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Psychometric properties of the Alcohol Use Disorders Identification Test (AUDIT) across cross-cultural subgroups, genders, and sexual orientations: Findings from the International Sex Survey (ISS)

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ABSTRACT

Introduction: Despite being a widely used screening questionnaire, there is no consensus on the most appropriate measurement model for the Alcohol Use Disorders Identification Test (AUDIT). Furthermore, there have been limited studies on its measurement invariance across cross-cultural subgroups, genders, and sexual orientations.
Aims: The present study aimed to examine the fit of different measurement models for the AUDIT and its measurement invariance across a wide range of subgroups by country, language, gender, and sexual orientation.
Methods: Responses concerning past-year alcohol use from the participants of the cross-sectional International Sex Survey were considered (N = 62,943; M_{age}: 32.73; SD = 12.59). Confirmatory factor analysis, as well as measurement invariance tests were performed for 21 countries, 14 languages, three genders, and four sexual-orientation subgroups that met the minimum sample size requirement for inclusion in these analyses.
Results: A two-factor model with factors describing 'alcohol use' (items 1–3) and 'alcohol problems' (items 4–10) showed the best model fit across countries, languages, genders, and sexual orientations. For the former two,

[1] Data curation, Investigation.
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scalar and latent mean levels of invariance were reached considering different criteria. For gender and sexual orientation, a latent mean level of invariance was reached.
Conclusions: In line with the two-factor model, the calculation of separate alcohol-use and alcohol-problem scores is recommended when using the AUDIT. The high levels of measurement invariance achieved for the AUDIT support its use in cross-cultural research, capable also of meaningful comparisons among genders and sexual orientations.

1. Introduction

Alcohol consumption is a major public health risk factor globally. According to World Health Organization, >2 billion people worldwide were considered current alcohol drinkers in 2016 (i.e., they have consumed alcohol in the past 12 months). The total worldwide alcohol per capita consumption was 6.4 l of pure alcohol in a year, while current alcohol drinkers consumed on average >30 g of pure alcohol per day [1]. Alcohol consumption leads to significant and harmful health consequences. Globally, >5% of all deaths and disability-adjusted life years were linked to alcohol consumption in 2016 (e.g., through injuries, digestive diseases, cardiovascular diseases, cancers, alcohol use disorders) [1].

The Alcohol Use Disorders Identification Test (AUDIT) is one of the most widely used self-report measures in research and clinical practice for rapid screening of disorders due to alcohol use [2,3]. Initially, the scale was developed to detect hazardous (i.e., a pattern of alcohol consumption that increases risk of experiencing [but not yet causing] negative alcohol use-related physical or mental consequences) and harmful alcohol use (i.e., a pattern of alcohol consumption that contributes to negative alcohol use-related physical or mental consequences to the individual, or causes harm to the health of others) among individuals in primary care—prior to the onset of alcohol dependence (i.e., experiencing physiological, psychological and behavior symptoms due to repeated or continuous alcohol consumption) [4]. However, in recent decades, the use of AUDIT has become widespread internationally and in many other contexts, such as in cross-cultural or epidemiological studies, among individuals with mental disorders, to mention a few [5–10]. The original and complete 10-item version of the AUDIT focused on three primary domains of alcohol use: alcohol consumption (items 1 to 3), alcohol dependence (items 4 to 6), and negative consequences (items 7 to 10). The total score on the AUDIT (with a range of 0–40 points) is calculated and evaluated most frequently in research and clinical practice. This score can express the degree of increasing risk of alcohol use. It can be used to categorize participants according to whether they show low-risk or abstinent drinking (0–7 points), the risk for hazardous (8–15 points) or harmful alcohol use (16–19 points), or alcohol dependence (20–40 points) [2]. It is important to note, however, that there are cross-cultural variations in the suggested cutoff points [11]. Respondents' gender can also relate to the screening performance of the AUDIT. For women, a lower threshold of 7 points was originally proposed for the AUDIT to indicate a risk for hazardous alcohol use [2]. However, there is a lack of consensus in the literature on the specific cutoff values recommended for men and women [11].

Previous studies have shown that the AUDIT has adequate reliability and validity [5,9,10]. However, there is contradictory evidence regarding its factorial structure, as well as limited evidence regarding its measurement invariance properties [12].

Regarding the AUDIT's factorial structure, some studies have suggested a one-factor model in line with the use and interpretation of the total score [13]. Other studies have also shown that a two-factor model provides a better fit to the data, consisting of alcohol-consumption (items 1 to 3) and alcohol-related-problems factors (items 4 to 10) [8,12]. Finally, some studies have provided evidence in support of a three-factor model (as defined previously) [6,11]. However, due to the strong correlation between the 'alcohol dependence' and 'negative consequences' factors, as well as the high similarity in model fit to the two-factor model (e.g., in Doyle et al.'s study, the three-factor model was found to be better by only 0.02 and 0.01 on the CFI and RMSEA, respectively, across several independent samples), thus far a two-factor solution is considered a more parsimonious model, and therefore preferred to use [12,14]. Still, determining conclusively which factorial structure is most appropriate for the AUDIT may have important practical implications for the scoring and interpretation of the scale. For example, a one-factor structure may support the use of the total AUDIT score, while the two-factor structure instead suggest that it may be preferable to assess respondents' alcohol use patterns through separate subscale scores of alcohol consumption and alcohol-related problems. Moreover, if items do not measure the same construct, they should not be combined to categorize participants based on cutoff scores derived from the whole scale [12].

Another critical issue is the degree to which the AUDIT measures the latent construct(s) equivalently across different subgroups (e.g., across countries, genders, or sexual orientations). Testing for measurement invariance is essential to establish whether the observed mean differences between subgroups represent genuine differences or whether these differences are driven by differential functioning of the scale in different subgroups (e.g., different interpretations, meanings, and psychometric characteristics of items in different groups). To date, few studies have tested the level of measurement invariance of the AUDIT concerning different background variables [8,12,15].

Alcohol consumption and alcohol use disorder (AUD, experiencing adverse psychological and social consequences and symptoms due to alcohol consumption, which generates significant impairments or distress in the individual's life) shows significant variation across countries or cultures [1,16]. It is often associated with cultural traditions and country-level differences in regulation for alcohol consumption [1]. However, few studies have examined to what extent AUDIT measures alcohol use and related problems similarly across different countries and language groups. For example, between US and Philippine college students, metric invariance was detected for the three-factor model of the AUDIT, while scalar invariance was not supported (i.e., factor loadings were equivalent while item intercepts were non-equivalent), which could lead to a bias in the comparison of means between the two groups [17].Given that the AUDIT is frequently used in cross-cultural research [8,18], it is important to understand the extent to which the cross-cultural differences observed in the AUDIT indicate genuine differences. Otherwise, it may be that differences in the AUDIT scores are due to cross-cultural differences in the psychometric properties of the scale (e.g., measurement bias due to different sizes of standard drinks in different countries).

The limited research regarding measurement invariance has mainly focused on whether the AUDIT provides equivalent measurement between men and women. For example, multiple studies have demonstrated gender-based invariance of factor loadings and thresholds of the AUDIT items for both the single-factor and the two-factor model [8,12,15]. These results suggest that the AUDIT may be a valid instrument for identifying differences between men and women regarding alcohol consumption and problems. However, previous research has not investigated whether gender-based measurement invariance is met in the presence of gender diverse individuals (e.g., non-binary, gender fluid, genderqueer, or indigenous/cultural gender minorities, such as two-spirit) for the AUDIT. Examining the psychometric functioning of the AUDIT among gender diverse individuals may also be relevant because previous studies have suggested an increased risk for excessive alcohol use and AUD among these groups [19,20].

Similarly, it is also important to test the degree of measurement equivalence of the AUDIT for constructs of alcohol consumption and alcohol-related problems across sexual orientations. However, previous research has not yet explored similarities and differences in measurement by sexual orientation for the AUDIT. The existing literature has not clearly shown differences in alcohol use and AUD between sexual orientations. Numerous studies have reported elevated levels of alcohol consumption and AUD among gay/lesbian and bisexual individuals compared to heterosexuals [21–24]. However, a review suggests small-to-marginal differences, or lower levels of negative alcohol outcomes among sexual minorities in general [25]. Such heterogeneous results may be explained by the possibility that some subgroups of sexual minority populations, such as lesbian and bisexual individuals, could be primarily characterized by the presence of adverse alcohol-use-related outcomes (e.g., heavy episodic drinking [HED], AUD, simultaneous use of alcohol and drugs, risk for being victim of sexual violence/aggression when using alcohol) [21,23,24]. In addition, the interaction between gender and sexual orientation has been highlighted by studies that have examined separately genders. There were greater disparities between sexual identities in terms of negative alcohol use outcomes among women, and especially bisexual women were at increased risk [21,23,24]. Some gender and sexual-minority subgroups may be at increased risk for elevated alcohol consumption and AUD, which might be partially related to different motivations for drinking (e.g., drinking to cope with stress related to sexual-orientation- and gender-based discrimination and stigma) [23]. Therefore, it is important to understand whether the AUDIT provides an equivalent measurement among gender- and sexual-orientation minorities and, thus, whether the values derived from the AUDIT are comparable across different gender and sexual orientation identities.

To address the aforementioned knowledge gaps in the literature, the aim of the present study was to ascertain the factorial structure of the AUDIT (i.e., one-, two- or three-dimensional model) in a large, cross-cultural sample. In addition, measurement invariance across a wide range of countries and language groups, as well as across gender (i.e., men, women, and gender diverse individuals) and sexual orientation identities (i.e., heterosexual, gay/lesbian, bisexual+, and emerging sexual identities) were tested to provide empirical evidence for the comparability of scores across groups.

2. Methods

2.1. Procedure

The present study capitalizes on data from the International Sex Survey (ISS) [26,27]. The ISS is a cross-sectional survey conducted in 42 countries[3] and 26 languages using self-report and online questionnaires. The survey was preregistered (general methodology of the study: https://osf.io/xcgzf and validation papers' methodology: https://osf.io/qg8c4) and had a pre-defined protocol with the use of standardized translation, data collection and recruitment, and data cleaning procedures across the participating countries. Participants were recruited through convenience sampling (except the Czech Republic where online panel was used) between October 2021 and May 2022. The ISS collaborators contacted news sites with broad coverage in each participating country in a standardized way to advertise the opportunity to participate in the research. In return, ISS collaborators offered to briefly describe about the sample participating in the given country on the news site. In some countries, additional recruitment methods were also needed to reach the planned sample size, so the opportunity to participate in the ISS was more broadly advertised in these countries (e.g., Canada), through advertisements or in mental health and sexuality-related forums. Participation in the research was anonymous, and informed consent was required from participants [26,27]. The research protocol was approved by the relevant ethical committees in each participating country (https://osf.io/e93kf).

2.2. Participants

The total sample of the ISS included 82,243 participants. For sociodemographic characteristics of the entire sample by country, see https://osf.io/cj658. However, in the present study, only data from participants who had consumed alcohol in the past 12 months were used to avoid the conditional dependence on responses to the AUDIT items. Specifically, respondents with consistent responses who reported on the first item of the AUDIT that they had not consumed alcohol in the past 12 months must have had responses on items 2–8 of the AUDIT in the first response category. Which could have biased the findings of the analyses (e.g., violation of the assumption of local independence, it is not possible to differentiate between abstinent and low-risk alcohol users). Consequently, the final sample included data from 62,943 individuals. The mean age of the participants in the final sample was 32.73 years ($SD = 12.59$). Most participants were women ($N = 36{,}099$; 57.37%), followed by men ($N = 24{,}811$; 39.43%) and gender diverse individuals (i.e., indigenous, or other cultural gender minority identity, non-binary and gender fluid identity, or other gender identities, $N = 2011$; 3.20%). Most individuals were heterosexual ($N = 42{,}979$; 68.49%), followed by bisexual, queer, pansexual individuals ($N = 8208$; 13.08%), individuals with emerging sexual identities (i.e., homo- and hetero-flexible, asexual, questioning and other identities; $N = 8088$; 12.89%), and gay or lesbian individuals ($N = 3476$; 5.54%). Sociodemographic characteristics in subgroups by country, language, gender, and sexual orientation are summarized in Table 1.

2.3. Measures

Questions on the country of residence, language, gender identity, sexual orientation and AUDIT items were used in the present analysis (the complete list of measures is reported in [26]). Country of residence and language were required to be provided by participants at the beginning of the survey, before the informed consent, while questions regarding gender identity and sexual orientation were included in the block of sociodemographic items. For the exact wording of the latter questions and the related response options, see https://osf.io/wq4yp.

During the ISS, the 10-item complete version of the AUDIT was administered in a standardized manner across all countries and languages [2,3]. For the translations of the AUDIT used in the ISS, see https://osf.io/tzfsh. The 10-item version of the AUDIT covers three primary domains of alcohol use: alcohol consumption (items 1 to 3, measuring the frequency, the typical quantity, and HED, respectively), alcohol dependence (items 4 to 6, measuring impaired control, failure to meet expectations, and morning drinking, respectively), and negative consequences (items 7 to 10, measuring guilt feelings, blackouts, injuries, and others' concerns, respectively). Each item is scored between 0 and 4 points, with five response options for items 1 to 8 and three response options for items 9 and 10. The total score on the AUDIT (with a range of 0–40 points) and distribution by the AUDIT risk categories (i.e., low-risk drinking between 1 and 7 points, risk for hazardous use between 8 and 15 points, risk for harmful alcohol use between 16 and 19 points, and risk for alcohol dependence between 20 and 40 points) were

[3] Egypt, Iran, Pakistan, and Romania were included in the study protocol paper as collaborating countries (Bőthe, Koós, 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 (Bőthe, Koós, et al., 2021), only 42 individual countries are considered in the present study; see details at https://osf.io/n3k2c/.

Table 1
Descriptive statistics.

