The dimensionality of alcohol use disorders and alcohol consumption in a cross-national perspective

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ABSTRACT

Aims To replicate the finding that there is a single dimension trait in alcohol use disorders and to test whether the usual 5+ drinks for men and 4+ drinks for women and other measures of alcohol consumption help to improve alcohol use disorder criteria in a series of diverse patients from emergency departments (EDs) in four countries. **Design** Cross-sectional surveys of patients aged 18 years and older that reflected consecutive arrival at the ED. The Composite International Diagnostic Interview Core was used to obtain a diagnosis of DSM-IV alcohol dependence and alcohol abuse; quantity and frequency of drinking and drunkenness as well as usual number of drinks consumed during the last year. **Setting** Participants were 5195 injured and non-injured patients attending seven EDs in four countries: Argentina, Mexico, Poland and the United States (between 1995–2001). **Findings** Using exploratory factor analyses alcohol use disorders can be described as a single, unidimensional continuum without any clear-cut distinction between the criteria for dependence and abuse in all sites. Results from item response theory analyses showed that the current DSM-IV criteria tap people in the middle–upper end of the alcohol use disorder continuum. Alcohol consumption (amount and frequency of use) can be used in all EDs with the current DSM-IV diagnostic criteria to help tap the middle–lower part of this continuum. Even though some specific diagnostic criteria and some alcohol consumption variables showed differential item function across sites, test response curves were invariant for ED sites and their inclusion would not impact the final (total) performance of the diagnostic system. **Conclusions** DSM-IV abuse and dependence form a unidimensional continuum in ED patients regardless of country of survey. Alcohol consumption variables, if added, would help to tap patients with more moderate severity. The DSM diagnostic system for alcohol use disorders showed invariance and performed extremely well in these samples.

Keywords Alcohol use disorder, DSM-IV, ethnicity, heavy drinking, IRT analysis.

INTRODUCTION

Results from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) [1,2] and from the Australian National Survey of Mental Health and Wellbeing [3] have suggested that there is evidence of a single dimension trait for alcohol abuse and dependence in the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition [4,5], but the current symptom items do not tap well into the less severe range of the alcohol disorder continuum. A good candidate to cover this part of

the spectrum could be measures of alcohol consumption. Using data from the NESARC, Saha [6] concluded that 'DSM-IV alcohol abuse and dependence criteria formed a continuum of alcohol use disorder severity along with drinking 5+/4+ at least once a week in the past year criterion'. That is, five or more drinks per occasion for males and four or more for females (5+/4+) at least once a week in the past year when introduced with other symptoms of the current DSM-IV criteria for alcohol abuse and dependence in an item response theory analysis (IRT) tapped into the mildest range of the alcohol use disorder

continuum (i.e. lower levels of severity) that was not captured by any other abuse or dependence criteria. Following the report of Saha [6], Helzer [7] discussed the evidence for the unidimensionality of substance use disorders and suggested that, for alcohol use disorders, the 5+/4+ criterion could be added to the categorical definition to strengthen the 'mild to moderate range of dimensional definition'. While each dimension of the DSM diagnostic scheme is intended to describe maladaptive patterns of consumption [8], a level of consumption considered 'maladaptive' has not been included in the diagnostic nosology due, in part, to cross-cultural variation in normative drinking levels [9].

The introduction of measures of alcohol consumption together with a clinical approach of categorical diagnosis is promising, but two limitations exist based on prior analysis in the general population. First, these results need to be replicated using different data sets, especially those across various types of clinical practice in which patients under consultation tend to have more symptoms and more severe symptoms than general population samples, such as the NESARC. Secondly, it is not clear what the impact may be, across countries and cultures, of introducing consumption into the DSM-IV alcohol use disorder diagnostic criteria. In 2004 the National Institute on Alcohol Abuse and Alcoholism (NIAAA) published guidelines for at-risk drinking (that which increases the risk of developing alcohol use disorders, morbidity and mortality), defined as five or more drinks per occasion for males and four or more for females (5+/4+) [10]. While drinking 5+/4+ at least once a week in the past year is, indeed, a marker of heavy episodic drinking, this measure has a large variation in prevalence across cultures, and the variation is not necessarily in the same direction as variation in alcohol abuse and dependence. For example, Mexico has been shown to have a low–medium per-capita consumption rate when compared to countries with similar development [11] and a high abstention rate, but low levels of alcohol use disorders [12] and high levels of episodic and intoxicating drinking (such as the 5+/4+) [13]. According to a World Health Organization (WHO) report, Mexico exhibits one of the most 'detrimental consumption patterns' (a value of 4) of any country, based on a large number of heavy drinking occasions, drinking outside of meals, a high level of fiesta drinking, and drinking in public places, etc. as opposed to a country exhibiting the least detrimental consumption pattern (a value of 1), based on few heavy drinking occasions, drinking with meals, no fiesta drinking and little drinking in public places [13]. By contrast, in this same region and with a similar level of development, Argentina has a higher per capita consumption than Mexico (almost double), a low abstention rate, a much higher prevalence of alcohol dependence com- pared to Mexico, especially among women, but low rates of heavy drinking (almost half the Mexican rate; and a detrimental drinking pattern value of 2) [13].

Here we build from prior work to test the unidimensionality of alcohol use disorders and the use of measures of heavy alcohol consumption in a sample of five emergency department (ED) sites in four countries, compiled as part of the Emergency Room Collaborative Alcohol Analysis Project [14]. We used exploratory factor analysis (EFA) and IRT to study the latent construct of alcohol use disorder in samples from ED patients from different countries in an effort to replicate the finding that there is a unique factor solution for alcohol use disorders [15]. Secondly, if unidimensionality exists, we will test whether 5+/4+ and other measures of alcohol consumption help to improve alcohol use disorder criteria by adding a criterion in the low–medium spectrum of the disorder, applicable to all four countries included here.

METHODS

Samples and data sets

The data set used for this analysis included 5195 ED patients from five sites in four countries, Santa Clara, California [US, 1995–1996 ($n = 1429$)], Pachuca, Mexico [during 1996–1997 ($n = 1417$)], Warsaw and Sosnowiec, Poland [2002–2003 ($n = 1317$)] and Mar del Plata, Argentina [during 2001 ($n = 978$)]. Details about these samples have been published elsewhere [16]. The response rates were: Santa Clara 73%, Pachuca 93%, Warsaw 67%, Sosnowiec 65% and Mar del Plata 92%. Both injured and non-injured patients were interviewed regarding quantity and frequency of usual drinking and frequency of high maximum occasions during the last year, frequency of drunkenness, alcohol dependence and abuse/harmful drinking questions, and demographic characteristics (age, gender, percentage injury and education). Data were collected using a similar methodology and instrumentation developed by Cherpitel [17]. All studies used a probability sampling design in which each shift was represented equally for each day of the week during the period in which data were collected in each ED facility. Across all studies, patient samples of those 18 and older were selected from ED admission forms, which included walk-in patients as well as those arriving by ambulance, and reflected consecutive arrival at the ED. The particular sampling frame in a study depended upon the number of patients admitted to the ED facility covered in each study. Once selected for the study, and as soon as possible after ED admission, patients were approached with an informed consent to participate, and were then breathalyzed and administered a questionnaire of about 25 minutes in length by trained interviewers while the

patient was in the waiting room or treatment area and/ or following treatment. Patients who were too severely injured or ill to be interviewed in the ED and who were subsequently hospitalized were interviewed later, after their condition had stabilized. Both injured and non-injured patients were interviewed regarding quantity and frequency of usual drinking and frequency of high maximum occasions during the last year, frequency of drunkenness, alcohol dependence and abuse questions and demographic characteristics.

