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RELIABILITY AND FACTOR STRUCTURE OF THE AUDIT AMONG MALE AND FEMALE BAR PATRONS IN A RURAL AREA OF SOUTH AFRICA

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ABSTRACT

We assessed the reliability and dimensional structure of the Alcohol Use Disorders Identification Test (AUDIT) among bar patrons in a rural area of South Africa. In total, 406 bar patrons completed a questionnaire containing the AUDIT, and demographic and psychosocial measures. The participants consisted of 314 (77.3%) males and 92 (22.6%) females. Their combined mean age was 30.0 years (SD = 8.45). The data were analysed using Confirmatory Factor Analysis (CFA) and Cronbach's alpha reliability analysis which were conducted separately for males and females. We found that Cronbach's alpha for the AUDIT was 0.81 and 0.72 for the males and females, respectively. CFA supported a two-factor and three-factor model for the males but failed to support a one-factor, two-factor, or three-factor model for the females. The results suggest that the AUDIT is highly reliable, but that potential gender differences in its factor structure should be considered, particularly when applied in new contexts.

Key words: AUDIT; South Africa; Bar patrons

INTRODUCTION

The Alcohol Use Disorders Identification Test (AUDIT) is one of the most widely used screening instruments for alcohol problems globally (De Meneses-Gaya et al., 2009; Reinert & Allen, 2007). It was developed in order to be able to screen for problem drinking in the form of hazardous or harmful alcohol use (Saunders et al., 1993). The AUDIT consists of ten items which reflect three sub-dimensions:

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consumption (three items), dependence (three items), and alcohol-related consequences (four items). In sub-Saharan Africa (SSA) the 10-item AUDIT has been employed extensively in studies among males and females in countries as diverse as South Africa (Kader et al., 2012; Peltzer et al., 2009), Angola (Cheng et al., 2012), Kenya (Luchters et al., 2011), Nigeria (Li et al., 2010), Rwanda (Harbertson et al., 2013), and Tanzania (Mongi et al., 2013). Most of the studies have involved populations in community (Clausen et al., 2005; 2006; Li et al., 2010), health care (Kader et al., 2012), educational (Betancourt & Herrera, 2006; Pengpid et al., 2013), military (Cheng et al., 2012), and to a much lesser extent bar, restaurant and recreational settings (Choi et al., 2014; Kalichman et al., 2012; Mongi et al., 2013). Despite this extensive use, however, further research is needed to continue to evaluate the psychometric properties and dimensions of the AUDIT when used in SSA settings.

In general, the AUDIT has been found to have good internal consistency reliability in studies in the SSA region, as indicated by Cronbach's alphas of between 0.71 and 0.92 (Chishinga et al., 2011; Farley et al., 2010; Louw et al., 2011; Martinez et al., 2008: Naidoo et al., 2013; Nakimuli-Mpungu et al., 2011; Peltzer et al., 2011; 2012; Peng et al., 2012; Pengpid et al., 2013). Indeed, we are not aware of any studies conducted in SSA that have reported a Cronbach's alpha of less than 0.70 for the AUDIT.

There have been relatively few studies in the SSA region (except Chishinga et al., 2011; Peng et al., 2012) which have assessed the dimensional structure of the AUDIT using either exploratory factor analysis (EFA) or confirmatory factor analysis (CFA). In instances (mainly outside SSA) where a factor analytical study of the AUDIT has been conducted, the original three-component dimensional structure (Saunders et al., 1993) has not always been supported. Instead, most research using PCA or EFA, which has involved systematic and multi-country studies, has revealed between one and two factors (Karno et al., 2000; Maisto et al., 2000). Similarly, studies using CFA have generally supported two factors (see reviews of Reinert & Allen, 2007; Rist et al., 2009); and later studies (e.g. Cook et al., 2011; Peng et al., 2012). Fewer studies have supported the three factor (Shevlin & Smith, 2007) or one factor models (Carey et al., 2003).