	Demographic distribution			Alcohol Use Disorders Identification Test (AUDIT)			
	Gender N %	Sexual orientation N %	Age M (SD)	M (SD)	Range	Skewness (SE) Kurtosis (SE)	Risk categories N %
Country of residence							
Algeria[1] (N_T = 24; N_{AU} = 9 [37.50%])	MN: 6 (66.67%) WM: 3 (33.33%) GD: 0 (0.00%)	HE: 7 (77.78%) GL: 2 (22.22%) BI+: 0 (0.00%) EM: 0 (0.00%)	41.44 (15.57)	4.67 (5.00)	1–17	S: 2.26 (0.72) K: 5.54 (1.40)	LR: 8 (88.89%) HZ: 0 (0.00%) HR: 1 (11.11%) AD: 0 (0.00%)
Australia **(N_T = 639; N_{AU} = 488 [76.37%])**	MN: 243 (49.90%) WM: 224 (46.60%) GD: 20 (4.11%)	HE: 257 (52.77%) GL: 40 (8.21%) BI+: 115 (23.61%) EM: 75 (15.40%)	41.37 (16.34)	6.13 (5.67)	1–39	S: 2.21 (0.11) K:6.36 (0.22)	LR: 359 (73.57%) HZ: 92 (18.85%) HR: 14 (2.87%) AD: 23 (4.71%)
Austria[2] (N_T = 746; N_{AU} = 628 [84.18%])	MN: 250 (39.81%) WM: 355 (56.53%) GD: 23 (3.66%)	HE: 446 (71.02%) GL: 20 (3.18%) BI+: 85 (13.54%) EM: 77 (12.26%)	33.37 (12.04)	5.98 (4.77)	1–29	S: 1.61 (0.10) K: 2.98 (0.20)	LR: 456 (72.61%) HZ: 130 (20.70%) HR: 23 (3.66%) AD: 19 (3.03%)
Bangladesh[1] (N_T = 373; N_{AU} = 36 [9.65%])	MN: 31 (86.11%) WM: 4 (11.11%) GD: 1 (2.78%)	HE: 24 (82.76%) GL: 0 (0.00%) BI+: 1 (3.45%) EM: 4 (13.79%)	25.97 (6.33)	6.76 (8.47)	1–40	S: 2.50 (0.40) K: 7.12 (0.79)	LR: 25 (69.44%) HZ: 6 (16.67%) HR: 0 (0.00%) AD: 5 (13.89%)
Belgium **(N_T = 644; N_{AU} = 507 [78.73%])**	MN: 277 (54.64%) WM: 220 (43.39%) GD: 10 (1.97%)	HE: 379 (74.75%) GL: 35 (6.90%) BI+: 37 (7.30%) EM: 56 (11.05%)	40.38 (13.75)	5.65 (4.87)	1–35	S: 1.89 (0.11) K: 4.85 (0.22)	LR: 382 (75.35%) HZ: 97 (19.13%) HR: 15 (2.96%) AD: 13 (2.56%)
Bolivia[1] (N_T = 385; N_{AU} = 261 [67.79%])	MN: 130 (49.81%) WM: 117 (44.83%) GD: 14 (5.36%)	HE: 161 (61.69%) GL: 10 (3.83%) BI+: 44 (16.86%) EM: 46 (17.62%)	28.66 (10.38)	6.24 (4.61)	1–26	S: 1.27 (0.15) K: 1.71 (0.30)	LR: 185 (70.88%) HZ: 61 (23.37%) HR: 9 (3.45%) AD: 6 (2.30%)
Brazil **(N_T = 3579; N_{AU} = 2564 [71.64%])**	MN: 1643 (64.10%) WM: 889 (34.69%) GD: 31 (1.21%)	HE: 1680 (65.60%) GL: 328 (12.81%) BI+: 280 (10.93%) EM: 273 (10.66%)	43.27 (12.17)	6.07 (5.33)	1–40	S: 1.86 (0.05) K: 4.49 (0.10)	LR: 1825 (71.18%) HZ: 557 (21.72%) HR: 84 (3.28%) AD: 98 (3.82%)
Canada **(N_T = 2541; N_{AU} = 1985 [78.12%])**	MN: 744 (37.52%) WM: 1074 (54.16%) GD: 165 (8.32%)	HE: 1040 (52.42%) GL: 133 (6.70%) BI+: 493 (24.85%) EM: 318 (16.03%)	35.13 (13.60)	5.49 (4.85)	1–35	S: 1.93 (0.06) K: 4.64 (0.11)	LR: 1528 (76.98%) HZ: 341 (17.18%) HR: 55 (2.77%) AD: 61 (3.07%)
Chile[3] (N_T = 1173; N_{AU} = 854 [72.80%])	MN: 450 (52.69%) WM: 373 (43.68%) GD: 31 (3.63%)	HE: 568 (66.82%) GL: 40 (4.71%) BI+: 145 (17.06%) EM: 97 (11.41%)	28.45 (8.91)	5.40 (4.56)	1–31	S: 1.76 (0.08) K: 4.08 (0.17)	LR: 648 (75.88%) HZ: 157 (18.38%) HR: 26 (3.04%) AD: 23 (2.69%)
China **(N_T = 2428; N_{AU} = 1558 [64.17%])**	MN: 821 (52.70%) WM: 631 (40.50%) GD: 106 (6.80%)	HE: 1044 (67.62%) GL: 190 (12.31%) BI+: 169 (10.95%) EM: 141 (9.13%)	29.25 (10.59)	5.20 (5.58)	1–38	S: 1.92 (0.06) K: 3.90 (0.12)	LR: 1207 (77.47%) HZ: 248 (15.92%) HR: 47 (3.02%) AD: 56 (3.59%)
Colombia **(N_T = 1913; N_{AU} = 1445 [75.54%])**	MN: 572 (39.58%) WM: 849 (58.75%) GD: 24 (1.66%)	HE: 1065 (75.00%) GL: 51 (3.59%) BI+: 159 (11.20%) EM: 145 (10.21%)	25.60 (9.48)	5.79 (4.92)	1–35	S: 1.77 (0.06) K: 4.06 (0.13)	LR: 1045 (72.37%) HZ: 307 (21.26%) HR: 41 (2.84%) AD: 51 (3.53%)
Croatia[2] (N_T = 2390; N_{AU} = 1982 [82.93%])	MN: 429 (21.64%) WM: 1505 (75.93%) GD: 48 (2.42%)	HE: 1272 (64.34%) GL: 149 (7.54%) BI+: 303 (15.33%) EM: 253 (12.80%)	28.74 (8.78)	5.49 (4.34)	1–34	S: 1.65 (0.06) K: 3.58 (0.11)	LR: 1498 (75.58%) HZ: 405 (20.43%) HR: 40 (2.02%) AD: 39 (1.97%)
Czech Republic **(N_T = 1640; N_{AU} = 1388 [84.63%])**	MN: 707 (50.94%) WM: 675 (48.63%) GD: 6 (0.43%)	HE: 1235 (90.88%) GL: 27 (1.99%) BI+: 55 (4.05%) EM: 42 (3.09%)	47.00 (16.88)	5.07 (4.45)	1–32	S: 2.03 (0.07) K: 5.31 (0.13)	LR: 1110 (80.03%) HZ: 220 (15.86%) HR: 34 (2.45%) AD: 23 (1.66%)
Ecuador[1] (N_T = 276; N_{AU} = 197 [71.38%])	MN: 122 (61.93%) WM: 70 (35.53%) GD: 5 (2.54%)	HE: 144 (73.10%) GL: 13 (6.60%) BI+: 19 (9.64%) EM: 21 (10.66%)	30.08 (11.99)	5.67 (5.27)	1–30	S: 2.01 (0.17) K: 4.76 (0.35)	LR: 149 (75.63%) HZ: 33 (16.75%) HR: 7 (3.55%) AD: 8 (4.06%)
France[2] (N_T = 1706; N_{AU} = 1275 [74.74%])	MN: 536 (42.07%) WM: 683 (53.61%) GD: 55 (4.32%)	HE: 828 (64.94%) GL: 78 (6.12%) BI+: 185 (14.51%) EM: 184 (14.43%)	33.92 (13.39)	5.36 (4.57)	1–33	S: 1.98 (0.07) K: 5.46 (0.14)	LR: 977 (76.63%) HZ: 234 (18.35%) HR: 32 (2.51%) AD: 32 (2.51%)
Germany **(N_T = 3271; N_{AU} = 2690 [82.24%])**	MN: 1217 (45.26%) WM: 1420 (52.81%) GD: 52 (1.93%)	HE: 2028 (75.50%) GL: 89 (3.31%) BI+: 249 (9.27%) EM: 320 (11.91%)	42.92 (15.39)	4.98 (4.03)	1–33	S: 1.90 (0.05) K: 5.21 (0.09)	LR: 2158 (80.25%) HZ: 436 (16.21%) HR: 54 (2.01%) AD: 41 (1.52%)
Gibraltar[1] (N_T = 64; N_{AU} = 42 [65.63%])	MN: 16 (39.02%) WM: 25 (60.98%) GD: 0 (0.00%)	HE: 29 (70.73%) GL: 4 (9.76%) BI+: 4 (9.76%) EM: 4 (9.76%)	40.36 (15.26)	5.74 (5.15)	1–26	S: 2.03 (0.37) K: 5.61 (0.72)	LR: 30 (71.43%) HZ: 10 (23.81%) HR: 0 (0.00%) AD: 2 (4.76%)
Hungary **(N_T = 11,200; N_{AU} = 9243 [82.53%])**	MN: 5380 (58.24%) WM: 3748 (40.57%) GD: 110 (1.19%)	HE: 7441 (80.55%) GL: 369 (3.99%)	35.92 (12.12)	5.76 (4.72)	1–33	S: 1.70 (0.03) K: 3.58 (0.05)	LR: 6824 (73.84%) HZ: 1916 (20.73%)

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Table 1 (*continued*)

	Demographic distribution			Alcohol Use Disorders Identification Test (AUDIT)			
	Gender N %	Sexual orientation N %	Age M (SD)	M (SD)	Range	Skewness (SE) Kurtosis (SE)	Risk categories N %
		BI+: 646 (6.99%) EM: 782 (8.47%)					HR: 254 (2.75%) AD: 248 (2.68%)
India[1] (N_T = 194; N_{AU} = 83 [42.78%])	MN: 53 (63.86%) WM: 27 (32.53%) GD: 3 (3.61%)	HE: 67 (80.72%) GL: 5 (6.02%) BI+: 10 (12.05%) EM: 1 (1.20%)	31.11 (11.07)	5.30 (6.02)	1–33	S: 2.64 (0.27) K: 8.08 (0.53)	LR: 63 (75.90%) HZ: 13 (15.66%) HR: 1 (1.20%) AD: 6 (7.23%)
Iraq[1] (N_T = 99; N_{AU} = 30 [30.30%])	MN: 23 (76.67%) WM: 5 (16.67%) GD: 2 (6.67%)	HE: 23 (76.67%) GL: 4 (13.33%) BI+: 2 (6.67%) EM: 1 (3.33%)	36.80 (15.25)	7.27 (5.51)	1–19	S: 1.18 (0.43) K: 0.15 (0.83)	LR: 22 (73.33%) HZ: 4 (13.33%) HR: 4 (13.33%) AD: 0 (0.00%)
Ireland **(N_T = 1702; N_{AU} = 1297 [76.20%])**	MN: 452 (34.88%) WM: 789 (60.88%) GD: 55 (4.24%)	HE: 786 (60.79%) GL: 97 (7.50%) BI+: 257 (19.88%) EM: 153 (11.83%)	33.88 (14.21)	7.52 (5.74)	1–34	S: 1.42 (0.07) K: 2.25 (0.14)	LR: 769 (59.29%) HZ: 393 (30.30%) HR: 64 (4.93%) AD: 71 (5.47%)
Israel[2] (N_T = 1334; N_{AU} = 997 [74.74%])	MN: 407 (40.82%) WM: 582 (58.38%) GD: 8 (0.80%)	HE: 773 (77.61%) GL: 33 (3.31%) BI+: 49 (4.92%) EM: 141 (14.16%)	37.08 (11.52)	3.39 (2.95)	1–24	S: 2.94 (0.08) K: 12.32 (0.16)	LR: 918 (92.08%) HZ: 57 (5.72%) HR: 4 (0.40%) AD: 18 (1.81%)
Italy[2] (N_T = 2401; N_{AU} = 1820 [75.80%])	MN: 386 (21.22%) WM: 1391 (76.47%) GD: 42 (2.31%)	HE: 1312 (72.13%) GL: 60 (3.30%) BI+: 214 (11.76%) EM: 233 (12.81%)	27.19 (7.79)	4.41 (3.76)	1–29	S: 2.28 (0.06) K: 7.46 (0.11)	LR: 1543 (84.78%) HZ: 228 (12.53%) HR: 23 (1.26%) AD: 26 (1.43%)
Japan[1] (N_T = 562; N_{AU} = 385 [68.51%])	MN: 239 (62.08%) WM: 116 (30.13%) GD: 30 (7.79%)	HE: 254 (66.15%) GL: 6 (1.56%) BI+: 64 (16.67%) EM: 60 (15.63%)	38.13 (12.36)	5.83 (5.50)	1–35	S: 2.07 (0.12) K: 5.50 (0.25)	LR: 283 (73.51%) HZ: 76 (19.74%) HR: 12 (3.12%) AD: 14 (3.64%)
Lithuania **(N_T = 2015; N_{AU} = 1623 [80.55%])**	MN: 504 (31.05%) WM: 1078 (66.42%) GD: 41 (2.53%)	HE: 1172 (72.80%) GL: 113 (7.02%) BI+: 162 (10.06%) EM: 163 (10.12%)	34.28 (10.98)	5.11 (4.48)	1–30	S: 1.89 (0.06) K: 4.41 (0.12)	LR: 1272 (78.37%) HZ: 280 (17.25%) HR: 38 (2.34%) AD: 33 (2.03%)
Malaysia[2] (N_T = 1170; N_{AU} = 713 [60.94%])	MN: 295 (41.37%) WM: 385 (54.00%) GD: 33 (4.63%)	HE: 521 (73.17%) GL: 54 (7.58%) BI+: 79 (11.10%) EM: 58 (8.15%)	26.81 (8.93)	3.57 (3.83)	1–26	S: 2.61 (0.09) K: 8.35 (0.18)	LR: 634 (88.92%) HZ: 63 (8.84%) HR: 9 (1.26%) AD: 7 (0.98%)
Mexico **(N_T = 2137; N_{AU} = 1493 [69.86%])**	MN: 386 (25.87%) WM: 1022 (68.50%) GD: 84 (5.63%)	HE: 833 (55.87%) GL: 148 (9.93%) BI+: 299 (20.05%) EM: 211 (14.15%)	32.04 (11.59)	4.90 (4.41)	1–33	S: 1.92 (0.06) K: 4.86 (0.13)	LR: 1177 (78.83%) HZ: 252 (16.88%) HR: 28 (1.88%) AD: 36 (2.41%)
New Zealand **(N_T = 2834; N_{AU} = 2220 [78.33%])**	MN: 950 (42.81%) WM: 1096 (49.39%) GD: 173 (7.80%)	HE: 1154 (52.03%) GL: 183 (8.25%) BI+: 597 (26.92%) EM: 284 (12.80%)	37.43 (14.44)	6.74 (5.70)	1–36	S: 1.64 (0.05) K: 2.91 (0.10)	LR: 1510 (68.02%) HZ: 498 (22.43%) HR: 99 (4.46%) AD: 113 (5.09%)
North Macedonia **(N_T = 1251; N_{AU} = 1064 [85.05%])**	MN: 448 (42.11%) WM: 604 (56.77%) GD: 12 (1.13%)	HE: 835 (80.44%) GL: 48 (4.62%) BI+: 81 (7.80%) EM: 74 (7.13%)	29.23 (10.06)	5.61 (5.10)	1–33	S: 1.93 (0.08) K: 4.17 (0.15)	LR: 815 (76.60%) HZ: 179 (16.82%) HR: 26 (2.44%) AD: 44 (4.14%)
Panama[1] (N_T = 333; N_{AU} = 232 [69.67%])	MN: 129 (55.60%) WM: 94 (40.52%) GD: 9 (3.88%)	HE: 141 (61.04%) GL: 31 (13.42%) BI+: 31 (13.42%) EM: 28 (12.12%)	36.69 (13.16)	5.70 (4.84)	1–26	S: 1.75 (0.16) K: 3.72 (0.32)	LR: 170 (73.28%) HZ: 49 (21.12%) HR: 4 (1.72%) AD: 9 (3.88%)
Peru[2] (N_T = 2672; N_{AU} = 1994 [74.63%])	MN: 959 (48.12%) WM: 989 (49.62%) GD: 45 (2.26%)	HE: 1456 (73.28%) GL: 150 (7.55%) BI+: 222 (11.17%) EM: 159 (8.00%)	32.48 (11.02)	4.91 (4.34)	1–30	S: 1.87 (0.06) K: 4.39 (0.11)	LR: 1585 (79.53%) HZ: 325 (16.31%) HR: 45 (2.26%) AD: 38 (1.91%)
Poland **(N_T = 9892; N_{AU} = 8032 [81.20%])**	MN: 862 (10.73%) WM: 6959 (86.65%) GD: 210 (2.61%)	HE: 4944 (61.63%) GL: 170 (2.12%) BI+: 1032 (12.86%) EM: 1876 (23.39%)	26.55 (6.07)	5.11 (4.07)	1–38	S: 1.88 (0.03) K: 5.19 (0.05)	LR: 6366 (79.27%) HZ: 1364 (16.98%) HR: 145 (1.81%) AD: 156 (1.94%)
Portugal[2] (N_T = 2262; N_{AU} = 1704 [75.33%])	MN: 296 (17.38%) WM: 1369 (80.39%) GD: 38 (2.23%)	HE: 1197 (70.29%) GL: 69 (4.05%) BI+: 224 (13.15%) EM: 213 (12.51%)	30.94 (10.41)	4.45 (3.98)	1–32	S: 2.49 (0.06) K: 9.12 (0.12)	LR: 1442 (84.67%) HZ: 204 (11.98%) HR: 17 (1.00%) AD: 40 (2.35%)
Slovakia **(N_T = 1134; N_{AU} = 904 [79.72%])**	MN: 404 (44.74%) WM: 487 (53.93%) GD: 12 (1.33%)	HE: 687 (76.16%) GL: 33 (3.66%) BI+: 103 (11.42%) EM: 79 (8.76%)	27.58 (9.08)	5.96 (4.86)	1–32	S: 1.70 (0.08) K: 3.53 (0.16)	LR: 654 (72.35%) HZ: 187 (20.69%) HR: 29 (3.21%) AD: 34 (3.76%)
South Africa **(N_T = 1849; N_{AU} = 1401 [75.77%])**	MN: 586 (41.83%) WM: 733 (52.32%) GD: 82 (5.85%)	HE: 906 (64.71%) GL: 83 (5.93%) BI+: 240 (17.14%) EM: 171 (12.21%)	30.99 (14.59)	6.26 (5.14)	1–34	S: 1.84 (0.07) K: 4.55 (0.13)	LR: 988 (70.52%) HZ: 317 (22.63%) HR: 54 (3.85%) AD: 42 (3.00%)
South Korea **(N_T = 1464; N_{AU} = 1063 [72.61%])**	MN: 376 (35.37%) WM: 653 (61.43%) GD: 34 (3.20%)	HE: 799 (75.31%) GL: 35 (3.30%)	25.42 (7.02)	8.38 (6.71)	1–34	S: 1.32 (0.08) K: 1.56 (0.15)	LR: 592 (55.69%) HZ: 316 (29.73%)

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Table 1 (*continued*)