Measures

Quantity–frequency (Q-F) of drinking and drunkenness

Patients were asked an abbreviated version of the graduated frequency series of questions [18] which obtains data, for the last year, on the frequency of drinking any alcoholic beverage, and the frequency, separately, of consuming 12 or more drinks in a day and five or more but less than 12 in a day. Patients were also asked their usual number of drinks and the frequency of drunkenness during the last year. The frequency of 12 or more drinks, five or more drinks and drunkenness ranged from every day, nearly every day, three or four times a week, once or twice a week, two to three times a month, about once a month, six to 11 times a year, one to five times a year and to never during the last 12 months. Different cut-points for these frequency options were used for males and females. Heavy drinking measures to be considered as candidate measures in each of the analyses include usual quantity of at least 5+/4+ drinks per occasion for men/ women, 12+ drinks monthly/any for men/women, 5+ drinks weekly/monthly for men/women, drunkenness weekly/monthly for men/women.

Diagnostic criteria for alcohol dependence and abuse

An adaptation of the Alcohol Section of the Composite International Diagnostic Interview (CIDI) core [19] was used to obtain a diagnosis of DSM-IV alcohol dependence and alcohol abuse. The CIDI diagnostic interview was developed as a joint project by the World Health Organization and the US Alcohol, Drug Abuse and Mental Health Administration, and has been tested in several countries. The alcohol section of the CIDI has been found to perform well, is easy to use and is acceptable to subjects in almost all cultures [20]. The DSM-IV criteria for 12-month dependence consist of three positive responses across seven domains (tolerance, withdrawal, drinking more than intended, unsuccessful efforts to control, giving up pleasures or interests to drink, spending a great deal of time in drinking activities, continued alcohol use despite problems). Also obtained was a diagnosis for DSM-IV alcohol abuse as life-time presence among

12-month drinkers based on any one of four items: role, physical, legal or social consequences of drinking.

Data analysis

Analysis followed closely the strategy used in Saha [6]. Dimensionality of the set of DSM-IV measures was first explored using standard factor analytical methods. This is referred to as the base model. In addition, individual heavy drinking measures were included, one at a time, in separate models along with DSM-IV items to investigate the performance of these items in the context of the larger set of DSM-IV items.

Standard psychometric methods were used, including examining marginal and bivariate distributions of variables before dimension reduction techniques were applied. To estimate the underlying factor structure on dichotomous items, non-linear link functions were utilized using Mplus [21]. A number of solutions were examined, including one-, two- and three-dimensional solutions, and their fit was assessed using standard measures, such as the CFI (comparative fit index), RMSEA (root mean squared error of approximation) and SRMR (standardized root mean square residual). Properties of the resulting scale(s) were examined using the Kuder–Richardson formula for examining internal scale reliability of a set of dichotomous items.

After the factor structure of the set of DSM-IV items was investigated, IRT models were used to study the latent alcohol use disorder construct separately in probability samples of ED patients from four different countries in an effort to replicate the finding that there is an underlying common structure [15] and, if so, whether individual heavy drinking measures help to improve alcohol use disorder criteria by adding a criterion in the low–medium spectrum of the disorder, applicable to all four countries. IRT analysis implemented in Mplus [21] was used to derive two main parameters, the threshold and the discrimination parameters. The first refers to the 'severity' of a criterion (threshold), with high severity being those endorsed less frequently by respondents. The second parameter measures the ability of a criterion to discriminate respondents from low to high levels of the disorder continuum (slope). Graphical aids and plots of both parameters were used. Finally, differential item functioning (DIF) was performed in the PARSCALE [22] to test whether the probabilities of responding in different categories of consumption differed by population for the same underlying level of the attribute (the latent trait measuring severity). Items were evaluated for DIF by contrasting the IRT difficulty or location (b_i) and slope (a_i) parameters between the groups. Finally, test response curves (TRCs) were plotted using the expected raw scores by the severity of the alcohol use disorder

continuum for each study site. If the TRCs for sites do not differ substantially it can conclude that the significant item-level DIFs (if found) cancel out when the total scale is used [6].

RESULTS

In Santa Clara, a low percentage of patients were admitted to the ED with an injury (22.5%) while in Poland, the majority of ED admissions were for injury (63.7%) (see Table 1). Patients from these EDs also differed on gender (a larger proportion of males in Pachuca and Poland), age (older in Poland and Santa Clara) and educational background (a high level of education in Santa Clara and Poland). Baseline differences are also evident on measures of life-time alcohol consumption (a larger proportion of abstention in Pachuca followed by Santa Clara), 12-month drinking (a lower proportion of in Pachuca and Santa Clara) and drinking prior to the injury (a lower proportion in Pachuca and Poland). Heavy drinking (5+/4+), nevertheless, was more common in Poland and Pachuca. All DSM-IV disorders were more common in Santa Clara, followed by Argentina, Poland and Mexico. Overall, as expected, a large variation in alcohol involvement was found across these four samples. Comparatively across sites, the Mexican sample tended to show lower overall consumption, higher episodic use and lower levels of disorders. In contrast, the sample from Argentina showed higher overall consumption, lower levels of heavy drinking and percentages of alcohol disorders midway between the other sites.

As seen from the prior data, large variation was found in life-time and 12-month (current) drinking prevalence rates. A different picture emerged when current drinkers only were examined (Table 2). The most striking difference was the high level of abuse and dependence among current drinkers in the Pachuca sample, which ranked second only behind the United States. Among current drinkers, Poland had the lowest rates of abuse and dependence. Overall, 20% of these EDs patients had a current DSM-IV alcohol use disorder which demonstrates, as expected, the large role of alcohol among these patients. Overall, the criterion with the largest prevalence was larger/longer and the criterion with the lowest prevalence was legal problems. As expected, the four measures of heavy drinking were found to have high variation in prevalence and large differences across sites. The usual 5+/4+ was highest in Pachuca and drunkenness was highest in Santa Clara. The consumption variable with the smallest variation in prevalence across sites was 5+ weekly for men or monthly for women.

Exploratory factor analysis was used for testing the unidimensionality of alcohol use disorders both in the merged ED sample as well as separately by site (Table 3). In the merged sample, all 11 criteria loaded significantly on a single dimension. A two-factor solution produced one factor with all dependence items and one abuse item. The second factor had only two of the four abuse items. Both factors had a strong correlation (0.854) and the first eigenvalue was much larger than the second, all of which suggest that a single factor solution is a reasonable description of the data and that the 11 criteria formed a

Table 1 Emergency Room Collaborative Alcohol Analysis Project (ERCAAP) sites with DSM-IV alcohol data characteristics of study population, *n* = 5195.

	Site	Santa Clara, CA	Pachuca, Mexico	Mar del Plata, Argentina	Warsaw and Sosnowiec, Poland	Total
	(year)	(1995–1996)	(1996–1997)	(2001)	(2002–2003)	
	n	1429	1417	867	1482	5195
Injury	%	22.5	47.4	45.8	63.7	44.9
Male	%	49.1	52.0	44.3	58.2	51.7
<=30 years	%	36.1	44.7	41.2	29.5	37.4
Education: some college and above	%	36.1	14.9	10.4	21.1	21.8
Life-time alcohol use	%	85.1	66.8	91.6	93.2	83.5
Alcohol use last 12 months	%	62.0	38.6	77.7	74.1	61.6
Alcohol use 6 hours prior	%	11.3	9.2	16.7	9.7	11.1
Last 12 months 5+/4+ drinks*	%	18.6	25.1	20.7	37.5	26.2
Last 12 months alcohol abuse	%	7.0	3.3	6.7	5.9	5.6
Last 12 months alcohol dependence	%	12.3	4.9	6.7	4.3	7.0
Last 12 months alcohol abuse or dependence	%	19.2	8.2	13.4	10.2	12.7

Santa Clara data are weighted. *Usual consumption of five or more drinks per occasion for males and four or more drinks for females per drinking occasion.

Table 2 DSM-IV alcohol use disorders and criterion list by Emergency Room Collaborative Alcohol Analysis Project (ERCAAP) sites.

