	65.197*	5	0.954	0.907	0.103	0.082–0.126	—	—	—	—	—
Taiwan	97.538*	5	0.981	0.963	0.084	0.070–0.099	—	—	—	—	—
Turkey	23.263*	5	0.977	0.953	0.067	0.041–0.096	—	—	—	—	—

Table 4 (continued)

Model	WLSMV $\chi 2$	df	CFI	TLI	RMSEA	90% CI	Comp	Δdf	ΔCFI	ΔTLI	ΔRMSEA
United Kingdom	67.545*	5	0.963	0.925	0.095	0.076–0.116	—	—	—	—	—
United States	94.424*	5	0.971	0.942	0.087	0.072–0.103	—	—	—	—	—
Country-based invariance – Set 1											
M1. Configural	1642.395*	85	0.965	0.930	0.088	0.0850.092	—	—	—	—	—
M2. Metric	2184.113*	158	0.954	0.948	0.076	0.073–0.079	M2-M1	73	-0.011	+0.018	-0.012
M3. Scalar	3423.036	226	0.928	0.943	0.080	0.078–0.082	M3-M2	55	-0.026	-0.005	+0.004
M3.1 Partial scalar[a]	3377.570*	225	0.929	0.943	0.080	0.077–0.082	M3.1-M2	67	-0.025	-0.005	+0.004
M3.2 Partial scalar[b]	3121.866*	224	0.935	0.948	0.076	0.074–0.078	M3.2-M2	66	-0.019	0	0
M3.3 Partial scalar[c]	3361.523*	223	0.939	0.950	0.074	0.072–0.077	M3.3-M2	65	-0.015	+0.002	-0.002
M3.4 Partial scalar[d]	3367.622*	222	0.939	0.950	0.074	0.072–0.077	M3.4-M2	64	-0.015	+0.002	-0.002
M3.5 Partial scalar[e]	3441.962*	221	0.939	0.950	0.074	0.072–0.077	M3.5-M2	63	-0.015	+0.002	-0.002
M3.6 Partial scalar[f]	3343.422*	220	0.942	0.953	0.073	0.070–0.075	M3.6-M2	62	-0.012	+0.005	-0.003
M3.7 Partial scalar[g]	3226.910*	219	0.945	0.955	0.071	0.068–0.073	M3.7-M2	61	-0.009	+0.007	-0.005
M4. Residual	3943.386*	304	0.918	0.951	0.074	0.072–0.076	M4-M3.7	85	-0.027	-0.004	+0.003
M4.1 Partial residual[h]	2641.378*	235	0.946	0.958	0.068	0.066–0.070	M4.1-M3.7	16	+0.001	+0.003	-0.003
M5. Latent variance–covariance	7160.446*	309	0.844	0.914	0.098	0.096–0.100	M5-M4.1	74	-0.102	-0.044	+0.027
M6. Latent mean	12374.064*	325	0.726	0.857	0.127	0.125–0.129	M6-M5	16	-0.118	-0.057	+0.029
Country-based invariance – Set 2											
M1. Configural	1987.387*	90	0.960	0.919	0.098	0.095–0.102	—	—	—	—	—
M2. Metric	2386.611*	158	0.953	0.946	0.080	0.078–0.083	M2-M1	68	-0.007	+0.027	-0.018
M3. Scalar	3923.514*	226	0.921	0.937	0.087	0.084–0.089	M3-M2	68	-0.032	-0.009	+0.007
M3.1 Partial scalar[i]	3569.685*	225	0.929	0.943	0.083	0.080–0.085	M3.1-M2	67	-0.024	-0.003	+0.003
M3.2 Partial scalar[j]	3089.566*	224	0.940	0.951	0.076	0.074–0.079	M3.2-M2	66	-0.014	+0.005	-0.004
M3.3 Partial scalar[k]	3128.302*	223	0.940	0.952	0.076	0.074–0.078	M3.3-M2	65	-0.015	+0.005	-0.003
M3.4 Partial scalar[l]	3087.050*	222	0.943	0.954	0.074	0.072–0.077	M3.4-M2	64	-0.010	-0.008	-0.006
M3.5 Partial scalar[m]	3045.583*	221	0.945	0.955	0.073	0.071–0.076	M3.5-M2	63	-0.008	+0.007	-0.007
M4. Residual	4340.881*	306	0.914	0.949	0.078	0.076–0.080	M4-M3.5	85	-0.031	-0.006	+0.005
M4.1 Partial residual[n]	2784.735*	237	0.946	0.959	0.070	0.068–0.073	M4.1-M3.5	16	+0.001	+0.004	-0.003
M5. Latent variance–covariance	8920.570*	328	0.817	0.900	0.110	0.108–0.112	M5-M4.1	91	-0.129	-0.059	+0.040
M6. Latent mean	13,521.937*	345	0.720	0.854	0.132	0.131–0.134	M6-M5	17	-0.097	-0.046	+0.022

WLSMV weighted least squares mean- and variance-adjusted estimator, χ^2 Chi-square, *df* degrees of freedom, *CFI* comparative fit index, *TLI* Tucker-Lewis index, *RMSEA* root-mean-square error of approximation, *90% CI* 90% confidence interval of the RMSEA, *Comp.* comparison, *ΔCFI* change in CFI value compared to the preceding model, *ΔTLI* change in the TLI value compared to the preceding model, *ΔRMSEA* change in the RMSEA value compared to the preceding model;* $p < .001$; [a] = The residual variance of item 5 was freed in China; [b] = In addition to the previous model, the residual variance of item 3 was freed in Italy; [c] = In addition to the previous model, the residual variance of item 2 was freed in China; [d] = In addition to the previous model, the residual variance of item 5 was freed in Japan; [e] = In addition to the previous model, the residual variance of item 2 was freed in Hungary; [f] = In addition to the previous model, the residual variance of item 4 was freed in Colombia; [g] = In addition to the previous model, the residual variance of item 5 was freed in Hungary; [h] = The residual variance of item 5 was freed in Germany; [i] = The residual variance of item 1 was freed in Turkey; [j] = In addition to the previous model, the residual variance of item 5 was freed in South Korea; [k] = In addition to the previous model, the residual variance of item 1 was freed in Taiwan; [l] = In addition to the previous model, the residual variance of item 2 was freed in Poland; [m] = In addition to the previous model, the residual variance of item 4 was freed in Turkey; [n] = The residual variance of item 4 was freed in Taiwan

