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Evaluating shortened versions of the AUDIT as screeners for alcohol use problems in a general population study

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Abstract

Background—Efficient alcohol screening measures are important to prevent or treat alcohol use disorders (AUDs).

Objectives—We studied different versions of the Alcohol Use Disorders Identification Test (AUDIT) comparing their performance to the full AUDIT and an AUD measure as screeners for alcohol use problems in Goa, India.

Methods—Data from a general population study on 743 male drinkers aged 18 to 49 years are reported. Drinkers completed the AUDIT and an AUD measure. We created shorter versions of the AUDIT by a) collapsing AUDIT item responses into 3 and 2 categories and b) deleting 2 items with the lowest factor loadings. Each version was evaluated using factor, reliability and validity, and differential item functioning (DIF) analysis by age, education, standard of living index (SLI), and area of residence.

Results—A single factor solution was found for each version with lower factor loadings for items on guilt and concern. There were no significant differences among the different AUDIT versions in predicting AUD. No significant DIF was found by education, SLI or area of residence. DIF was observed for the alcohol frequency item by age.

Conclusions/Importance—The AUDIT may be used with dichotomized response options without loss of predictive validity. A shortened 8-item dichotomized scale can adequately screen for AUDs in Goa when brevity is of paramount importance, although with lower predictive validity. Although the frequency item was endorsed more by older men, there is no evidence that the AUDIT items perform differently in other groups of male drinkers in Goa.

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Keywords

screeners; item analyses; AUDIT versions; AUDs; India

INTRODUCTION

Increased alcohol production and use (Prasad, 2009) and heavy use among drinkers (Benegal, 2005; Ray, 2004) have fueled a public health crisis in India (Bonu, Rani, Peters, Jha, & Nguyen, 2005; Neufeld, Peters, Rani, Bonu, & Brooner, 2005). Alcohol is cheap and readily available due to low excise duties, thriving tourism, and local production of cashew-based spirits in Goa, one of India's smallest, (Office of the Registrar General and Census Commissioner India, 2001) but heavier-drinking states (Ray, 2004). While less than half (39%) of men in Goa report drinking alcohol in the past year, hazardous alcohol use is common (Nayak, Bond, Cherpitel, Patel, & Greenfield, 2009; Pillai et al., 2013). A third of men in industrial and primary care settings in Goa drink at levels likely to create physical and mental health problems (D'Costa et al., 2007; Silva, Gaunekar, Patel, Kukalekar, & Fernandes, 2003). A third of all male drinkers in this state also report at least monthly drunkenness (Pillai et al., 2013).

Brief interventions have been found to reduce alcohol-related problems (Babor et al., 2007) but necessitate efficient screening for problematic alcohol use. Given time limitations in health care settings, scientific data on strengths and limitations of more efficient screening tests have the potential to increase cost-effective reduction of alcohol-related disease burden and are important to prevention efforts (Stewart & Connors, 2004/2005).

The Alcohol Use Disorders Identification Test (AUDIT) (Babor, de la Fuente, Saunders, & Grant, 1992) is an alcohol use screening measure that has been used world-wide. Originally developed for use in primary care settings, it is increasingly used in population surveys (Reinert & Allen, 2002). The AUDIT is superior to shorter screening measures for detecting Alcohol Use Disorders (AUDs) in Goa (Nayak et al., 2009) but its cut-off scores need to be adjusted for a better balance of sensitivity and specificity for hazardous drinking and AUDs in clinical (Pal, Jena, & Yadav, 2004) and population samples in India (Nayak et al., 2009).

A barrier to the AUDIT's implementation is the time needed to administer its 10 multiple-answer-format items (Bischof et al., 2007; Meneses-Gaya et al., 2010). Screeners with dichotomous (yes/no) response options reduce response burden by taking less time to complete than the multi-response AUDIT items (Hays, Hill, Gillogly, Lewis, & Bell, 1993). Only one study has examined the AUDIT with dichotomized responses in primary care and reported little effect on its validity, including no difference in sensitivity and specificity from the original AUDIT (Bischof et al., 2007). However, the performance of the AUDIT with reduced response options in population samples has not been studied. Given the need for time-efficient measures in population studies, particularly in the more common broad-based health surveys that seek to assess alcohol use as briefly as possible, information on the performance of shortened screeners is very important.

Because AUDIT item responses are summed to provide a severity index for AUDs, culturally irrelevant items can result in imprecise measurement and AUD misclassification (Midanik, Greenfield, & Bond, 2007). Variability across subgroups in responses to standard items is acknowledged as a measurement issue in survey research (King, Murray, Salomon, & Tandon, 2003) but has been little studied for alcohol screeners such as the AUDIT, despite its wide adoption. Cultural factors are particularly relevant for item response functioning in relation to AUD, in part because alcohol dependence symptoms vary across cultures (Room, Janca, Bennett, Schmidt, & Sartorius, 1996; Schmidt & Room, 1999). For instance, the third item on the AUDIT item on consumption of 6 or more drinks may be less informative in India, where high quantity consumption is the signature drinking pattern even in very infrequent drinkers, but could be a good indicator of alcohol problems in a culture with *infrequent* heavy drinking.