	Santa Clara	Pachuca	Mar del Plata	Warsaw and Sosnowiec	Total
Among 12-month drinkers (*n*)	884	547	662	1098	3191
12-month prevalence of DSM-IV alcohol abuse (%)	11.3	8.6	8.6	8.0	9.1
12-month prevalence of DSM-IV alcohol dependence (%)	19.8	12.6	8.8	5.7	11.4
12-month prevalence of DSM-IV abuse or dependence (%)	31.0	21.2	17.4	13.8	20.6
DSM-IV criterion					
D1 tolerance (%)	16.5	6.0	7.9	4.4	8.7
D2 withdrawal (%)	21.6	18.1	9.1	11.6	14.9
D3 larger/longer (%)	25.0	14.5	13.6	10.7	16.0
D4 quit/control (%)	17.1	12.8	7.9	3.5	9.8
D5 time spent (%)	17.2	8.6	10.7	2.9	9.5
D6 activities given up (%)	13.1	6.6	5.1	2.4	6.6
D7 physical/psychological problems (%)	23.8	13.0	11.9	10.1	14.8
A1 neglect roles (%)	16.0	15.7	9.2	6.9	11.4
A2 hazardous use (%)	11.2	4.8	7.6	4.8	7.1
A3 legal problems (%)	9.5	1.8	1.8	2.1	4.1
A4 social/interpersonal problems (%)	19.9	7.7	7.1	7.1	10.7
Alcohol consumption					
Drinks do you usually take (5+/4+) for men/women (%)	29.2	64.4	24.8	50.3	41.6
12+ monthly/any for men/women (%)	23.9	25.4	24.0	16.3	21.6
5+ weekly/monthly for men/women (%)	25.0	15.7	27.5	21.6	22.7
Drunkenness weekly/monthly for men/women (%)	16.0	7.9	10.0	3.4	9.0

DSM-IV criterion description
Alcohol dependence (D)
Tolerance: tolerance to the effects of alcohol; need more to get desired effect
Withdrawal: withdrawal syndrome, or alcohol or similar substance taken to avoid or relieve withdrawal symptoms
Larger/longer: alcohol is taken in larger amounts or for longer periods than required
Quit/control: persistent desire, or unsuccessful efforts to cut down
Time spent: a great deal of time spent obtaining, using or recovering from the effects of alcohol
Activities given up: reduction in important social, occupational or recreational activities because of alcohol use
Physical/psychological problems: continued use despite awareness of alcohol use causing physical or psychological problems
Alcohol abuse (A)
Neglect roles: failure to fulfill obligations, important activities at work, school or home because of alcohol use
Hazardous use: recurrent use in physically dangerous situations, e.g. driving, operating machinery, injured after drinking
Legal: recurrent alcohol-related legal problems
Social/interpersonal problems: recurrent use despite awareness of alcohol use causing social or interpersonal problems
Alcohol consumption description
Drinks do you usually take (5+/4+) for men/women: five or more drinks per occasion for males and four or more for females per drinking occasion
12+ monthly/any for men/women: any 12 or more drinks per day for females and 12 or more drinks per day at least monthly for males
5+ weekly/monthly for men/women: five or more drinks per day at least monthly for females and five or more drinks per day at least weekly for males
Drunkenness weekly/monthly for men/women: drunkenness episodes at least monthly for females and at least weekly for males

Table 3 Exploratory factor analyses of alcohol use disorder by Emergency Room Collaborative Alcohol Analysis Project (ERCAAP) sites.

	ALL EDs			US: Santa Clara			Mexico: Pachuca			Mar del Plata: Argentina			Poland: Warsaw and Sosnowiec		
	Base model			Base model			Base model			Base model			Base model		
	One factor (n = 3191)	Two factors (n = 3191)		One factor (n = 884)	Two factors (n = 884)		One factor (n = 547)	Two factors (n = 547)		One factor (n = 662)	Two factors (n = 662)		One factor (n = 1098)	Two factors (n = 1098)	
Tolerance (D)	0.860	0.880	−0.015	0.888	0.971	−0.084	0.888	0.743	0.163	0.808	0.809	0.009	0.746	0.821	−0.219
Withdrawal (D)	0.844	0.733	0.129	0.911	0.911	0.005	0.788	0.850	−0.049	0.778	0.783	0.243	0.824	0.840	−0.026
Larger/longer (D)	0.892	0.951	−0.057	0.906	0.932	−0.024	0.963	0.987	−0.004	0.879	0.872	−0.169	0.788	0.902	−0.304
Quit/control (D)	0.896	0.851	0.056	0.953	0.942	0.016	0.790	0.023	0.797	0.842	0.846	0.018	0.847	0.850	0.010
Time spent (D)	0.947	0.957	−0.004	0.967	0.942	0.032	0.924	0.562	0.387	0.943	0.937	−0.274	0.913	0.917	0.017
Activities given up (D)	0.942	0.944	0.006	0.958	0.966	−0.005	0.877	0.452	0.451	0.978	0.975	−0.060	0.868	0.907	−0.089
Physical/psychological problems (D)	0.886	0.658	0.257	0.890	0.634	0.286	0.873	0.833	0.056	0.921	0.926	0.089	0.830	0.790	0.133
Neglect roles (A)	0.819	0.443	0.416	0.810	0.189	0.676	0.901	0.174	0.763	0.821	0.815	−0.180	0.791	0.768	0.086
Hazardous use (A)	0.782	0.558	0.251	0.795	0.589	0.231	0.726	0.386	0.360	0.818	0.820	0.086	0.755	0.763	−0.003
Legal problems (A)	0.894	−0.001	0.968	0.881	−0.006	0.958	0.796	0.002	0.820	0.931	0.931	−0.035	0.953	0.659	0.678
Social/interpersonal problems (A)	0.895	0.228	0.730	0.885	0.216	0.730	0.857	−0.062	0.953	0.881	0.888	0.217	0.944	0.816	0.286
Factor correlation	–	0.854		–	0.867		–	0.892		–	−0.006		–	0.293	
Eigenvalue	8.659	9.112		8.955	9.473		8.189	8.905		8.563	9.134		7.910	8.632	
Comparative fit index (CFI)	0.998	1.000		0.998	1.000		1.000	1.000		0.999	1.000		0.995	0.999	
Tucker Lewis index (TLI)	0.997	1.000		0.998	1.000		1.000	1.000		0.999	1.000		0.993	0.998	
Root mean squared error of approximation (RMSEA)	0.030	0.011		0.039	0.000		0.010	0.000		0.021	0.011		0.031	0.015	
Factor loadings when one alcohol consumption variable added															
'Usual 5+/4+' for men/women	0.470	–	–	0.611	–	–	0.503	–	–	0.608	–	–	0.537	–	–
'12+ drinks' (monthly/any)	0.726	–	–	0.741	–	–	0.706	–	–	0.782	–	–	0.754	–	–
'5+ drinks' (weekly/monthly)	0.730	–	–	0.775	–	–	0.733	–	–	0.773	–	–	0.764	–	–
'Got drunk' (weekly/monthly)	0.792	–	–	0.771	–	–	0.741	–	–	0.788	–	–	0.865	–	–

EDs: emergency departments.