Table 5 Language-based confirmatory factor analyses and tests of invariance on the Arizona sexual experience scale (ASEX)

Model	WLSMV χ^2	df	CFI	TLI	RMSEA	90% CI	Comp	Δdf	ΔCFI	ΔTLI	ΔRMSEA
Croatian	167.040*	5	0.939	0.878	0.115	0.100–0.130	—	—	—	—	—
Czech	21.209	5	0.993	0.987	0.046	0.027–0.066	—	—	—	—	—
Dutch	14.343	5	0.983	0.967	0.060	0.025–0.098	—	—	—	—	—
English	562.161*	5	0.968	0.937	0.090	0.084–0.097	—	—	—	—	—
French	227.606*	5	0.946	0.892	0.107	0.095–0.119	—	—	—	—	—
German	123.251*	5	0.963	0.925	0.083	0.070–0.096	—	—	—	—	—
Hebrew	67.384*	5	0.957	0.914	0.098	0.078–0.120	—	—	—	—	—
Hungarian	306.571*	5	0.971	0.943	0.074	0.068–0.082	—	—	—	—	—
Italian	184.486*	5	0.924	0.848	0.122	0.107–0.137	—	—	—	—	—
Japanese	47.776*	5	0.924	0.847	0.137	0.103–0.174	—	—	—	—	—
Korean	74.547*	5	0.971	0.942	0.099	0.080–0.119	—	—	—	—	—
Lithuanian	68.240*	5	0.971	0.943	0.078	0.062–0.095	—	—	—	—	—
Macedonian	40.128*	5	0.980	0.960	0.074	0.054–0.096	—	—	—	—	—
Mandarin – simplified	53.757*	5	0.989	0.978	0.063	0.049–0.079	—	—	—	—	—
Mandarin – traditional	97.751*	5	0.982	0.963	0.084	0.070–0.098	—	—	—	—	—
Polish	678.088*	5	0.933	0.867	0.115	0.107–0.122	—	—	—	—	—
Portuguese – Brazil	158.646*	5	0.963	0.926	0.092	0.080–0.105	—	—	—	—	—
Portuguese – Portugal	149.410*	5	0.936	0.872	0.113	0.098–0.130	—	—	—	—	—
Slovak	70.110*	5	0.960	0.920	0.080	0.064–0.097	—	—	—	—	—
Spanish – Latin American	403.622*	5	0.961	0.922	0.095	0.088–0.103	—	—	—	—	—
Spanish – Spain	122.278*	5	0.949	0.899	0.101	0.086–0.117	—	—	—	—	—
Turkish	19.771	5	0.981	0.962	0.059	0.033–0.088	—	—	—	—	—
Language-based invariance											
M1. Configural	3658.176*	110	0.962	0.923	0.094	0.091–0.096	—	—	—	—	—
M2. Metric	4590.298*	194	0.953	0.946	0.079	0.077–0.081	M2-M1	84	-0.009	+0.023	-0.015
M3. Scalar	7755.025*	278	0.919	0.936	0.086	0.084–0.087	M3-M2	84	-0.034	-0.010	+0.007
M3.1 Partial scalar[a]	7189.657*	277	0.925	0.941	0.083	0.081–0.084	M3.1-M2	83	-0.028	-0.005	+0.004
M3.2 Partial scalar[b]	6955.550*	276	0.928	0.943	0.081	0.079–0.083	M3.2-M2	82	-0.025	-0.003	+0.002
M3.3 Partial scalar[c]	6433.194*	275	0.934	0.947	0.078	0.076–0.080	M3.3-M2	81	-0.019	+0.001	-0.001
M3.4 Partial scalar[d]	5933.997*	274	0.939	0.951	0.075	0.073–0.076	M3.4-M2	80	-0.014	+0.005	-0.004
M3.5 Partial scalar[e]	6931.159*	273	0.937	0.949	0.076	0.075–0.078	M3.5-M2	79	-0.016	+0.003	-0.003
M3.6 Partial scalar[f]	7007.262*	272	0.938	0.950	0.076	0.074–0.078	M3.6-M2	78	-0.015	+0.004	-0.003
M3.7 Partial scalar[g]	7023.333*	271	0.938	0.949	0.076	0.075–0.078	M3.7-M2	77	-0.015	+0.003	-0.003
M3.8 Partial scalar[h]	6664.305*	270	0.942	0.953	0.074	0.072–0.075	M3.8-M2	76	-0.011	+0.007	-0.005
M3.9 Partial scalar[i]	6677.720*	269	0.942	0.953	0.074	0.072–0.075	M3.9-M2	75	-0.011	+0.007	-0.005
M3.10 Partial scalar[j]	6644.652*	268	0.943	0.953	0.074	0.072–0.075	M3.10-M2	74	-0.010	+0.007	-0.005

Table 5 (continued)

Model	WLSMV χ^2	df	CFI	TLI	RMSEA	90% CI	Comp	Δdf	ΔCFI	ΔTLI	ΔRMSEA
M3.11 Partial scalar[k]	5562.329*	267	0.943	0.953	0.074	0.072–0.075	M3.11-M2	73	-0.010	+0.007	-0.005
M3.12 Partial scalar[l]	5456.878*	266	0.944	0.954	0.073	0.071–0.075	M3.12-M2	72	-0.009	+0.008	-0.006
M4. Residual	8596.931*	371	0.911	0.947	0.078	0.076–0.079	M4-M3.12	105	+0.033	-0.007	+0.005
M4.1 Partial residual[m]	5358.305*	265	0.945	0.954	0.072	0.071–0.074	M4.1-M3.12	1	+0.001	0	-0.001
M5. Latent variance–covariance	17110.586*	404	0.820	0.902	0.106	0.105–0.108	M5-M4.1	139	-0.125	0.043	+0.088
M6. Latent mean	29333.954*	425	0.688	0.839	0.136	0.135–0.138	M6-M5	21	-0.132	-0.063	+0.030

