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Gender Differences in the Factor Structure of the Alcohol Use Disorders Identification Test in Multinational General Population Surveys*

Chun-Zi Peng, Richard W. Wilsnack, Arlinda F. Kristjanson, Perry Benson, and Sharon C. Wilsnack*

Department of Clinical Neuroscience, University of North Dakota School of Medicine and Health Sciences, Grand Forks, North Dakota, USA

Abstract

Background—Most gender-specific studies of the Alcohol Use Disorders Identification Test (AUDIT) have focused on gender differences in thresholds for hazardous drinking. This study examines gender differences in the factor structure of the AUDIT in general-population surveys.

Methods—General-population surveys from 15 countries provided 27,478 current drinkers' responses to the AUDIT and related measures. We used single-group confirmatory factor analysis (CFA) to evaluate goodness-of-fit of three hypothesized models for responses to the AUDIT by men and women in each country. Bayesian Information Criteria (BIC) using a maximum likelihood robust (MLR) estimator was evaluated to identify the best fitted model. We then assessed factorial invariance within country surveys where fit indices were acceptable for both genders. Gender-specific internal consistency and concurrent validity were also evaluated in all 15 countries. Results: CFA revealed that the fit indices of 2-factor or 3-factor models were consistently better than fit indices for a 1-factor model in 14 of 15 countries. Comparisons of BIC values indicated that the 2-factor solution was the best fitted model. Factorial invariance tests in data from 3 countries indicated that the factor loadings and thresholds of the AUDIT were invariant across gender. The internal reliability and concurrent validity of AUDIT and its subscales were acceptable in both genders.

Conclusions—A two-factor model best describes AUDIT responses across general-population surveys in 12 of 15 countries, with acceptable internal reliability and concurrent validity, and supports a gender-invariant structure in at least three of those countries.

Keywords

AUDIT; Gender difference; Factor structure

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*Correspondence: Sharon C. Wilsnack, Department of Clinical Neuroscience, University of North Dakota, School of Medicine and Health Sciences, PO Box 9037, Grand Forks, North Dakota, 58202-9037 USA, sharon.wilsnack@med.und.edu, Phone: 701-777-3065, Fax: 701-777-6478.

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1. Introduction

The Alcohol Use Disorders Identification Test (AUDIT) (Babor, 1992) was developed as a brief screening instrument to identify hazardous and harmful alcohol use in primary health care settings, using samples of primary health care patients from six countries. Over time, use of this instrument has changed somewhat from its original intent, with increasing use in general population surveys (Aalto et al., 2009; Fleming, 1996; New Zealand Ministry of Health, 1999; Kawada et al., 2011) to evaluate the prevalence of hazardous drinking behavior and alcohol-related problems and to assess characteristics of drinking behavior.

According to Saunders and colleagues (Saunders et al., 1993), the ten AUDIT questions represent three conceptual domains: alcohol consumption (Items 1–3), dependence (Items 4–6) and alcohol-related consequences (Items 7–10), suggesting a structure of three underlying factors. To date, however, studies using a variety of Exploratory Factor Analysis (EFA) and/or Confirmatory Factor Analysis (CFA) methods have produced mixed evidence regarding the factor structure of the AUDIT. There has been some support for the presumed three-factor model (Maisto et al., 2000; Shields et al., 2004). When the AUDIT is used as a screening tool in clinical settings, all the items are summed to provide a measure of hazardous drinking behavior; this implies a unidimensional structure, which has been supported by some researchers (Carey et al., 2003; Skipsey et al., 1997). The majority of studies to date support a two-factor model, with Items 1–3 loading on factor one (generally labeled “alcohol consumption”) and Items 4–10 loading on factor two (labeled “alcohol-related problems”; Maisto et al., 2000; Medina-Mora, 1998; O’Hare and Sherrer, 1999; Smith et al., 2010). Other researchers who compared one-, two-, and three-factor structures have concluded that the two-factor solution was superior to the one- or three-factor solutions (Bergman and Kallmen, 2002; Chung et al., 2002; Karno et al., 2000; Kelly and Donovan, 2001; Lima et al., 2005; Shields et al., 2004). Gmel, however, proposed a four-factor solution in a study that used CFA with a modified version of the AUDIT (Gmel et al., 2001).

