SCREENING AND IDENTIFICATION

Socio-demographic Predictors of Dimensions of the AUDIT Score in A Population Sample of Working-age Men in Izhevsk, Russia

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Abstract — Aims: To investigate the relationship between socio-demographic factors and alcohol drinking patterns identified through a formal analysis of the factor structure of the Alcohol Use Disorders Identification Test (AUDIT) score in a population sample of working-age men in Russia. **Methods:** In 2008–2009, a sample of 1005 men aged 25–59 years living in Izhevsk, Russia were interviewed and information collected about socio-demographic circumstances. Responses to the AUDIT questions were obtained through a self-completed questionnaire. Latent dimensions of the AUDIT score were determined using confirmatory factor analysis and expressed as standard deviation (SD) units. Structural equation modelling was used to estimate the strength of association of these dimensions with socio-demographic variables. **Results:** The AUDIT was found to have a two-factor structure: alcohol consumption and alcohol-related problems. Both dimensions were higher in men who were unemployed seeking work compared with those in regular paid employment. For consumption, there was a difference of 0.59 SDs, (95% confidence interval (CI): 0.23, 0.88) and for alcohol-related problems one of 0.66 SD (95% CI: 0.31, 1.00). Alcohol-related problems were greater among less educated compared with more educated men (*P*-value for trend = 0.05), while consumption was not related to education. Similar results were found for associations with an amenity index based on car ownership and central heating. Neither dimension was associated with marital status. While we found evidence that the consumption component of AUDIT was underestimated, this did not appear to explain the associations of this dimension with socio-demographic factors. **Conclusions:** Education and amenity index, both measures of socio-economic position, were inversely associated with alcohol-related problems but not with consumption. This discordance suggests that self-reported questions on frequency and volume may be less sensitive markers of socio-economic variation in drinking than are questions about dependence and harm. Further investigation of the validity of the consumption component of AUDIT in Russia is warranted as it appears that the concept of a standard 'drink' as used in the instrument is not understood.

INTRODUCTION

Life expectancy in Russia is extremely low for an industrialized country (Leon *et al*., 2009). Hazardous alcohol consumption among working-age men is a particularly important contributory factor to this (Leon *et al*., 2007; Zaridze *et al*., 2009). However, understanding the determinants of hazardous drinking in Russia has received only limited attention. In an earlier study in Izhevsk, Russia (Tomkins *et al*., 2007), low educational level, being unemployed and lower levels of household wealth/amenities were all associated with hazardous drinking defined in terms of indicators such as consumption of non-beverage alcohols and being continuously drunk for two or more days. However, daily consumption of spirits was associated with being unemployed but not with education or household amenities. The relationship between socio-economic variables and alcohol use is particularly important in Russia where socio-economic differences in mortality have been increasing (Shkolnikov *et al*., 1998; Murphy *et al*., 2006).

The Alcohol Use Disorders Identification Test (AUDIT) was developed as a screening instrument for harmful or hazardous alcohol consumption for use in primary health care settings (Saunders *et al*., 1993). However, today the AUDIT is also increasingly used in epidemiological studies as a standard measure of hazardous drinking in a population (Coulthard *et al*., 2002; Mendoza-Sassi and Beria, 2003; Nilssen *et al*., 2005; Kallmen *et al*., 2007; Reinert and Allen, 2007).

The AUDIT score was originally designed to cover three conceptual domains of hazardous alcohol use—elevated consumption, alcohol dependence and alcohol-related harm (Saunders *et al*., 1993; Babor *et al*., 2001). However, there has been considerable debate over the actual number of domains represented by the AUDIT. Studies in Sweden, Brazil and the UK of general population samples have all suggested a two factor structure with one factor measuring alcohol consumption and one measuring alcohol-related problems(Bergman and Kallmen, 2002; Lima *et al*., 2005; Shevlin and Smith, 2007). The validity of the AUDIT has recently been investigated in Russia in a sample of 255 tuberculosis patients and found to have high internal consistency and high sensitivity for detecting alcohol use disorders in such a clinical population (Mathew *et al*., 2010). This study also supported a two factor structure (Mathew *et al*., 2010). However, the structure has not yet been investigated in a Russian general population sample.