More research is also needed to assess the validity of the individual AUDIT items in varied settings in SSA. Item-level analyses have revealed problems with respect to certain items (Knibbe et al., 2006). Some items that are of particular concern include Item 6 (morning drinking) and Item 9 (injury to self or others) (Karno et al., 2000; Peng et al., 2012). The possibility that participants interpret each AUDIT item differently to the intended manner has not been investigated extensively in SSA settings.

In summary, the AUDIT is put forward as a useful internationally validated tool for assessing and screening for hazardous or harmful alcohol use (Saunders et al., 1993). It is usually highly reliable, but studies have not always supported its originally proposed three-dimensional structure (Saunders et al., 1993). Furthermore, while used extensively in various settings, the AUDIT's utility in research studies among bar/tavern patrons in countries in SSA, such as South Africa, still needs further examination. Consequently, this study was conducted to determine the ex-

tent to which the AUDIT is an appropriate and valid tool for use in research among bar/tavern patrons in bar/tavern settings in a rural area of South Africa. The present study sought to assess the dimensional structure of the AUDIT, using CFA, among male and female bar/tavern patrons in two rural villages in North West province, South Africa. A further aim of the study was to assess the internal consistency reliability of the AUDIT in the same sample. The final aim was to assess participants' patterns of responses on each AUDIT item.

METHOD

Design and Participants

The research was approved by the Ethics Committee of the South African Medical Research Council (Protocol number EC10-13) and the Centers for Disease Control and Prevention.

The study was conducted among male and female bar/tavern patrons in two rural villages in North West Province, in South Africa. The study employed a cross-sectional design in which participants were recruited from within bar/tavern settings using purposive sampling. The participating bars were those that met the criteria of having: (i) at least 30 patrons on a normal weekday; (ii) at least 25% of the patrons as female; and (iii) a relatively stable clientele over time. The bar/tavern patrons were recruited systematically from the selected venues with every third person who crossed a predetermined intercept zone being approached and invited to take part in the study. Those who were eligible had to: (i) be at least 18 years old; (ii) visit the bar/tavern at least once a month; and (iii) not be intoxicated at the time of recruitment.

Measures

We used an interviewer-administered questionnaire which comprised various measures that were relevant to our initial study on alcohol use and sexual risk behaviour (Nkosi et al., 2014). The measures that are relevant for the current analyses were those that assessed the participants' demographic characteristics and alcohol consumption. The demographic factors that were assessed were age, gender, education level, marital status, and employment status. The ten-item Alcohol Use Disorders Identification Test (AUDIT) (Babor et al., 2001) was used to assess the participants' alcohol consumption.

Procedure

We obtained permission to conduct the study in the selected drinking venues from the establishments' managers and/or owners. Fieldworkers visited the bars/taverns during peak drinking periods (Friday evenings, Saturdays and Sundays) to conduct face-to-face interviews with the patrons. Informed consent was obtained from eligible bar patrons who were willing to take part in the study. The participants were then interviewed by the fieldworkers in quiet places in and around the bars/taverns. At the end of the interview they were given a t-shirt and a resource list with contact details of local counselling and treatment services that deal with problems related to alcohol consumption and sexual risk behaviour.

Statistical Analysis

We conducted CFA and Cronbach's alpha reliability analyses. All statistical analyses were conducted for the males and females separately.

Three alternative factor models were fitted using CFA. We used the STATA confa

command (Kolenikov, 2009) which fits CFA using maximum likelihood. The three (factor) models that we specified were: (1) a single factor model, for which all ten AUDIT items were specified to load on the one factor; (2) a two-factor model, for which Items 1-3, and Items 4-10 were specified to load on Factor 1 and Factor 2, respectively; and (3) a three-factor model, for which Items 1-3, Items 4-6, and Items 7-10 were specified to load on Factor 1, Factor 2, and Factor 3, respectively. We extracted several statistical indices to determine how well each of the three hypothesised latent structure models (the number of "a priori" factors and the constituent items) fit our data. We used the Chi-square test, the root mean square error of approximation (RMSEA), the comparative fit index (CFI), and the standardized root mean square residual (SRMR) to determine the model fit. Goodness of fit was based on the following rules of thumb: Chi-square to degrees of freedom ratio (χ^2/df) < 2; RMSEA < 0.05; CFI ≥ 0.95; and SRMR ≤ 0.08 (Hu & Bentler, 1999; MacCallum et al., 1996; Tabachnick & Fidell, 2013).