	Demographic distribution			Alcohol Use Disorders Identification Test (AUDIT)			
	Gender N %	Sexual orientation N %	Age M (SD)	M (SD)	Range	Skewness (SE) Kurtosis (SE)	Risk categories N %
		BI+: 91 (8.58%) EM: 136 (12.82%)					HR: 62 (5.83%) AD: 93 (8.75%)
Spain **($N_T = 2327$; $N_{AU} = 1841$ [79.11%])**	MN: 614 (33.35%) WM: 1179 (64.04%) GD: 48 (2.61%)	HE: 1131 (61.60%) GL: 121 (6.59%) BI+: 375 (20.42%) EM: 209 (11.38%)	24.47 (7.23)	5.86 (4.71)	1–31	S: 1.45 (0.06) K: 2.45 (0.11)	LR: 1328 (72.13%) HZ: 419 (22.76%) HR: 49 (2.66%) AD: 45 (2.44%)
Switzerland **($N_T = 1144$; $N_{AU} = 965$ [84.35%])**	MN: 310 (32.12%) WM: 619 (64.15%) GD: 36 (3.73%)	HE: 664 (68.81%) GL: 48 (4.97%) BI+: 136 (14.09%) EM: 117 (12.12%)	29.55 (11.29)	6.43 (4.80)	1–33	S: 1.57 (0.08) K: 3.21 (0.16)	LR: 651 (67.46%) HZ: 259 (26.84%) HR: 24 (2.49%) AD: 31 (3.21%)
Taiwan **($N_T = 2668$; $N_{AU} = 1854$ [69.49%])**	MN: 978 (52.75%) WM: 850 (45.85%) GD: 26 (1.40%)	HE: 1383 (74.84%) GL: 100 (5.41%) BI+: 81 (4.38%) EM: 284 (15.37%)	30.43 (7.57)	3.02 (3.61)	1–40	S: 4.09 (0.06) K: 23.85 (0.11)	LR: 1718 (92.66%) HZ: 100 (5.39%) HR: 12 (0.65%) AD: 24 (1.29%)
Turkey[2] ($N_T = 820$; $N_{AU} = 593$ [72.32%])	MN: 275 (46.45%) WM: 286 (48.31%) GD: 31 (5.24%)	HE: 418 (71.09%) GL: 26 (4.42%) BI+: 70 (11.90%) EM: 74 (12.59%)	30.26 (9.50)	5.79 (4.84)	1–32	S: 1.98 (0.10) K: 4.93 (0.20)	LR: 442 (74.54%) HZ: 112 (18.89%) HR: 14 (2.36%) AD: 25 (4.22%)
United Kingdom[2] ($N_T = 1412$; $N_{AU} = 1096$ [77.62%])	MN: 357 (32.57%) WM: 686 (62.59%) GD: 53 (4.84%)	HE: 614 (56.02%) GL: 111 (10.13%) BI+: 217 (19.80%) EM: 154 (14.05%)	33.95 (13.77)	6.75 (5.65)	1–32	S: 1.52 (0.07) K: 2.39 (0.15)	LR: 738 (67.34%) HZ: 265 (24.18%) HR: 40 (3.65%) AD: 53 (4.84%)
United States of America[2] ($N_T = 2398$; $N_{AU} = 1619$ [67.51%])	MN: 647 (39.96%) WM: 806 (49.78%) GD: 166 (10.25%)	HE: 762 (47.12%) GL: 130 (8.04%) BI+: 473 (29.25%) EM: 252 (15.58%)	32.41 (14.38)	5.29 (4.89)	1–33	S: 2.16 (0.06) K: 6.26 (0.12)	LR: 1258 (77.70%) HZ: 283 (17.48%) HR: 39 (2.41%) AD: 39 (2.41%)
Language							
Arabic[1] ($N_T = 142$; $N_{AU} = 31$ [21.83%])	MN: 26 (83.87%) WM: 4 (12.90%) GD: 1 (3.23%)	HE: 24 (77.42%) GL: 5 (16.13%) BI+: 1 (3.23%) EM: 1 (3.23%)	35.61 (12.83)	6.45 (5.38)	1–19	S: 1.42 (0.42) K: 1.06 (0.82)	LR: 25 (80.65%) HZ: 3 (9.68%) HR: 3 (9.68%) AD: 0 (0.00%)
Bangla[1] ($N_T = 332$; $N_{AU} = 27$ [8.13%])	MN: 24 (88.89%) WM: 3 (11.11%) GD: 0 (0.00%)	HE: 17 (80.95%) GL: 0 (0.00%) BI+: 0 (0.00%) EM: 4 (19.05%)	26.70 (6.84)	7.03 (8.47)	1–40	S: 2.68 (0.46) K: 9.19 (0.90)	LR: 17 (62.96%) HZ: 6 (22.22%) HR: 1 (3.70%) AD: 3 (11.11%)
Croatian[2] ($N_T = 2522$; $N_{AU} = 2086$ [82.71%])	MN: 457 (21.92%) WM: 1577 (75.64%) GD: 51 (2.45%)	HE: 1353 (65.05%) GL: 152 (7.31%) BI+: 312 (15.00%) EM: 263 (12.64%)	28.74 (8.76)	5.54 (4.41)	1–34	S: 1.69 (0.05) K: 3.74 (0.11)	LR: 1572 (75.36%) HZ: 426 (20.42%) HR: 45 (2.16%) AD: 43 (2.06%)
Czech **($N_T = 1583$; $N_{AU} = 1348$ [85.15%])**	MN: 691 (51.26%) WM: 652 (48.37%) GD: 5 (0.37%)	HE: 1210 (91.67%) GL: 25 (1.89%) BI+: 50 (3.79%) EM: 35 (2.65%)	47.52 (16.81)	5.06 (4.54)	1–32	S: 2.12 (0.07) K: 5.74 (0.13)	LR: 1080 (80.18%) HZ: 209 (15.52%) HR: 32 (2.38%) AD: 26 (1.93%)
Dutch[1] ($N_T = 518$; $N_{AU} = 407$ [78.57%])	MN: 244 (59.95%) WM: 152 (37.35%) GD: 11 (2.70%)	HE: 303 (74.45%) GL: 30 (7.37%) BI+: 29 (7.13%) EM: 45 (11.06%)	42.08 (14.21)	5.79 (5.00)	1–35	S: 1.98 (0.12) K: 5.27 (0.24)	LR: 307 (75.43%) HZ: 76 (18.67%) HR: 11 (2.70%) AD: 13 (3.19%)
English **($N_T = 13,994$; $N_{AU} = 10,106$ [72.22%])**	MN: 4239 (41.96%) WM: 5109 (50.57%) GD: 755 (7.47%)	HE: 5587 (55.36%) GL: 811 (8.04%) BI+: 2372 (23.50%) EM: 1323 (13.11%)	34.15 (14.64)	6.15 (5.38)	1–39	S: 1.78 (0.02) K: 3.83 (0.05)	LR: 7202 (71.26%) HZ: 2161 (21.38%) HR: 348 (3.44%) AD: 395 (3.91%)
French **($N_T = 3941$; $N_{AU} = 3113$ [78.99%])**	MN: 1101 (35.39%) WM: 1877 (60.33%) GD: 133 (4.28%)	HE: 1993 (64.04%) GL: 178 (5.72%) BI+: 500 (16.07%) EM: 441 (14.17%)	32.12 (12.24)	5.76 (4.77)	1–35	S: 1.80 (0.04) K: 4.22 (0.09)	LR: 2299 (73.85%) HZ: 640 (20.56%) HR: 87 (2.79%) AD: 87 (2.79%)
German[2] ($N_T = 3494$; $N_{AU} = 2905$ [83.14%])	MN: 1311 (45.14%) WM: 1528 (52.62%) GD: 65 (2.24%)	HE: 2186 (75.33%) GL: 83 (2.86%) BI+: 295 (10.17%) EM: 338 (11.65%)	42.41 (15.73)	5.13 (4.15)	1–33	S: 1.87 (0.05) K: 4.97 (0.09)	LR: 2298 (79.10%) HZ: 493 (16.97%) HR: 65 (2.24%) AD: 49 (1.69%)
Hebrew[2] ($N_T = 1315$; $N_{AU} = 982$ [74.68%])	MN: 389 (39.61%) WM: 586 (59.67%) GD: 7 (0.71%)	HE: 759 (77.37%) GL: 32 (3.26%) BI+: 48 (4.89%) EM: 142 (14.48%)	36.86 (11.39)	3.35 (2.94)	1–24	S: 3.03 (0.08) K: 12.92 (0.16)	LR: 905 (92.16%) HZ: 55 (5.60%) HR: 4 (0.41%) AD: 18 (1.83%)
Hindi[1] ($N_T = 17$; $N_{AU} = 4$ [23.53%])	MN: 4 (100.00%) WM: 0 (0.00%) GD: 0 (0.00%)	HE: 2 (50.00%) GL: 0 (0.00%) BI+: 1 (25.00%) EM: 1 (25.00%)	42.00 (15.06)	8.75 (9.67)	1–21	S: 0.69 (1.01) K: −2.14 (2.62)	LR: 2 (50.00%) HZ: 1 (25.00%) HR: 0 (0.00%) AD: 1 (25.00%)
Hungarian **($N_T = 10,937$; $N_{AU} = 9036$ [82.62%])**	MN: 5429 (60.11%) WM: 3497 (38.72%) GD: 106 (1.17%)	HE: 7313 (80.97%) GL: 357 (3.95%) BI+: 596 (6.60%) EM: 766 (8.48%)	36.77 (11.92)	5.74 (4.71)	1–33	S: 1.72 (0.03) K: 3.73 (0.05)	LR: 6675 (73.88%) HZ: 1876 (20.76%) HR: 239 (2.65%) AD: 245 (2.71%)

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Table 1 (*continued*)

	Demographic distribution			Alcohol Use Disorders Identification Test (AUDIT)			
	Gender N %	Sexual orientation N %	Age M (SD)	M (SD)	Range	Skewness (SE) Kurtosis (SE)	Risk categories N %
Italian[2] (N_T = 2437; N_{AU} = 1857 [76.20%])	MN: 388 (20.91%) WM: 1426 (76.83%) GD: 42 (2.26%)	HE: 1335 (71.93%) GL: 60 (3.23%) BI+: 221 (11.91%) EM: 240 (12.93%)	26.92 (7.59)	4.47 (3.83)	1–29	S: 2.26 (0.06) K: 7.11 (0.11)	LR: 1567 (84.38%) HZ: 235 (12.65%) HR: 25 (1.35%) AD: 30 (1.62%)
Japanese[1] (N_T = 466; N_{AU} = 313 [67.17%])	MN: 187 (59.74%) WM: 101 (32.27%) GD: 25 (7.99%)	HE: 214 (68.59%) GL: 2 (0.64%) BI+: 46 (14.74%) EM: 50 (16.03%)	38.65 (12.84)	5.84 (5.54)	1–35	S: 2.07 (0.14) K: 5.55 (0.27)	LR: 229 (73.16%) HZ: 62 (19.81%) HR: 10 (3.19%) AD: 12 (3.83%)
Korean **(N_T = 1437; N_{AU} = 1041 [72.44%])**	MN: 361 (34.68%) WM: 648 (62.25%) GD: 32 (3.07%)	HE: 786 (75.65%) GL: 35 (3.37%) BI+: 84 (8.08%) EM: 134 (12.90%)	25.35 (6.98)	8.44 (6.73)	1–34	S: 1.31 (0.08) K: 1.53 (0.15)	LR: 577 (55.43%) HZ: 311 (29.88%) HR: 61 (5.86%) AD: 92 (8.84%)
Lithuanian **(N_T = 2094; N_{AU} = 1686 [80.52%])**	MN: 527 (31.26%) WM: 1116 (66.19%) GD: 43 (2.55%)	HE: 1215 (72.62%) GL: 119 (7.11%) BI+: 169 (10.10%) EM: 170 (10.16%)	34.25 (10.83)	5.21 (4.62)	1–31	S: 1.89 (0.06) K: 4.36 (0.12)	LR: 1307 (77.52%) HZ: 299 (17.73%) HR: 41 (2.43%) AD: 39 (2.31%)
Macedonian **(N_T = 1301; N_{AU} = 1103 [84.78%])**	MN: 464 (42.07%) WM: 629 (57.03%) GD: 10 (0.91%)	HE: 869 (80.84%) GL: 51 (4.74%) BI+: 82 (7.63%) EM: 73 (6.79%)	29.29 (10.01)	5.66 (5.14)	1–33	S: 1.94 (0.07) K: 4.22 (0.15)	LR: 842 (76.41%) HZ: 187 (16.97%) HR: 27 (2.45%) AD: 46 (4.17%)
Mandarin – simplified **(N_T = 2474; N_{AU} = 1583 [63.99%])**	MN: 830 (52.43%) WM: 644 (40.68%) GD: 109 (6.89%)	HE: 1057 (67.37%) GL: 194 (12.36%) BI+: 173 (11.03%) EM: 145 (9.24%)	29.12 (10.48)	5.15 (5.57)	1–38	S: 1.94 (0.06) K: 3.97 (0.12)	LR: 1231 (77.76%) HZ: 248 (15.67%) HR: 47 (2.97%) AD: 57 (3.60%)
Mandarin – traditional **(N_T = 2685; N_{AU} = 1867 [69.53%])**	MN: 980 (52.49%) WM: 861 (46.12%) GD: 26 (1.39%)	HE: 1391 (74.74%) GL: 102 (5.48%) BI+: 82 (4.41%) EM: 286 (15.37%)	30.40 (7.58)	3.02 (3.60)	1–40	S: 4.09 (0.06) K: 23.97 (0.11)	LR: 1730 (92.66%) HZ: 100 (5.36%) HR: 12 (0.64%) AD: 25 (1.34%)
Polish **(N_T = 10,343; N_{AU} = 8392 [81.14%])**	MN: 828 (9.87%) WM: 7354 (87.64%) GD: 209 (2.49%)	HE: 5165 (61.62%) GL: 175 (2.09%) BI+: 1069 (12.75%) EM: 1973 (23.54%)	26.71 (6.07)	5.09 (4.06)	1–38	S: 1.89 (0.03) K: 5.18 (0.05)	LR: 6664 (79.42%) HZ: 1415 (16.86%) HR: 149 (1.78%) AD: 163 (1.94%)
Portuguese – Brazil **(N_T = 3650; N_{AU} = 2631 [72.08%])**	MN: 1687 (64.14%) WM: 909 (34.56%) GD: 34 (1.29%)	HE: 1716 (65.30%) GL: 343 (13.05%) BI+: 291 (11.07%) EM: 278 (10.58%)	43.19 (12.16)	6.06 (5.33)	1–40	S: 1.86 (0.05) K: 4.49 (0.10)	LR: 1877 (71.34%) HZ: 566 (21.51%) HR: 87 (3.31%) AD: 101 (3.84%)
Portuguese – Portugal[2] (N_T = 2277; N_{AU} = 1698 [74.57%])	MN: 284 (16.74%) WM: 1380 (81.32%) GD: 33 (1.94%)	HE: 1201 (70.77%) GL: 67 (3.95%) BI+: 217 (12.79%) EM: 212 (12.49%)	30.93 (10.38)	4.37 (3.87)	1–32	S: 2.53 (0.06) K: 9.56 (0.12)	LR: 1449 (85.39%) HZ: 194 (11.43%) HR: 17 (1.00%) AD: 37 (2.18%)
Slovak **(N_T = 2118; N_{AU} = 1718 [81.11%])**	MN: 705 (41.11%) WM: 985 (57.43%) GD: 25 (1.46%)	HE: 1294 (75.45%) GL: 68 (3.97%) BI+: 194 (11.31%) EM: 159 (9.27%)	27.28 (8.98)	5.80 (4.75)	1–32	S: 1.61 (0.06) K: 2.98 (0.12)	LR: 1267 (73.75%) HZ: 344 (20.02%) HR: 61 (3.55%) AD: 46 (2.68%)
Spanish – Latin American **(N_T = 8926; N_{AU} = 6502 [72.84%])**	MN: 2730 (42.00%) WM: 3560 (54.77%) GD: 210 (3.23%)	HE: 4389 (67.91%) GL: 442 (6.84%) BI+: 922 (14.27%) EM: 710 (10.99%)	30.24 (11.05)	5.26 (4.57)	1–35	S: 1.81 (0.03) K: 4.21 (0.06)	LR: 4983 (76.66%) HZ: 1187 (18.26%) HR: 163 (2.51%) AD: 167 (2.57%)
Spanish – Spain **(N_T = 2312; N_{AU} = 1822 [78.81%])**	MN: 613 (33.66%) WM: 1161 (63.76%) GD: 47 (2.58%)	HE: 1112 (61.20%) GL: 116 (6.38%) BI+: 378 (20.80%) EM: 211 (11.61%)	24.38 (7.27)	5.85 (4.72)	1–31	S: 1.47 (0.06) K: 2.55 (0.11)	LR: 1315 (72.17%) HZ: 412 (22.61%) HR: 49 (2.69%) AD: 46 (2.52%)
Turkish[2] (N_T = 853; N_{AU} = 623 [73.04%])	MN: 284 (45.66%) WM: 306 (49.20%) GD: 32 (5.14%)	HE: 447 (72.21%) GL: 26 (4.20%) BI+: 67 (10.82%) EM: 79 (12.76%)	30.13 (9.14)	5.80 (4.83)	1–32	S: 1.97 (0.10) K: 4.83 (0.20)	LR: 466 (74.80%) HZ: 118 (18.94%) HR: 13 (2.09%) AD: 26 (4.17%)
Gender							
Man **(N_T = 32,549; N_{AU} = 24,811 [76.23%])**	–	HE: 18872 (76.32%) GL: 2276 (9.20%) BI+: 1676 (6.78%) EM: 1905 (7.70%)	37.50 (14.45)	6.03 (5.08)	1–40	S: 1.75 (0.02) K: 3.80 (0.03)	LR: 17898 (72.15%) HZ: 5271 (21.25%) HR: 804 (3.24%) AD: 834 (3.36%)
Woman **(N_T = 46,874; N_{AU} = 36,099 [77.01%])**	–	HE: 23965 (66.58%) GL: 937 (2.60%) BI+: 5383 (14.95%) EM: 5711 (15.87%)	29.77 (10.06)	5.06 (4.48)	1–40	S: 2.02 (0.01) K: 5.53 (0.03)	LR: 28505 (78.97%) HZ: 5995 (16.61%) HR: 741 (2.05%) AD: 855 (2.37%)
Gender diverse individuals **(N_T = 2783; N_{AU} = 2011 [72.26%])**	–	HE: 135 (6.73%) GL: 260 (12.97%) BI+: 1144 (57.06%) EM: 466 (23.24%)	26.97 (9.37)	5.61 (5.21)	1–34	S: 2.10 (0.05) K: 5.46 (0.11)	LR: 1519 (75.53%) HZ: 365 (18.15%) HR: 52 (2.59%) AD: 75 (3.73%)
Sexual orientation							
Heterosexual **(N_T = 56,125; N_{AU} = 42,979 [76.58%])**	MN: 18872 (43.92%) WM: 23965 (55.77%) GD: 135 (0.31%)	–	34.32 (13.07)	5.31 (4.63)	1–40	S: 1.92 (0.01) K: 4.80 (0.02)	LR: 33241 (77.36%) HZ: 7601 (17.69%)

(*continued on next page*)

Table 1 (*continued*)