single, unidimensional trait in the merged ED patients. Inspection of the four samples did not show divergent conclusions. Among the US and Mexican samples, a large correlation between the two factors and a small second eigenvalue suggest that unidimensionality is a reasonable and more parsimonious explanation for these data. The two-factor solution for Santa Clara produced a first factor composed of all dependence items and one abuse item (hazardous use), while the second factor included the other three abuse items. For Pachuca, the two-factor solution produced one factor with only four dependence items and a second factor with three abuse items (neglect roles, legal problems and social/interpersonal problems) and one dependence item (quit/control) that was not easily interpretable. The factor correlation is very high for the first and second dimensions of the solution for both factors (0.87 in Santa Clara and 0.89 in Pachuca), indicating little difference between the two in terms of additional information. The CFAs are also extremely high for both sites for the one-dimensional solution (0.998 in Santa Clara and 1.0 in Pachuca), where above 0.95 is considered very good. Additionally, the RMSEA is considered to be very low and indicates a very good fit for both sites (RMSEA = 0.05 is considered a good fit and RMSEA = 0.04 in Santa Clara and 0.01 in Pachuca). Finally, the second eigenvalues were much smaller than

the first for both sites (0.518 for Santa Clara and 0.716 for Pachuca), which strongly supports a one-dimensional solution. On the other hand, for Argentina and Poland, there was clearly only one factor. A second factor in both data sets produced small and non-significant loadings with small eigenvalues. Most importantly, this second factor had loadings that were almost identical to the loadings of the one factor solution, again supporting a one-dimensional solution. The lower part of Table 3 shows the factor loadings of the four consumption candidates, assuming a single dimension solution. That is, assuming that the 11 items are considered to be a single factor in the merged sample, the addition of 5+/4+ would produce a factor loading of 0.470. In all sites the alcohol consumption variables loaded in the unidimensional alcohol use disorder trait, ranging from a low of 0.470 to a high of 0.865. The variables 5+/4+ and drunkenness produced the most variable loadings across sites, while 12+ drinks and 5+ drinks produced more homogeneous loadings across sites.

IRT results for the merged sample and by site are presented in Table 4. In the merged sample, the largest discrimination score was found for the item 'time spent' and the lowest for the item 'hazardous use'. The largest severity score was found for the item 'legal problems' and the lowest for the item 'larger/longer' (see Fig. 1).
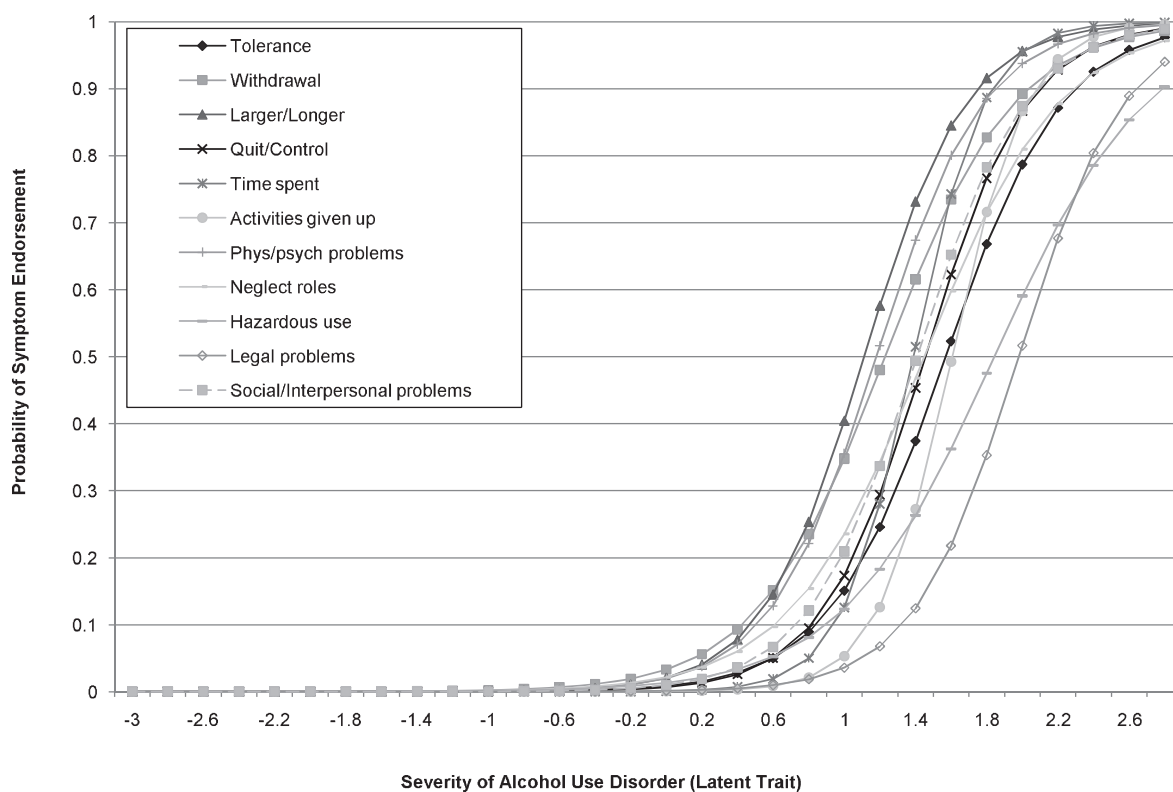

Figure 1 Criterion response curves for DSM-IV abuse and dependence criteria in the Emergency Room Collaborative Alcohol Analysis Project (ERCAAP), all emergency departments combined

Table 4 Item response theory analyses of alcohol use disorder by Emergency Room Collaborative Alcohol Analysis Project (ERCAAP) sites.