Item response biases include a wide range of factors that might influence the responses to items on self-report measures. This is because human subjects integrate several pieces of information, such as their own experience, their perceptions of their culture, and of drinking, to respond to an item on drinking rather than responding to the item alone. Thus, item bias with respect to age, education, urbanicity, marital status, and standard of living (SLI), including that within a given culture, can result in differential probability of responses to individual AUDIT items, even at the same underlying severity level. This variability would then result in differential reliability and validity of AUD diagnoses for the AUDIT across different subgroups within the same culture.

Frequent heavy episodic drinking in Goa occurs among older, less educated men and those with lower SLI (Pillai et al., 2013). These subgroups may minimize problems related to drinking and respond differently to specific AUDIT items on concern and negative effects related to their drinking compared to younger, more educated men and those of higher SLI. Data on item subgroup response variability for AUDIT items can help determine which items have less response biases and, therefore, work in the same way for important demographic subgroups. Additionally, simpler or briefer forms of the AUDIT are more time-efficient for screening in community surveys.

In the educational literature, incomparability of items by personal characteristics has been studied with differential item function (DIF) (King et al., 2003). DIF occurs when people from different groups with the same latent trait being measured have a different relative (to the group mean problem severity) probability of endorsing an item. Thus, an item displays DIF if and only if people from different groups *with the same underlying trait* have differing item endorsement probabilities. Item Response Theory (IRT) modelling, which encompasses a class of latent variable methods for the analysis of categorical items forming a scale, is used to study DIF. IRT models assume that the items examined measure a single underlying latent construct (e.g., alcohol problem severity) and identify parameters representing important item characteristics. For dichotomous items, a commonly used IRT model has parameters for an item's *discrimination*, or the degree to which the item aligns with the underlying latent trait, and *difficulty or relative* rate of endorsement of an item (de Ayala, 2009).

A DIF evaluation formally assesses variability in item behavior across subpopulations and identifies a) items that are differentially relevant measures of the construct for specific subgroups and b) items that have differential relative endorsement rates across such groups. A desirable screening scale would have items that do not indicate significant DIF across key subgroups. To the best of our knowledge IRT methods have been conducted on the AUDIT items, only to a limited extent worldwide and not at all in India.

Building on prior work on alcohol screening measures in Goa (Nayak et al., 2009), we conducted detailed item-level analyses on three versions of the 10-item AUDIT, a) the original, 10 multi-response items; and versions that collapsed response options into b) three, and c) two categories. We also examined a shortened version of the AUDIT using findings from item-level analyses to remove items with lower loadings on the underlying severity (alcohol use problems) factor and/or showing lower scale reliability. Item-level analyses included: a) factor analyses, b) Receiver operating curves (ROC) analyses to estimate relative validity of each version against a more comprehensive survey measure of AUDs; and c) DIF across subgroups based on age, education, SLI, and area of residence using item response theory (IRT) methods. DIF analyses focused on the AUDIT version determined by the factor and ROC analyses to be the most efficient measure of AUDs in Goa.

METHODS

Sample

We report data from 743 male drinkers, aged 18 to 49 years, who participated in a general population study on alcohol use patterns and sexual risk behaviors conducted in Northern Goa, India, from 2005 to 2008. Participants were randomly selected within rural and urban areas using a two-stage probability sampling procedure to select households for participation. Within each selected household, adults were randomly selected on a probability basis based on electoral roll information.

A total of 1,899 men completed in-person screening interviews that assessed alcohol consumption using detailed beverage-specific drink size information (Nayak, Kerr, Greenfield, & Pillai, 2008). Thirty-nine percent reported drinking alcohol in the past year. Women were excluded from our analyses due to extremely low drinking rates (2.2%). A sub-sample of 1,034 men completing screening, including an over-sample of 743 current drinkers, participated in a second detailed main interview. Refusal rates, respectively, for screening and main interviews, were very low (2% and <1%, respectively). More detailed information on the study procedures is provided elsewhere (Nayak et al., 2009).

Measures

Current (past year) drinking—Respondents were asked if they had ever tasted alcohol or had a drink containing alcohol. Those responding ‘yes’, were then asked if they had a whole drink of any alcoholic beverage in the last 12 months. Only those responding ‘yes’ to the second question (current drinkers) completed the alcohol use screening given that the AUDIT assessed any drinking within the past year.