	Demographic distribution			Alcohol Use Disorders Identification Test (AUDIT)			
	Gender N %	Sexual orientation N %	Age M (SD)	M (SD)	Range	Skewness (SE) Kurtosis (SE)	Risk categories N %
							HR: 1035 (2.41%) AD: 1095 (2.55%)
Gay and lesbian **($N_T = 4607$; $N_{AU} = 3476$ [75.45%])**	MN: 2276 (65.53%) WM: 937 (26.98%) GD: 260 (7.49%)	–	33.16 (12.22)	5.76 (5.11)	1–38	S: 1.90 (0.04) K: 4.77 (0.08)	LR: 2553 (73.45%) HZ: 712 (20.48%) HR: 101 (2.91%) AD: 110 (3.16%)
Bisexual+ **($N_T = 10{,}614$; $N_{AU} = 8208$ [77.33%])**	MN: 1676 (20.43%) WM: 5383 (65.62%) GD: 1144 (13.95%)	–	27.80 (10.07)	6.00 (5.14)	1–39	S: 1.85 (0.03) K: 4.44 (0.05)	LR: 5918 (72.10%) HZ: 1746 (21.27%) HR: 253 (3.08%) AD: 291 (3.55%)
Emerging sexual identities **($N_T = 10{,}556$; $N_{AU} = 8088$ [76.62%])**	MN: 1905 (23.57%) WM: 5711 (70.66%) GD: 466 (5.77%)	–	29.09 (10.13)	5.61 (4.90)	1–40	S: 1.88 (0.03) K: 4.56 (0.05)	LR: 6086 (75.25%) HZ: 1541 (19.05%) HR: 201 (2.49%) AD: 260 (3.21%)

Notes. N_T: Total number of participants in the given subgroup. N_{AU} (%): Number of individuals with past-year alcohol use in the given subgroup (proportion compared to the total subgroup size). All data in the table are based on the responses of individuals with past-year alcohol use. Bolded subgroups were included in the analyses.[1]The subgroup was not used in the analyses because the final subgroup sample size (N_{AU}) did not reach the minimum required sample size of N = 485.[2]Although the sample size of the subgroup exceeded the minimum sample size required, the subgroup was not included in the analyses because for some of the items of the AUDIT there were no valid responses for some of the response options/categories and/or due to one or more zero cells in bivariate cross-tables between the items of the AUDIT.[3]Chile was not included in the analyses as it joined as a collaborating country after publishing the study protocol. Gender: MN – man, WM – woman, GD – gender diverse individuals. Sexual orientation: HE – heterosexual, GL – gay and lesbian, BI – bisexual, queer, pansexual, EM – emerging sexual identities. Skewness & kurtosis statistics: S – skewness, K – kurtosis. AUDIT risk categories: LR – low-risk alcohol drinking (total score of 1–7 on the AUDIT), HZ – hazardous alcohol use (total score of 8–15 on the AUDIT), HR – harmful alcohol use (total score of 16–19 on the AUDIT), AD – possible alcohol dependence (total score of 20–40 on the AUDIT). Only valid responses on the given variable were considered for calculating % values.

calculated [2]. For women, the presence of risk of hazardous or more severe alcohol use was also assessed with a cut-off of 7 points [2].

2.4. Statistical analyses

As a preliminary analysis, the total AUDIT score and the distribution by the AUDIT risk categories were calculated for each country, language, gender, and sexual-orientation subgroup.

To identify the best measurement model captured by the 10 items of the AUDIT, one-factor, two-factor, and three-factor models were first tested separately in each subgroup of the variables by country, language, gender, and sexual orientation using confirmatory factor analysis (CFA). A similar, subgroup-specific approach was also applied by previous cross-cultural psychometric studies [28,29]. In the one-factor model, all ten items are loaded on a common factor. The two-factor model incorporated factors of alcohol consumption (with items 1 to 3) and alcohol problems (with items 4 to 10), while the three-factor model included factors of alcohol consumption (with items 1 to 3), alcohol dependence (with items 4 to 6), and negative consequences (with items 7 to 10). Based on the Monte Carlo simulation performed during pre-registration, at least 485 individuals in a subgroup had to be included in the analysis (see: https://osf.io/qg8c4). As a result, nine countries and five language subgroups were excluded from the final analyses. In addition, CFA and measurement invariance testing with ordered categorical variables also required to have valid data for each response option of all the items and/or not to have empty cells in the bivariate cross-tables between the AUDIT items in each subgroup separately. For this reason, 11 countries and six language subgroups were not included in these analyses.

In total, 21 countries and 14 language subgroups were included in the final analyses. For all three gender subgroups (i.e., men, women, gender diverse individuals) and all four sexual orientation subgroups (i.e., heterosexual, gay and lesbian, bi+, and emerging sexual identities), the sample size requirements for conducting CFA and measurement invariance testing were met. A list of the subgroups included in the CFA, and the reasons for the exclusion of each subgroup are given in Table 1. In the CFA, each AUDIT item was defined as an ordinal categorical variable; thus, the weighted least squares means and variance adjusted (WLSMV) estimation procedure with theta parameterization was applied. The non-normal distribution of the AUDIT items in most subgroups, as well as their ordinal type (especially for items 9–10), provided a rationale for using the WLSMV method. The level of model fit was assessed using the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). An adequate fit was indicated by values ≥0.900 for the CFI and TLI and ≤ 0.080 for the RMSEA, while an optimal fit was indicated by values ≥0.950 for the CFI and TLI and ≤ 0.050 for the RMSEA [30]. The internal consistency in the measurement models was measured by the McDonald's omega (ω) index.

Next, for the model with the most appropriate psychometric characteristics, measurement invariance was tested across subgroups by country, language, gender, and sexual orientation. Six invariance models assuming progressively increasing restriction and equality of statistical parameters across groups were tested: (1) configural invariance (i.e., assuming equivalence of the factor structure), (2) metric invariance (i.e., in addition to the equivalence of the factor structure, the factor loadings were also held as equal across subgroups), (3) scalar invariance (i.e., in addition to the level of equivalence defined in the previous model, the item thresholds were also held as equal across subgroups), (4) residual invariance (i.e., in addition to the level of equivalence defined in the previous model, the item residuals were also held as equal across subgroups), (5) latent factor variance and covariance invariance (i.e., in addition to the level of equivalence defined in the previous model, the variances of the latent factor(s) as well as the inter-factor correlation(s) were also held as equal across subgroups), and (6) latent mean invariance (i.e., in addition to the level of equivalence defined in the previous model, the means of the latent factor(s) were also held as equal across subgroups). The first four invariance levels are more specific tests of measurement equivalence between groups, focusing on the relationships between observed indicators and latent variables. The last two invariance levels are used to test for structural equivalence between groups, whether there were differences between groups at the latent variable level (variance, covariance, mean). The first four levels are of primary importance in invariance testing, while the last two levels are considered optional but recommended [31]. Several recent psychometric studies have tested both measurement and structural invariance simultaneously [32,33]. Each measurement invariance model was evaluated according to the CFI, TLI, and RMSEA using the cutoffs described above. However, more permissive cutoff values for the RMSEA are recommended to detect an adequate fit when testing for invariance between a large number of groups (i.e., <0.100 and 0.150 for 10 and 20 groups, respectively) [34]. Therefore, the latter cutoffs were also considered for evaluating the model fit of each country- and language-based invariance level. Additionally, we examined the degree of change between consecutive measurement invariance models in terms of the CFI, TLI, and RMSEA. The preference for a more restrictive invariance model representing the equality of more statistical parameters is indicated if the decrease in the CFI is ≤0.010 and if the increase in the RMSEA is ≤0.015 [35,36]. However, for invariance analysis between a large number of groups (e.g., with >10 groups), it may be worth considering more permissive cutoff values for the changes observed in the CFI and RMSEA (i.e., decrease in the CFI ≤0.020 and increase in the RMSEA ≤0.030) [34]. Therefore, these less restrictive cut-offs were also considered for comparing the consecutive country- and language-based invariance levels.

Finally, for those grouping variables where at least the level of scalar invariance was reached, observed scores on the AUDIT were compared between the subgroups (i.e., these invariance levels can imply that there is no sign of measurement bias in the comparison of means). This was conducted by calculating one-way analyses of variance (ANOVAs) and Kruskal-Wallis tests. Games-Howell post-hoc tests were performed with Tukey's correction for significance testing.

Descriptive statistics were calculated by using the IBM SPSS Statistics 26 software [37], CFA and measurement invariance testing were performed by using the Mplus 8.0 software [38], and the JASP 0.17.1.0 [39] software was applied for multiple comparisons between subgroups in terms of the observed scores on the AUDIT. Due to the high number of significance tests performed during the analyses, each coefficient was considered significant at $p < 0.001$ level to control for the familywise error.

3. Results

3.1. Descriptive statistics

Descriptive statistics for the AUDIT in each subgroup by country, language, gender, and sexual orientation are presented in Table 1. For the total AUDIT score, the means varied between 3.02 and 8.38 across the included countries (individuals from Taiwan and South Korea, respectively), between 3.02 and 8.44 across the included language subgroups (individuals speaking Mandarin – traditional and Korean, respectively), between 5.06 and 6.03 across genders (among women and men, respectively), and between 5.31 and 6.00 across sexual orientations (among heterosexual and bi+ individuals, respectively). Similar patterns were seen for the risk of hazardous or more severe alcohol use (i.e., scores of 8 or more on the AUDIT): the occurrence varied between 7.34% and 44.31% across the included countries (individuals from Taiwan and South Korea, respectively), between 7.34% and 44.31% across the included language subgroups (individuals speaking Mandarin – traditional and Korean, respectively), between 21.03% and 27.85% across genders (among women and men, respectively), and between 22.64% and 27.90% across sexual orientations (among heterosexual and bi+ individuals, respectively). The occurrence rate of risk of hazardous or more severe alcohol use among women was 26.09% with a cut-off of 7 points.

3.2. Confirmatory factor analysis in each subgroup by country, language, gender, and sexual orientation

Table 2 reports the fit of the measurement models in each subgroup by country, language, gender, and sexual orientation. In most of the countries and language groups, in all gender and sexual orientation subgroups, both the CFI and TLI indicated adequate or optimal levels of model fit for the one-factor model. However, adequate levels of model fit for the RMSEA were only observed in eight countries, seven language subgroups, and only among women and heterosexual individuals. Thus, at least adequate levels of model fit on all three fit indices were found only in these subgroups. Overall, these results indicated that it was not possible to determine a satisfactory fit for the single-factor model clearly.

For the two- and three-factor models, adequate or optimal levels of fit were reported for each subgroup by country, language, gender, and sexual orientation in terms of the CFI, TLI and RMSEA. Overall, small and marginal differences were most frequently detected between these two models in the three fit indices across the subgroups of country, language, gender and sexual orientation. The two-factor model was characterized by equal or closer fit to the data in most subgroups based on the TLI and RMSEA, and in multiple subgroups based on the CFI. In those cases where the three-factor model showed a closer fit to the data, very small differences were observed in the fit indices. It is also important to mention that for eight countries, four language groups and gender diverse individuals, the latent variable covariance matrix was not positive definite for the three-factor model due to out-of-range correlations (≥1.00) between factors of alcohol dependence and negative consequences. In addition, very high correlations ($r \geq 0.89$) between these two factors were also evident in the other country, language, gender, and sexual orientation subgroups. Overall, due to the very similar levels of fit between the two-factor and three-factor models, and the difficulty of statistically distinguishing the alcohol dependence and the negative consequences factors (which form a common factor in the two-factor model), the two-factor model was considered as the best-fitting and more parsimonious solution for each grouping variable.

The factor loadings, correlations, and internal consistency estimates for each measurement model are shown in Table 3. For the two-factor model, significant and moderate-to-strong factor loadings were seen on the alcohol-consumption and alcohol-problems factors for each subgroup ($\lambda = 0.45$–0.94 and $\lambda = 0.45$–0.92, respectively). In addition, the internal consistency of the alcohol-consumption and alcohol-problems factors varied between moderately high and high levels in each subgroup ($\omega = 0.73$–0.84 and $\omega = 0.86$–0.96, respectively). Significant and strong correlations were observed between the two factors in each subgroup ($r \geq 0.68$).

3.3. Measurement invariance testing

The results of the measurement invariance testing for the two-factor model across countries, language, gender, and sexual-orientation subgroups are presented in Table 4. At all country- and language-based invariance levels, the CFI and TLI indicated adequate-to-optimal levels of fit. Based on the more liberal RMSEA cutoff, all country- and language-based invariance models showed an adequate fit. Based on the conventional RMSEA cutoff, an adequate fit was observed at the country- and language-based scalar invariance, residual invariance, variance and covariance invariance, and latent mean invariance levels. Overall, the closest fit to the data were shown at the levels of scalar invariance and variance and covariance invariance. Based on the more permissive cutoffs for the changes in the CFI and RMSEA, no significant decreases in model fit were observed between consecutive invariance models. Therefore, it was considered that the level of latent mean invariance was reached between subgroups of countries and language. However, it is important to note that a different conclusion might have been reached if the conventional cutoffs for the changes in the CFI and RMSEA had been considered. Compared to the scalar invariance level, significant decreases were observed on the CFI at the residual level, while no significant change was apparent on the RMSEA. Therefore, this method would rather suggest that the scalar invariance level was reached between subgroups of countries and languages. Yet, given the number of countries and languages in the study, the less restrictive cut-off values were considered in this study [34].

The invariance testing across gender and sexual orientation subgroups revealed optimal levels of fit at the configural and metric

Table 2
Model fit of the measurement models in each country-, language-, gender- and sexual-orientation-based subgroup.

Subgroup	Model	χ^2	df	p	CFI	TLI	RMSEA [90% CI]
Country of residence							
	One-factor model	158.845	35	<0.001	0.968	0.958	0.085 [0.072; 0.099]
Australia	Two-factor model	122.935	34	<0.001	0.977	0.969	0.073 [0.060; 0.087]
	Three-factor model[1]	116.934	32	<0.001	0.978	0.969	0.074 [0.060; 0.088]
	One-factor model	162.564	35	<0.001	0.968	0.958	0.085 [0.072; 0.098]
Belgium	Two-factor model	120.551	34	<0.001	0.978	0.971	0.071 [0.057; 0.085]
	Three-factor model[1]	118.182	32	<0.001	0.978	0.969	0.073 [0.059; 0.087]
	One-factor model	910.157	35	<0.001	0.944	0.928	0.099 [0.093; 0.104]
Brazil	Two-factor model	363.699	34	<0.001	0.979	0.972	0.061 [0.056; 0.067]
	Three-factor model	354.089	32	<0.001	0.979	0.971	0.063 [0.057; 0.069]
	One-factor model	392.738	35	<0.001	0.970	0.962	0.072 [0.065; 0.078]
Canada	Two-factor model	294.032	34	<0.001	0.979	0.972	0.062 [0.056; 0.069]
	Three-factor model[1]	302.441	32	<0.001	0.978	0.969	0.065 [0.059; 0.072]
	One-factor model	538.718	35	<0.001	0.974	0.967	0.096 [0.089; 0.103]
China	Two-factor model	239.243	34	<0.001	0.990	0.986	0.062 [0.055; 0.070]
	Three-factor model	221.181	32	<0.001	0.990	0.986	0.062 [0.054; 0.069]
	One-factor model	678.855	35	<0.001	0.887	0.855	0.113 [0.106; 0.120]
Colombia	Two-factor model	236.927	34	<0.001	0.964	0.953	0.064 [0.057; 0.072]
	Three-factor model	232.705	32	<0.001	0.965	0.951	0.066 [0.058; 0.074]
	One-factor model	445.960	35	<0.001	0.943	0.927	0.092 [0.084; 0.100]
Czech Republic	Two-factor model	152.142	34	<0.001	0.984	0.978	0.050 [0.042; 0.058]
	Three-factor model	150.058	32	<0.001	0.984	0.977	0.052 [0.043; 0.060]
	One-factor model	540.060	35	<0.001	0.949	0.934	0.073 [0.068; 0.079]
Germany	Two-factor model	460.766	34	<0.001	0.957	0.943	0.068 [0.063; 0.074]
	Three-factor model[1]	430.643	32	<0.001	0.960	0.943	0.068 [0.062; 0.074]
	One-factor model	2493.259	35	<0.001	0.947	0.932	0.087 [0.084; 0.090]
Hungary	Two-factor model	1775.779	34	<0.001	0.963	0.951	0.074 [0.072; 0.077]
	Three-factor model[1]	1744.123	32	<0.001	0.963	0.948	0.076 [0.073; 0.079]
	One-factor model	455.668	35	<0.001	0.962	0.951	0.096 [0.088; 0.104]
Ireland	Two-factor model	274.551	34	<0.001	0.978	0.971	0.074 [0.066; 0.082]
	Three-factor model[1]	264.018	32	<0.001	0.979	0.970	0.075 [0.067; 0.083]
	One-factor model	331.084	35	<0.001	0.965	0.955	0.072 [0.065; 0.079]
Lithuania	Two-factor model	185.108	34	<0.001	0.982	0.976	0.052 [0.045; 0.060]
	Three-factor model[1]	220.451	32	<0.001	0.978	0.969	0.060 [0.053; 0.068]
	One-factor model	473.775	35	<0.001	0.934	0.915	0.092 [0.084; 0.099]
Mexico	Two-factor model	239.647	34	<0.001	0.969	0.959	0.064 [0.056; 0.071]
	Three-factor model	222.980	32	<0.001	0.971	0.960	0.063 [0.056; 0.071]
	One-factor model	554.252	35	<0.001	0.970	0.962	0.082 [0.076; 0.088]
New Zealand	Two-factor model	354.984	34	<0.001	0.982	0.976	0.065 [0.059; 0.071]
	Three-factor model	355.147	32	<0.001	0.981	0.974	0.067 [0.061; 0.074]
	One-factor model	207.321	35	<0.001	0.973	0.965	0.068 [0.059; 0.077]
North Macedonia	Two-factor model	129.098	34	<0.001	0.985	0.980	0.051 [0.042; 0.061]
	Three-factor model	124.499	32	<0.001	0.985	0.980	0.052 [0.043; 0.062]
	One-factor model	1857.809	35	<0.001	0.943	0.927	0.081 [0.077; 0.084]
Poland	Two-factor model	1353.87	34	<0.001	0.959	0.945	0.070 [0.066; 0.073]
	Three-factor model[1]	1328.473	32	<0.001	0.959	0.943	0.071 [0.068; 0.074]
	One-factor model	218.769	35	<0.001	0.957	0.945	0.076 [0.067; 0.086]
Slovakia	Two-factor model	162.189	34	<0.001	0.970	0.961	0.065 [0.055; 0.075]
	Three-factor model	160.962	32	<0.001	0.970	0.958	0.067 [0.057; 0.077]
	One-factor model	392.118	35	<0.001	0.959	0.947	0.085 [0.078; 0.093]
South Africa	Two-factor model	216.544	34	<0.001	0.979	0.972	0.062 [0.054; 0.070]
	Three-factor model	205.193	32	<0.001	0.980	0.972	0.062 [0.054; 0.070]
	One-factor model	489.203	35	<0.001	0.956	0.944	0.110 [0.102; 0.119]
South Korea	Two-factor model	211.875	34	<0.001	0.983	0.977	0.070 [0.061; 0.079]
	Three-factor model	198.152	32	<0.001	0.984	0.977	0.070 [0.061; 0.079]
	One-factor model	343.846	35	<0.001	0.963	0.952	0.069 [0.063; 0.076]
Spain	Two-factor model	193.905	34	<0.001	0.981	0.974	0.051 [0.044; 0.058]
	Three-factor model	195.773	32	<0.001	0.980	0.972	0.053 [0.046; 0.060]
	One-factor model	246.136	35	<0.001	0.952	0.938	0.079 [0.070; 0.088]
Switzerland	Two-factor model	171.359	34	<0.001	0.969	0.958	0.065 [0.055; 0.074]
	Three-factor model	165.551	32	<0.001	0.969	0.957	0.066 [0.056; 0.076]
	One-factor model	286.892	35	<0.001	0.980	0.974	0.062 [0.056; 0.069]
Taiwan	Two-factor model	191.026	34	<0.001	0.987	0.983	0.050 [0.043; 0.057]
	Three-factor model	165.087	32	<0.001	0.989	0.985	0.047 [0.040; 0.055]
Language							
	One-factor model	429.075	35	<0.001	0.947	0.932	0.091 [0.084; 0.099]
Czech	Two-factor model	150.971	34	<0.001	0.984	0.979	0.051 [0.042; 0.059]
	Three-factor model	144.611	32	<0.001	0.985	0.979	0.051 [0.043; 0.060]
	One-factor model	2519.089	35	<0.001	0.963	0.953	0.084 [0.081; 0.087]
English	Two-factor model	1496.120	34	<0.001	0.978	0.971	0.065 [0.062; 0.068]
	Three-factor model	1418.580	32	<0.001	0.980	0.971	0.065 [0.063; 0.068]
	One-factor model	676.386	35	<0.001	0.958	0.947	0.077 [0.072; 0.082]
French	Two-factor model	483.221	34	<0.001	0.971	0.961	0.065 [0.060; 0.070]
	Three-factor model[1]	481.499	32	<0.001	0.971	0.959	0.067 [0.062; 0.073]