WLSMV weighted least squares mean- and variance-adjusted estimator, χ^2 Chi-square, *df* degrees of freedom, *CFI* comparative fit index, *TLI* Tucker-Lewis index, *RMSEA* root-mean-square error of approximation, *90% CI* 90% confidence interval of the RMSEA, *Comp.* comparison, *ΔCFI* change in CFI value compared to the preceding model, *ΔTLI* change in the TLI value compared to the preceding model, *ΔRMSEA* change in the RMSEA value compared to the preceding model. *$p < .001$; [a] = The residual variance of item 1 was freed in Turkish; [b] = In addition to the previous model, the residual variance of item 5 was freed in Korean; [c] = In addition to the previous model, the residual variance of item 3 was freed in Italian; [d] = In addition to the previous model, the residual variance of item 4 was freed in Polish; [e] = In addition to the previous model, the residual variance of item 2 was freed in Polish; [f] = In addition to the previous model, the residual variance of item 5 was freed in Mandarin; [g] = In addition to the previous model, the residual variance of item 4 was freed in Turkish; [h] = In addition to the previous model, the residual variance of item 5 was freed in Hungarian; [i] = In addition to the previous model, the residual variance of item 2 was freed in Hungarian; [j] = In addition to the previous model, the residual variance of item 1 was freed in Mandarin; [k] = In addition to the previous model, the residual variance of item 4 was freed in Portuguese; [l] = In addition to the previous model, the residual variance of item 4 was freed in Hungarian; [m] = The residual variance of item 5 was freed in German

Table 6 Gender-based confirmatory factor analyses and tests of invariance on the Arizona sexual experience scale (ASEX)

Model	WLSMV χ^2	df	CFI	TLI	RMSEA	90% CI	Comp	Δdf	ΔCFI	ΔTLI	ΔRMSEA
Men	661.800*	5	0.975	0.949	0.064	0.060–0.068	—	—	—	—	—
Women	3721.199*	5	0.937	0.874	0.127	0.123–0.130	—	—	—	—	—
Gender-diverse individuals	144.695*	5	0.960	0.921	0.106	0.091–0.121	—	—	—	—	—
Gender-based invariance											
M1. Configural	4527.694*	15	0.949	0.898	0.106	0.103–0.108	—	—	—	—	—
M2. Metric	4910.402*	23	0.945	0.928	0.089	0.087–0.091	M2-M1	8	-0.004	+0.030	-0.017
M3. Scalar	8375.837*	31	0.905	0.909	0.100	0.098–0.102	M3-M2	8	-0.040	-0.019	-0.011
M3.1 Partial scalar[a]	5474.906*	30	0.938	0.938	0.082	0.080–0.084	M3.1-M2	7	-0.007	+0.010	-0.007
M4. Residual	10189.473*	40	0.885	0.914	0.097	0.095–0.099	M4-M3.1	10	-0.053	-0.024	+0.015
M.4.1 Partial residual[b]	5386.485*	35	0.939	0.948	0.075	0.074- 0.077	M4.1-M3.1	5	+0.001	-0.010	-0.007
M5. Latent variance–covariance	20609.225*	43	0.767	0.837	0.133	0.132–0.135	M5-M4.1	8	-0.169	-0.111	+0.058
M6. Latent mean	44440.333*	45	0.497	0.665	0.191	0.190–0.193	M6-M5	2	-0.270	-0.172	+0.058

WLSMV weighted least squares mean- and variance-adjusted estimator, χ^2 Chi-square, *df* degrees of freedom, *CFI* comparative fit index, *TLI* Tucker-Lewis index, *RMSEA* root-mean-square error of approximation, *90% CI* 90% confidence interval of the RMSEA, *Comp.* comparison, *ΔCFI* change in CFI value compared to the preceding model, *ΔTLI* change in the TLI value compared to the preceding model, *ΔRMSEA* change in the RMSEA value compared to the preceding model. *$p < .001$; [a] = The residual variance of item 4 was freed in women; [b] = The residual variance of item 5 was freed in men

Differences Between Groups and Means of the ASEX According to Languages, Countries, Genders, and Sexual Orientations

Results suggested moderate differences between gender groups ($H(2) = 7901.4$; $p < 0.001$; $\eta^2 = 0.096$), small differences between sexual-orientation groups ($H(7) = 2161.3$; $p < 0.001$; $\eta^2 = 0.026$), and small differences between country groups (set1; $H(17) = 1915.4$; $p < 0.001$; $\eta^2 = 0.047$) (set2; $H(17) = 1999.2$; $p < 0.001$; $\eta^2 = 0.050$). All scores for the ASEX according to language, country, gender, and sexual orientation are included as additional information in the supplemental materials (Tables S1-S4). The top three countries with the highest SFPs scores were Taiwan ($M = 16.32$), South Korea ($M = 15.81$), and Malaysia ($M = 15.72$), whereas the lowest scores were observed in Turkey ($M = 13.01$), Hungary ($M = 12.95$) and Brazil ($M = 12.63$). This corresponds with the languages, with being traditional Mandarin ($M = 16.34$) and Korean ($M = 15.84$) at the top, and Hungarian ($M = 12.87$) and Portuguese ($M = 12.61$) in the bottom of average ASEX scores. According to gender, women had higher means than men ($M = 15.25$ and $M = 12.54$, respectively), with gender-diverse individuals being closer to men ($M = 14.80$). Finally, asexual people had the highest scores on the ASEX ($M = 20.79$). Heterosexual ($M = 14.05$), bisexual ($M = 13.97$) and gay and lesbian ($M = 13.09$) individuals had the lowest means, suggesting the fewest SFPs.