|	ALL ERs		US: Santa Clara		Mexico: Pachuca		Mar del Plata: Argentina		Poland: Warsaw and Sosnowiec	
	Base model		Base model		Base model		Base model		Base model	
	Discrimination (SE)	Severity (SE)	Discrimination (SE)	Severity (SE)	Discrimination (SE)	Severity (SE)	Discrimination (SE)	Severity (SE)	Discrimination (SE)	Severity (SE)
Tolerance (D)	1.79 (0.1)	1.57 (0.05)	1.97 (0.2)	1.10 (0.07)	2.32 (0.4)	1.69 (0.11)	1.43 (0.2)	1.74 (0.14)	1.33 (0.2)	2.18 (0.14)
Withdrawal (D)	1.62 (0.1)	1.23 (0.04)	2.15 (0.2)	0.86 (0.06)	1.38 (0.2)	1.14 (0.10)	1.26 (0.2)	1.72 (0.14)	1.58 (0.2)	1.44 (0.08)
Larger/longer (D)	2.04 (0.1)	1.11 (0.04)	2.19 (0.3)	0.73 (0.06)	3.41 (0.6)	1.11 (0.07)	1.99 (0.3)	1.23 (0.09)	1.28 (0.1)	1.61 (0.10)
Quit/control (D)	2.02 (0.1)	1.45 (0.05)	2.99 (0.4)	1.00 (0.06)	1.33 (0.2)	1.44 (0.12)	1.60 (0.2)	1.68 (0.13)	1.78 (0.3)	2.11 (0.13)
Time spent (D)	2.94 (0.2)	1.39 (0.04)	3.52 (0.5)	0.98 (0.06)	2.88 (0.5)	1.46 (0.09)	2.88 (0.5)	1.30 (0.08)	2.76 (0.5)	2.02 (0.10)
Activities given up (D)	2.80 (0.3)	1.61 (0.05)	3.03 (0.5)	1.19 (0.07)	2.14 (0.4)	1.67 (0.11)	3.45 (0.9)	1.69 (0.11)	2.13 (0.3)	2.21 (0.12)
Physical/psychological problems (D)	1.95 (0.1)	1.18 (0.04)	1.89 (0.2)	0.80 (0.06)	1.88 (0.3)	1.30 (0.09)	2.57 (0.4)	1.25 (0.08)	1.58 (0.2)	1.54 (0.09)
Neglect roles (A)	1.54 (0.1)	1.45 (0.05)	1.38 (0.1)	1.24 (0.09)	2.13 (0.3)	1.13 (0.08)	1.57 (0.2)	1.58 (0.12)	1.48 (0.2)	1.82 (0.11)
Hazardous use (A)	1.37 (0.1)	1.84 (0.07)	1.39 (0.2)	1.52 (0.11)	1.23 (0.2)	2.18 (0.23)	1.49 (0.2)	1.74 (0.14)	1.34 (0.2)	2.12 (0.14)
Legal problems (A)	1.98 (0.2)	1.98 (0.07)	1.79 (0.2)	1.52 (0.09)	1.76 (0.4)	2.39 (0.25)	2.35 (0.7)	2.32 (0.19)	2.38 (0.4)	2.22 (0.13)
Social/interpersonal problems (A)	1.92 (0.1)	1.41 (0.05)	1.73 (0.2)	0.98 (0.07)	1.91 (0.3)	1.62 (0.11)	1.87 (0.3)	1.67 (0.12)	2.44 (0.4)	1.61 (0.08)
Bayesian information criterion (BIC)	15280.343		5602.446		2680.439		2907.884		4054.591	
Sample-size adjusted BIC	15210.439		5532.578		2610.602		2838.033		3984.713	
Akaike information criterion (AIC)	15146.845		5497.188		2585.741		2808.988		3944.563	
Usual 5+/4+ for men/women	0.54 (0.04)	0.44 (0.05)	0.77 (0.1)	0.89 (0.10)	0.54 (0.1)	−0.76 (0.15)	0.85 (0.1)	1.05 (0.11)	0.69 (0.1)	(−0.01) (0.07)
BIC	19318.55		6518.006		3362.339		3548.913		5470.552	
Sample-size adjusted BIC	19242.292		6441.787		3286.153		3472.712		5394.322	
AIC	19172.916		6403.179		3259.032		3441.026		5350.522	
12+ monthly/any for men/women	1.08 (0.1)	1.08 (0.05)	1.09 (0.1)	0.97 (0.09)	0.87 (0.1)	1.01 (0.12)	1.38 (0.2)	0.88 (0.08)	1.23 (0.1)	1.29 (0.08)
BIC	17877.09		6342.244		3214.044		3453.668		4813.899	
Sample-size adjusted BIC	17800.831		6266.025		3137.858		3377.467		4737.669	
AIC	17731.455		6227.417		3110.737		3345.782		4693.869	
5+ weekly/monthly for men/women	1.08 (0.1)	1.03 (0.05)	1.23 (0.1)	0.87 (0.08)	0.97 (0.1)	1.46 (0.15)	1.29 (0.2)	0.76 (0.08)	1.22 (0.1)	1.03 (0.07)
BIC	17956.534		6321.914		3076.866		3510.967		4964.491	
Sample-size adjusted BIC	17880.276		6245.695		3000.68		3434.766		4888.261	
AIC	17810.9		6207.087		2973.559		3403.08		4844.461	
Drunk monthly/any for men/women	1.34 (0.1)	1.69 (0.05)	1.18 (0.1)	1.31 (0.10)	1.14 (0.2)	1.91 (0.19)	1.30 (0.2)	1.63 (0.13)	1.92 (0.3)	2.09 (0.13)
BIC	16608.255		6168.202		2919.738		3223.419		4253.866	
Sample-size adjusted BIC	16531.997		6091.983		2843.552		3147.218		4177.636	
AIC	16462.621		6053.375		2816.431		3115.533		4133.836	

ERs: emergency rooms.
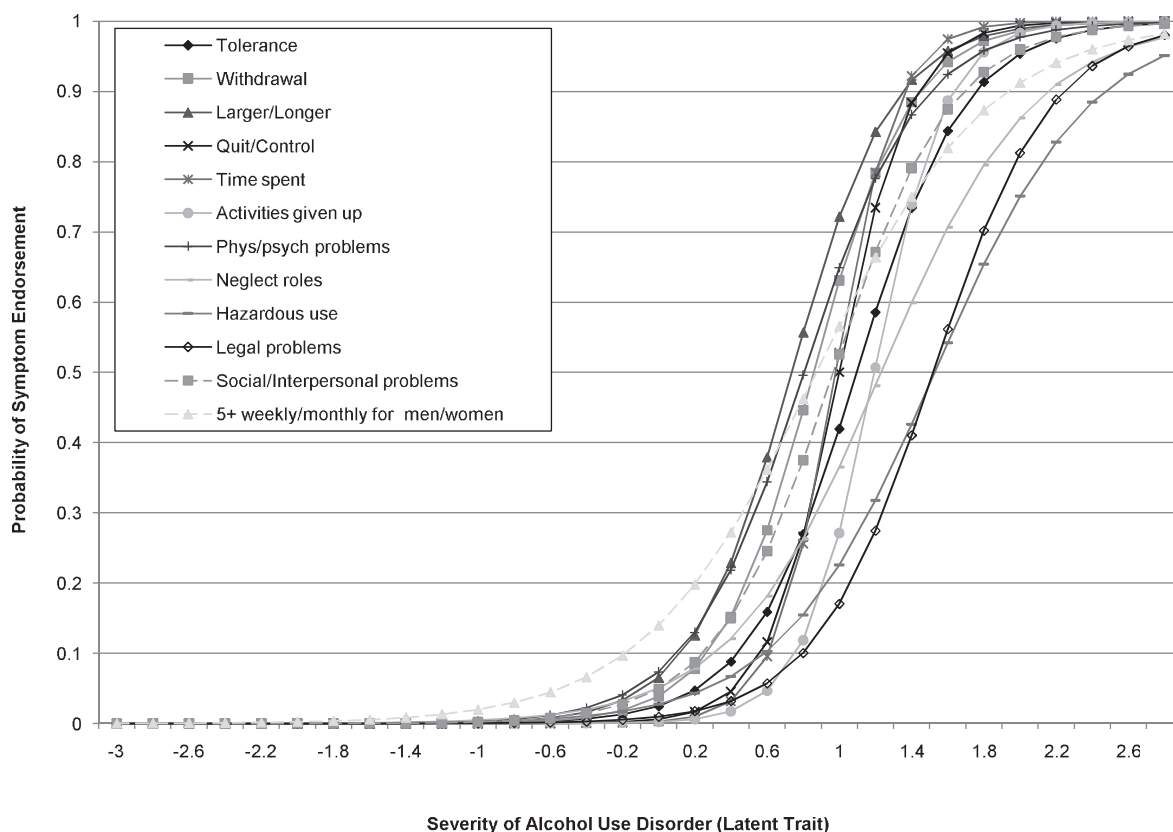
Figure 2 Criterion response curves for DSM-IV abuse and dependence criteria and 5+ weekly/monthly for men/women in each study site (US: Santa Clara)

It is apparent from the comparison across sites that there are several differences in both the discrimination and severity estimates for different criterion. The bottom of Table 4 shows the values of discrimination and severity for the consumption variables. In general, the inclusion of a consumption measure item along with other DSM items appears to have accomplished the stated goal of including an additional item that is consistent with other items of alcohol use disorders and that also taps the mildest range of the alcohol use disorder continuum. Nevertheless, the usual 5+/4+ is too low in discrimination and severity [also with very high Bayesian information criterion (BIC) values] and while slightly lower BICs were found in the model using the drunkenness variable, the BIC value was still too high, possibly a result of multidimensionality introduced by including the item. These conclusions apply for all sites. The two best candidates to tap the lower level of severity of the continuum while keeping acceptable BIC scores were 12+ drinks monthly/ any for men/women, and 5+ drinks weekly/monthly for men/women. The variable 5+ drinks weekly/monthly for men/women performed slightly better for Santa Clara and Pachuca, while the 12+ drinks monthly/any for men/women variable performed slightly better for Argentina and Poland, accordingly to their BIC values. For illus-

trative purposes we present the graphs of the criterion response curves for DSM-IV abuse and dependence criteria and 5+ drinks weekly/monthly for men/women in each study site (Figs 2–5).