(*continued on next page*)

Table 2 (*continued*)

Subgroup	Model	χ^2	df	p	CFI	TLI	RMSEA [90% CI]
	One-factor model	2483.721	35	<0.001	0.946	0.931	0.088 [0.085; 0.091]
Hungarian	Two-factor model	1792.519	34	<0.001	0.961	0.949	0.076 [0.073; 0.079]
	Three-factor model	1761.494	32	<0.001	0.962	0.947	0.077 [0.074; 0.080]
	One-factor model	483.157	35	<0.001	0.956	0.943	0.111 [0.102; 0.120]
Korean	Two-factor model	203.654	34	<0.001	0.983	0.978	0.069 [0.060; 0.079]
	Three-factor model	190.638	32	<0.001	0.984	0.978	0.069 [0.060; 0.079]
	One-factor model	343.515	35	<0.001	0.967	0.957	0.072 [0.065; 0.079]
Lithuanian	Two-factor model	204.637	34	<0.001	0.982	0.976	0.055 [0.047; 0.062]
	Three-factor model[1]	194.704	32	<0.001	0.983	0.975	0.055 [0.048; 0.062]
	One-factor model	218.639	35	<0.001	0.972	0.964	0.069 [0.060; 0.078]
Macedonian	Two-factor model	142.809	34	<0.001	0.983	0.978	0.054 [0.045; 0.063]
	Three-factor model	139.499	32	<0.001	0.984	0.977	0.055 [0.046; 0.065]
	One-factor model	545.230	35	<0.001	0.975	0.968	0.096 [0.089; 0.103]
Mandarin - Simplified	Two-factor model	255.760	34	<0.001	0.989	0.985	0.064 [0.057; 0.072]
	Three-factor model	239.026	32	<0.001	0.990	0.986	0.064 [0.056; 0.072]
	One-factor model	287.073	35	<0.001	0.980	0.974	0.062 [0.056; 0.069]
Mandarin - Traditional	Two-factor model	173.662	34	<0.001	0.989	0.985	0.047 [0.040; 0.054]
	Three-factor model	155.745	32	<0.001	0.990	0.986	0.046 [0.039; 0.053]
	One-factor model	1922.463	35	<0.001	0.944	0.927	0.080 [0.077; 0.083]
Polish	Two-factor model	1357.260	34	<0.001	0.960	0.948	0.068 [0.065; 0.071]
	Three-factor model[1]	1361.554	32	<0.001	0.960	0.944	0.070 [0.067; 0.074]
	One-factor model	969.569	35	<0.001	0.942	0.925	0.101 [0.095; 0.106]
Portuguese – Brazil	Two-factor model	387.416	34	<0.001	0.978	0.971	0.063 [0.057; 0.069]
	Three-factor model	387.810	32	<0.001	0.978	0.969	0.065 [0.059; 0.071]
	One-factor model	406.340	35	<0.001	0.956	0.943	0.079 [0.072; 0.086]
Slovak	Two-factor model	289.851	34	<0.001	0.970	0.960	0.066 [0.059; 0.073]
	Three-factor model	283.314	32	<0.001	0.970	0.958	0.068 [0.060; 0.075]
	One-factor model	2701.460	35	<0.001	0.907	0.880	0.108 [0.105; 0.112]
Spanish – Latin American	Two-factor model	852.245	34	<0.001	0.971	0.962	0.061 [0.057; 0.064]
	Three-factor model	883.711	32	<0.001	0.970	0.958	0.064 [0.060; 0.068]
	One-factor model	336.647	35	<0.001	0.963	0.952	0.069 [0.062; 0.076]
Spanish – Spain	Two-factor model	184.978	34	<0.001	0.982	0.976	0.049 [0.043; 0.056]
	Three-factor model[1]	195.836	32	<0.001	0.980	0.972	0.053 [0.046; 0.060]
Gender							
	One-factor model	6171.127	35	<0.001	0.952	0.938	0.084 [0.082; 0.086]
Man	Two-factor model	3298.967	34	<0.001	0.974	0.966	0.062 [0.060; 0.064]
	Three-factor model	3171.965	32	<0.001	0.975	0.965	0.063 [0.061; 0.065]
	One-factor model	7906.185	35	<0.001	0.951	0.937	0.079 [0.077; 0.080]
Woman	Two-factor model	4963.741	34	<0.001	0.970	0.960	0.063 [0.062; 0.065]
	Three-factor model	5015.806	32	<0.001	0.969	0.957	0.066 [0.064; 0.067]
	One-factor model	554.989	35	<0.001	0.953	0.940	0.086 [0.080; 0.092]
Gender diverse individuals[1]	Two-factor model	321.678	34	<0.001	0.974	0.966	0.065 [0.058; 0.071]
	Three-factor model	314.206	32	<0.001	0.975	0.964	0.066 [0.060; 0.073]
Sexual orientation							
	One-factor model	9505.657	35	<0.001	0.952	0.938	0.079 [0.078; 0.081]
Heterosexual	Two-factor model	5290.075	34	<0.001	0.973	0.965	0.060 [0.059; 0.061]
	Three-factor model	5244.805	32	<0.001	0.974	0.963	0.062 [0.060; 0.063]
	One-factor model	1020.618	35	<0.001	0.948	0.933	0.090 [0.085; 0.095]
Gay and lesbian	Two-factor model	476.902	34	<0.001	0.977	0.969	0.061 [0.056; 0.066]
	Three-factor model	465.191	32	<0.001	0.977	0.968	0.062 [0.057; 0.067]
	One-factor model	2300.166	35	<0.001	0.947	0.932	0.089 [0.086; 0.092]
Bisexual	Two-factor model	1248.001	34	<0.001	0.972	0.962	0.066 [0.063; 0.069]
	Three-factor model	1230.046	32	<0.001	0.972	0.961	0.068 [0.064; 0.071]
	One-factor model	1990.296	35	<0.001	0.952	0.939	0.083 [0.080; 0.086]
Emerging sexual identities	Two-factor model	1153.886	34	<0.001	0.973	0.964	0.064 [0.061; 0.067]
	Three-factor model	1121.344	32	<0.001	0.973	0.963	0.065 [0.062; 0.068]

Notes. χ^2: Chi-square test of model fit. CFI: Comparative Fit Index. TLI: Tucker-Lewis Index. RMSEA [90% CI]: Root Mean Square Error of Approximation [90% Confidence Interval].[1]The latent variable covariance matrix of the model was not positive definite due to the correlation ≥1.00 between the factors of alcohol dependence and negative consequences.

invariance levels based on the CFI, adequate-to-optimal levels of fit based on the TLI, and adequate levels of fit based on the RMSEA. At the scalar invariance, residual invariance, variance and covariance invariance, and latent mean invariance levels, optimal degrees of model fit were detected according to all three fit indices, and for both grouping variables. The most optimal fit indices were shown at the level of variance and covariance invariance followed by the latent mean invariance. However, there was no significant change between the latter two invariance levels in terms of the CFI and RMSEA. Therefore, it was considered that the level of latent mean invariance was reached between subgroups of gender and sexual orientation.

3.4. Comparisons across subgroups by country, language, gender, and sexual orientation

Since high levels of invariance were reached for each grouping variable, it was considered reasonable to compare the AUDIT subscale scores of alcohol consumption and alcohol problems between subgroups by country, language, gender, and sexual orientation. The results of these comparisons are presented in Table 5.

For the AUDIT subscale of alcohol consumption, significant and small-to-medium overall differences were found between countries and language subgroups. In the case of the AUDIT subscale of alcohol problems, there were significant and small overall differences between countries and language subgroups. For both subscales, South Korean and

Table 3
Factor loadings, correlations and internal reliability estimates in the measurement models.

Subgroup	Measurement model	Standardized factor loadings (λ) on the items of the Alcohol Use Disorders Identification Test (AUDIT)										McDonald's ω	Inter-factor correlations (r)
		1	2	3	4	5	6	7	8	9	10		
Country of residence													
Australia	One-factor model	0.58	0.68	0.86	0.88	0.83	0.78	0.85	0.86	0.59	0.78	0.94	–
	Two-factor model	0.60	0.71	0.92	0.90	0.84	0.80	0.86	0.88	0.60	0.79	AC: 0.79 AP: 0.93	0.87
	Three-factor model[1]	0.60	0.71	0.93	0.87	0.83	0.79	0.84	0.87	0.58	0.78	AC: 0.80 AD: 0.87 NC: 0.86	AC – AD: 0.85 AC – NC: 0.89 AD – NC: 1.05
Belgium	One-factor model	0.61	0.75	0.88	0.90	0.77	0.76	0.77	0.82	0.49	0.59	0.92	–
	Two-factor model	0.63	0.79	0.93	0.92	0.79	0.78	0.79	0.84	0.50	0.60	AC: 0.83 AP: 0.90	0.87
	Three-factor model[1]	0.63	0.79	0.93	0.92	0.79	0.78	0.78	0.83	0.49	0.60	AC: 0.83 AD: 0.87 NC: 0.78	AC – AD: 0.86 AC – NC: 0.89 AD – NC: 1.01
Brazil	One-factor model	0.56	0.76	0.86	0.83	0.82	0.62	0.81	0.80	0.59	0.71	0.92	–
	Two-factor model	0.60	0.79	0.91	0.86	0.83	0.64	0.84	0.83	0.62	0.73	AC: 0.82 AP: 0.91	0.80
	Three-factor model	0.60	0.80	0.92	0.86	0.84	0.64	0.85	0.84	0.62	0.74	AC: 0.82 AD: 0.82 NC: 0.85	AC – AD: 0.81 AC – NC: 0.79 AD – NC: 0.99
Canada	One-factor model	0.57	0.68	0.85	0.89	0.78	0.66	0.79	0.79	0.56	0.67	0.92	–
	Two-factor model	0.59	0.70	0.90	0.90	0.79	0.66	0.81	0.81	0.57	0.69	AC: 0.78 AP: 0.90	0.89
	Three-factor model[1]	0.59	0.71	0.91	0.88	0.78	0.66	0.81	0.81	0.58	0.69	AC: 0.78 AD: 0.82 NC: 0.81	AC – AD: 0.90 AC – NC: 0.88 AD – NC: 1.02
China	One-factor model	0.65	0.65	0.79	0.88	0.90	0.88	0.88	0.89	0.75	0.66	0.95	–
	Two-factor model	0.70	0.71	0.91	0.90	0.90	0.89	0.89	0.89	0.76	0.67	AC: 0.82 AP: 0.95	0.81
	Three-factor model	0.70	0.71	0.92	0.90	0.91	0.89	0.90	0.90	0.77	0.67	AC: 0.82 AD: 0.93 NC: 0.89	AC – AD: 0.82 AC – NC: 0.78 AD – NC: 0.97
Colombia	One-factor model	0.64	0.60	0.74	0.65	0.75	0.68	0.76	0.72	0.42	0.68	0.89	–
	Two-factor model	0.71	0.67	0.86	0.69	0.79	0.73	0.80	0.74	0.45	0.71	AC: 0.79 AP: 0.87	0.68
	Three-factor model	0.72	0.67	0.85	0.73	0.81	0.74	0.82	0.78	0.45	0.74	AC: 0.79 AD: 0.80 NC: 0.80	AC – AD: 0.65 AC – NC: 0.66 AD – NC: 0.89
Czech Republic	One-factor model	0.40	0.66	0.75	0.87	0.79	0.78	0.82	0.82	0.54	0.70	0.91	–
	Two-factor model	0.45	0.75	0.89	0.88	0.80	0.79	0.84	0.83	0.56	0.72	AC: 0.75 AP: 0.91	0.72
	Three-factor model	0.45	0.74	0.90	0.89	0.80	0.79	0.84	0.84	0.56	0.72	AC: 0.75 AD: 0.87 NC: 0.83	AC – AD: 0.71 AC – NC: 0.72 AD – NC: 0.99
Germany	One-factor model	0.46	0.72	0.80	0.82	0.71	0.51	0.78	0.80	0.50	0.63	0.90	–
	Two-factor model	0.47	0.75	0.85	0.84	0.72	0.52	0.79	0.82	0.51	0.65	AC: 0.74 AP: 0.87	0.88
	Three-factor model[1]	0.47	0.74	0.87	0.85	0.73	0.53	0.79	0.82	0.51	0.64	AC: 0.75 AD: 0.75 NC: 0.79	AC – AD: 0.83 AC – NC: 0.90 AD – NC: 1.00
Hungary	One-factor model	0.52	0.64	0.81	0.84	0.78	0.60	0.76	0.79	0.57	0.70	0.91	–
	Two-factor model	0.54	0.67	0.90	0.87	0.78	0.61	0.76	0.81	0.58	0.72	AC: 0.75 AP: 0.89	0.89
	Three-factor model[1]	0.54	0.67	0.90	0.87	0.79	0.62	0.75	0.81	0.57	0.71	AC: 0.75 AD: 0.81 NC: 0.81	AC – AD: 0.83 AC – NC: 0.87 AD – NC: 1.00
Ireland	One-factor model	0.54	0.69	0.86	0.83	0.80	0.70	0.84	0.83	0.58	0.64	0.92	–
	Two-factor model	0.57	0.73	0.93	0.85	0.81	0.72	0.86	0.85	0.59	0.66	AC: 0.79 AP: 0.91	0.84
	Three-factor model[1]	0.57	0.73	0.92	0.84	0.81	0.73	0.84	0.84	0.58	0.64	AC: 0.79 AD: 0.84 NC: 0.82	AC – AD: 0.82 AC – NC: 0.87 AD – NC: 1.04
Lithuania	One-factor model	0.58	0.66	0.84	0.83	0.80	0.74	0.75	0.77	0.47	0.69	0.91	–
	Two-factor model	0.62	0.69	0.91	0.85	0.81	0.75	0.77	0.79	0.48	0.70	AC: 0.79 AP: 0.89	0.84
	Three-factor model[1]	0.62	0.70	0.89	0.82	0.79	0.73	0.79	0.79	0.48	0.71	AC: 0.78 AD: 0.82 NC: 0.79	AC – AD: 0.88 AC – NC: 0.83 AD – NC: 1.01
Mexico	One-factor model	0.59	0.67	0.78	0.73	0.73	0.64	0.78	0.74	0.55	0.72	0.90	–
	Two-factor model	0.63	0.72	0.87	0.77	0.75	0.65	0.80	0.78	0.57	0.74	AC: 0.79 AP: 0.89	0.77