Validity of the ASEX

Concerning validity, Table 8 displays the correlations between ASEX and different sexual behaviors. The correlation results indicated significant relationships ranging from weak to moderate, supporting convergent validity. For example, individuals with higher ASEX scores reported less frequent masturbation and engagement in partnered sexual activities.

Discussion

Sexual responses and SFPs have been widely studied in the past twenty years and are common across countries, genders, and sexual orientations (van Lankveld et al., 2021). The ASEX has been adapted to different countries and populations, such as Turkey in patients with symptoms related to end-stage renal disease (Soykan, 2004); France among patients with depression (Briki et al., 2014); Thailand in patients with Parkinson´s disease (Jitkritsadakul et al., 2014); in Tunisian patients with schizophrenia (Nakhli et al., 2014); in Italian psychotic patients (Jannini et al., 2022); and Spanish general population (Sánchez-Fuentes et al., 2019). In all these studies, the ASEX has shown adequate psychometric properties and has been established as a sound and robust measurement tool to assess SPFs in diverse populations. However, most validations have been carried out with

Table 7 Sexual Orientation-based confirmatory factor analyses and tests of invariance on the Arizona Sexual experience scale (ASEX)

Model	WLSMV χ^2	df	CFI	TLI	RMSEA	90% CI	Comp	Δdf	ΔCFI	ΔTLI	ΔRMSEA
Heterosexual	1967.957*	5	0.969	0.939	0.084	0.081–0.087	—	—	—	—	—
Gay or lesbian	172.883*	5	0.961	0.922	0.086	0.075–0.097	—	—	—	—	—
Bisexual	406.972*	5	0.951	0.902	0.103	0.095–0.112	—	—	—	—	—
Queer and pansexual	190.750*	5	0.936	0.873	0.115	0.102- 0.130	—	—	—	—	—
Homo-and heteroflexible identities	340.416*	5	0.953	0.906	0.100	0.091- 0.109	—	—	—	—	—
Asexual	106.655*	5	0.954	0.909	0.146	0.123–0.171	—	—	—	—	—
Questioning	198.287*	5	0.931	0.862	0.143	0.127–0.161	—	—	—	—	—
Other	65.233*	5	0.948	0.897	0.125	0.099- 0.153	—	—	—	—	—
Sexual orientation-based invariance											
M1. Configural	3449.154*	40	0.963	0.927	0.092	0.089–0.095	—	—	—	—	—
M2. Metric	3783.943*	68	0.960	0.953	0.074	0.072–0.076	M2-M1	28	+0.003	+0.023	-0.018
M3. Scalar	4453.096*	96	0.953	0.961	0.067	0.065–0.069	M3-M2	28	+0.007	+0.008	-0.007
M4. Residual	5048.713*	131	0.947	0.968	0.061	0.060–0.062	M4-M3	35	+0.006	+0.007	-0.006
M5. Latent variance–covariance	6875.436*	138	0.927	0.958	0.070	0.068–0.071	M5-M4	7	+0.020	-0.010	0.009
M6. Latent mean	13913.448*	145	0.852	0.918	0.097	0.096–0.098	M6-M5	7	+0.075	-0.040	0.027

WLSMV weighted least squares mean- and variance-adjusted estimator, χ^2 Chi-square, *df* degrees of freedom, *CFI* comparative fit index, *TLI* Tucker-Lewis index, *RMSEA* root-mean-square error of approximation, *90% CI* 90% confidence interval of the RMSEA, *Comp.* comparison, *ΔCFI* change in CFI value compared to the preceding model, *ΔTLI* change in the TLI value compared to the preceding model, *ΔRMSEA* change in the RMSEA value compared to the preceding model. * $p < .001$

a clinical population. Moreover, the psychometric properties of the ASEX had not been concurrently examined across a wide range of countries, languages, genders (including gender-diverse individuals) and the wide diversity of sexual orientations. Therefore, the present study evaluated its psychometric properties in a sample of more than 80,000 people from different countries, speaking different languages, and of multiple genders and sexual orientations.

A one-dimensional structure of the ASEX was supported, as reported in the original validation study (McGahuey et al., 2000). CFA supported appropriate fit across countries. However, 12 of 35 countries had slightly higher RMSEA values than the recommended cut-off scores. This issue was also reported by Sánchez-Fuentes et al. (2019) when evaluating the ASEX's psychometric properties. Nevertheless, considering the RMSEA confidence intervals, most countries had acceptable values, especially given the sample's normal distribution, and therefore the confidence intervals were not considered to be biased (Tebbs, 2013). Furthermore, in a one-factor models with only a limited number of items, the RMSEAs tend to be higher (Kenny et al., 2014). Finally, the RMSEA values should be considered as supplements to other fit indices, and multiple fit indices should be evaluated simultaneously when deciding a model's adequacy (Chen, 2007). Thus, in this study, although the RMSEA values exceeded the commonly used cut-off values for the RMSEA for some countries, the CFI and TLI values were good or excellent, supporting the scale's construct validity. Similar considerations applied to some of the examined language versions as well (i.e., although the CFI and TLI were good or excellent, 7 of 22 languages had slightly higher RMSEA values).

Regarding invariance results, configural, metric, partial scalar, and partial residual invariances were achieved across countries, languages, genders, and sexual orientations. However, higher level of measurement invariance (i.e., latent variances-covariances and means) were not achieved. This means that items loaded on the same factor structure, that items had the same factorial loadings, and that items intercepts and errors were equal across all these groups, but latent mean and variances-covariances were not equal across the tested levels (i.e., differences between the study groups can be expected in their mean scores and their variances). Concerning internal consistency, the ASEX showed excellent values, consistent with previous studies (e.g., Sánchez-Fuentes et al., 2019; Santos-Iglesias et al., 2016).