DIF analyses were performed for each of the 11 alcohol use disorder criteria, at the same time contrasting severity (thresholds) and discrimination (slopes) parameters (Table 5). Four dependence items (withdrawal, time spent, larger/longer and quit/control) showed heterogeneity across study site ($P < 0.05$), while three abuse items and three consumption variables showed heterogeneity in threshold estimates. DIF was also found in discrimination (slopes) for two dependence criteria (time spent and physical/psychological problems), one abuse criterion (social/interpersonal) and three consumption variables, suggesting heterogeneity of discrimination estimates across EDs sites. Next, the test response curves were plotted to examine whether these item-specific differences canceled out in the total alcohol use disorder continuum. The results were very similar for most alcohol consumption variables (with the exception of usual 5+/4+), and suggested that there was no evidence of DIF between study site at the total score level. As an example, Fig. 6 shows the DIF results that incorporated the variable 5+ drinks weekly/
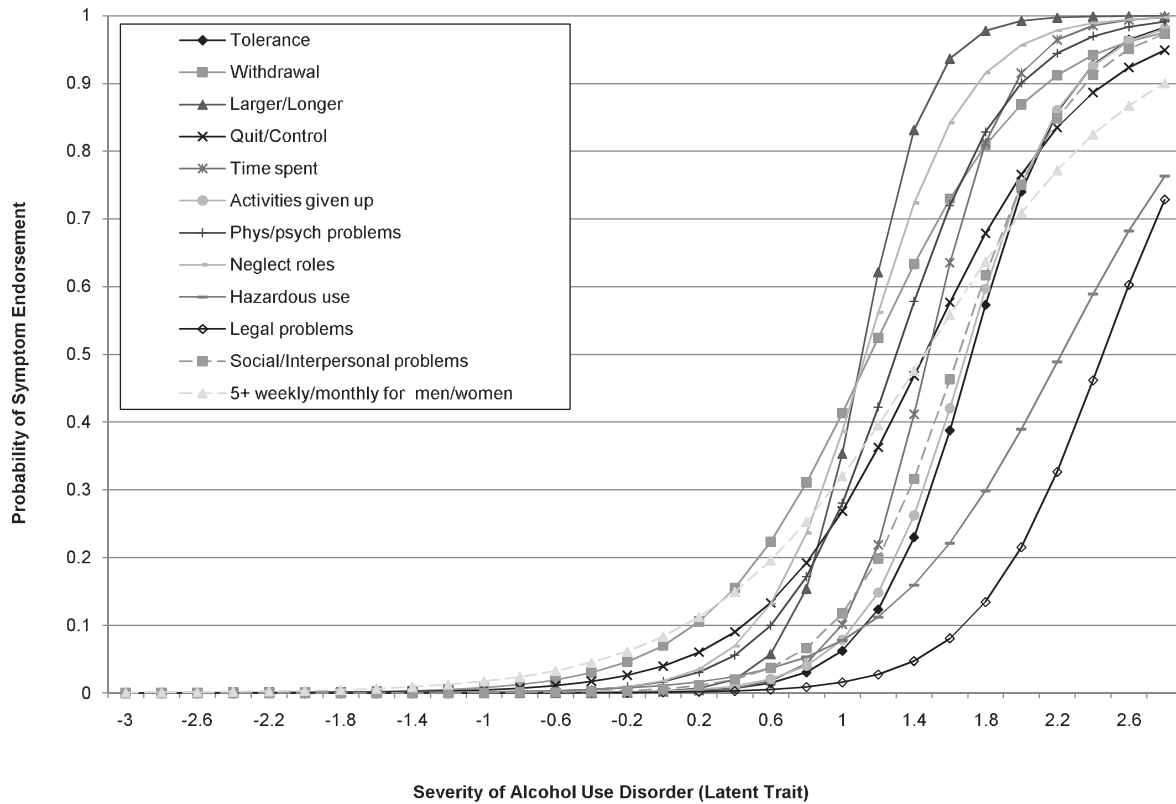
Figure 3 Criterion response curves for DSM-IV abuse and dependence criteria and 5+ weekly/monthly for men/women in each study site (Mexico: Pachuca)
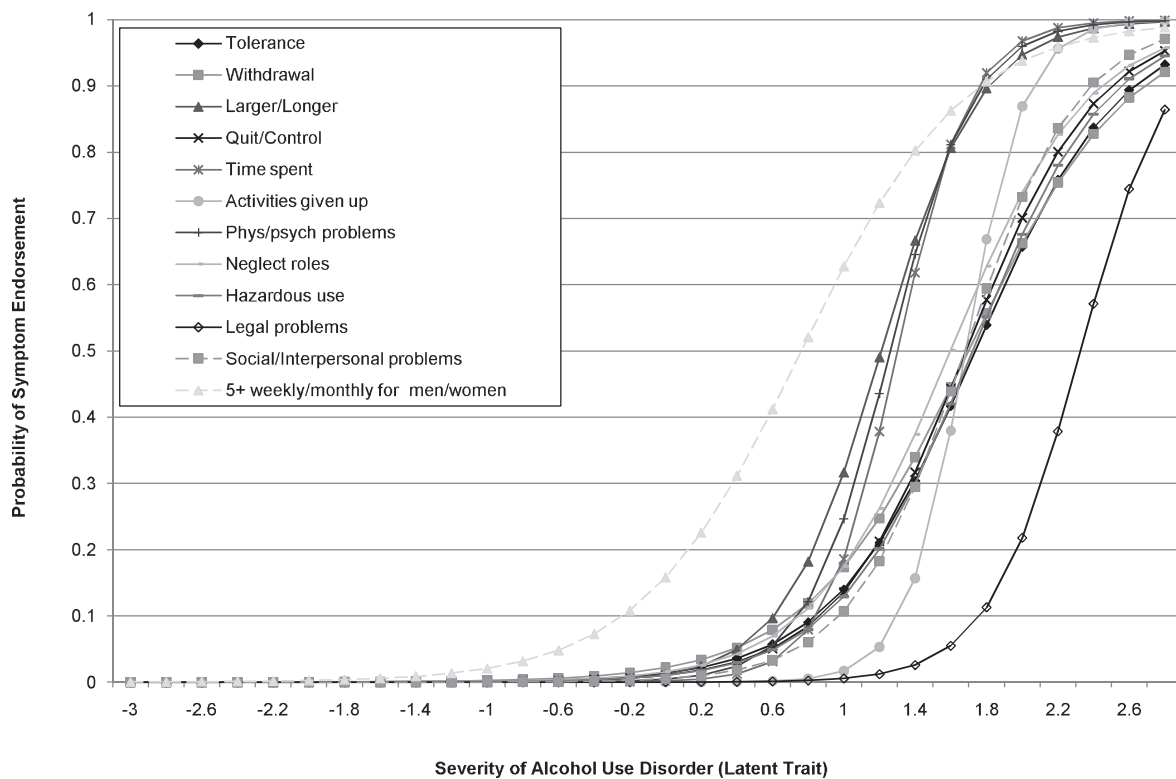