We conducted Cronbach's alpha reliability analyses to determine the internal consistency of the full 10-item AUDIT as well as the scales that would be made up of the sub-sets of AUDIT items that were specified in the three models. These scales and sub-scales comprise: (a) the full set of 10 items; (b) Items 1-3 (consumption dimension); (c) Items 4-6 (dependence dimension); (d) Items 7-10 (consequences dimension); and (e) Items 4-10 (alcohol-related problems dimension).

RESULTS

The participants consisted of 314 males and 92 females, with a mean age for both genders of 30.0 years (SD=8.45). As shown in Table 1, most of the participants had up to a Grade 12 level of education, most were single, and just over half were unemployed.

Table 2 depicts the males' and females' scores on each of the ten AUDIT items. As shown, the participants' mean scores on Items 1, 2 and 3 were at or above the mid-

Table 1. Participants' demographic characteristics

Variables		Total sample (N=406) N (%)	Male (N=314) N (%)	Female (N=92) N (%)
Age	18-24	112 (27.6)	78 (24.8)	34 (37.0)
	25-29	105 (25.9)	88 (28.0)	17 (18.5)
	30-34	90 (22.2)	60 (19.1)	30 (32.6)
	>34	99 (24.4)	88 (28.0)	11 (12.0)
Education	≤grade 12	289 (71.5)	227 (72.5)	62 (68.1)
	>grade 12	115 (28.5)	86 (27.5)	29 (31.9)
Marital status	Single	297 (73.2)	221 (70.4)	76 (82.6)
	Cohabiting	39 (9.6)	36 (11.5)	3 (3.3)
	Married	60 (14.8)	49 (15.6)	11 (12.0)
	Other*	10 (2.5)	8 (2.5)	2 (2.2)
Employment status	Employed	229 (56.5)	207 (66.1)	22 (23.9)
	Unemployed	176 (43.5)	106 (33.9)	70 (76.1)

*other includes divorced, separated, and widowed. Note: Totals do not always add up due to missing data.

Table 2. Mean scores and standard deviations (SD) on the AUDIT items for males and females

	Males		Females		
	Mean	**SD**	**Mean**	**SD**	**t**
1. How often do you have a drink containing alcohol?	2.58	0.92	1.96	1.00	5.62***
2. How many drinks containing alcohol do you have on a typical day when you are drinking?	3.48	0.96	2.88	1.13	4.40***
3. How often do you have six or more drinks on one occasion?	2.12	1.16	1.63	1.11	3.45***
4. How often during the last year have you found that you were not able to stop drinking once you had started?	1.18	1.34	0.77	1.12	2.82**
5. How often during the last year have you failed to do what was normally expected of you because of drinking?	0.82	1.15	0.44	0.92	3.08**
6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?	0.83	1.28	0.51	0.98	2.43*
7. How often during the last year have you had a feeling of guilt or remorse after drinking?	1.20	1.35	0.78	1.19	2.75**
8. How often during the last year have you been unable to remember what happened the night before because of your drinking?	0.72	1.18	0.19	0.50	5.97***
9. Have you or someone else been injured because of your drinking?	0.27	0.66	0.13	0.47	2.14*
10. Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?	1.03	1.40	0.67	1.18	2.40*

*ρ<0.05; **ρ<0.01; ***ρ<0.001w

point of the range of scores (i.e. around "2"). However, scores on the remaining seven items were all much closer to "1" which represents an infrequent (i.e. less than monthly or never) occurrence of the various alcohol-related outcomes. The males had a significantly higher mean score than the females on each item.