Gender differences in drinking behavior and drinking consequences (Holmila and Raitasalo, 2005; Wilsnack, 1997), raise questions about whether the factor structure of the AUDIT may differ between men and women. To date most gender-specific studies of the AUDIT have focused on gender differences in thresholds for hazardous drinking or gender-specific item definition (Cherpitel, 1999; Fillmore and Jude, 2011; Gentilello et al., 2000; Neumann et al., 2004; Olthuis et al., 2011). Few studies have examined the AUDIT’s factor structure in men and women separately, or evaluated the gender comparability of the factor structure. In a study of imprisoned women offenders in New York City, El-Bassel and colleagues (El-Bassel et al., 1998) found a one-factor structure using principal components analysis. In contrast, a Canadian general population telephone survey (Bernards et al., 2007) explored the factor structure of the AUDIT for men and women separately, and found a similar, three-dimension structure for both men and women: frequency of drinking; usual quantity and frequency of heavy episodic drinking; and problem consequences from drinking. In another recent study conducted in Finland, a two-factor solution was supported for both men and women (von der Pahlen et al., 2008).

The inconsistent research findings on the factor structure of the AUDIT may have resulted in part from differences in sample characteristics and from differences in factor analytic procedures (Cherpitel, 1999; Kelly and Donovan, 2001), because different factor analytic procedures, even on the same data set, may result in different findings. A general impression from past research on the psychometric properties of the AUDIT is that these properties vary as a function of the samples and settings in which the AUDIT is used.

Considering the frequency with which the AUDIT is used in general population surveys, and the limited gender comparisons to date, it is important to provide empirical evidence about possible gender differences in the AUDIT's factor structure in general population samples. It is particularly valuable to investigate possible gender differences in multiple countries that vary in both drinking behavior and gender roles. The present study evaluates such differences in the factor structure of a modified version of the AUDIT in multinational general population survey samples. We employ the same CFA procedures in samples of men and women separately to evaluate one-, two-, and three-factor models, using data from 15 countries in the multinational GENACIS project (Gender, Alcohol, and Culture: An International Study), and we evaluate the factorial invariance across genders based on the fitted baseline model. We also evaluate the internal reliability of the entire AUDIT and its factor-based subscales, and the concurrent validity of the AUDIT and its subscales based on correlations with other measures of alcohol-related social consequences, symptoms of alcohol withdrawal, intoxication, alcohol-related expectancies, and an index measuring the quality of the respondent's relationship intimacy.

2. Methods

2.1 Data and Sample

The present study is part of the GENACIS project (Gender, Alcohol, and Culture: An International Study), a multinational collaborative study developed through the work of the International Research Group on Gender and Alcohol (IRGGA) (R. Wilsnack et al., 2009). The GENACIS database includes data on men's and women's drinking behavior, drinking contexts, and drinking consequences from national and regional general-population surveys in more than 40 countries in Europe, North America, South America, Africa, Asia and Oceania. Analyses of responses to all items in the AUDIT were possible for 15 surveys in Argentina, Australia, Canada, Costa Rica, Finland, Isle of Man, Japan, Kazakhstan, New Zealand, Nigeria, Spain, Sweden, Peru, Uganda, and Uruguay. All of these surveys sampled either an entire country or a region that (1) included both urban and rural areas, and (2) included a large population of drinkers. Sampling procedures helped insure that these surveys adequately covered most of the variation in drinking patterns and consequences in the sampled populations.

Because survey samples differed in age range and prevalence of abstaining from alcohol, analyses here are restricted to respondents aged 18–65, who reported drinking in the preceding 12 months. Socio-economic status was measured by educational level. Ages and educational levels of men and women sampled were similar in most countries. Details regarding the sampling and methods of the GENACIS surveys can be found in Table 1 and other GENACIS publications (Wilsnack et al., 2009).

2.2 Measures

AUDIT—AUDIT data hardly ever have normal distributions due to skewed item responses. To get robust model estimations, it is often necessary to collapse data to obtain sufficient answers, even for analytic methods appropriate for skewed data. Some studies have found that dichotomizing answers does not impair the sensitivity and specificity of the AUDIT (Bischof et al., 2007), and that dichotomizing may not alter associations between items and scales constructed from them (Rist et al., 2009). Therefore, we dichotomized all AUDIT items for the factor structure analysis. To evaluate reliability and concurrent validity, however, we retained ordinal categories in the following ways to obtain comparable data from the multiple surveys: Responses to Items 1, 2, 4, 5, 6, 7, and 8 were trichotomized into three ordinal categories. Item 1 (frequency of drinking) was coded as 1 (“less than weekly”), 2 (“1–4 times a week”), and 3 (“at least 5 times a week”). Item 2 (generic quantity) was

coded 0 (“1 or 2 drinks”), 1 (“3 or 4 drinks”), and 2 (“5 or more drinks”). Heavy episodic drinking (Item 3) was dichotomized into “never” or “at least once in the past 12 months.” For Items 4, 5, 6, 7, and 8, measuring frequency of drinking consequences in the past year, we merged the three highest-rank answers (“4, daily or almost daily,” “3, weekly,” and “2, monthly”) into one category “2, monthly or more than monthly,” with “1” as “less than monthly” and “0” as “never”. The Canadian survey did not ask light infrequent drinkers (who drank less than once a month and drank less than 2 drinks per day) about alcohol-related problems (Items 4–10), but they were included with responses equal to zeros (i.e., did not have the problem) for these items.