Figure 4 Criterion response curves for DSM-IV abuse and dependence criteria and 5+ weekly/monthly for men/women in each study site (Mar del Plata: Argentina)
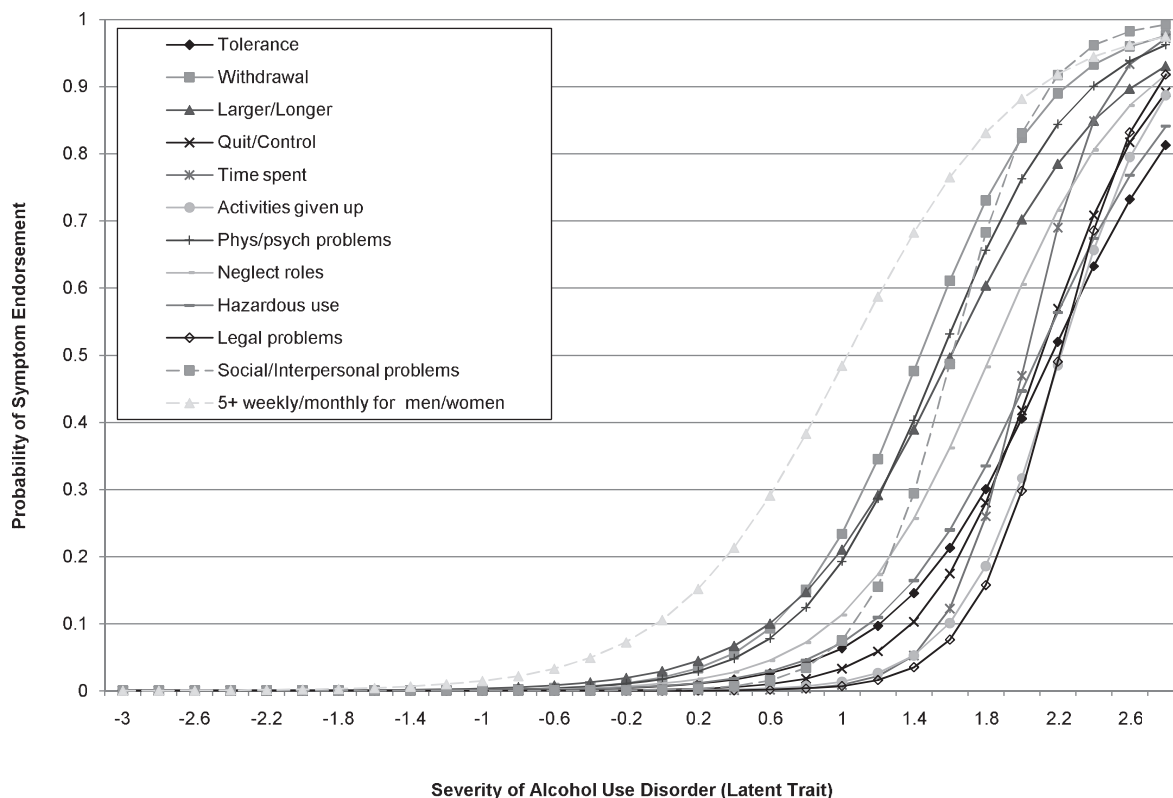
Figure 5 Criterion response curves for DSM-IV abuse and dependence criteria and 5+ weekly/monthly for men/women in each study site (Warsaw and Sosnowiec: Poland)

monthly for men/women. The DIF curves for all sites were virtually identical, suggesting that even if consumption variables had different severities and discriminations across sites, as expected, in the aggregate level their inclusion would not impact the final (total) performance of the diagnostic scheme.

DISCUSSION

Two main conclusions can be drawn from these analyses based on clinical samples of EDs patients from four different countries with very heterogeneous per-capita alcohol consumption and drinking cultures. First, exploratory factor analyses indicated that alcohol use disorders can be described as a single, unidimensional continuum without any clear-cut distinctions between the criteria for dependence and abuse in all sites. This finding is in concordance with other reports from general population samples in Australia [3], the United States[2,23], samples of US adolescents from clinical [24] and adjudicated, clinical and community samples [25], and samples of treatment-seeking addicts [26] and psychiatric outpatients [27]. In these studies, as in the one reported here, even when some abuse items loaded on a second factor, a single unidimensional trait emerges as a much more parsimonious solution. Samples here of patients undergoing

medical or injury treatment also strengthen the generalizability of the unidimensional finding for alcohol use disorders beyond community samples. These samples included patients who have been characterized as heavy chronic and acute drinkers [28,29]and, indeed, have a much higher prevalence of both alcohol use disorders and endorsement of alcohol use disorders symptoms than that reported in community samples, but lower than that reported in a clinical sample of adolescents in alcohol treatment [25] and under clinical treatment [26,27]. The cross-national nature of our sample widens the applicability of this conclusion and supports a unitary diagnosis of DSM alcohol use disorders that goes beyond a US or English-speaking milieu.

Secondly, results from the IRT analyses showed that in all EDs the current DSM-IV criteria tap people in the middle–upper end of the alcohol use disorder continuum. Data on alcohol consumption (amount and frequency of use) can be used in all EDs with the current DSM-IV diagnostic criteria to help tap the middle to lower part of this continuum, as first reported by Saha [6]. Nevertheless, as expected, there is no single alcohol consumption measure that is, by itself, invariant (both on severity and discrimination values) within these diverse ED populations. Even when, in all ED samples, a single dimension of alcohol use disorders exists and alcohol
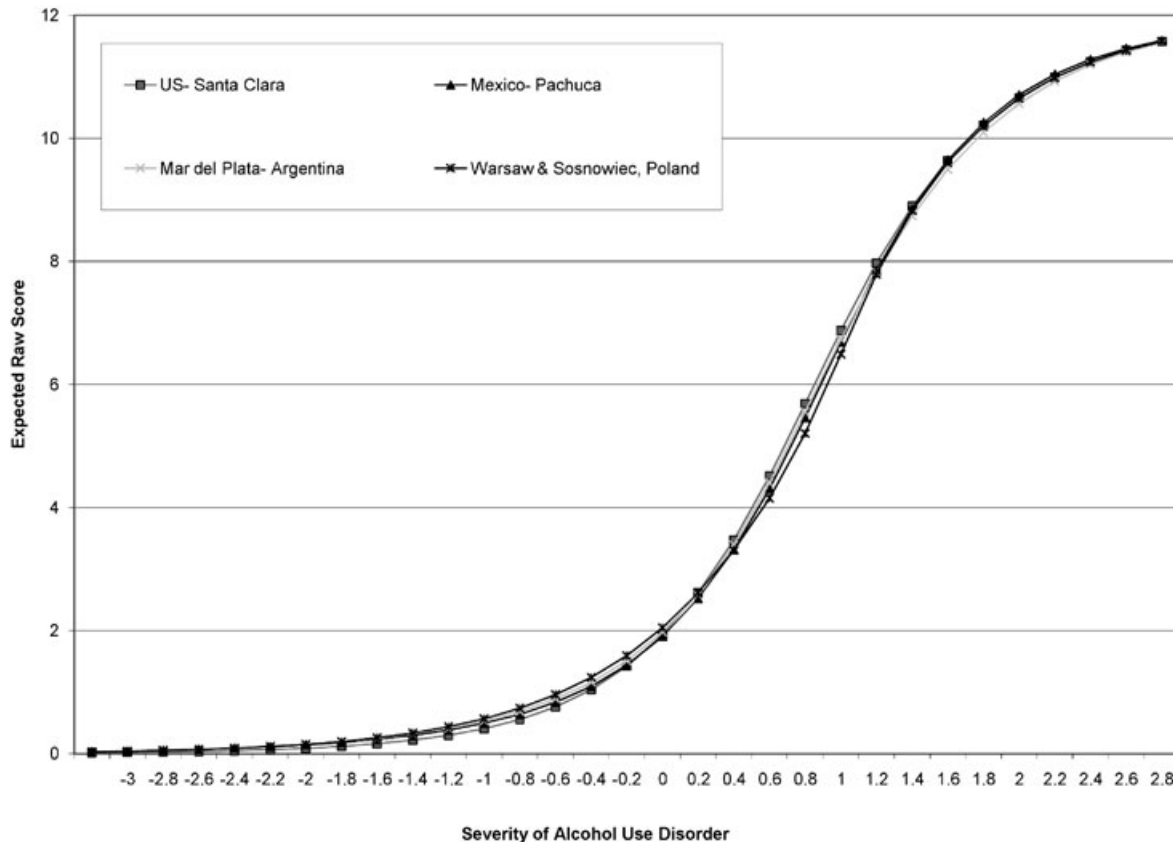
Figure 6 Test response curves (TRCs) for DSM-IV abuse and dependence criteria, and 5+ weekly/monthly for men/women by each study site