The Alcohol Use Disorders Identification Test (AUDIT) was used as part of the screening interview. The AUDIT is a 10-item screening measure for hazardous alcohol use and AUDs, including harmful alcohol use and alcohol dependence (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001; Saunders & Aasland, 1987) that was validated on primary health care patients (Saunders, Aasland, Babor, de la Fuente, & Grant, 1993). It has been used previously in Goa with industrial workers and primary care samples (D'Costa et al., 2007; Gaunekar et al., 2004; Gaunekar, Patel, & Rane, 2005; Silva et al., 2003). When summed, scores of 8, 16, and 20 or more are reported to indicate hazardous use, harmful use (alcohol abuse) and alcohol dependence, respectively (Babor et al., 2001).

The original AUDIT includes 3 items on past year alcohol consumption and 7 items on alcohol-related problems and dependence symptoms. The first 3 items assess past year frequency of drinking (A1); usual quantity (A2), frequency of heavy episodic drinking or more than 6 drinks ((60 g ethanol) per occasion (A3). The alcohol problem items assess frequency of being unable to stop drinking once started (A4), role failure due to drinking (A5), needing a drink in the morning (A6), guilt or remorse after drinking (A7), inability to remember because of drinking (A8), injury related to drinking (A9), and concern by others regarding the respondent's drinking (A10). Items 1, 3 and 4 through 8 use five response categories: never, less than monthly, monthly, weekly, and daily. Item 2 uses four response categories: 1 or 2, 3 or 4, 5 or 6, 7, 8, or 9, and 10 or more. Items 9 and 10 use three response categories: No, Yes, but not in the last year, and Yes, during the last year. Those reporting "never" to item A1, skipped over items A2–A8, were only asked items A9 and A10, and are excluded from analyses for this paper.

Alcohol Use Disorders (Criterion) measures (AUDs, Alcohol Abuse and Alcohol Dependence) were administered in the main interviews. The DSM-IV (American Psychiatric Association, 2000) characterizes two distinct alcohol use disorders (i.e., abuse and dependence) (Hasin, 2003). The alcohol abuse measure in our study assessed relevant alcohol-related consequences using a 15-item scale used extensively in prior U.S. national studies of alcohol use (Greenfield, Nayak, Bond, Ye, & Midanik, 2006; L. Midanik & Greenfield, 2000). It assesses five alcohol-related problem areas: work problems, fights or arguments, family reactions, vehicular accidents and trouble with the law, and health problems. Two or more alcohol-related consequences denote alcohol abuse (Cherpitel, 2002; Midanik & Greenfield, 2000). Consistent with DSM-IV abuse criteria's exclusion of alcohol-related health problems, we used 2 or more alcohol-related consequences, other than those related to health, to indicate abuse.

Our alcohol dependence measure, also adapted from U.S. National Alcohol Surveys, included 17 items reflecting DSM-IV's (American Psychiatric Association, 2000) 7 symptom domains or criteria for alcohol dependence (Caetano & Greenfield, 1997; Caetano & Tam, 1995). One positive item from each of three or more symptom domains denoted alcohol dependence. Our alcohol abuse measure does not assess frequency of occurrence of consequences, and our dependence measure does not estimate two week co-occurrence of symptoms as per diagnostic criteria (American Psychiatric Association, 2000). Therefore, our AUD measures, while standardized for surveys (Caetano & Tam, 1995), do not denote a

formal clinical diagnosis. We used a combined measure of either alcohol abuse or dependence to indicate any AUD (Nayak et al., 2009).

Procedure

As per specifications for cross-cultural use of measures (Bracken & Barona, 1991), all study measures were translated and back-translated from English into Konkani, Marathi and Hindi, languages spoken in Goa. Our study protocol and procedures were approved by the research ethics committees at Sangath in Goa and the Public Health Institute in the US, and by the Indian Council of Medical Research.

All study procedures were completed in the respondent's home. Interviews were completed predominantly in Konkani (93.1%, $n=692$), others in English (3.2%), Hindi (2%) and Marathi (1.6%). Screening and main interviews, respectively, took under 20 minutes (mean=17.09, $SD=7.01$) and just over an hour (mean=65.38, $SD=26.76$) to complete. To limit participant burden, light drinkers ($n=48$) were not administered alcohol use disorders (criterion) measures and coded as negative for AUDs. Light drinkers were defined as those who drank less than once a month, had a maximum consumption of less than 24 grams of pure ethanol, and a score of less than 8 on the AUDIT.