Considering country-based differences, four of the six highest scoring on the ASEX were Asian countries, similar to a prior report with women only (Koops & Briken, 2018) suggesting that Asian countries (such as Taiwan, South Korea, Malaysia or China) had higher prevalence estimates of SFPs (not necessarily a diagnosable sexual dysfunction) than most of the European and American countries. Attitudes towards sex, different cultural practices, cultural beliefs about the causes of sexual problems, lack of privacy in some cultures, or gender inequality may vary greatly by culture and may relate to SFPs (Bhugra & De Silva, 2009). Cultural differences may be expressed, among other ways, in different prevalence estimates of SFPs. For example, strongly held cultural beliefs about the danger of using up limited sperm reserves, may impact vulnerable individuals to develop concerns about sexual performance, leading to anxiety which may in turn promote the onset and maintenance of problems (Bhugra & De Silva, 2009). However, cultural differences in SFPs should be considered cautiously given that research to date has largely used concepts, assessment tools, and diagnostic criteria developed in Western cultures (Bhavsar & Bhugra, 2018). Capitalizing on them to study sexuality in Eastern cultures is thus susceptible to lead to inaccuracies and misunderstanding of sexuality and SFPs in non-Western countries.

At the opposite extreme, Hungarians, Turkish and Brazilians have reported the lowest rates of SFPs in our study. Considering the poor performance on smoking, alcohol use and cardiovascular indicators in some of these countries such as

Table 8 Associations between the Arizona sexual experience scale (ASEX) and theoretically relevant correlates (convergent validity)

	Range	*M*	*SD*	*Mdn*	1	2	3	4	5	6
1. *Arizona Sexual Experience Scale (ASEX)*	5–30	14.15	4.30	14.00						
2. Total number of sexual partners (in and out of a relationship)	0–1000	12.59	42.53	4.00	-.09**					
3. Past-year sexual frequency (in and out of a relationship)[a]	0–10	4.07	2.72	5.00	-.29**	.10**				
4. Past-year sexual frequency (with the partner)[a,b]	0–1000	5.30	2.14	6.00	-.24**	-.00	.86**			
5. Number of past-year casual sexual partners	0–340	1.12	5.85	0.00	-.07**	.39**	.08**	<.01		
6. Past-year casual sexual frequency[a]	0–10	0.74	1.59	0.00	-.14**	.26**	.18**	.03**	.37**	
7. Past-year frequency of masturbation[a]	0–10	5.36	2.61	6.00	-.35**	.10**	-.02**	.02**	.10**	.18**

M mean, *SD* standard deviation, *Mdn* median; a = 0: never, 1: once in the past year, 2: 2–6 times in the past year, 3: 7–11 times in the past year, 4: monthly, 5: 2–3 times a month, 6: weekly, 7: 2–3 times a week, 8: 4–5 times a week, 9: 6–7 times a week, 10: more than 7 times a week; b = Only partnered individuals responded to this question ($n = 51{,}754$). *$p < .001$

Hungary these results may seem counter intuitive. Probably under-reporting and cultural differences in admitting sexual problems could explain these and other results that may be surprising.

Regarding gender, women had higher levels of SFPs than men and gender-diverse individuals, consistent with prior reports that women experience more SFPs than men (Lau et al., 2005; Laumann et al., 1999). These results may reflect, amongst other factors, the dominance of an androcentric model in societies where men's pleasure is prioritized while there is less knowledge and interest about women's anatomy, physiology, and sexual pleasure (Gil-Llario et al., 2017). In such androcentric models, women may feel trapped and follow sexual scripts in which women's roles in sexuality are more passive and in which the active pursuit of pleasure is punished, stigmatized, or self-stigmatized (Ballester-Arnal, 2020; Ruiz-Palomino et al., 2019). Some studies have highlighted that women's sexual problems are higher in societies with low levels of gender equality (Giménez-García et al., 2020). The highest punctuation in SFP in women may also be due to the lack of self-esteem in women by their body image (Nobre & Pinto-Gouveia, 2008), the low desire related with aging (Carvalho & Nobre, 2010) or even problems in the inhibitory/excitatory mechanism (Janssen & Bancroft, 2007; Sanders et al., 2008), which are quite common in women. Finally, our results regarding gender-diverse individuals differ from prior reports of higher levels of SFPs among non-binary and trans individuals (Lafortune et al., 2022). In that study, 17.1% of non-binary and/or trans individuals experienced sex aversion, followed by 11.3% of women and 6.9% of men. These differences warrant further studies given that SFPs in non-binary and binary transgender individuals may differ depending on multiple variables, such as gender dysphoria, sex reassignment surgery, or being a trans woman or trans man. For example, lower sexual desire and sexual arousal, and poorer overall sexual health have been reported in trans women compared to cisgender women (Gil-Llario et al., 2021). Therefore, when making comparisons across studies in gender-diverse and transgender people, it is important to carefully consider the sample's characteristics.

Concerning sexual orientation, our study findings suggested fewer SFPs among bisexual and gay or lesbian people than among heterosexual individuals. More than four decades ago, Masters and Johnson (1979) described major differences between heterosexual and same-sex/gender couples in ways sexual response patterns develop in interactions between partners. They observed that same-sex/gender couples have more information about the sexual anatomy and physiology of the partner, take more time for each other and each other's feelings of pleasure, place less emphasis on rushing towards orgasm, and focus less on simultaneous orgasm, which may result in optimized sexual functioning. Also, noncoital sexuality, such as oral sex, is more frequent in same-sex/gender interactions (Sandfort & de Keizer, 2001). According to these authors, physical differences between sexually diverse and heterosexual sexuality are likely to have psychological consequences. Whereas in heterosexual interactions sexual positions may be limited by the gender of the partners, these positions may need to be negotiated in same-sex/gender sexual interactions. Other psychological differences may derive from the gendered nature of sexual expression and dominance of heterosexual scripts with men usually being more performance- and pleasure-oriented and women being more expressive and oriented toward relationships and intimacy (Sandfort & de Keizer, 2001). These differences may impact sexual functioning of heterosexual and sexually-diverse individuals, resulting in more SFPs among heterosexual individuals. Our results, however, seem to contradict prior reports in the sense that gay and lesbian individuals had more SFPs and distress than their heterosexual counterparts (Waterhouse & Burkill, 2019). We believe a potential explanation for gay and lesbian individuals reporting more SFPs than their heterosexual counterparts is the stigma that pervades same-sex/gender sexual behaviors. This stigma leads to such behaviors and attractions being devalued compared to heterosexual sexual activity and are often met with hostility and malevolent stereotypes (Herek et al., 2009). In the case of gay men, this deleterious impact of sexual stigma may be aggravated by stereotypes within and outside of the gay community regarding gay men's physical characteristics and sexual performance (Campbell & Whiteley, 2006). In the case of lesbian women, a gender- and sexuality-specific factor that might negatively impact their sexual functioning is the misconception around their desire for, and participation in, vaginal penetrative sexual activity (Sobecki-Rausch et al., 2017). These minority-specific mechanisms might negatively relate to gay men and lesbian women's sexual functioning, while they may not be present among heterosexual individuals. The contradictory results regarding the higher or lower prevalence of SFP in heterosexual versus gay, lesbian, or bisexual people warrant caution and further research into what factors may contribute to these differences.