To examine concurrent validity of the AUDIT, we used several other measures of: alcohol-related social problems, symptoms of alcohol withdrawal, intoxication, alcohol-related expectancies, and relationship intimacy.

Alcohol-Related Social Problems—A scale of social problems summed reports of experiencing in the past 12 months the following outcomes that were attributed to drinking: “trouble with the law,” “affected working or regular activities,” “lost a job,” “people were annoyed,” “partner threatened to leave,” “lost a friendship,” and “got into a fight.” This scale’s Cronbach’s α was 0.75.

Symptoms of Alcohol Withdrawal—This scale summed responses to questions asking whether the respondent had during the past 12 months “had a headache and/or felt nauseated as a result of drinking,” “taken a drink to get over any of the bad after-effects of drinking” and “felt sick or shaking when cut down or stop drinking.” The Cronbach’s α for this scale was 0.65.

Frequency of Intoxication—This measure was based on responses to the question, “How often during the last 12 months have you drunk enough to feel the effect of the alcohol—for example, your speech was slurred and/or you had trouble walking steadily?” The 5 response options were: “4, daily or almost daily,” “3, weekly,” “2, monthly,” “1, less than monthly,” “0, never”.

Alcohol-related Expectancies—A 5-item scale summed ordinal responses (“3, usually true,” “2, sometimes true,” “1, never true”) about positive effects expected from drinking alcohol: easier to be open with other people; easier to talk about feelings or problems; less inhibited about sex; sexual activity is more pleasurable; and feeling more sexually attractive. The Cronbach’s α for this scale was 0.83.

Relationship Intimacy¹—A measure of relationship intimacy summed responses to questions about (1) happiness with one’s intimate relationship; (2) ease of talking about feelings or problems in that relationship; (3) frequency of quarrels (reverse coded); (4) having ways to solve disagreements; and (5) being afraid of one’s partner (reverse coded). A high score was indicative of a better-quality intimacy relationship. The Cronbach’s α for this measure was 0.65. Because problematic drinking is often associated with impaired relationship quality (Covington, 1997) we predicted negative associations between the AUDIT measures and the relationship intimacy index.

2.3 Data Analysis

Confirmatory Factor Analysis (CFA)—Three factor models were specified and estimated for the AUDIT. In the first model, all items were specified to load on a single

¹These measures can be found by accessing the online version of this paper at <http://dx.doi.org> and by entering doi:...

factor. A second, two-factor model specified factors for “alcohol consumption” (Items 1–3) and “alcohol-related problems” (Items 4–10). The third model specified three factors: “alcohol consumption” (Items 1–3), “symptoms of dependence” (Items 4–6), and “adverse consequences” (Items 7–10). CFA used Mplus (Muthén and Muthén, 2006) to evaluate the latent factors, because Mplus can deal with our weighted and skewed data. Brown (2006) concludes that the weighted least squares means and variance adjusted (WLSMV) estimator is the best option for evaluating models of categorical data and can give accurate parameter estimates for variables with floor or ceiling effects. This is an advantage here because floor effects are expected for the AUDIT scores. Chi-square values were considered less appropriate for evaluating the models because they would be more affected by varying sample sizes and score distributions (Hu, 1998).

To estimate goodness of fit for the models, we used three widely-used measures: the comparative fit index (CFI), Tucker-Lewis Index (TLI), and root mean square error of approximation (RMSEA). Good fit for the models would be indicated by CFI and TLI values of 0.95 or greater and a RMSEA value of 0.06 or lower (Hu, 1999). When data from a sample fit more than one model, we used the Bayesian Information Criterion (BIC) to compare these models, with the model with the smallest BIC considered the preferred model (Schwarz, 1978).

Factorial Invariance (FI)—For countries in which models with the same number of factors best fit both men and women, we evaluated the factorial invariance across gender. Configural, metric and scalar invariance were evaluated step by step as further constraints were added to the models. A decline in model fit at a given step indicated invariance was not supported at that step (French, 2006). Cheung and Rensvold (2002) advise that a CFI decline of more than 0.01 and an RMSEA increase of more than 0.01 indicate that invariance is not supported.