The results of the CFA for the male sample (Table 3) revealed that Models 2 and 3 met all the model fit criteria (while Model 1 did not). Model 3 was a slightly better fit than Model 2 as it performed slightly better with regard to three of the four fit criteria i.e. having a lower χ^2 to df ratio, a lower RMSEA, and a higher CFI. Table 3 also shows that all the factor loadings for each item in each of the three models were positive and statistically significant. In addition, almost all the loadings were high (ranging between 0.42-0.85) except for those for AUDIT Item 9 (which ranged between 0.26 and 0.29) in all three models.

For the females (see Table 4), none of the three models demonstrated a good fit for the observed data as none met any of the model fit criteria. Table 4 also shows that the factor loadings were positive and generally significant except for Item 1 in Model 1, Item 9 in Models 1 and 2, and Item 8 in Model 3. The factor loading of Item 1 in Model 1 (0.20), Item 8 in all three models (0.20, 0.20 and 0.10, respectively), and Item 9 in all three models (0.09, 0.10 and 0.16, respectively) was low.

Table 5 indicates that there were very good Cronbach's alphas for the total sample, the males, and the females for the 10-items (full AUDIT), and the 7-items (combined dependence/consequences dimension). However, Cronbach's alpha was only moderately high for the items

Table 3. Factor loadings (standard errors), factor covariance, and fit indices for three alternative factor models of the AUDIT for the males (n=282)

	Model 1	Model 2		Model 3		
	Factor 1:	Factor 1:	Factor 2:	Factor 1:	Factor 2:	Factor 3:
	Hazardous drinking	Alcohol consumption	Alcohol-related problems	Alcohol consumption	Dependence	Alcohol-related consequences
Item						
1. How often do you have a drink containing alcohol?	0.42 (0.05)*	0.46 (0.05)*		0.46 (0.05)*		
2. How many drinks containing alcohol do you have on a typical day when you are drinking?	0.46 (0.06)*	0.51 (0.06)*		0.51 (0.06)*		
3. How often do you have six or more drinks on one occasion?	0.82 (0.07)*	1.09 (0.07)*		1.09 (0.07)*		
4. How often during the last year have you found that you were not able to stop drinking once you had started?	0.82 (0.08)*		0.80 (0.08)*		0.80 (0.08)*	
5. How often during the last year have you failed to do what was normally expected of you because of drinking?	0.68 (0.07)*		0.73 (0.07)*		0.69 (0.07)*	
6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?	0.67 (0.08)*		0.68 (0.08)*		0.66 (0.08)*	
7. How often during the last year have you had a feeling of guilt or remorse after drinking?	0.80 (0.08)*		0.84 (0.08)*			0.85 (0.08)*
8. How often during the last year have you been unable to remember what happened the night before because of your drinking?	0.64 (0.07)*		0.69 (0.07)*			0.71 (0.07)*
9. Have you or someone else been injured because of your drinking?	0.26 (0.04)*		0.28 (0.04)*			0.29 (0.04)*
10. Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?	0.75 (0.09)*		0.77 (0.09)*			0.78 (0.09)*
Factor Covariance						
Factor 1	1.00	1.00		1.00		
Factor 2		0.65 (0.06)*	1.00	0.74 (0.07)*	1.00	
Factor 3				0.58 (0.07)*	1.00 (0.06)*	1.00
Goodness of Fit Indices						
χ^2	117.26	57.07		50.63		
df	35	34		32		
ρ-value	0.000	0.008		0.019		
RMSEA	0.092	0.049		0.046		
CFI	0.84	0.96		0.97		
RMSR	0.07	0.05		0.05		

χ^2: Chi-square; df: degrees of freedom; RMSEA: root-mean-square error of approximation; CFI: comparative fit index; RMSR: root-mean-square residual *ρ<0.05

Table 4. Factor loadings (standard errors), factor covariance, and fit indices for three alternative factor models of the AUDIT for the females (n=76)