consumption may be used to tap people at the low end of the continuum, differences in severity and discrimination were observed across samples in some of the 11 alcohol use disorder criteria and in three of the four alcohol consumption variables. Prior qualitative research in the scope of current nosological classifications [30] and quantitative analyses at the criterion level for an alcohol dependence diagnosis [31] has warned that not all criteria are similarly understood across different societies (such as impaired control and neglect of interests) and should be fine-tuned for use in a cross-cultural context. While reports of cross-cultural differences in the prevalence of alcohol consumption variables, especially measures of heavy or harmful drinking, have been reported previously, this is the first report to show that differences on heavy drinking measures also abound in the context of the two parameters, severity and discrimination, on IRT analyses. Nevertheless, just a few of such DSM-IV criteria for alcohol dependence showed heterogeneity in estimates across sites. Most of the heterogeneity was found in abuse criteria and in alcohol consumption variables. These results also supported the finding from Saha [6], that even when some individual criteria show heterogeneity in severity and discrimination across sub-

groups (here among study sites) the total classification of the alcohol use disorder continuum is basically invariant. The addition of a consumption variable to the 11 criteria does not change the total performance of current diagnostic criteria. Two measures of consumption emerged as particularly useful for these countries, 12+ drinks monthly/any for men/women, and 5+ drinks weekly/monthly for men/women.

As a summary of our results, the inclusion of a Q-F measure performed as expected; it improved DSM criteria by including respondents at the lower end of the dependence continuum. When a Q-F measure was included, it did not change the overall performance of the diagnostic criteria, but our analyses also found cross-country variation in the difficulty of endorsing a heavy drinking criterion such as 5+ drinks weekly/monthly for men/women, one of the best Q-F candidate measures for these samples. Although differential item functioning was also observed among several other DSM-IV criteria, the heavy drinking measures appeared to exhibit some of the largest cross-cultural variation in the difficulty parameter seen among all DSM-IV criteria. While the four countries examined here are clearly not representative of all drinking cultures, and although the ER samples are probably different

Table 5 Differential item function analyses for thresholds (severity) and slopes (discrimination) of alcohol use disorder by Emergency Room Collaborative Alcohol Analysis Project (ERCAAP) sites; results from PARSCALE: adjusted thresholds and slopes across four sites.

	US: Santa Clara	Mexico: Pachuca	Mar del Plata: Argentina	Poland: Warsaw and Sosnowiec	χ^2 (3 df)	P
Threshold estimates						
Tolerance (D)	1.10	1.28	1.19	1.28	2.96	0.400
Withdrawal (D)	0.86	0.49	0.99	0.34	38.92	<0.001
Larger/longer (D)	0.73	0.53	0.64	0.45	12.05	0.007
Quit/Control (D)	1.00	0.96	1.25	1.50	13.51	0.004
Time spent (D)	0.98	1.00	0.70	1.27	11.17	0.011
Activities given up (D)	1.19	1.28	1.25	1.39	2.47	0.483
Physical/psychological problems (D)	0.80	0.73	0.75	0.55	4.70	0.193
Neglect roles (A)	1.24	0.64	0.86	1.27	21.96	<0.001
Hazardous use (A)	1.52	1.67	1.11	1.45	5.13	0.161
Legal problems (A)	1.52	2.12	2.01	1.71	13.65	0.004
Social/interpersonal problems (A)	0.98	1.23	1.19	0.73	9.43	0.024
Usual 5+/4+ for men/women	0.89	−1.72	0.74	−1.78	320.16	<0.001
12+ monthly/any for men/women	0.97	0.70	0.38	0.65	31.47	<0.001
5+ weekly/monthly for men/women	0.88	0.88	0.43	0.71	18.88	<0.001
Drunk monthly/any for men/women	1.32	1.45	1.23	1.36	0.80	0.851
Slopes estimates						
Tolerance (D)	1.97	2.33	1.51	3.85	18.97	<0.001
Withdrawal (D)	2.15	1.31	1.66	1.54	20.57	<0.001
Larger/longer (D)	2.19	4.11	1.84	1.40	19.76	<0.001
Quit/control (D)	3.00	1.19	2.26	2.72	37.13	<0.001
Time spent (D)	3.53	2.52	3.11	5.40	6.10	0.105
Activities given up (D)	3.04	1.91	2.90	0.56	21.49	<0.001
Physical/psychological problems (D)	1.89	2.09	2.44	1.64	2.89	0.410
Neglect roles (A)	1.37	3.31	1.52	0.82	30.68	<0.001
Hazardous use (A)	1.39	1.67	1.81	2.31	9.15	0.027
Legal problems (A)	1.79	2.25	2.82	7.30	17.93	0.001
Social/interpersonal problems (A)	1.73	1.77	1.88	2.16	1.35	0.722
Usual 5+/4+ for men/women	0.77	0.75	0.64	0.60	4.00	0.260
12+ monthly/any for men/women	1.08	0.84	1.22	1.13	2.75	0.433
5+ weekly/monthly for men/women	1.22	0.97	1.10	1.14	2.08	0.560
Drunk monthly/any for men/women	1.17	1.49	1.32	2.64	12.06	0.007

DSM-IV criterion: A = alcohol abuse; D = alcohol dependence.

from their respective general populations, findings here suggest that caution should be used in including culturally sensitive measures such as heavy drinking in the proposed DSM-V, and that additional research in this area is necessary.

Finally, in order to recommend a change in the current DSM-IV criteria we still need to consider the overall impact that this change may have in the performance of the full criteria, especially the impact in sensitivity and specificity. How the choice of a particular measure of alcohol consumption affects the total prevalence of alcohol use disorders when added to the current 11 criteria is a matter of great relevance, but goes beyond the scope of the present analyses. This change may have implications/ramifications across cultures, because different cultures have very different drinking patterns. Even more, when applied to different cultures, Q-F measures also need to consider other dimensions such as

drinking context and duration of drinking. These issues were not discussed in this paper, as they go beyond the scope of any EFA and IRT framework and merit a separate analysis. From the differential item functioning of some measures of heavy drinking (such as any 5+/4+ for men/women or monthly drunkenness/any for men/women) it is clear that the choice of the alcohol consumption measure can have dramatic influences on the definition of the final criteria under study, as showed in the NESARC when adding a binge drinking measure to the current 11 criteria of DSM-IV [32].

Study limitations

This study is limited to an analysis of data from patients with non-fatal injuries and medical emergencies who attended specific EDs. Although the study design provides a representative sample of patients from each ED facility,

patients may not be representative of other ED facilities in the region or country. Additionally, reported here are data from only four countries, and while each demonstrated distinctly different drinking patterns, the inclusion of EDs from other countries may have influenced study findings. An additional limitation is that cultural factors may have influenced willingness to report the presence of specific criteria as well as the interpretation of survey items related to these criteria, such as the hazardous use criterion illustrated by drinking and driving behaviors [33]. It is important to note that even when we presented data on the inclusion of Q-F questions into current DSM-IV definition of alcohol use disorders, our definitions of Q-F were not exactly the same used by Saha *et al.* [6] and replication of their findings may still be needed. Finally, results reported here are limited to the scope of the EFA and IRT analyses. Whether the addition of a consumption item (and which item) as a new criterion for alcohol use disorders would affect prevalence estimates across societies is an important topic that is beyond the scope of this report, but will be pursued in future analyses.

Declarations of interest

None.

Disclaimer

The authors have worked to ensure that all information in this paper is accurate at the time of publication and consistent with general psychiatric and medical standards, and that information concerning drug dosages, schedules, and routes of administration is accurate at the time of publication and consistent with standards set by the US Food and Drug Administration and the general medical community. As medical research and practice continue to advance, however, therapeutic standards may change. Moreover, specific situations may require a specific therapeutic response not included in this paper. For these reasons and because human and mechanical errors sometimes occur, we recommend that readers follow the advice of physicians directly involved in their care or the care of a member of their family.

Acknowledgements

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