Internal Consistency—Cronbach’s α , measured for the samples of men and women separately, was used as a measure of inter-item consistency for the AUDIT and its subscales. Cronbach’s α equal to or greater than 0.5 was considered acceptable (Devellis, 2003).

Concurrent Validity—To assess concurrent validity, we calculated Pearson correlation coefficients between (1) factor scores for the factors derived from the three alternative models, and (2) the five other measures hypothetically related to alcohol consumption: symptoms of alcohol withdrawal, alcohol-related social problems, alcohol-related expectancies, intoxication, and relationship intimacy. We predicted that the total score of the AUDIT would show stronger positive correlations with measures of more closely-related concepts (symptoms of alcohol withdrawal, alcohol-related social consequences, and intoxication) than with measures of less related concepts (alcohol-related expectancies and relationship intimacy) in both men and women. The subscale of alcohol consumption (Items 1–3) hypothetically would correlate more closely with symptoms of alcohol withdrawal and intoxication than with alcohol expectancies or alcohol-related social problems; the subscale of adverse consequences (7–10) would have higher correlations with alcohol-related social problems than with other measures; and the larger subscale of problem drinking indicators (4–10) would have higher correlations with alcohol-related social problems, intoxication, and symptoms of alcohol withdrawal than with other measures. All of the alcohol-related measures would hypothetically be negatively correlated with relationship intimacy in both men and women (Bakhireva et al., 2011; Fischer et al., 2005; Leonard and Roberts, 1998; Whisman et al., 2006). Correlation coefficients of 0.4 or greater were considered as evidence that two measures represented the same underlying concept (Strener, 1995).

3. Results

The combined survey sample consisted of 27,478 current drinkers, with a mean age of 40.86 (SD=12.82); 52% of the respondents were women. The mean AUDIT score was higher for men (M=5.09; SD=3.51) than for women (M=3.30; SD=2.58) ($t=48.00$, $p<.00$). Men also had significantly higher mean scores than women on all the subscales of the AUDIT (as shown below in the last table).

Confirmatory Factor Analyses

Common statistical and descriptive indices of overall fit for the three CFA models, tested by using a WLSMV estimator, are listed in Table 2. The fit indices for either 2-factor or 3-factor models were generally better than fit indices for a 1-factor model for samples of both men and women. Also, 2-factor or 3-factor solutions were more consistently supported than the 1-factor solution in samples of both men and women. The 1-factor model met criteria for a good fit (CFI 0.95, TLI 0.95 and RSMEA 0.06) in only four samples: Australia (men), Canada (both men and women), and Sweden (women). Most countries had adequate goodness-of-fit for both 2-factor and 3-factor models in men, women, or both genders, except in Argentina, Costa Rica, Isle of Man and Kazakhstan. For the pooled samples of women and men, the 2-factor model fit the best for both genders.

However, none of the three models fit for nine samples of women and five samples of men. Furthermore, when we checked the factor loadings of AUDIT items for each model, we found that “drinking frequency,” “morning drinking” and “injury (because of drinking)” were problem items. These items repeatedly either loaded negatively on their predicted factors or did not have significant factor loadings on their predicted factors.

For samples with adequate goodness of fit for more than one model, a model with a smaller value of the Bayesian Information Criterion (BIC) would be preferred over a model with a higher value of BIC. As shown in Table 3, the BICs for a 2-factor model were consistently smallest among three fitted models, or smaller between two fitted models, including the models for the pooled samples of men and of women.

Factorial Invariance—In three countries men and women had well fitting models of AUDIT scores with the same number of factors. A baseline 2-factor configurally invariant model, M0, shows excellent fit to the data in these countries as shown in Table 4. The difference in fit statistics for model M1 compared with M0 indicates that the assumption of metric invariance holds in the three countries, with a decrease in CFI not greater than 0.01. By constraining factor loadings and thresholds to be equal across gender, the scalar invariance (imposing strong factorial invariance) was also supported in these three countries.

Reliability—We assessed internal consistency for the three model subscales for men and women in each survey, as summarized in Table 5. For men Cronbach’s α for the one-factor model (10 items) varied from 0.58 to 0.80 (M=0.71); for women α varied from 0.51 to 0.79 (M=0.67). Men’s alphas were not consistently greater than women’s for the 10-item AUDIT across the countries surveyed. Internal consistency of the alcohol-problems subscale composed of AUDIT Items 4–10, and of all 10 AUDIT items, was acceptable for most countries for both men and women (Table 5).