Analysis

We first analyzed data using the 3 versions of the 10-item AUDIT (see Table 1). The 5-category AUDIT retained the original 5 response categories for the first 8 items. The 3-category AUDIT collapsed responses to items A1, A2, A4, A5, A6, A7, and A8 into three categories, retaining 3 categories for A9 and A10 (Peng, Wilsnack, Kristjanson, Benson, & Wilsnack, 2012) as follows: Item A1 was coded as 0 ('less than weekly'), 1 ('1–4 times a week'), and 2 ('at least 5 times a week'); A2 as 0, 1, 2 for '1 or 2 drinks', '3 or 4 drinks', and '5 or more drinks'; and A3 as 0, 1, and 2 for 'never', 'less than monthly', and 'monthly or more often'. For items A4–A8, the three highest-rank answers were recoded to 'monthly or more often' with the value 2, retaining 1 for 'less than monthly' and 0 for 'never'.

The 2-category AUDIT coded responses using: A1 by combining 0–2 into "0" defined as '4 or fewer times per month' and 3–4 into "1" defined as '2 or more times per week'; A2 by combining 0–1 into 0 and '4 or fewer' and 2–4 into 1 '5 or more'; A3 by 0 as 'Never' and 1–4 recoded into 1 defined as 'any in the past 12 months'; A4–A8 by 0 defined as 'Never' and 1–4 into 1 defined as 'any in the past 12 months'; and A9 and A10 by 0 defined as 'Never' and 2–4 into 1 defined as 'ever in my lifetime'.

Exploratory factor analyses (EFA) were estimated for all three AUDIT versions using the WLSM estimator (i.e., weighted least squares with a diagonal weight matrix (Muthén & Muthén, 2011)). First, eigenvalues of the tetrachoric or polychoric correlation matrices were examined. Factor loadings obtained from a principal component analysis (PCA) of the relevant correlation matrix and the comparative fit index (CFI), Tucker-Lewis fit index (TLI), and root mean square error of approximation (RMSEA) were examined.

Receiver operating curves (ROC) analyses were carried out using three "silver standard" dichotomous criterion measures defined as (a) endorsing items in 3 or more DSM-IV

symptom domains (dependence); b) 2 or more alcohol related consequences and c) any (1 or more) Alcohol Use Disorders (AUD vs. none). Using Stata (Stata Corp., 2009), t-Tests for differences in areas under the ROC curves (AUC) were conducted for the three 10-item AUDIT versions and for parallel versions with items with comparatively lower factor loadings removed. ROC analyses were also conducted to determine cut points for dependence, consequences and any AUDs for each AUDIT version.

Item response theory modeling (IRT)—EFA and ROC analyses indicated a unidimensional construct and insignificant loss in predictive validity by dichotomizing AUDIT items. Therefore, the 2-parameter logistic IRT (2PL) model (i.e., $\text{logit}(p_{i,j}(\theta_j)) = a_i(\theta_j - b_i)$) was estimated to examine invariance, or differential item functioning (DIF) among men, in the difficulty (b_i) and discrimination (a_i) parameters across categories of age (under vs. 30 and over), area of residence (urban vs. rural), education (< HS vs. HS grad+), marital status (married vs. not married), and standard of living index (1–2 vs. 3–5 quintile) using IRTPRO (Li, Thissen, & du Toit, 2012).

The item difficulties were parameterized as deviations from group-specific latent mean problem severities and estimated as separate parameters in the IRT model as $b_i = (d_i - \mu_g)$, with μ_g as the group mean severity and d_i as the difficulty parameter. Shown in Table 5 are estimates of b_i with significance testing based on the relative prevalence parameters d_i . As the μ_g are typically of less interest than the d_i , they are not reported here. In the above model, the subscript i indexes items for which the discrimination and difficulty parameters were allowed to vary across items, and j indexes individuals (i.e., each respondent has their own latent trait (severity) level). Invariance was examined in discrimination (alignment of the item with the underlying latent trait) and difficulty (relative rate of endorsement) parameters of the 2PL model. (Li et al., 2012)

RESULTS

Factor Analyses

Table 2 presents distributions of the 5-, 3-, and 2-category AUDIT items with factor loadings, Cronbach's scale α , and α -if-item-deleted for each item. Response distributions indicated that, except for the first (usual frequency) item, each of the 5- and 3-category AUDIT items were strongly skewed to the right. A single factor solution was evidenced by: a) High CFIs and TLIs (above .97) and low RMSEAs (.08 or lower), b) a second eigenvalue under 1, and c) ratios of 6 and 1.5, respectively, between the first and second and between the second and third eigenvalues. These findings together suggested lack of scale multidimensionality.

Factor loadings for each of the three AUDIT versions in a single dimension model were mostly above .70, with slightly lower loadings for injury (.67–.69 across the 3 scales) and substantially lower loadings for guilt and concern (loadings for both items ranging from .53–.56 for all 3 scales). Cronbach's α estimates indicated good item reliability for all 3 scales, ranging from .77–.80. Cronbach's α -if-item-deleted estimates were all under the overall scale α , except for the Concern item, which yielded only a very slightly higher α .