(*continued on next page*)

Table 3 (*continued*)

Subgroup	Measurement model	Standardized factor loadings (λ) on the items of the Alcohol Use Disorders Identification Test (AUDIT)										McDonald's ω	Inter-factor correlations (r)
		1	2	3	4	5	6	7	8	9	10		
	Three-factor model	0.62	0.72	0.88	0.79	0.78	0.67	0.81	0.77	0.57	0.76	AC: 0.79 AD: 0.79 NC: 0.82	AC – AD: 0.74 AC – NC: 0.77 AD – NC: 0.95
New Zealand	One-factor model	0.54	0.70	0.84	0.88	0.80	0.73	0.83	0.83	0.55	0.76	0.93	–
	Two-factor model	0.56	0.74	0.92	0.89	0.81	0.74	0.84	0.84	0.56	0.77	AC: 0.79 AP: 0.92	0.86
	Three-factor model	0.57	0.74	0.93	0.89	0.81	0.74	0.85	0.85	0.56	0.77	AC: 0.79 AD: 0.85 NC: 0.85	AC – AD: 0.87 AC – NC: 0.86 AD – NC: 1.00
North Macedonia	One-factor model	0.58	0.61	0.81	0.87	0.82	0.68	0.79	0.82	0.61	0.67	0.92	–
	Two-factor model	0.62	0.65	0.88	0.89	0.83	0.69	0.80	0.84	0.63	0.68	AC: 0.76 AP: 0.91	0.85
	Three-factor model	0.62	0.65	0.89	0.88	0.83	0.69	0.81	0.85	0.63	0.69	AC: 0.77 AD: 0.85 NC: 0.84	AC – AD: 0.86 AC – NC: 0.81 AD – NC: 0.97
Poland	One-factor model	0.57	0.57	0.77	0.80	0.76	0.63	0.77	0.79	0.53	0.67	0.90	–
	Two-factor model	0.60	0.61	0.85	0.82	0.77	0.63	0.79	0.80	0.54	0.68	AC: 0.73 AP: 0.88	0.83
	Three-factor model[1]	0.60	0.61	0.85	0.81	0.76	0.64	0.79	0.81	0.54	0.69	AC: 0.73 AD: 0.78 NC: 0.80	AC – AD: 0.85 AC – NC: 0.82 AD – NC: 1.00
Slovakia	One-factor model	0.56	0.59	0.80	0.81	0.80	0.65	0.76	0.80	0.51	0.63	0.90	–
	Two-factor model	0.59	0.62	0.88	0.82	0.81	0.66	0.77	0.82	0.51	0.65	AC: 0.74 AP: 0.88	0.84
	Three-factor model	0.59	0.62	0.88	0.82	0.81	0.66	0.78	0.82	0.52	0.65	AC: 0.74 AD: 0.81 NC: 0.79	AC – AD: 0.85 AC – NC: 0.83 AD – NC: 0.98
South Africa	One-factor model	0.43	0.69	0.82	0.84	0.79	0.74	0.81	0.81	0.56	0.70	0.92	–
	Two-factor model	0.46	0.74	0.90	0.86	0.80	0.75	0.82	0.83	0.58	0.72	AC: 0.75 AP: 0.91	0.83
	Three-factor model	0.46	0.75	0.91	0.86	0.80	0.75	0.82	0.83	0.58	0.71	AC: 0.76 AD: 0.85 NC: 0.83	AC – AD: 0.82 AC – NC: 0.82 AD – NC: 0.99
South Korea	One-factor model	0.65	0.71	0.88	0.87	0.82	0.53	0.81	0.85	0.62	0.71	0.93	–
	Two-factor model	0.69	0.75	0.93	0.89	0.84	0.55	0.83	0.87	0.64	0.73	AC: 0.84 AP: 0.91	0.81
	Three-factor model	0.69	0.75	0.95	0.91	0.85	0.56	0.83	0.88	0.65	0.73	AC: 0.84 AD: 0.82 NC: 0.86	AC – AD: 0.78 AC – NC: 0.81 AD – NC: 0.96
Spain	One-factor model	0.60	0.59	0.74	0.72	0.74	0.54	0.74	0.76	0.47	0.66	0.88	–
	Two-factor model	0.65	0.65	0.82	0.73	0.77	0.55	0.75	0.78	0.48	0.67	AC: 0.75 AP: 0.86	0.82
	Three-factor model	0.66	0.64	0.82	0.73	0.76	0.55	0.75	0.78	0.48	0.67	AC: 0.75 AD: 0.73 NC: 0.77	AC – AD: 0.81 AC – NC: 0.82 AD – NC: 1.00
Switzerland	One-factor model	0.55	0.61	0.83	0.82	0.72	0.67	0.71	0.74	0.50	0.65	0.90	–
	Two-factor model	0.58	0.65	0.89	0.84	0.73	0.68	0.74	0.76	0.51	0.67	AC: 0.75 AP: 0.88	0.83
	Three-factor model	0.58	0.64	0.91	0.84	0.73	0.68	0.74	0.76	0.51	0.67	AC: 0.76 AD: 0.80 NC: 0.77	AC – AD: 0.82 AC – NC: 0.83 AD – NC: 1.00
Taiwan	One-factor model	0.54	0.58	0.77	0.92	0.92	0.90	0.90	0.91	0.78	0.73	0.95	–
	Two-factor model	0.58	0.64	0.86	0.92	0.92	0.91	0.90	0.91	0.79	0.74	AC: 0.74 AP: 0.96	0.85
	Three-factor model	0.58	0.63	0.87	0.93	0.93	0.91	0.91	0.92	0.80	0.75	AC: 0.74 AD: 0.95 NC: 0.91	AC – AD: 0.86 AC – NC: 0.81 AD – NC: 0.97
Language													
Czech	One-factor model	0.40	0.66	0.76	0.88	0.79	0.80	0.82	0.82	0.58	0.71	0.92	–
	Two-factor model	0.45	0.75	0.89	0.89	0.80	0.81	0.84	0.84	0.59	0.73	AC: 0.75 AP: 0.92	0.73
	Three-factor model	0.45	0.74	0.90	0.89	0.80	0.81	0.84	0.84	0.59	0.73	AC: 0.75 AD: 0.88 NC: 0.84	AC – AD: 0.72 AC – NC: 0.72 AD – NC: 0.99
English	One-factor model	0.53	0.72	0.86	0.86	0.79	0.70	0.81	0.82	0.58	0.70	0.92	–
	Two-factor model	0.56	0.75	0.91	0.88	0.80	0.71	0.83	0.85	0.59	0.71	AC: 0.79 AP: 0.91	0.86
	Three-factor model	0.55	0.75	0.92	0.88	0.81	0.72	0.83	0.85	0.59	0.71	AC: 0.80 AD: 0.85 NC: 0.83	AC – AD: 0.83 AC – NC: 0.86 AD – NC: 0.99
French	One-factor model	0.59	0.64	0.83	0.84	0.75	0.58	0.78	0.74	0.55	0.67	0.91	–
	Two-factor model	0.61	0.66	0.89	0.87	0.76	0.60	0.79	0.76	0.56	0.69	AC: 0.77 AP: 0.88	0.87

(continued on next page)

Table 3 (*continued*)

Subgroup	Measurement model	Standardized factor loadings (λ) on the items of the Alcohol Use Disorders Identification Test (AUDIT)										McDonald's ω	Inter-factor correlations (r)
		1	2	3	4	5	6	7	8	9	10		
	Three-factor model[1]	0.61	0.66	0.90	0.85	0.75	0.59	0.79	0.76	0.56	0.69	AC: 0.77 AD: 0.78 NC: 0.80	AC – AD: 0.89 AC – NC: 0.86 AD – NC: 1.03
Hungarian	One-factor model	0.52	0.64	0.82	0.84	0.78	0.59	0.75	0.80	0.58	0.70	0.91	–
	Two-factor model	0.54	0.67	0.90	0.87	0.78	0.60	0.75	0.82	0.58	0.72	AC: 0.75 AP: 0.89	0.85
	Three-factor model	0.54	0.67	0.91	0.88	0.79	0.60	0.75	0.81	0.58	0.71	AC: 0.76 AD: 0.81 NC: 0.81	AC – AD: 0.83 AC – NC: 0.86 AD – NC: 1.00
Korean	One-factor model	0.65	0.71	0.88	0.87	0.82	0.53	0.81	0.85	0.62	0.71	0.93	–
	Two-factor model	0.69	0.74	0.94	0.89	0.84	0.55	0.83	0.87	0.64	0.73	AC: 0.84 AP: 0.91	0.81
	Three-factor model	0.69	0.75	0.95	0.91	0.86	0.56	0.83	0.88	0.64	0.73	AC: 0.84 AD: 0.83 NC: 0.86	AC – AD: 0.78 AC – NC: 0.80 AD – NC: 0.96
Lithuanian	One-factor model	0.59	0.66	0.84	0.82	0.80	0.73	0.76	0.77	0.51	0.72	0.92	–
	Two-factor model	0.62	0.69	0.90	0.84	0.82	0.75	0.78	0.79	0.52	0.73	AC: 0.79 AP: 0.90	0.85
	Three-factor model[1]	0.62	0.68	0.91	0.83	0.81	0.74	0.78	0.78	0.52	0.73	AC: 0.79 AD: 0.84 NC: 0.80	AC – AD: 0.86 AC – NC: 0.85 AD – NC: 1.01
Macedonian	One-factor model	0.58	0.60	0.79	0.87	0.83	0.68	0.80	0.82	0.63	0.67	0.92	–
	Two-factor model	0.62	0.64	0.87	0.88	0.84	0.69	0.81	0.83	0.64	0.68	AC: 0.76 AP: 0.91	0.85
	Three-factor model	0.62	0.64	0.88	0.88	0.84	0.69	0.82	0.85	0.64	0.69	AC: 0.76 AD: 0.85 NC: 0.84	AC – AD: 0.85 AC – NC: 0.82 AD – NC: 0.98
Mandarin - Simplified	One-factor model	0.65	0.65	0.79	0.89	0.90	0.88	0.88	0.89	0.75	0.67	0.95	–
	Two-factor model	0.71	0.71	0.91	0.90	0.90	0.89	0.89	0.89	0.77	0.68	AC: 0.82 AP: 0.95	0.81
	Three-factor model	0.70	0.71	0.92	0.90	0.91	0.89	0.90	0.90	0.78	0.68	AC: 0.82 AD: 0.93 NC: 0.89	AC – AD: 0.82 AC – NC: 0.78 AD – NC: 0.98
Mandarin - Traditional	One-factor model	0.53	0.58	0.77	0.92	0.92	0.90	0.90	0.90	0.78	0.74	0.95	–
	Two-factor model	0.58	0.63	0.86	0.92	0.92	0.91	0.90	0.91	0.78	0.74	AC: 0.74 AP: 0.96	0.85
	Three-factor model	0.59	0.63	0.87	0.93	0.93	0.91	0.91	0.92	0.80	0.75	AC: 0.74 AD: 0.95 NC: 0.91	AC – AD: 0.86 AC – NC: 0.80 AD – NC: 0.97
Polish	One-factor model	0.57	0.58	0.77	0.80	0.75	0.62	0.77	0.78	0.53	0.67	0.90	–
	Two-factor model	0.60	0.62	0.85	0.82	0.77	0.63	0.79	0.81	0.53	0.69	AC: 0.74 AP: 0.88	0.83
	Three-factor model[1]	0.61	0.61	0.85	0.81	0.76	0.62	0.79	0.81	0.54	0.69	AC: 0.73 AD: 0.77 NC: 0.80	AC – AD: 0.85 AC – NC: 0.83 AD – NC: 1.01
Portuguese – Brazil	One-factor model	0.55	0.76	0.86	0.84	0.82	0.63	0.81	0.80	0.60	0.72	0.92	–
	Two-factor model	0.59	0.80	0.92	0.87	0.84	0.65	0.83	0.83	0.62	0.74	AC: 0.82 AP: 0.91	0.80
	Three-factor model	0.59	0.80	0.92	0.86	0.84	0.65	0.84	0.84	0.62	0.75	AC: 0.82 AD: 0.83 NC: 0.85	AC – AD: 0.80 AC – NC: 0.79 AD – NC: 0.99
Slovak	One-factor model	0.55	0.62	0.81	0.81	0.78	0.66	0.78	0.78	0.49	0.67	0.90	–
	Two-factor model	0.59	0.65	0.88	0.83	0.79	0.66	0.78	0.79	0.50	0.69	AC: 0.75 AP: 0.89	0.85
	Three-factor model	0.58	0.66	0.88	0.83	0.80	0.67	0.79	0.79	0.49	0.69	AC: 0.76 AD: 0.81 NC: 0.79	AC – AD: 0.85 AC – NC: 0.85 AD – NC: 0.99
Spanish – Latin American	One-factor model	0.56	0.63	0.76	0.70	0.76	0.64	0.79	0.77	0.52	0.67	0.90	–
	Two-factor model	0.62	0.70	0.88	0.74	0.79	0.67	0.81	0.79	0.55	0.71	AC: 0.78 AP: 0.89	0.69
	Three-factor model	0.62	0.71	0.87	0.76	0.80	0.68	0.82	0.81	0.55	0.70	AC: 0.78 AD: 0.79 NC: 0.82	AC – AD: 0.69 AC – NC: 0.68 AD – NC: 0.94
Spanish – Spain	One-factor model	0.59	0.59	0.74	0.72	0.75	0.54	0.74	0.76	0.46	0.66	0.88	–
	Two-factor model	0.64	0.64	0.83	0.73	0.77	0.55	0.75	0.77	0.47	0.68	AC: 0.75 AP: 0.86	0.82
	Three-factor model[1]	0.65	0.64	0.82	0.73	0.77	0.54	0.75	0.78	0.47	0.67	AC: 0.75 AD: 0.72 NC: 0.77	AC – AD: 0.83 AC – NC: 0.82 AD – NC: 1.00
Gender													
Man	One-factor model	0.49	0.65	0.80	0.83	0.79	0.67	0.79	0.81	0.54	0.68	0.91	–
	Two-factor model	0.51	0.69	0.90	0.85	0.80	0.68	0.80	0.83	0.55	0.69	AC: 0.75 AP: 0.90	0.81

(*continued on next page*)

Table 3 (*continued*)

Subgroup	Measurement model	Standardized factor loadings (λ) on the items of the Alcohol Use Disorders Identification Test (AUDIT)										McDonald's ω	Inter-factor correlations (r)
		1	2	3	4	5	6	7	8	9	10		
	Three-factor model	0.52	0.69	0.91	0.86	0.81	0.69	0.81	0.83	0.55	0.69	AC: 0.76 AD: 0.83 NC: 0.82	AC – AD: 0.77 AC – NC: 0.82 AD – NC: 0.97
Woman	One-factor model	0.54	0.66	0.80	0.82	0.77	0.59	0.79	0.79	0.53	0.68	0.91	–
	Two-factor model	0.57	0.70	0.86	0.84	0.79	0.61	0.81	0.82	0.55	0.69	AC: 0.76 AP: 0.89	0.84
	Three-factor model	0.57	0.70	0.87	0.84	0.79	0.61	0.82	0.82	0.55	0.69	AC: 0.76 AD: 0.79 NC: 0.82	AC – AD: 0.83 AC – NC: 0.82 AD – NC: 0.97
Gender diverse individuals	One-factor model	0.59	0.64	0.81	0.84	0.79	0.75	0.75	0.80	0.60	0.71	0.92	–
	Two-factor model	0.63	0.68	0.88	0.86	0.81	0.77	0.76	0.82	0.60	0.73	AC: 0.78 AP: 0.91	0.83
	Three-factor model[1]	0.63	0.68	0.89	0.85	0.80	0.76	0.76	0.82	0.60	0.73	AC: 0.78 AD: 0.84 NC: 0.82	AC – AD: 0.84 AC – NC: 0.83 AD – NC: 1.02
Sexual orientation													
Heterosexual	One-factor model	0.51	0.66	0.81	0.82	0.77	0.62	0.78	0.80	0.54	0.68	0.91	–
	Two-factor model	0.54	0.70	0.89	0.84	0.79	0.64	0.80	0.82	0.54	0.70	AC: 0.76 AP: 0.89	0.82
	Three-factor model	0.54	0.69	0.89	0.85	0.80	0.65	0.81	0.83	0.55	0.70	AC: 0.76 AD: 0.81 NC: 0.81	AC – AD: 0.80 AC – NC: 0.82 AD – NC: 0.97
Gay and lesbian	One-factor model	0.57	0.66	0.83	0.83	0.80	0.70	0.76	0.82	0.56	0.70	0.91	–
	Two-factor model	0.61	0.70	0.91	0.86	0.82	0.72	0.78	0.85	0.57	0.72	AC: 0.79 AP: 0.91	0.80
	Three-factor model	0.61	0.70	0.92	0.87	0.83	0.72	0.79	0.85	0.58	0.72	AC: 0.79 AD: 0.85 NC: 0.83	AC – AD: 0.78 AC – NC: 0.81 AD – NC: 0.97
Bisexual	One-factor model	0.58	0.63	0.81	0.83	0.78	0.63	0.78	0.78	0.52	0.68	0.91	–
	Two-factor model	0.62	0.68	0.88	0.85	0.79	0.64	0.80	0.80	0.53	0.70	AC: 0.77 AP: 0.89	0.82
	Three-factor model	0.62	0.67	0.89	0.84	0.79	0.64	0.81	0.81	0.53	0.70	AC: 0.78 AD: 0.81 NC: 0.81	AC – AD: 0.83 AC – NC: 0.81 AD – NC: 0.99
Emerging sexual identities	One-factor model	0.55	0.65	0.80	0.84	0.77	0.65	0.78	0.79	0.57	0.70	0.91	–
	Two-factor model	0.59	0.69	0.87	0.86	0.79	0.66	0.80	0.81	0.58	0.72	AC: 0.77 AP: 0.90	0.83
	Three-factor model	0.59	0.70	0.88	0.86	0.79	0.67	0.80	0.81	0.58	0.72	AC: 0.77 AD: 0.82 NC: 0.82	AC – AD: 0.82 AC – NC: 0.83 AD – NC: 0.99

Notes. Items – 1: frequency of alcohol consumption, 2: quantity of alcohol consumption, 3: heavy episodic drinking, 4: impaired control, 5: failure to meet expectations, 6: morning drinking, 7: guilt feelings, 8: blackouts, 9: injuries, 10: others' concerns. One-factor model: items 1 to 10 load on one factor. Two-factor model: items 1 to 3 load on the factor of alcohol consumption (AC), and items 4 to 10 load on the factor of alcohol problems (AP). Three-factor model: items 1–3 load on the factor of alcohol consumption (AC), items 4 to 6 load on the factor of alcohol dependence (AD), and items 7 to 10 load on the factor of negative consequences (NC). All factor loadings and correlations are significant at $p < 0.001$ level.[1]The model was not considered as the latent variable covariance matrix was not positive definite due to the correlation ≥1.00 between the factors of alcohol dependence and negative consequences.