Correlations—Table 6 presents the correlations of the AUDIT and its subscales with other measures of interest, for the pooled samples. All of the correlations in Table 6 were statistically significant and were in the predicted directions. For both women and men, the AUDIT and its problem-related subscales were consistently highly correlated (above 0.40) with the measures of alcohol-related social problems, symptoms of alcohol withdrawal, and

frequency of intoxication in both genders; correlations were somewhat smaller (0.25–0.44) with the alcohol consumption subscale. As hypothesized, the AUDIT and its subscales were not as strongly related to the measure of alcohol expectancies, and the measure of relationship intimacy was negatively correlated with the AUDIT and its subscales in both men and women, but the negative correlations with intimacy were greater in men than in women.

4. Discussion

This study examined the gender-specific factor structure of the AUDIT in general population surveys from 15 countries, and also compared the AUDIT's internal consistency and concurrent validity in men and women. Initially, the AUDIT was meant to be considered one-dimensional, and some studies have found a single factor in responses to the AUDIT questions in populations with a high prevalence of alcohol use disorders (Carey et al., 2003; El-Bassel, 1998; Skipsey et al., 1997). In our multinational data, confirmatory factor analysis found stronger support for models that distinguished between a factor for three items measuring "alcohol consumption" and one or two factors measuring symptoms of alcohol dependence (Items 4–6) and problem consequences from drinking (Items 7–10). In comparisons of BIC values, the two-factor solution was superior to the three-factor model. There were no consistent cross-cultural gender differences in the AUDIT factor structure, but in more surveys of women (9) than men (5) none of the three factor models were supported.

As distinct from results for clinical samples, finding a two-factor structure of the AUDIT in general population samples replicates many previous studies (Bergman and Kallmen, 2002; Chung et al., 2002; Doyle et al., 2007; Karno et al., 2000; Kelly and Donovan, 2001; Lima et al., 2005; Maisto et al., 2000; Mathew, 2010; Medina-Mora et al., 1998; O'Hare and Sherrer, 1999; Shields et al., 2004; von der Pahlen et al., 2008). Evaluating two distinct dimensions of the AUDIT ("alcohol consumption" and "alcohol related problems") may aid the interpretation of AUDIT scores in general population studies. However, although the items measuring drinking patterns (1–3) have correctly identified hazardous drinkers in clinical settings, that subscale cannot replace the assessment of alcohol-related consequences in general population studies as a short version of the AUDIT, and the three items had relatively low values of Cronbach's α in our multinational surveys (consistent with the findings of Lima et al. [2005] in Brazil).

An important question for this study was whether gender differences in drinking and social roles would affect how the questions in the AUDIT are interpreted and answered, and influence the factor structure of the AUDIT. The results from this study do confirm that men in the general population drink more than women do and have a higher prevalence of alcohol-related problems than women have. Some researchers have proposed that women's higher sensitivity to alcohol should be taken into account in interpreting the significance of AUDIT scores (Bergman and Kallmen, 2000; Nolen-Hoeksema and Hilt, 2006). However, any such difference of sensitivity does not necessarily lead to a gender difference in the factor structure of the AUDIT, considering that the initial design of the AUDIT gave special attention in item selection to gender appropriateness and cross-national generalizability, and was intended to function well for both men and women (Allen et al., 1997; Babor, 2001; Saunders et al., 1993). Our failure to find any clear-cut gender differentiation of AUDIT factors confirms earlier research that the 10-item AUDIT is equally appropriate to use for men and women (Aalto et al., 2006; Aertgeerts et al., 2001; Allen et al., 1997), and the preferable two-factor model for both genders undercuts earlier concerns that gender heterogeneity in samples will bias results toward a 1-factor model (Rist et al., 2009). A two-

factor AUDIT structure for both men and women was also supported in a Finnish population study (von der Pahlen et al., 2008).

It is also worth noting that the subscale of the AUDIT measuring “alcohol-related problems” (Items 4–10), which merged the subscales for “symptoms of dependence” (Items 4–6) and “adverse consequences” (Items 7–10), had reliabilities and concurrent validity comparable to the complete AUDIT in both genders. This finding supports Selin’s (2006) conclusion that this subscale could perform equally well as the full AUDIT as a measure of alcohol-related social problems and alcohol dependence. Use of this subscale might avoid questions about whether individuals should be identified as hazardous drinkers solely on the basis of their drinking patterns (Items 1–3), despite scoring zero on alcohol-related problems (Items 4–10). The poor performance of the items measuring “drinking frequency,” “morning drinking,” and “injury” (supplementary material²) has also been reported by other researchers (Bergman and Kallmen, 2002; Karno et al., 2000; Kypri et al., 2002; Shevlin and Smith, 2007). These authors have suggested that variation in how these questions are interpreted, together with the relative rarity of morning drinking and injury, might reduce these items’ utility. However, the results here were based on highly skewed item responses in some samples (because of low prevalence of some alcohol problems in the general population), and we should note that collapsing the responses of the AUDIT may have had an effect on its internal consistency and correlations with other measures.