Table 3 shows areas under the curve (AUC) for each of three AUDIT versions corresponding to the three silver standard criterion AUD measures of dependence, abuse, and any AUD. Due to the somewhat lower factor loadings for the Guilt and Concern items, AUCs were estimated both for the 10-item scale and an additional 8-item version with these 2 items removed. We then compared AUCs for the 5-, 3-, and 2-category version of the 10-item and 8-item AUDITs. No significant differences were found, indicating versions with a reduced number of response categories performed similarly to the full AUDIT scale. Comparisons within each of the three AUDIT versions found AUC differences between the 10- and 8-item scales with higher AUC values for the 10 versus 8-item scale for each AUDIT version indicating better predictive validity for the full 10-item scale ($p < .05$ for the 5-category, $p < .01$ for the 3-category, $p < .001$ for the 2-category AUDIT for both dependence and consequences; $p < .01$ for the 5- and 3-category AUDIT, $p < .001$ for the 2-category AUDIT for any AUD).

Findings for the predictive validity of different cut-points for the 10 and 8 item scales with dichotomized response categories are shown in Table 4. These analyses indicate that cut-off scores of 3 or more and of 2 or more provided a balance between sensitivity and specificity for any AUD for the 10-item and 8-item dichotomized versions of the AUDIT respectively.

IRT analyses

Results of DIF analyses of item parameters are shown in Table 5 with p-values for the test of equality of the difficulty and discrimination parameters across categories of each demographic variable considered. To adjust for multiple comparisons, Bonferroni corrections were applied by dividing the standard significance level $\alpha = .05$ by the number of items within the scale to set the required significance level to .005. Using this adjusted significance level, DIF was only observed for the difficulty parameter for the usual frequency item by age. Specifically, older men (age 30 and older) endorsed item A1 (frequency of drinking) differentially higher than expected compared to younger men (18–29).

DISCUSSION

Scientific information on screening measures informs efficient screening and intervention. We evaluated different versions of the AUDIT using data from a general population study in Goa, India, using detailed item analyses for this widely used screening measure of alcohol-related problems. Consistent with findings for clinical samples (Skipsey, Burleson, & Kranzler, 1997), including in India (Carey, Carey, & Chandra, 2003), we found a single factor for the AUDIT. This suggests a unidimensional structure for the AUDIT as in its original development as a screen for hazardous drinking and supports use of a score that sums responses across all items of the measure.

Our findings contrast with those of 3 factors (consumption, abuse and dependence) for the AUDIT in alcohol dependent and population samples in the U.S. (Doyle, Donovan, & Kivlahan, 2007) and Finland (von der Pahlen et al., 2008). They also contrast with several other studies that support a two-factor model, with the first 3 items loading on a factor usually labeled as “alcohol consumption” and the remaining items loading on a second

factor labeled “alcohol-related problems (Shields, Guttmanova, & Caruso, 2004; Smith, Shevlin, Murphy, & Houston, 2010).

Variability in criteria used to extract additional factors in the other studies may explain differences in findings for the AUDITs factor structure. However, consistent with the variability in the factor structure found for the AUDIT in a multi-country-study (Peng et al., 2012), our findings suggest that cultural factors impact AUDIT performance and that more data on its cross-cultural implementation are needed.

Our results demonstrated low factor loadings for two items of the AUDIT for male drinkers in Goa: guilt associated with drinking and concern from others. Ambivalence regarding alcohol use in India is well documented (Benegal, 2005). Given that heavy consumption is the typical drinking pattern (Pillai et al., 2013), any alcohol use may be perceived by both the drinker and others as “bad behavior”. Thus, guilt and concern may be less valuable than other AUDIT items for identifying alcohol use problems. Because guilt and concern related to drinking are not unique to India, it would be useful to evaluate these items in more culturally diverse samples, such as in cross-nation studies (Peng et al., 2012).

To the best of our knowledge, very few studies have compared the psychometric properties of versions of the AUDIT that use fewer (3 and 2) response categories. This is important because simplicity of administration often facilitates use of screening measures. Thus, despite its relatively poor performance compared to other measures, the CAGE continues to be used globally, primarily due to its brevity and dichotomized response format (Hayes et al., 1993). All versions of the AUDIT in our study were associated with high AUCs, supporting their use in screening for AUDs. Consistent with prior research outside India (Bischof et al., 2007), we found that a dichotomized response version of the AUDIT performs as well as the original multi-response AUDIT in identifying risk for AUDs. The shortened 8-item scale (items on guilt and concern removed) also provided a reasonable estimate of risk for AUDs. Thus we recommend its use when brevity is of paramount importance, as in short health surveys.