Korean-speaking individuals had the highest mean scores, with significantly higher scores than the majority of countries and language subgroups – in numerous cases with medium to strong effect sizes for the alcohol-consumption subscale. It is important to note that these two groups were largely overlapping as most individuals from South Korea in the present sample spoke Korean. The lowest average scores for both subscales were observed among those living in Taiwan and in the Mandarin – Traditional language subgroup (these were two largely overlapping groups, as most individuals from Taiwan in the study completed the traditional Mandarin survey version), with significantly lower scores for the two AUDIT subscales compared to all countries and language subgroups. These differences were almost always at medium to strong effect sizes for the alcohol consumption subscale (except compared to China and the Mandarin – Simplified subgroup, which were also two largely overlapping groups, as most individuals from China completed the simplified Mandarin survey version).

Significant and small overall differences were shown for the alcohol consumption and alcohol problems subscales between gender and sexual orientation subgroups. Men showed significantly and marginally higher alcohol consumption compared to gender diverse individuals and women. Gender diverse individuals and men had significantly higher rates of alcohol problems compared to women – with small effect sizes. Among sexual orientation identities, gay and lesbian and bisexual+ individuals had significantly higher scores on the AUDIT alcohol consumption subscale (with small effect size), compared to individuals with heterosexual and emerging sexual identities. Bisexual+ individuals demonstrated significantly higher and heterosexual individuals significantly lower levels of alcohol problems compared to all other sexual orientation identities (with small effect sizes in each case).

4. Discussion

The present study investigated the fit of different measurement models for the AUDIT and its measurement invariance across a wide range of subgroups by country, language, gender, and sexual orientation. The AUDIT is often used in cross-cultural studies to measure and compare alcohol consumption and alcohol problems cross-nationally [40], but previous studies have not examined, in a thorough manner and across a large number of countries and language subgroups, whether the questionnaire measures these constructs equivalently, which may lead to biased comparisons.

Overall, a two-factor model with factors of alcohol consumption and

Table 4
Measurement invariance testing.

Invariance model	χ^2	df	p	CFI	TLI	RMSEA [90% CI]	Comparison	ΔCFI	ΔTLI	ΔRMSEA
Country of residence										
Configural invariance (M1)	13,351.600	714	<0.001	0.950	0.933	0.090 [0.089; 0.092]	–	–	–	–
Metric invariance[1] (M2)	16,434.706	874	<0.001	0.938	0.933	0.091 [0.089; 0.092]	M1 vs. M2	−0.012	0.000	−0.001
Scalar invariance (M3)	**15,397.944**	**1334**	**<0.001**	**0.944**	**0.960**	**0.070 [0.069; 0.071]**	M2 vs. M3	+0.006	+0.027	+0.021
Residual invariance (M4)	19,219.113	1534	<0.001	0.930	0.957	0.073 [0.072; 0.074]	M3 vs. M4	−0.014	−0.003	−0.003
Variance and covariance invariance (M5)	17,045.195	1594	<0.001	0.938	0.964	0.067 [0.066; 0.068]	M4 vs. M5	+0.008	+0.007	+0.006
Latent mean invariance (M6)	**20,781.258**	**1634**	**<0.001**	**0.924**	**0.956**	**0.073 [0.073; 0.074]**	M5 vs. M6	−0.014	−0.008	−0.006
Language										
Configural invariance (M1)	17,520.716	476	<0.001	0.940	0.920	0.098 [0.097; 0.099]	–	–	–	–
Metric invariance (M2)	19,868.077	580	<0.001	0.932	0.926	0.095 [0.094; 0.096]	M1 vs. M2	−0.008	+0.006	+0.003
Scalar invariance (M3)	**16,097.533**	**879**	**<0.001**	**0.946**	**0.962**	**0.068 [0.067; 0.069]**	M2 vs. M3	+0.014	+0.036	+0.027
Residual invariance (M4)	20,130.945	1009	<0.001	0.933	0.958	0.071 [0.071; 0.072]	M3 vs. M4	−0.013	−0.004	−0.003
Variance and covariance invariance (M5)	17,131.259	1048	<0.001	0.943	0.966	0.064 [0.063; 0.065]	M4 vs. M5	+0.010	+0.008	+0.007
Latent mean invariance (M6)	**19,378.467**	**1074**	**<0.001**	**0.935**	**0.962**	**0.068 [0.067; 0.069]**	M5 vs. M6	−0.008	−0.004	−0.004
Gender										
Configural invariance (M1)	9690.578	102	<0.001	0.968	0.957	0.067 [0.066; 0.068]	–	–	–	–
Metric invariance (M2)	9880.748	118	<0.001	0.967	0.962	0.063 [0.062; 0.064]	M1 vs. M2	−0.001	+0.005	+0.004
Scalar invariance (M3)	7135.012	164	<0.001	0.976	0.981	0.045 [0.044; 0.046]	M2 vs. M3	+0.009	+0.019	+0.018
Residual invariance (M4)	7771.055	184	<0.001	0.974	0.981	0.044 [0.043; 0.045]	M3 vs. M4	−0.002	0.000	+0.001
Variance and covariance invariance (M5)	5145.973	190	<0.001	0.983	0.988	0.035 [0.034; 0.036]	M4 vs. M5	+0.009	+0.007	+0.009
Latent mean invariance (M6)	**7207.236**	**194**	**<0.001**	**0.976**	**0.984**	**0.042 [0.041; 0.042]**	M5 vs. M6	−0.007	−0.004	−0.007
Sexual orientation										
Configural invariance (M1)	11,332.359	136	<0.001	0.962	0.949	0.072 [0.071; 0.074]	–	–	–	–
Metric invariance[2] (M2)	9260.518	160	<0.001	0.969	0.965	0.060 [0.059; 0.061]	M1 vs. M2	+0.007	+0.016	+0.012
Scalar invariance (M3)	6317.931	229	<0.001	0.979	0.984	0.041 [0.040; 0.042]	M2 vs. M3	+0.010	+0.019	+0.019
Residual invariance (M4)	6104.070	259	<0.001	0.980	0.986	0.038 [0.037; 0.039]	M3 vs. M4	+0.001	+0.002	+0.003
Variance and covariance invariance (M5)	3845.371	268	<0.001	0.988	0.992	0.029 [0.028; 0.030]	M4 vs. M5	+0.008	+0.006	+0.009
Latent mean invariance (M6)	**4083.373**	**274**	**<0.001**	**0.987**	**0.991**	**0.030 [0.029; 0.031]**	M5 vs. M6	−0.001	−0.001	−0.001

Notes. χ^2: Chi-square test of model fit. CFI: Comparative Fit Index. TLI: Tucker-Lewis Index. RMSEA [90% CI]: Root Mean Square Error of Approximation [90% Confidence Interval]. ΔCFI, ΔTLI, ΔRMSEA: differences on the CFI, the TLI and the RMSEA between the two given invariance models. Positive values for the comparisons of invariance models indicate improvement for the more restrictive model (with larger degrees of freedom) and negative values show decrease in model fit for the more restrictive model.[1]The latent variable covariance matrix in the subgroup of Australia was not positive definite due to the correlation >1.00 between the two latent factors. The bolded invariance models were considered as the best fitting invariance model.[2]The residual covariance matrix in the subgroup of homosexuals was not positive definite due to the negative residual variance on item 3.

alcohol problems was found to be the most appropriate across subgroups by country, language, gender, and sexual orientation, with at least adequate reliability values. This model was characterized by very similar levels of model fit compared to the three-factor model, in which the separability of the alcohol dependence and the negative consequences factors was highly questionable, making it more parsimonious to group the related items into a common factor. In other words, the results of the present study are consistent with previous studies that have also observed the most appropriate model fit for the two-factor model [8,12]. The acceptance of the two-factor model may have important practical implications for the use of the AUDIT. In line with the one-factor model, the total score on the AUDIT is calculated and evaluated most frequently in research and clinical practice [2]. However, the results of the present study did not suggest robust evidence of model fit for the one-factor of the AUDIT. Thus, based on the two-factor model, a two-step screening process may be worth considering using the AUDIT: first, the severity of alcohol consumption is assessed, and among those at risk, an assessment of alcohol problems may also be warranted [41]. However, it is important to note that the present study did not examine the screening performance of the AUDIT, so conclusions in this regard should be drawn cautiously. Another important limitation of the two-factor model was the strong positive correlation between the two factors in each subgroup, which may raise concerns about the use of these constructs as independent variables in multivariate statistical models.

The two-factor model assuming latent mean level invariance was found to have the best fit across countries and language subgroups. This model describes a high level of measurement equivalence between groups, assuming similarity in measurement parameters (i.e., factor structure, factor loadings, item thresholds and residuals) as well as in structural characteristics (i.e., factor variances, correlation between factors, and means of latent factors). However, it is important to highlight that under more stringent criteria, scalar level invariance would have been reached (i.e., in a similar factor structure, factor loadings and item thresholds were equal between the groups, but item residuals and structural parameters were different). Given the high number of countries and languages in the study, the less restrictive cut-off values were considered in drawing the conclusions, and these indicated a higher level of invariance (i.e., latent mean invariance) [34]. The significance of the present study is that, compared to previous studies testing cross-cultural measurement invariance [17], the psychometric properties of the AUDIT were analyzed over a much larger number of subgroups. The high level of measurement invariance that has been proposed may suggest that cross-cultural comparisons of the AUDIT scores can be justified, as they may capture genuine differences between groups and are not attributable to measurement bias. That is, these results may provide an empirical basis for the use of the AUDIT in cross-cultural research.

In the present research, the comparison between countries and language groups yielded intriguing results. Although a very cautious interpretation of these differences is recommended due to the non-representative sample, individual from South Korea, respectively those speaking Korean, showed the highest scores for alcohol consumption and alcohol problems. Previous research has reported that although there has been a decline in the prevalence of AUD in South Korea in recent decades, the prevalence of AUD can still be considered high (e.g., higher prevalence than in other Asian countries and comparable to the rate in the US) [42–44]. The high levels of alcohol use and alcohol problems among them may in part be explained by low levels of treatment utilization [43]. In addition, the demographic characteristics and recruitment methods of participants from South Korea and speaking Korean may have influenced the results. For example, participants from South Korea and speaking Korean had one of the lowest mean ages compared to the other countries and language subgroups included, and

Table 5
Post-hoc comparison of country- and language-based subgroups.

Country of residence					
Alcohol consumption[1]			Alcohol problems[2]		
Subgroup	M (SD) Range	Subgroups with significantly smaller mean ($p_{Tukey} < 0.001$)	Subgroup	M (SD) Range	Subgroups with significantly smaller mean ($p_{Tukey} < 0.001$)
South Korea (KOR)	5.16 (2.87) 1–12	IRL (d = 0.25), NZL (d = 0.44), CHE (d = 0.47), AUS (d = 0.50), ZAF (d = 0.56), BRA (d = 0.59), BEL (d = 0.64), SVK (d = 0.70), CAN (d = 0.72), HUN (d = 0.72), MKD (d = 0.76), COL (d = 0.79), CZE (d = 0.82), DEU (d = 0.87), POL (d = 0.87), LTU (d = 0.89), ESP (d = 0.90), MEX (d = 0.94), CHN (d = 1.10), TWN (d = 1.47)	South Korea (KOR)	3.23 (4.57) 0–23	NZL (d = 0.23), CHN (d = 0.27), ZAF (d = 0.29), SVK (d = 0.30), CHE (d = 0.30), COL (d = 0.30), BRA (d = 0.34), HUN (d = 0.34), MKD (d = 0.36), AUS (d = 0.37), CAN (d = 0.43), LTU (d = 0.44), BEL (d = 0.44), POL (d = 0.45), MEX (d = 0.47), DEU (d = 0.49), CZE (d = 0.49), TWN (d = 0.70)
Ireland (IRL)	4.64 (2.42) 1–12	NZL (d = 0.19), CHE (d = 0.22), ZAF (d = 0.31), BRA (d = 0.34), BEL (d = 0.39), SVK (d = 0.45), CAN (d = 0.47), HUN (d = 0.48), MKD (d = 0.52), COL (d = 0.54), CZE (d = 0.58), DEU (d = 0.62), POL (d = 0.62), LTU (d = 0.64), ESP (d = 0.65), MEX (d = 0.69), CHN (d = 0.85), TWN (d = 1.22)	Ireland (IRL)	2.88 (3.91) 0–23	BRA (d = 0.23), HUN (d = 0.23), MKD (d = 0.25), CAN (d = 0.32), LTU (d = 0.33), BEL (d = 0.33), POL (d = 0.34), MEX (d = 0.36), DEU (d = 0.38), CZE (d = 0.38), TWN (d = 0.60)
New Zealand (NZL)	4.25 (2.49) 1–12	SVK (d = 0.26), CAN (d = 0.28), HUN (d = 0.29), MKD (d = 0.33), COL (d = 0.36), CZE (d = 0.39), DEU (d = 0.43), POL (d = 0.43), LTU (d = 0.46), ESP (d = 0.47), MEX (d = 0.50), CHN (d = 0.66), TWN (d = 1.04)	Spain (ESP)	2.59 (3.37) 0–21	HUN (d = 0.15), CAN (d = 0.23), LTU (d = 0.24), BEL (d = 0.24), POL (d = 0.25), MEX (d = 0.27), DEU (d = 0.29), CZE (d = 0.29), TWN (d = 0.51)
Switzerland (CHE)	4.18 (2.14) 1–11	SVK (d = 0.23), CAN (d = 0.25), HUN (d = 0.26), MKD (d = 0.30), COL (d = 0.32), CZE (d = 0.35), DEU (d = 0.40), POL (d = 0.40), LTU (d = 0.42), ESP (d = 0.43), MEX (d = 0.47), CHN (d = 0.63), TWN (d = 1.00)	New Zealand (NZL)	2.49 (3.79) 0–25	CAN (d = 0.20), LTU (d = 0.21), POL (d = 0.22), MEX (d = 0.24), DEU (d = 0.26), CZE (d = 0.26), TWN (d = 0.48)
Australia (AUS)	4.11 (2.51) 1–12	COL (d = 0.29), CZE (d = 0.32), DEU (d = 0.37), POL (d = 0.37), LTU (d = 0.39), ESP (d = 0.40), MEX (d = 0.44), CHN (d = 0.60), TWN (d = 0.83)	China (CHN)	2.34 (4.05) 0–26	POL (d = 0.18), MEX (d = 0.20), DEU (d = 0.22), CZE (d = 0.22), TWN (d = 0.43)
South Africa (ZAF)	3.99 (2.17) 1–12	HUN (d = 0.16), MKD (d = 0.20), COL (d = 0.23), CZE (d = 0.26), DEU (d = 0.31), POL (d = 0.31), LTU (d = 0.33), ESP (d = 0.34), MEX (d = 0.38), CHN (d = 0.54), TWN (d = 0.91)	South Africa (ZAF)	2.28 (3.58) 0–26	POL (d = 0.16), MEX (d = 0.18), DEU (d = 0.20), CZE (d = 0.20), TWN (d = 0.41)
Brazil (BRA)	3.93 (2.51) 1–12	HUN (d = 0.14), COL (d = 0.20), CZE (d = 0.24), DEU (d = 0.28), POL (d = 0.28), LTU (d = 0.30), ESP (d = 0.31), MEX (d = 0.35), CHN (d = 0.51), TWN (d = 0.88)	Slovakia (SVK)	2.27 (3.37) 0–22	DEU (d = 0.19), TWN (d = 0.41)
Belgium (BEL)	3.82 (2.36) 1–12	ESP (d = 0.26), MEX (d = 0.30), CHN (d = 0.46), TWN (d = 0.83)	Switzerland (CHE)	2.25 (3.25) 0–23	DEU (d = 0.19), CZE (d = 0.19), TWN (d = 0.40)
Slovakia (SVK)	3.69 (2.04) 1–12	POL (d = 0.17), LTU (d = 0.19), ESP (d = 0.20), MEX (d = 0.24), CHN (d = 0.40), TWN (d = 0.77)	Colombia (COL)	2.24 (3.39) 0–24	POL (d = 0.15), MEX (d = 0.17), DEU (d = 0.19), CZE (d = 0.19), TWN (d = 0.40)
Canada (CAN)	3.65 (2.20) 1–12	DEU (d = 0.15), POL (d = 0.15), LTU (d = 0.17), ESP (d = 0.18), MEX (d = 0.22), CHN (d = 0.38), TWN (d = 0.75)	Brazil (BRA)	2.14 (3.48) 0–28	POL (d = 0.11), DEU (d = 0.15), CZE (d = 0.15), TWN (d = 0.37)
Hungary (HUN)	3.64 (2.04) 1–12	DEU (d = 0.15), POL (d = 0.15), LTU (d = 0.17), ESP (d = 0.18), MEX (d = 0.21), CHN (d = 0.37), TWN (d = 0.75)	Hungary (HUN)	2.12 (3.20) 0–23	POL (d = 0.11), MEX (d = 0.13), DEU (d = 0.15), CZE (d = 0.15), TWN (d = 0.36)
North Macedonia (MKD)	3.56 (2.15) 1–12	CHN (d = 0.33), TWN (d = 0.71)	North Macedonia (MKD)	2.06 (3.53) 0–21	TWN (d = 0.34)
Colombia (COL)	3.50 (2.27) 1–11	CHN (d = 0.31), TWN (d = 0.68)	Australia (AUS)	2.02 (3.76) 0–27	TWN (d = 0.33)
Czech Republic (CZE)	3.43 (2.08) 1–12	CHN (d = 0.27), TWN (d = 0.65)	Canada (CAN)	1.84 (3.18) 0–24	TWN (d = 0.28)
Germany (DEU)	3.34 (1.88) 1–12	CHN (d = 0.23), TWN (d = 0.60)	Lithuania (LTU)	1.82 (2.94) 0–19	TWN (d = 0.27)
Poland (POL)	3.34 (1.80) 1–12	CHN (d = 0.23), TWN (d = 0.60)	Belgium (BEL)	1.80 (2.99) 0–25	TWN (d = 0.26)
Lithuania (LTU)	3.29 (2.05) 1–12	CHN (d = 0.20), TWN (d = 0.58)	Poland (POL)	1.77 (2.79) 0–26	TWN (d = 0.25)
Spain (ESP)	3.27 (1.92) 1–11	CHN (d = 0.19), TWN (d = 0.57)	Mexico (MEX)	1.70 (2.97) 0–22	TWN (d = 0.23)
Mexico (MEX)	3.20 (2.07) 1–11	TWN (d = 0.53)	Germany (DEU)	1.64 (2.64) 0–21	TWN (d = 0.21)
China (CHN)	2.86 (2.11) 1–12	TWN (d = 0.37)	Czech Republic (CZE)	1.64 (3.06) 0–23	TWN (d = 0.21)
Taiwan (TWN)	2.08 (1.43) 1–12	–	Taiwan (TWN)	0.95 (2.61) 0–28	–