Asexual individuals in the present study experienced the most SFPs. To the best of our knowledge, no previous study has compared SFPs in asexual individuals to individuals with other sexual orientations. On the one hand, although significant heterogeneity exists within the asexual community, asexual individuals are defined by their lack of sexual attraction, potentially resulting in more SFPs among asexual individuals (Bradshaw et al., 2021; Brotto et al., 2015), which does not necessarily mean the existence of distress caused by these problems. But on the other hand, there are some proposals arguing that asexuality could be classified

as "Hypoactive Sexual Desire Disorder" or HSDS; as long as there will be the presence of significant distress (Bogaert, 2006). As far as we have explored here, we cannot affirm that there could be distress in those people; although it could be interesting to have that into account for future research.

All these data should be interpreted with caution and not be confused with the prevalence of sexual dysfunction as a clinical disorder. Some studies have highlighted the large differences in the figures when we talk about one-off problems or disorders that meet clinical criteria. Thus Mitchell et al. (2016) in a national probability survey (Natsal-3) found that among sexually active men, the prevalence of reporting one or more of four specific sexual problems was 38.2%, but 4.2% after applying three morbidity criteria (distress, duration and symptom severity); corresponding figures for women reporting one or more of three specific sexual problems, were 22.8% and 3.6% respectively. Just over a third of men and women reporting a problem meeting all three morbidity criteria had sought help in the last year. Similarly, Briken et al. (2020) in the representative GeSiD study found that the reported prevalence in Germany of one or more sexual problems, including mild distress, in the previous 12 months was 33.4% in men and 45.7% in women. However sexual dysfunction causing marked distress, as per the ICD-11 guidelines, was reported by 13.3% of the sexually active men and by 17.5% of the sexually active women.

Regarding convergent validity in our study, individuals with higher ASEX scores reported lower levels of engagement in different, theoretically relevant sexual activities. These results are consistent with prior reports of negative associations between ASEX and sexual excitation and sexual sensation-seeking (Santos-Iglesias et al., 2016) and negative correlations between SFPs and sexual satisfaction, orgasm satisfaction, sexual interest, and erection (Sánchez-Fuentes et al., 2019). However, while erection problems and premature ejaculation have been related to the frequency of sexual intercourse among the young and middle-aged men (Peng & Peng, 2022), decreased intercourse was not related to worse sexual functioning in older women (Athey et al., 2021). Thus, these relationships may be complex and warrant further research.

Limitations and Future Studies

General limitations of the International Sex Survey are discussed elsewhere.[13] Firstly, it is important to acknowledge that ASEX do not assess distress, that is a critical part of the definition of sexual dysfunction according to the DSM-5 and ICD-11. This omission is significant because, for example, some individuals might experience low desire without any distress or concern. Thus, our results refer to problems in sexual function but not to sexual dysfunctions understood as clinical disorders. Secondly, in the present study, eleven countries and four languages were removed due to small sample sizes from measurement invariance tests. In addition, the lack of other scales assessing sexual function to examine the convergent validity of the ASEX should be addressed in future studies, given that the variables used here for the convergent validity were descriptive items about sexuality (e.g., frequency of masturbation). Future studies should consider examining relationships between ASEX scores and other variables related to sexual functioning, such as sexual satisfaction. On the other hand, although the ASEX has proven to be a valuable screening instrument, future studies may consider adding items assessing other areas of sexual functioning including premature ejaculation or pain associated with vaginal or anal penetration given its high prevalence and impact (Berenguer-Soler et al., 2022).

Conclusions

Sexuality is an important part of people's lives, and experiencing SFPs may impact self-esteem, emotional well-being, relationships with partners, and the general quality of life as well (Heiman, 2002). Thus, it is important to have a simple and brief instrument that can evaluate important aspects of sexual function in diverse populations. This study showed that the ASEX had good psychometric properties and is a reliable and valid measure for evaluating SFPs across different countries, languages, genders, and sexual orientations. This cross-cultural study's findings support the use of the ASEX as a well-validated scale to improve knowledge about SFPs in different populations.

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[13] https://osf.io/e93kf?view_only=838146f6027c4e6bb68371d9d14220b5

Authors' Contributions *Conceptualization*: R.B.-A., M.E.-M., J.C.-C., P.B.-M., L.N., M.K., S.W.K., Z.D., M.N.P., F.P.P., G.R.Q., and B.B.

Data curation: R.B.-A., M.E.-M., J.C.-C., P.B.-M., L.N., M.K., S.W.K., Z.D., M.N.P., D.B., S.B., J. Bi, P.B., J. Bu, G.C.-L., J.C., J.-K.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.C.J.-M., T.J., O.K., V.K., A.K., S.-K.L., K. Le, C.-Y.L., C.L., S.L.-A., K. Lu, P.M.-T., D.J.M., O.O., G.O., S.U.s.r.t., 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., B.C.Ü., M.-P.V.-M., M.C.V.H., and B.B.

Formal analysis: M.E.-M., J.C.-C., and P.B.-M.

Funding acquisition:
L.N., M.K., Z.D., J.-K.C., H.F., K. Le, C.-Y.L., and B.B.