The AUC associated with the 8-item version, however, was lower than that for 10-item AUDIT. Outside India, the 3- item AUDIT-C has been documented to show excellent performance for detecting heavy drinking but its validity for AUDs is lower than that for the full AUDIT (Bischof et al., 2007; Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998). Therefore, costs in reduced accuracy of classification of case must be considered when using the shortened scale. In clinical samples, where greater accuracy is needed, it would be best to use the 10 item scale using dichotomized answer categories to save time in extremely busy settings.

Because lack of time is cited as a barrier to screening for AUDs in primary care (Meneses-Gaya et al., 2010), screeners with dichotomized response formats may be particularly useful. Such screeners (e.g., Short-MAST, CAGE) are shown to have substantially lower response times, even when the number of items in the screener are accounted for (Hays et al., 1993). The multiple answer format AUDIT is documented to take 4 times as long as the dichotomized answer format 4-item CAGE (8 seconds per item) (Hayes et al., 1993). Use of

a dichotomized version of the AUDIT can thus reduce time for administration and scoring by a third, use of a dichotomized 8 item version by half. A limitation to note here is that we collapsed categories from the conventional multiple response AUDIT items to generate data for our dichotomous version of the AUDIT. Reduced categories might affect how participants answer the items, something our study did not investigate.

A particularly unique contribution of our study is the exploration of differential responding to AUDIT items across different demographic subgroups of men in Goa. Cultural attitudes affect the reporting of problems and diagnosis of AUDs and can result in significant differences in the threshold of “problem,” diagnostic significance, or harmful use (Room et al., 1996) and must be considered when interpreting scores and adapting screening instruments (Schmidt & Room, 1999).

Our data suggest no significant differences in how participants from different subgroups of men responded to the 10 AUDIT items. Thus, the dichotomized version may be used with varied groups of male drinkers in Goa. Our finding that older men were relatively more likely to endorse AUDIT item 1 of the AUDIT (more frequent drinking) is consistent with associations of more frequent drinking with age found across India (Ray, 2004). It may reflect cultural beliefs that drinking is an age-related privilege, thus potentially resulting in a higher relative prevalence of this item.

Age-related privileges related to drinking could be particularly salient for certain subgroups, such as the less wealthy. Our sample size limited our ability to conduct analyses on such subgroups based on combinations of demographics. Future studies could examine differential item functioning for AUDIT items in subgroups based on combined demographic characteristics. A further limitation is the lack of data on women. This is an important area for further research given documented gender differences in alcohol use problems worldwide and heavy consumption and alcohol use problems among women drinkers in India (Benegal, Nayak, Murthy, Chandra, & Gururaj, 2005). Because all study participants were from one state in India, our findings may not be generalizable to other Indian states or outside India. Despite these limitations, our study provides valuable information on a widely used alcohol use screening tool for use in community surveys in India. Results can be used for improved screening and intervention to reduce the considerable alcohol-related health burden in India.

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Glossary

Hazardous alcohol use	Drinking at levels likely to result in physical, social, and mental health problems.
Differential Item Functioning (DIF)	Variability in the probability of endorsing an item by respondents from different groups <i>with the same level of severity of the</i>

	<i>underlying trait</i> . DIF provides an indication of whether an item performs in different ways within a scale for different groups of respondents.
Item response theory (IRT) methods	Latent variable analysis methods for studying scaling properties of categorical items that form a scale
Item discrimination	The degree to which the item aligns with an underlying latent trait (e.g., severity of alcohol problems).
Item difficulty	A measure of the relative rate of endorsement of an item on the logit scale. For single group analyses, the latent problem severity at which the probability of a respondent endorsing an item is .5.

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Table 1
Method for Combining response Categories for the 3-Category (A) and 2-Category (B) AUDIT versions

Original Category	Usual Freq		Usual Quant		Freq Heavy		Can't Stop		Role Failure		Eye Opener		Guilt		Blackout		Injured		Concern	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
1	.. ^a		1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2			2		2		2		2		2		2		2		2		2	
3	1																			
4			3		2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3
5	2																			
	3																			

^a Analyses used only those reporting drinking in the past 12 months
^b AUDIT items 9 and 10 each have 3 response categories defined as 'no', 'yes but not in the last year', and 'yes, in the past year'

Table 2
AUDIT Item Distributions, Reliabilities, and Exploratory Factor Analysis Results by version