Our study, by applying a uniform procedure to data from multiple and diverse general population samples, provides evidence that the AUDIT can be interpreted as measuring two related constructs (Alcohol Consumption and Alcohol-Related Problems), a structure evident among both male and female drinkers. As additional surveys are added to the GENACIS database, future analyses can explore whether factorial invariance will hold in a more diverse set of countries, and can evaluate the stability and utility of a two-factor approach when using the AUDIT to screen for hazardous drinking in both women and men.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Graham, Ph.D., Canadian Institutes of Health Research (CIHR); **Costa Rica**: Julio Bejarano, M.Sc., World Health Organization; **Finland**: Pia Mäkelä, Ph.D., National Research and Development Centre for Welfare and Health (STAKES); **Isle of Man**: Martin Plant, Ph.D., and Moira Plant, Ph.D., Isle of Man Medical Research; University of the West of England, Bristol; **Japan**: Shinji Shimizu, Ph.D., Japan Society for the Promotion of Science (Grant 13410072); **Kazakhstan**: Bedel Sarbayev, Ph.D., World Health Organization; **Nigeria**: Akanidomo Ibanga, Ph.D., World Health Organization; **Peru**: Marina Piazza, MPH, Sc.D., Pan American Health Organization; **Spain**: Juan Carlos Valderrama, M.D., Dirección General de Atención a la Dependencia, Conselleria de Sanidad, Generalitat Valenciana; Comisionado do Plan de Galicia sobre Drogas, Conselleria de Sanidade, Xunta de Galicia; Dirección General de Drogodependencias y Servicios Sociales, Gobierno de Cantabria; **Sweden**: Karin Helmersson Bergmark, Ph.D., Ministry for Social Affairs and Health, Sweden; **Uganda**: M. Nazarius Tumwesigye, Ph.D., World Health Organization; **Uruguay**: Raquel Magri, M.D., World Health Organization.

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Survey Characteristics

Table 1

Country	Survey year	Drinking Men (age: M±SD)	Drinking Women (age: M±SD)	Sampling frame	Survey mode
Argentina ^{##}	2003	367 (37.98±13.64)	441 (40.02±13.40)	Regional	Face-to-face
Australia ^{##}	2007	751 (42.94±12.91)	1046 (42.13±12.60)	National	Telephone
Canada	2004	4475 (40.02±12.55)	5346 (40.79±12.18)	National	Telephone
Costa Rica ^{##}	2003	269 (34.06±12.49)	354 (34.76±11.71)	Regional	Face-to-face
Finland ^{##}	2000	806 (41.44±13.00)	807 (41.03±13.12)	National	Face-to-face
Isle of Man ^{##}	2005	352 (44.94±12.82)	390 (44.46±12.46)	National	Face-to-face
Japan ^{##}	2001	948 (43.24±12.61)	832 (42.83±12.48)	National	Self-administered
Kazakhstan [*]	2002	377 (39.58±12.75)	363 (39.90±13.11)	Regional	Face-to-face
New Zealand ^{##}	2007	695 (44.37±12.41)	905 (43.62±12.33)	National	Postal
Nigeria	2003	457 (41.95±11.24)	211 (38.06±11.00)	Regional	Face-to-face
Peru [*]	2005	425 (34.71±12.33)	620 (35.72±11.62)	Regional	Face-to-face
Spain ^{##}	2002	541 (38.28±13.21)	383 (37.17±12.73)	Regional	Face-to-face
Sweden [*]	2002	2024 (40.86±13.40)	1931 (41.16±13.27)	National	Telephone
Uganda	2003	384 (35.03±10.36)	297 (32.70±10.56)	Regional	Face-to-face
Uruguay ^{##}	2004	305 (38.29±13.89)	376 (38.86±14.02)	National	Face-to-face
All [*]		13176 (40.77±12.93)	14302 (40.95±12.71)		

Note: Respondents are 12-month drinkers and aged 18–65. Sample sizes for individual GENACIS country surveys may differ slightly across publications reporting GENACIS findings. Small variations in total sample sizes may reflect the effects of ongoing data cleaning and editing of the project's centralized data base at Addiction-Info Switzerland in Lausanne.