Investigation: R.B.-A., M.E.-M., J.C.-C., P.B.-M., L.N., M.K., S.W.K., Z.D., M.N.P., D.B., S.B., J. Bi, P.B., J. Bu, G.C.-L., J.C., J.-K.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.C.J.-M., T.J., O.K., V.K., A.K., S.-K.L., K. Le, C.-Y.L., C.L., S.L.-A., K. Lu, P.M.-T., D.J.M., O.O., G.O., S.U.s.r.t., 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., B.C.Ü., M.-P.V.-M., M.C.V.H., and B.B.

Methodology: R.B.-A., M.E.-M., J.C.-C., and P.B.-M.

Project administration: L.N., M.K., and B.B.

Resources: R.B.-A., M.E.-M., J.C.-C., P.B.-M., J.R.-D., and B.B.

Supervision: R.B.-A., J.C.-C., and B.B.

Validation: R.B.-A., J.C.-C., and B.B.

Visualization: R.B.-A., M.E.-M., J.C.-C., and P.B.-M.

Writing-original draft: R.B.-A. and M.E.-M.

Writing-review & editing: R.B.-A., M.E.-M., J.C.-C., P.B.-M., J. Bi, P.B., G.C.-L., J.C., J.-K.C., D.P.F., M.S.I., M.C.J.-M., T.J., K. Le, C.-Y.L., C.L., S.L.-A., P.M.-T., G.O., F.P.P., G.R.Q., V.S.-L., M.C.V.H., and B.B.

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Data Availability Data are available upon request from the project's principal investigator, Beáta Bőthe.

Declarations

Ethics Approval The study procedures were conducted in accordance with the Declaration of Helsinki. Furthermore, each collaborating country obtained ethical approval from their respective Institutional Review Boards or were deemed exempt (for more information about the IRBs and approvals, https://osf.io/e93kf?view_only=838146f6027c4e6bb68371d9d14220b5).

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Authors and Affiliations

Rafael Ballester-Arnal[1] · Marcel Elipe-Miravet[1] · Jesús Castro-Calvo[2] · Patricia Beltrán-Martínez[2] · Léna Nagy[3,4] · Mónika Koós[4] · Shane W. Kraus[5] · Zsolt Demetrovics[4,6,76] · Marc N. Potenza[7,8] · Dominik Batthyány[9] · Sophie Bergeron[10] · Joël Billieux[11,12] · Peer Briken[13] · Julius Burkauskas[14] · Georgina Cárdenas-López[15] · Joana Carvalho[16] · Ji-Kang Chen[17] · Lijun Chen[18] · Giacomo Ciocca[19] · Ornella Corazza[20,21] · Rita I. Csako[22] · David P. Fernandez[23] · Elaine F. Fernandez[24] · Hironobu Fujiwara[25,26] · Johannes Fuss[27] · Roman Gabrhelík[28,29] · Ateret Gewirtz-Meydan[30] · Biljana Gjoneska[31] · Mateusz Gola[32,33] · Joshua B. Grubbs[34,35] · Hashim T. Hashim[36] · Md. Saiful Islam[37,38] · Mustafa Ismail[39] · Martha C. Jiménez-Martínez[40,41] · Tanja Jurin[42] · Ondrej Kalina[43] · Verena Klein[44] · András Költő[45] · Sang-Kyu Lee[46,47] · Karol Lewczuk[48,77] · Chung-Ying Lin[49,50] · Christine Lochner[51] · Silvia López-Alvarado[52] · Kateřina Lukavská[28,53] · Percy Mayta-Tristán[54] · Dan J. Miller[55] · Oľga Orosová[43] · Gábor Orosz[56] · Sungkyunkwan University's research team NA[57] · Fernando P. Ponce[58] · Gonzalo R. Quintana[59] · Gabriel C. Quintero Garzola[60,61] · Jano Ramos-Diaz[62] · Kévin Rigaud[56] · Ann Rousseau[63] · Marco De Tubino Scanavino[64,65] · Marion K. Schulmeyer[66] · Pratap Sharan[67] · Mami Shibata[25] · Sheikh Shoib[68,69] · Vera Sigre-Leirós[11] · Luke Sniewski[70] · Ognen Spasovski[71] · Vesta Steibliene[14] · Dan J. Stein[72] · Berk C. Ünsal[3,4] · Marie-Pier Vaillancourt-Morel[73] · Marie Claire Van Hout[74] · Beáta Bőthe[10,75]

✉ Jesús Castro-Calvo
jesus.castro@uv.es

[1] Departmento de Psicología Básica, Clínica y Psicobiología, University Jaume I of Castellón, Castellón de la Plana, Spain

[2] Department of Personality, Assessment, and Psychological Treatments, University of Valencia, Av. Blasco-Ibáñez, 21, 46010 Valencia, Spain

[3] School of Psychology, ELTE Eötvös Loránd University, Budapest, Hungary

[4] Institute of Psychology, ELTE Eötvös Loránd University, Budapest, Hungary

[5] Department of Psychology, University of Nevada, Las Vegas, NV, USA

[6] Centre of Excellence in Responsible Gaming, University of Gibraltar, Gibraltar, Gibraltar

[7] Yale University School of Medicine, New Haven, CT, USA

[8] Connecticut Council On Problem Gambling, Wethersfield, CT, USA

[9] Institute for Behavioural Addictions, Sigmund Freud University Vienna, Vienna, Austria

[10] Département de Psychologie, Université de Montréal, Montréal, Canada

[11] Institute of Psychology, University of Lausanne, Lausanne, Switzerland

[12] Center for Excessive Gambling, Addiction Medicine, Lausanne University Hospitals (CHUV), Lausanne, Switzerland

[13] Institute for Sex Research, Sexual Medicine, and Forensic Psychiatry, University Medical Centre Hamburg-Eppendorf, Hamburg, Germany

[14] Laboratory of Behavioral Medicine, Neuroscience Institute, Lithuanian University of Health Sciences, Palanga, Lithuania