	Model 1	Model 2		Model 3		
	Factor 1:	Factor 1:	Factor 2:	Factor 1:	Factor 2:	Factor 3:
	Hazardous drinking	Alcohol consumption	Alcohol-related problems	Alcohol consumption	Dependence	Alcohol-related consequences
Item						
1. How often do you have a drink containing alcohol?	0.20 (0.11)	0.40 (0.11)*		0.40 (0.11)*		
2. How many drinks containing alcohol do you have on a typical day when you are drinking?	0.44 (0.14)*	0.47 (0.15)*		0.47 (0.16)*		
3. How often do you have six or more drinks on one occasion?	0.50 (0.14)*	0.88 (0.18)*		0.87 (0.18)*		
4. How often during the last year have you found that you were not able to stop drinking once you had started?	0.77 (0.13)*		0.76 (0.13)*		0.79 (0.14)*	
5. How often during the last year have you failed to do what was normally expected of you because of drinking?	0.59 (0.11)*		0.61 (0.11)*		0.60 (0.11)*	
6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?	0.47 (0.13)*		0.48 (0.13)*		0.45 (0.14)*	
7. How often during the last year have you had a feeling of guilt or remorse after drinking?	0.53 (0.15)*		0.53 (0.16)*			0.74 (0.17)*
8. How often during the last year have you been unable to remember what happened the night before because of your drinking?	0.20 (0.06)*		0.20 (0.06)*			0.10 (0.86)
9. Have you or someone else been injured because of your drinking?	0.09 (0.07)		0.10 (0.07)			0.16 (0.08)*
10. Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?	0.46 (0.14)*		0.47 (0.15)*			0.77 (0.20)*
Factor Covariance						
Factor 1	1.00	1.00		1.00		
Factor 2		0.51 (0.15)*	1.00	0.54 (0.16)*	1.00	
Factor 3				0.36 (0.17)*	0.62 (0.19)*	1.00
Goodness of Fit Indices						
χ^2	82.36	70.56		68.16		
df	35	34		32		
ρ	0.000	0.0002		0.0002		
RMSEA	0.134	0.120		0.123		
CFI	0.00	0.37		0.40		
RMSR	0.10	0.09		0.08		

χ^2: Chi-square; df: degrees of freedom; RMSEA: root-mean-square error of approximation; CFI: comparative fit index; RMSR: root-mean-square residual *p<0.05

Table 5. Cronbach's alphas

Dimensions	AUDIT items	Total	Males	Females
Full AUDIT	1-10	0.808	0.808	0.719
Alcohol consumption	1-3	0.687	0.684	0.582
Dependence	4-6	0.600	0.583	0.613
Alcohol-related consequences	7-10	0.632	0.633	0.502
Alcohol-related problems (Dependence and consequences)	4-10	0.758	0.756	0.696

making up the three sub-dimensions (i.e. consumption, dependence, alcohol-related consequences), particularly for the women.

DISCUSSION

The primary purposes of this study were to examine the reliability and factor structure of the AUDIT among male and female adults who were recruited from bars and taverns in a rural area of South Africa. This is one of the first studies of this kind to be conducted in SSA (apart from Chishinga et al., 2011; Peng et al., 2012), and in a cultural context in which the reliability and the validity of the AUDIT may be somewhat different from the cultural contexts in which most similar analyses have been conducted. Based on the assumption of the gendered nature of alcohol consumption (Bond et al., 2010), we analysed all the data separately for the males and females separately. The results supported this choice given the significant differences in males' and females' mean scores on all the AUDIT items, and the CFA results.

The findings of the CFA for the males concur with the trend of previous research in having supported a three-factor and two factor-model, but not supporting a one-factor model (Cook et al., 2011; Reinert & Allen, 2007). These results are consistent with those of similar analyses that were conducted for general population samples of men in two countries in SSA: Uganda and Nigeria (Peng et al., 2012).