* There is no significant age difference between men and women samples by t-test ($p > .01$).

there is no significant difference in educational level between men and women by the Mann-Whitney test ($p > .01$).

Table 2

Fit-indices ^a of the three models for men and women separately in 15 countries

Country	Sex	One-factor			Good fit		Two-factor			Good fit		Three-factor			Good fit	
		CFI	TLI	RMSEA	CFI	TLI	CFI	TLI	RMSEA	CFI	TLI	CFI	TLI	RMSEA	CFI	TLI
Argentina	M	.60	.69	.21	.92	.93	.09			.65	.71	.21				
	F	.79	.81	.15	.53	.42	.17			.81	.81	.15				
Australia	M	.95	.96	.05	*	.99	.99	.02		*	.96	.96	.04		*	
	F	.90	.89	.08	.94	.95	.07			.95	.95	.07				
Canada	M	.96	.97	.05	*	.99	.99	.02		*	.97	.97	.05		*	
	F	.97	.98	.04	*	.98	.99	.02		*	.99	.99	.04		*	
Costa Rica	M	.95	.94	.08	.95	.95	.06			*	.94	.95	.07			
	F	.82	.81	.15	.83	.84	.14			.84	.84	.14				
Finland	M	.93	.94	.10	.94	.95	.09			.95	.95	.07				
	F	.94	.95	.08	.96	.97	.06			*	.97	.98	.06		*	
Isle of Man	M	.88	.88	.10	.92	.92	.08			.94	.94	.07				
	F	.51	.64	.23	.71	.78	.18			.70	.77	.18				
Japan	M	.95	.94	.07	.97	.97	.05			*	.98	.98	.05		*	
	F	.92	.93	.10	.93	.93	.09			.93	.92	.09				
Kazakhstan	M	.94	.96	.10	.94	.95	.10			.95	.96	.10				
	F	.98	.98	.07	.97	.98	.07			.97	.98	.07				
New Zealand	M	.95	.94	.08	.95	.96	.07			.94	.95	.07				
	F	.95	.95	.07	.98	.98	.04			*	.98	.98	.05		*	
Nigeria	M	.96	.97	.08	.99	.99	.03			*	.99	.99	.05		*	

Country	Sex	One-factor			Good fit			Two-factor			Good fit			Three-factor			Good fit		
		CFI	TLI	RMSEA	CFI	TLI	RMSEA	CFI	TLI	RMSEA	CFI	TLI	RMSEA	CFI	TLI	RMSEA	CFI	TLI	RMSEA
Peru [#]	F	.94	.95	.09	.95	.96	.08	.96	.96	.07	.96	.96	.07	.96	.96	.07			
	M	.85	.86	.12	.98	.97	.03	.98	.97	.03	*	.97	.97	.05			*		
Spain	M	.94	.95	.08	.97	.98	.06	.97	.98	.06	*	.98	.98	.06			*		
	F	.87	.86	.18	.92	.93	.15	.92	.93	.15		.94	.93	.15					
Sweden	M	.93	.94	.05	.98	.98	.03	.98	.98	.03	*	.97	.98	.03			*		
	F	.95	.95	.06	*	.98	.99	.02	.98	.99	.02	*	.98	.98	.03			*	
Uganda	M	.90	.92	.08	.95	.95	.06	.95	.95	.06	*	.95	.95	.06			*		
	F	.93	.94	.07	.95	.96	.06	.95	.96	.06	*	.95	.96	.06			*		
Uruguay	M	.94	.95	.07	.98	.98	.03	.98	.98	.03	*	1.00	1.00	.00			*		
	F	.84	.88	.11	.90	.92	.09	.90	.92	.09	.89	.91	.10						
All men		.94	.96	.06	.98	.99	.03	.98	.99	.03	*	.97	.97	.04			*		
	All women	.95	.97	.05	*	.98	.99	.03	.98	.99	.03	*	.98	.98	.04			*	

^a Appropriate fit criteria: CFI .95, TLI .95, and RMSEA .06;

* Met all goodness-of-fit criteria.

[#] Women's data from Peru could not be analyzed because of too few positive responses to Item 6 (morning drinking).