	Usual Frequency	Usual Quant	Frequency Heavy	Can't Stop	Role Failure	Eye Opener	Guilt	Blackout	Injured	Concern
5-category (original) Version										
Scale $\alpha=.80$, Eigenvalues = (6.01, .98, .65, ...), CFI=.98, TLI=.97, RMSEA=.08, $\chi^2(35)=212.3$										
Prevalence	1	.20	.58	.90	.93	.94	.80	.93	.94	.61
	2	.36	.51	.03	.02	.02	.10	.03	.03	.07
	3	.28	.19	.07	.02	.02	.05	.01	.03	.32
	4	.15	.03	.10	.02	.01	.03	.02	.02	.02
	5	.21	.06	.11	.03	.01	.02	.01	.02	.02
α if deleted		.77	.76	.77	.79	.80	.78	.79	.79	.83
Factor Loading		.79	.78	.95	.84	.83	.56	.74	.68	.53
3-category Version										
Scale $\alpha=.79$, Eigenvalues = (5.87, .95, .65, ...), CFI=.98, TLI=.97, RMSEA=.07, $\chi^2(35)=153.5$										
Prevalence	1	.64	.20	.58	.90	.93	.80	.93	.94	.61
	2	.15	.51	.14	.03	.02	.10	.03	.03	.07
	3	.21	.29	.28	.07	.05	.10	.04	.03	.32
α if deleted		.75	.77	.75	.77	.77	.78	.78	.78	.79
Factor Loading		.78	.76	.92	.83	.84	.55	.74	.67	.54
2-category Version										
Scale $\alpha=.77$, Eigenvalues = (5.92, .93, .68, ...), CFI=.99, TLI=.98, RMSEA=.07, $\chi^2(35)=90.9$										
Prevalence	1	.64	.71	.58	.90	.93	.80	.93	.94	.61
	2	.36	.29	.42	.10	.07	.20	.07	.06	.39
α if deleted		.74	.74	.73	.75	.76	.77	.76	.77	.77
Factor Loading		.76	.83	.90	.81	.82	.54	.75	.69	.56

^a Only those reporting any drinking in the past 12 months are used for the present analyses;

^b AUDIT items 7–10 include only 3 response categories

Table 3

Estimates of Area Under the Curve and Tests of Area Differences Across Scales

	3+ DSM-IV Dependence Symptoms	2+ Alcohol-Related Consequences	Any Alcohol Use Disorder
10-Item AUDIT			
5-Categories	.875* (.019)	.840* (.023)	.875** (.017)
3-Categories	.881†† (.019)	.845†† (.022)	.881††† (.016)
2-Categories	.880&& (.019)	.843&&& (.022)	.875&&& (.017)
8-Item AUDIT			
5-Categories	.851* (.023)	.812* (.026)	.847** (.020)
3-Categories	.854†† (.023)	.817†† (.025)	.850††† (.020)
2-Categories	.854&& (.023)	.806&&& (.025)	.841&&& (.020)

*, **, *** Indicates a significant area under the curve difference between 10-Item and 8-Item AUDIT, each using 5-category items, at the .05, .01, .001 level

†, ††, ††† Indicates a significant area under the curve difference between 10-Item and 8-Item AUDIT, each using 3-category items, at the .05, .01, .001 level

&, &&, &&& Indicates a significant area under the curve difference between 10-Item and 8-Item AUDIT, each using 2-category items, at the .05, .01, .001 level

Table 4

Cut points for the Dichotomous 8- and 10-item AUDIT for Current Drinkers

Standard Criterion	Item count	Cut point	Sensitivity	Specificity	% Correctly Classified	NPV	PPV
Alcohol Dependence	10	2+	92.05	58.17	62.18	98.20	22.82
		3+	85.23	72.52	74.02	97.34	29.41
		4+	73.86	85.50	84.12	96.05	40.63
		5+	60.23	92.67	88.83	94.55	52.48
Consequences	10	2+	91.95	58.08	62.05	98.20	22.54
		3+	81.61	71.95	73.08	96.72	27.84
		4+	70.11	84.91	83.18	95.54	38.13
		5+	50.57	91.31	86.54	93.30	43.56
Any AUD	10	2+	91.80	60.87	65.95	97.42	31.55
		3+	83.61	75.36	76.72	95.90	40.00
		4+	69.67	87.92	84.93	93.65	53.13
		5+	53.28	94.20	87.48	91.12	64.36
Alcohol Dependence	8	2+	86.36	68.70	70.79	98.20	22.82
		3+	70.45	81.53	80.22	97.34	29.41
		4+	55.68	93.89	89.37	96.05	40.63
		2+	80.46	67.87	69.31	98.20	22.54
Consequences	8	3+	62.07	80.34	78.20	96.72	27.84
		4+	47.13	92.68	87.35	95.54	38.13
		2+	85.25	71.50	73.76	97.42	31.55
		3+	63.93	83.09	79.95	95.90	40.00
Any AUD	8	4+	47.54	95.01	87.27	93.65	53.13

Table 5
Differential Item Functioning for Difficulty (Diff) and Discrimination (Disc) Parameters Across Demographic Characteristics