On the other hand, the CFA for the females failed to support a three-factor, two-factor, or one-factor model. We are aware of a few other studies reporting similar findings. For example, in their cross-national study involving 15 countries, Peng and colleagues (2012) were generally less likely to lend support to any of the three models (i.e. the one-factor, two-factor or three-factor model) for the study's female sub-samples than for its male sub-samples. For the female sub-samples from the countries in SSA (Nigeria and Uganda) specifically, Peng et al. (2012) failed to support any of the three models for women in Nigeria, but did support a two-factor and one-factor model for women in Uganda.

The internal consistency reliability of the full 10-item AUDIT was high for both males and females, which is consistent with general findings of studies globally (Reinert & Allen, 2007) and in SSA (Chishinga et al., 2011; Farley et al., 2010; Louw et al., 2011; Martinez et al., 2008; Naidoo et al., 2013; Nakimuli-Mpungu et al., 2011; Peltzer et al., 2011; 2012; Peng et al., 2012; Pengpid et al., 2013). However, Cronbach's alpha was not as high for any of the three proposed sub-dimensions

of the AUDIT, although it was just under 0.70 for the seven-item combined dependence/consequences items for both males and females.

A subsidiary aim of the study was to assess the participants' patterns of responses on each of the AUDIT items. Examination of the participants' mean scores on each AUDIT item revealed high levels of endorsement of Items 1-3, but lower levels of endorsement of the remaining items. This concurs with the males' CFA finding which supported the two models in which Items 1 to 3 were not included with other items, but failed to support the model in which Items 1 to 3 were included with the remaining items (i.e. Model 1). Some authors have indicated that higher mean scores on the earlier appearing items could be due to an order effect (Bischof et al., 2005; De Meneses-Gaya et al., 2009). However, in the present study, conducted among regular bar/tavern patrons in a high consumption country where binge drinking is commonplace, it is not surprising to find participants endorsing these consumption items to a greater extent than the remaining dependence and consequences items.

The validity of individual AUDIT items may differ cross-culturally (Knibbe et al. 2006). The AUDIT items which seemed to be most problematic in this study were Item 1 (frequency of consumption) and Item 8 (memory loss) for the females, and Item 9 (injury to self or others) for both the males and the females. The observed low and non-significant loading of Item 1 on the first factor for women may reflect the observation that while women in South Africa drink relatively infrequently, their rate of binge drinking per occasion is relatively high (Peltzer & Ramlagan, 2009), not unlike their male counterparts. Indeed, other studies have found alcohol frequency to have a low correlation with the other AUDIT items (Knibbe et al. 2006). The observed non-significant loading of memory loss (Item 8) on Factor 3 (i.e. alcohol-related consequences) for the women may be due to the overall low level of reporting of memory loss among the women in the sample. Item 9 was problematic in terms of participants' low level of endorsement on it, its low (but significant) loading on all the factors in the CFA for the males, and its non-significant loadings for the females. A problem with Item 9 has been observed by other investigators (Karno et al., 2000; Kelly et al., 2010; Kypri et al., 2002; Peng et al., 2012) who have questioned how the injury item might be interpreted. In the current study among bar-goers, low endorsement of Item 9 may seem surprising, but participants may conceivably have interpreted the question to refer to a more severe level of harm than minor scrapes, bruises and falls that may occur relatively routinely due to alcohol consumption in drinking settings.

This study provides a potentially valuable addition to the literature by examining the factor structure of the 10-item AUDIT with patrons of bars and taverns in rural areas of South Africa. However, its main limitation is the small sample size for the females which limits our ability to be conclusive about the results. Another possible shortcoming is the limited generalizability of the findings to other populations.

Further validation studies on the AUDIT are warranted among populations of males and females in SSA. We recommend continued studies on the psychometric properties of the AUDIT, including its factor structure with larger samples, and its

specificity and sensitivity at different cut-off points. However, this study supports the growing body of literature supporting the two- and three-dimensional structure of the AUDIT in diverse populations and settings globally, particularly among males, and has important implications for research and clinical care.

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