Table 3

Bayesian Information Criteria for three models, for samples where more than one model had adequate goodness of fit

Country	gender	One-factor	Two-factor	Three-factor
Australia	M	7260	7347	7380
Canada	M	42937	42884	42899
	F	38030	37972	37989
Finland	F		6741	6759
Japan	M		9274	9295
New Zealand	F		8307	8412
Nigeria	M		4658	4758
Peru	M		3090	3118
Spain	M		4343	4451
Sweden	M		14143	14175
	F	10494	10455	10486
Uganda	M		4334	4344
	F		2887	2903
Uruguay	M		2444	2547
All men		137610	137188	137252
All women		106748	106285	106482

Table 4

Testing for factorial invariance across gender in three countries

Country	Model	CFI	TLI	RMSEA
Canada	M0	.99	.99	.02
	M1	.99	.99	.02
	M2	.99	.99	.02
Sweden	M0	.98	.98	.03
	M1	.98	.98	.03
	M2	.98	.98	.03
Uganda	M0	.95	.95	.06
	M1	.96	.96	.05
	M2	.95	.96	.06

M0, configural invariance (no invariance imposed);

M1, Metric invariance (invariant factor loadings);

M2, Scalar invariance (invariant thresholds);

 $\Delta CFI < -0.01$ indicates lack of invariance of nested models.

Table 5

Cronbach's α of AUDIT and its subscales in 15 countries

Country	1-3		4-6		7-10		4-10		1-10	
	alcohol consumption		symptoms of dependence		adverse consequences		alcohol-related problems		AUDIT	
	M	F	M	F	M	F	M	F	M	F
Argentina	.45	.35	.43	.37	.69	.35	.74	.53	.70	.55
Australia	.62	.63	.37	.26	.52	.62	.61	.65	.58	.58
Canada	.48	.49	.56	.51	.48	.49	.64	.64	.70	.69
Costa Rica	.64	.59	.74	.39	.56	.61	.75	.66	.79	.70
Finland	.22	.54	.72	.62	.63	.62	.73	.71	.75	.76
Isle of Man	.55	.49	.65	.63	.54	.58	.61	.70	.66	.67
Japan	.56	.44	.52	.59	.46	.49	.57	.65	.68	.70
Kazakhstan	.33	.31	.74	.75	.64	.68	.76	.77	.75	.71
New Zealand	.50	.37	.58	.54	.64	.67	.75	.76	.76	.74
Nigeria	.55	.52	.69	.68	.76	.68	.82	.74	.80	.79
Spain	.42	.46	.82	.90	.65	.45	.79	.77	.72	.61
Sweden	.30	.38	.51	.42	.57	.49	.67	.61	.65	.59
Peru	.40	.42	.51	.40	.57	.41	.69	.50	.67	.51
Uganda	.55	.51	.70	.72	.58	.64	.73	.76	.73	.77
Uruguay	.58	.37	.54	.69	.44	.41	.59	.69	.66	.62
<i>Averaged α</i>	<i>.48</i>	<i>.46</i>	<i>.61</i>	<i>.56</i>	<i>.58</i>	<i>.55</i>	<i>.70</i>	<i>.68</i>	<i>.71</i>	<i>.67</i>

Table 6
Correlations of the AUDIT and its subscales with related measures for the pooled samples

	Sex	M(±SD)	Problems r (n)	Withdrawal r (n)	Intoxication r (n)	Expectancy r (n)	Intimacy r (n)
AUDIT	M	5.09 ±3.51	.57(6554)	.60(11778)	.56(10720)	.33(10606)	-.21(3685)
	F	3.30±2.58	.50(6349)	.61(11545)	.58(10891)	.31(10686)	-.12(3650)
1-3	M	3.44 ±1.36	.27(6615)	.38(12183)	.41(10869)	.26(11240)	-.10(3945)
alcohol consumption	F	2.46±1.27	.25(6388)	.43(12580)	.44(10984)	.32(11957)	-.03(4063)
4-6	M	0.40±0.97	.53(6677)	.59(12602)	.46(11008)	.27(11198)	-.17(3824)
symptoms of dependence	F	0.17±0.61	.44(6474)	.57(13017)	.45(11315)	.23(11936)	-.12(3892)
7-10	M	1.19±2.14	.54(6640)	.50(12255)	.45(10968)	.27(10857)	-.20(3815)
adverse consequences	F	0.54±1.41	.49(6433)	.51(12002)	.46(11250)	.23(10942)	-.14(3866)
4-10	M	1.58±2.79	.59(6617)	.59(12209)	.51(10916)	.30(10826)	-.21(3801)
alcohol-related problems	F	0.72±1.82	.53(6432)	.59(11974)	.52(11222)	.25(10907)	-.15(3860)

Note: All correlation coefficients were statistically significant, $p<.01$;