Language

Alcohol consumption[3]

Subgroup	M (SD) Range	Subgroups with significantly smaller mean ($p_{Tukey} < 0.001$)
Korean (KOR)	5.18 (2.88) 1–12	ENG (d = 0.59), PR-B (d = 0.60), FRE (d = 0.65), SVK (d = 0.73), HUN (d = 0.73), MKD (d = 0.76), CZE (d = 0.83), POL (d = 0.88), LTU (d = 0.88), SP-L (d = 0.89), SP-S (d = 0.92), MN-S (d = 1.11), MN-T (d = 1.46)
English (ENG)	3.94 (2.37) 1–12	SVK (d = 0.14), HUN (d = 0.14), MKD (d = 0.17), CZE (d = 0.24), POL (d = 0.29), LTU (d = 0.29), SP-L (d = 0.30), SP-S (d = 0.33), MN-S (d = 0.52), MN-T (d = 0.88)
Portuguese – Brazil (PR-B)	3.92 (2.49) 1–12	HUN (d = 0.13), CZE (d = 0.23), POL (d = 0.28), LTU (d = 0.28), SP-L (d = 0.30), SP-S (d = 0.32), MN-S (d = 0.51), MN-T (d = 0.87)
French (FRE)	3.80 (2.14) 1–12	CZE (d = 0.18), POL (d = 0.22), LTU (d = 0.23), SP-L (d = 0.24), SP-S (d = 0.26), MN-S (d = 0.45), MN-T (d = 0.81)
Slovak (SVK)	3.64 (2.06) 1–12	POL (d = 0.14), LTU (d = 0.15), SP-L (d = 0.16), SP-S (d = 0.18), MN-S (d = 0.37), MN-T (d = 0.73)
Hungarian (HUN)	3.63 (2.03) 1–12	POL (d = 0.14), LTU (d = 0.15), SP-L (d = 0.16), SP-S (d = 0.18), MN-S (d = 0.37), MN-T (d = 0.73)
Macedonian (MKD)	3.57 (2.15) 1–12	MN-S (d = 0.34), MN-T (d = 0.70)
Czech (CZE)	3.43 (2.09) 1–12	MN-S (d = 0.28), MN-T (d = 0.64)
Polish (POL)	3.33 (1.80) 1–12	MN-S (d = 0.23), MN-T (d = 0.59)
Lithuanian (LTU)	3.32 (2.07) 1–12	MN-S (d = 0.23), MN-T (d = 0.58)
Spanish – Latin American (SP-L)	3.29 (2.11) 1–11	MN-S (d = 0.21), MN-T (d = 0.57)
Spanish – Spain (SP-S)	3.25 (1.89) 1–10	MN-S (d = 0.19), MN-T (d = 0.55)
Mandarin – simplified (MN-S)	2.84 (2.10) 1–12	MN-T (d = 0.36)
Mandarin – traditional (MN-T)	2.09 (1.44) 1–12	–

Alcohol problems[4]

Subgroup	M (SD) Range	Subgroups with significantly smaller mean ($p_{Tukey} < 0.001$)
Korean (KOR)	3.26 (4.59) 0–23	MN-S (d = 0.29), ENG (d = 0.32), SVK (d = 0.33), PR-B (d = 0.34), HUN (d = 0.35), MKD (d = 0.36), FRE (d = 0.40), SP-L (d = 0.40), LTU (d = 0.42), POL (d = 0.46), CZE (d = 0.50), MN-T (d = 0.71)
Spanish – Spain (SP-S)	2.61 (3.41) 0–21	ENG (d = 0.12), PR-B (d = 0.14), HUN (d = 0.15), FRE (d = 0.20), SP-L (d = 0.20), LTU (d = 0.22), POL (d = 0.26), CZE (d = 0.30), MN-T (d = 0.51)
Mandarin – simplified (MN-S)	2.31 (4.03) 0–26	POL (d = 0.17), CZE (d = 0.21), MN-T (d = 0.42)
English (ENG)	2.21 (3.57) 0–27	SP-L (d = 0.08), POL (d = 0.14), CZE (d = 0.18), MN-T (d = 0.39)
Slovak (SVK)	2.17 (3.24) 0–22	POL (d = 0.13), CZE (d = 0.17), MN-T (d = 0.38)
Portuguese – Brazil (PR-B)	2.14 (3.49) 0–28	POL (d = 0.12), CZE (d = 0.15), MN-T (d = 0.37)
Hungarian (HUN)	2.11 (3.19) 0–23	POL (d = 0.11), CZE (d = 0.15), MN-T (d = 0.36)
Macedonian (MKD)	2.10 (3.57) 0–21	MN-T (d = 0.35)
French (FRE)	1.97 (3.17) 0–24	MN-T (d = 0.31)
Spanish – Latin American (SP-L)	1.96 (3.17) 0–24	MN-T (d = 0.31)
Lithuanian (LTU)	1.90 (3.05) 0–22	MN-T (d = 0.29)
Polish (POL)	1.76 (2.77) 0–26	MN-T (d = 0.25)
Czech (CZE)	1.63 (3.13) 0–23	MN-T (d = 0.21)
Mandarin – traditional (MN-T)	0.94 (2.60) 0–28	–

Gender

Alcohol consumption[5]

Subgroup	M (SD) Range	Subgroups with significantly smaller mean ($p_{Tukey} < 0.001$)
Man (MN)	3.89 (2.29) 1–12	GD (d = 0.28), WM (d = 0.31)
Gender diverse individuals (GD)	3.31 (2.13) 1–12	–
Woman (WM)	3.23 (1.96) 1–12	–

Alcohol problems[6]

Subgroup	M (SD) Range	Subgroups with significantly smaller mean ($p_{Tukey} < 0.001$)
Gender diverse individuals (GD)	2.30 (3.65) 0–24	WM (d = 0.15)
Man (MN)	2.14 (3.40) 0–28	WM (d = 0.09)
Woman (WM)	1.83 (3.04) 0–28	–

Sexual orientation

Alcohol consumption[7]

Subgroup	M (SD) Range	Subgroups with significantly smaller mean ($p_{Tukey} < 0.001$)
Gay and lesbian (GL)	3.67 (2.29) 1–12	HE (d = 0.09), EM (d = 0.10)
Bisexual+ (BI+)	3.60 (2.15) 1–12	HE (d = 0.06), EM (d = 0.07)

Alcohol problems[8]

Subgroup	M (SD) Range	Subgroups with significantly smaller mean ($p_{Tukey} < 0.001$)
Bisexual+ (BI+)	2.39 (3.57) 0–27	EM (d = 0.07), GL (d = 0.10), HE (d = 0.17)
Emerging sexual identities (EM)	2.16 (3.38) 0–28	HE (d = 0.10)

(continued on next page)

Table 5 (*continued*)

Sexual orientation					
Alcohol consumption[7]			Alcohol problems[8]		
Subgroup	M (SD) Range	Subgroups with significantly smaller mean ($p_{Tukey} < 0.001$)	Subgroup	M (SD) Range	Subgroups with significantly smaller mean ($p_{Tukey} < 0.001$)
Heterosexual (HE)	3.47 (2.12) 1–12	–	Gay and lesbian (GL)	2.08 (3.43) 0–26	HE (d = 0.08)
Emerging sexual identities (EM)	3.45 (2.07) 1–12	–	Heterosexual (HE)	1.84 (3.08) 0–28	–

Notes.[1]One-way ANOVA: F (20, 45,249) = 140.28; $p < 0.001$; $\eta^2 = 0.06$; Kruskal-Wallis-test: H (20) = 2541.07; $p < 0.001$; $\eta^2 = 0.06$.[2]One-way ANOVA: F (20, 45,198) = 36.21; $p < 0.001$; $\eta^2 = 0.02$; Kruskal-Wallis-test: H (20) = 926.15; $p < 0.001$; $\eta^2 = 0.02$.[3]One-way ANOVA: F (13, 51,529) = 184.84; $p < 0.001$; $\eta^2 = 0.05$; Kruskal-Wallis-test: H (13) = 2228.04; $p < 0.001$; $\eta^2 = 0.04$.[4]One-way ANOVA: F (13, 51,463) = 41.99; $p < 0.001$; $\eta^2 = 0.01$; Kruskal-Wallis-test: H (13) = 735.43; $p < 0.001$; $\eta^2 = 0.01$.[5]One-way ANOVA: F (2, 62,417) = 728.31; $p < 0.001$; $\eta^2 = 0.02$; Kruskal-Wallis-test: H (2) = 1246.70; $p < 0.001$; $\eta^2 = 0.02$.[6]One-way ANOVA: F (2, 62,340) = 76.83; $p < 0.001$; $\eta^2 = 0.00$; Kruskal-Wallis-test: H (2) = 84.76; $p < 0.001$; $\eta^2 = 0.00$.[7]One-way ANOVA: F (3, 62,251) = 18.08; $p < 0.001$; $\eta^2 = 0.00$; Kruskal-Wallis-test: H (3) = 46.42; $p < 0.001$; $\eta^2 = 0.00$.[8]One-way ANOVA: F (3, 62,179) = 81.50; $p < 0.001$; $\eta^2 = 0.00$; Kruskal-Wallis-test: H (3) = 297.10; $p < 0.001$; $\eta^2 = 0.01$. Games-Howell post-hoc test was performed with Tukey's correction for significance testing. d: Cohen's d (effect size of mean difference).

more than half of them were currently studying in tertiary education. Previous studies have indicated that young adults and those in tertiary education may be at risk for experiencing adverse alcohol use outcomes [45]. In addition, a significant number of participants from South Korea and speaking Korean were recruited via social networking sites (e.g., Instagram, Facebook). It may be possible that greater exposure to alcohol-related content on social media sites could have influenced the alcohol use of young adult participants from South Korea and speaking Korean [46].

The highest-level invariance assuming equality of means of latent factors was accepted across gender and sexual orientation subgroups for the two-factor model. The data suggested that high levels of model fit and only slight decreases in fit were detected if, in a similar factor structure, the means of the alcohol-consumption and the alcohol-problems factors were held to be equal in addition to factor loadings, item thresholds and residuals, and factor variances and correlations between factors. These results imply that the AUDIT provides an equivalent measurement across gender and sexual-orientation identities and allows for comparing scores across genders and sexual orientations. The present study makes an important contribution to previous research reporting that the factor loadings and thresholds of the AUDIT items showed invariance between men and women [8,12,15]. To the best of our knowledge, gender diverse individuals were included in the invariance analysis for the first time. In addition, the present study investigated for the first time whether measurement invariance for the AUDIT can be identified with respect to sexual orientation. These findings could be considered relevant primarily because a number of previous studies have reported significant gender- and sexual-orientation-related differences in alcohol consumption and AUD [20,47,48], suggesting that the AUDIT may be an appropriate instrument to detect these differences.

In the present study, only small differences were observed between gender and sexual orientation identities. Men showed the highest levels of alcohol consumption, while men and gender diverse individuals had more severe alcohol problems than women. In terms of sexual orientation, bisexual+ individuals showed the highest levels of alcohol consumption and alcohol problems, and gay and lesbian individuals also showed elevated levels of alcohol consumption. That is, these findings are in line with some previous research findings showing significantly higher rates of alcohol use and alcohol problems among men, gender diverse individuals, and sexual-minority subgroups, such as lesbian and bisexual individuals [20,24,47,48]. However, these small differences between genders and sexual orientations can be linked to previous research that has found narrowing gender differences in alcohol consumption and AUD between men and women [49,50] and reported low-marginal differences in negative alcohol consumption outcomes between heterosexual and sexual minority individuals [25]. However, several factors may explain why only small differences were detected. Gender diverse and sexual-orientation subgroups were heterogeneous in the present study, and it is possible that significant heterogeneity in alcohol use was observed within each group. Possible interactions of sexual orientation and gender/sex were not considered in the invariance analysis (e.g., it might be possible that non-binary individuals with a male sex at birth and lesbian and bisexual women might have shown increased scores on the AUDIT), and age effects and the presence of gender incongruence/transgender could have influenced disparities [19,22,48,51]. It is plausible that varying levels of economic development in different countries, more lenient attitudes towards alcohol use based on gender, and social rejection and discrimination towards sexual-orientation and gender minorities may have masked actual differences between gender and sexual-orientation subgroups [22,48]. Finally, it is important to note that sexual orientation was assessed in the present study based on participants' self-identification, and it is also possible that a different pattern might have emerged in measurement invariance testing if behavior or attraction would have been considered [24].

4.1. Limitations

Cautious conclusions should be drawn from the results due to study limitations. For a summary of the general limitations of the ISS, see https://osf.io/6kscb. In addition, it is important to highlight multiple specific limitations in relation to the analysis performed in the context of the AUDIT. First, the definition of the subgroups and the inclusion of the subgroups in the study could have influenced the results of CFA and measurement invariance testing. For example, multiple participating countries and language subgroups were excluded due to sample-size requirements, and gender and sexual-orientation minority groups were combined in several cases. In addition, it may have been worthwhile to investigate measurement invariance along additional grouping variables. Second, some approaches to measurement invariance testing were not or could not be applied in the present study. In the case of having large numbers of subgroups, the use of an alignment invariance method may be recommended in addition to the traditional approach [29], while the cross-sectional nature of the study prevented longitudinal measurement invariance testing for the AUDIT [52]. Fourth, several aspects of the validity of the AUDIT were not addressed and assessed in the present study. For example, the criterion or convergent validity of the instrument, the screening performance of different cutoffs of the AUDIT (e.g., testing the validity of different cutoff scores across gender and sexual-orientation subgroups) [5,10], the possible role of different standard drink sizes across countries [53], or the psychometric properties and measurement invariance of various abbreviated versions of the AUDIT were not examined [54]. Finally, it is important to highlight that a cautious interpretation of differences on the AUDIT between subgroups is recommended due to the applied non-representative sampling and subtle differences in recruitment and sampling strategies between the participating countries.

5. Conclusions

Using data from a large cross-cultural study (The International Sex Survey), the present study examined the latent structure and measurement invariance of the AUDIT across 21 countries, 14 language subgroups, three gender groups (including gender diverse individuals in addition to men and women), and four sexual-orientation groups (including gay and lesbian, bisexual+, individuals with emerging sexual identities in addition to heterosexual individuals). Overall, the two-factor model was found to be the most appropriate for the AUDIT, which may call for consideration of calculating separate scores for alcohol use and alcohol-related problems when using the questionnaire. In addition, high levels of measurement invariance were demonstrated across subgroups by country, language, gender, and sexual orientation. This may provide a better understanding of the psychometric properties of the AUDIT and an empirical basis for considering the AUDIT as an appropriate instrument for measuring and comparing constructs of alcohol use and alcohol problems in cross-cultural studies, or between genders and sexual orientations.

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