[15] Virtual Teaching and Cyberpsychology Laboratory, School of Psychology, National Autonomous University of Mexico, Mexico City, Mexico

[16] Departamento de Educação E Psicologia, William James Center for Research, Universidade de Aveiro, Aveiro, Portugal

[17] Department of Social Work at the Chinese University of Hong Kong, Hong Kong, China

[18] Department of Psychology, College of Humanity and Social Science, Fuzhou University, Fuzhou, China

[19] Section of Sexual Psychopathology, Department of Dynamic and Clinical Psychology, and Health Studies, Sapienza University of Rome, Rome, Italy

[20] Department of Clinical, Pharmaceutical and Biological Sciences, University of Hertfordshire, Hatfield, UK

[21] Department of Psychology and Cognitive Science, University of Trento, Trento, Italy

[22] Department of Psychology and Neuroscience, Auckland University of Technology, Auckland, New Zealand

[23] Nottingham Trent University, Nottingham, UK

[24] HELP University, Kuala Lumpur, Malaysia

[25] Department of Neuropsychiatry, Graduate School of Medicine, Kyoto University, Kyoto, Japan

[26] Decentralized Big Data Team, RIKEN Center for Advanced Intelligence Project, Tokyo, Japan

[27] Institute of Forensic Psychiatry and Sex Research, Center for Translational Neuro- and Behavioral Sciences, University of Duisburg-Essen, Essen, Germany

[28] First Faculty of Medicine, Department of Addictology, Charles University, Prague, Czech Republic

[29] Department of Addictology, General University Hospital in Prague, Prague, Czech Republic

[30] School of Social Work, Faculty of Social Welfare and Health Sciences, University of Haifa, Haifa, Israel

[31] Macedonian Academy of Sciences and Arts, Skopje, Republic of North Macedonia

[32] Institute of Psychlogy, Polish Academy of Sciences, Warsaw, Poland

[33] Institute for Neural Computations, University of California San Diego, La Jolla, CA, USA

[34] Center On Alcohol, Substance Use, And Addictions, University of New Mexico, Albuquerque, NM, USA

[35] Department of Psychology, University of New Mexico, Albuquerque, NM, USA

[36] College of Medicine, University of Warith Al-Anbiyaa, Karbala, Iraq

[37] Department of Public Health and Informatics, Jahangirnagar University, Savar, Dhaka 1342, Bangladesh

[38] Centre for Advanced Research Excellence in Public Health, Savar, Dhaka 1342, Bangladesh

[39] College of Medicine, University of Baghdad, Baghdad, Iraq

[40] Universidad Pedagógica y Tecnológica de Colombia, Boyacá, Colombia

[41] Grupo de Investigación Biomédica y de Patología, Boyacá, Colombia

[42] Department of Psychology, Humanities and Social Sciences, University of Zagreb, Zagreb, Croatia

[43] Department of Educational Psychology and Psychology of Health, Pavol Jozef Safarik University in Kosice, Košice, Slovakia

[44] School of Psychology, University of Southampton, Southampton, UK

[45] Health Promotion Research Centre, University of Galway, Galway, Ireland

[46] Department of Psychiatry, Hallym University Chuncheon Sacred Heart Hospital, Chuncheon-si, South Korea

[47] Chuncheon Addiction Management Center, Chuncheon-si, South Korea

[48] Institute of Psychology, Cardinal Stefan Wyszynski University, Warsaw, Poland

[49] Institute of Allied Health Sciences, College of Medicine, National Cheng Kung University, Tainan, Taiwan

[50] Biostatistics Consulting Center, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan

[51] SAMRC Unit On Risk & Resilience in Mental Disorders, Stellenbosch University, Stellenbosch, South Africa

[52] University of Cuenca, Cuenca, Ecuador

[53] Faculty of Education, Department of Psychology, Charles University, Prague, Czech Republic

[54] Facultad de Medicina, Universidad Científica del Sur, Lima, Perú

[55] College of Healthcare Sciences, James Cook University, Townsville, Australia

[56] Artois University, Arras, France

[57] Department of Psychology, Sungkyunkwan University, Seoul, South Korea

[58] Facultad de Psicología, Universidad de Talca, Talca, Chile

[59] Departamento de Psicología y Filosofía, Facultad de Ciencias Sociales, Universidad de Tarapacá, Arica, Arica y Parinacota, Chile

[60] Florida State University, Panamá City, Republic of Panama

[61] Sistema Nacional de Investigación (SNI), SENACYT, Panamá, Panama

[62] Facultad de Ciencias de La Salud, Universidad Privada del Norte, Lima, Perú

[63] Leuven School for Mass Communication, KU Leuven, Louvain, Belgium

[64] Department of Psychiatry, Schulich School of Medicine & Dentistry, Western University, St. Joseph's Health Care London and London Health Sciences Centre, London, Canada

[65] Lawson Health Research Institute, London, Canada

[66] Universidad Privada de Santa Cruz de La Sierra, Santa Cruz de la Sierra, Bolivia

[67] Department of Psychiatry, All India Institute of Medical Sciences, New Delhi, India

[68] Department of Psychology, Shardha University, Greater Noida, India

[69] Department of Health Services, Srinagar, India

[70] Compassionate Inquiry, Vancouver, Canada

[71] Faculty of Philosophy, University of St. Cyril and Methodius in Trnava, Trnava, Slovakia

[72] SAMRC Unit On Risk & Resilience in Mental Disorders, Department of Psychiatry & Neuroscience Institute, University of Cape Town, Cape Town, South Africa

[73] Département de Psychologie, Université du Québec À Trois-Rivières, Trois-Rivières, Canada

[74] Public Health Institute, Faculty of Health, Liverpool John Moores University, Liverpool, UK

[75] Present Address: Centre de recherche interdisciplinaire sur les problèmes conjugaux et les agressions sexuelles (CRIPCAS), Montreal, Canada

[76] College of Education, Psychology and Social Work, Flinders University, Adelaide, Australia

[77] Centre of Excellence in Responsible Gaming, University of Gibraltar, Gibraltar, Gibraltar