AUDIT Item	Age				Urbanicity				Education				Marital Status				Standard of Living Index			
	18-29		30+		Rural		Urban		< HS		HS+		Not Married		Married		Quartile 1-2		Quartile 3-5	
	Diff	Disc	Diff	Disc	Diff	Disc	Diff	Disc	Diff	Disc	Diff	Disc	Diff	Disc	Diff	Disc	Diff	Disc	Diff	Disc
Usual Freq	1.03** (.23)	2.11 (.46)	.41** (.09)	2.25 (.29)	.36 (.11)	2.14 (.32)	.44 (.07)	2.45 (.36)	-.16 (.18)	2.05 (.41)	0.2 (.09)	1.90 (.25)	.81* (.26)	2.02 (.35)	.20* (.09)	2.19 (.30)	.67 (.18)	1.83 (.31)	.69 (.08)	1.89 (.27)
Usual Quant	.79 (.14)	2.23 (.42)	.81 (.08)	3.15 (.50)	.56 (.11)	2.78 (.45)	.59 (.06)	3.28 (.55)	.32 (.19)	2.79 (.66)	0.25 (.08)	2.60 (.37)	.59 (.29)	2.09 (.39)	.66 (.08)	3.14 (.53)	.88 (.16)	2.41 (.46)	.89 (.08)	2.58 (.43)
Freq Heavy	.29 (.16)	3.02 (.78)	.43 (.08)	4.12 (.78)	.26 (.10)	4.08 (.84)	.16 (.05)	4.34 (.90)	-.03 (.17)	3.56 (.96)	-.23 (.06)	3.99 (.76)	.10 (.28)	3.03 (.100)	.24 (.08)	3.78 (.70)	.52 (.17)	3.71 (.103)	.38 (.06)	3.43 (.62)
Can't Stop	1.47 (.16)	3.04 (1.20)	1.76 (.13)	2.47 (.48)	1.33 (.12)	2.83 (.59)	1.41 (.15)	2.89 (.62)	1.21 (.16)	2.21 (.70)	1.16 (.14)	2.63 (.48)	1.66 (.24)	2.18 (.62)	1.51 (.13)	2.57 (.61)	1.77 (.14)	2.31 (.71)	2.00 (.25)	2.20 (.49)
Role Failure	1.82 (.24)	2.79 (1.28)	2.10 (.21)	2.11 (.49)	1.64 (.16)	2.41 (.57)	1.75 (.24)	2.56 (.63)	1.65 (.24)	1.86 (.62)	1.43 (.19)	2.48 (.51)	1.47 (.15)	3.18 (.205)	2.28 (.29)	1.81 (.40)	2.36 (.28)	1.56 (.46)	2.09 (.25)	2.81 (.79)
Eye Opener	2.00 (.26)	2.54 (.72)	1.89 (.16)	2.95 (.88)	1.57 (.12)	3.22 (.72)	1.65 (.20)	2.94 (.72)	1.36 (.17)	2.22 (.75)	1.46 (.19)	3.47 (.128)	1.85 (.24)	2.57 (.147)	1.79 (.18)	2.79 (.87)	2.04 (.17)	2.43 (.93)	2.32 (.32)	2.47 (.72)
Guilt	1.42 (.24)	1.34 (.28)	1.84 (.25)	0.93 (.17)	1.19 (.18)	1.19 (.21)	1.66 (.33)	1.07 (.24)	1.35 (.27)	1.17 (.27)	1.04 (.22)	1.03 (.17)	1.66 (.34)	1.02 (.22)	1.51 (.22)	.98 (.17)	1.76 (.24)	.96 (.20)	2.01 (.32)	.92 (.18)
Blackout	1.71 (.22)	3.26 (1.87)	2.12 (.20)	1.97 (.40)	1.58 (.15)	2.49 (.58)	1.81 (.26)	2.31 (.55)	1.57 (.22)	2.10 (.81)	1.41 (.18)	2.32 (.45)	1.71 (.21)	2.74 (.168)	2.02 (.22)	1.85 (.35)	2.31 (.26)	1.61 (.46)	2.09 (.24)	2.58 (.68)
Injured	2.19 (.32)	2.15 (.63)	2.22 (.22)	1.78 (.33)	2.18 (.29)	1.74 (.41)	1.46 (.15)	2.96 (.64)	1.64 (.26)	2.35 (.19)	1.79 (.30)	1.65 (.33)	2.05 (.38)	1.98 (.101)	2.17 (.26)	1.68 (.33)	2.71* (.37)	1.71 (.60)	2.09* (.25)	2.00 (.46)
Concern	.81 (.22)	.85 (.19)	.57 (.10)	1.17 (.17)	.63* (.13)	1.21 (.20)	.24* (.09)	1.31 (.22)	-.12 (.16)	1.09 (.25)	.23 (.13)	.97 (.15)	.53 (.19)	.96 (.19)	.41 (.11)	1.05 (.16)	.82 (.17)	.88 (.18)	.61 (.11)	1.11 (.17)