Several recent studies have found that demographic and clinical variables do not show the same relationships with different dimensions of the AUDIT (Shevlin and Smith, 2007; Smith *et al*., 2010). In this paper, we set out to (i) investigate the factor structure of AUDIT in a population sample in Russia and (ii) investigate the relationship between socio-demographic variables and dimensions of alcohol drinking patterns and consequences as measured by the AUDIT.

METHODS

The analyses were based on data from the Izhevsk Family Study-2. This was a follow-up study of men who were

originally recruited as live population controls for a case–control study (2003–2006) of alcohol and premature mortality among working-age men (Leon *et al*., 2007). The study was conducted in Izhevsk, an industrial city west of the Ural Mountains, Russia. The original controls were a random sample from a 2002 population list of the city frequency matched by age to the deaths occurring in the city among men aged 25–54 years.

Of the original 2041 live controls, in 2008–2009, we successfully followed up and completed interviewer-administered questionnaires for 1515. The questionnaire collected information on socio-demographic characteristics including educational level, household amenities (access to a car and central heating), marital status and employment status. Questions on alcohol consumption included frequency and usual quantity of spirits, wine and beer consumed on a typical occasion. Smoking status was also ascertained.

All re-interviewed subjects were offered a health check which 1052 men attended. This typically took place 2–3 weeks after the re-interview and involved measurements of height, weight, blood pressure and collection of a blood sample. Levels of the liver enzyme γ-glutamyl transferase (GGT) were measured.

Men attending the health check examination were also given a self-completed questionnaire containing the AUDIT questions (Babor *et al*., 2001). We adapted the WHO Russian translation of the AUDIT questions in two respects: (i) the 1-year reference period for behaviours and consequences was replaced with a 3-month period. This was done because we were using the same instrument in a 3-month follow-up interview for a subset of the subjects enrolled in a brief intervention trial (Tomkins *et al*., 2008).This may have affected the total AUDIT score but should not affect the factor structure since the structure of the questions was unaltered. (ii) The first AUDIT question 'how often do you have a drink containing alcohol?' was modified by adding 'including substances not intended to be drunk'. This was done because of the relatively high prevalence of non-beverage alcohol consumption in this population (Gil *et al*., 2009). The questions used are shown in Table 2. In the main analyses presented in this paper, we focus on the 1005 (66.3%) subjects who had a complete AUDIT score.

In order to determine if there was selection bias in the sample of men included, we investigated whether subjects with a complete AUDIT score differed from those without by comparing the distribution of the characteristics recorded at the interviewer-administered questionnaire for both groups. To study associations among the available variables, we examined the distribution of AUDIT score by age, education, amenity index, marital status, employment and smoking. To provide some element of validation, we also examined the distribution of AUDIT scores by fourths of GGT.

It is acknowledged in the literature that the concept of a standard drink used in the AUDIT questionnaire is potentially problematic, as it may be understood in different ways across cultures (Lemmens, 1994; World Health Organisation, 2000; Gill and Donaghy, 2004). For this reason, as is commonly done, in our study the AUDIT questions were preceded by explicit text stating that a standard drink was defined to be 25 g of vodka, one 330 ml bottle of beer or 150 ml of wine. However, the design of the Izhevsk study provided an unusual opportunity to investigate the sensitivity of the

'drinks' question. This was done by comparing responses to the AUDIT question on number of drinks to responses given in the preceding interviewer-administered questionnaire about the usual quantity of each beverage consumed in explicit categories that are used by Russians in their everyday life (spirits and wine in grams and beer in bottles).

Statistical methods

To determine the factor structure of the AUDIT in a Russian context, we fitted two alternative confirmatory factor analysis (CFA) models estimated using weighted least squares with mean and variance adjustment (Muthèn and Muthèn, 1998–2007; Flora and Curran, 2004). Model 1 specified the three factors the AUDIT was designed to measure—alcohol consumption (loading on Questions 1–3), dependence (loading on Questions 4–6) and alcohol-related harm (loading on Questions 7–10). Model 2 specified two factors—alcohol consumption (loading on Questions 1–3) and alcohol-related problems (loading on Questions 4–10).They were compared using the Comparative Fit Index (CFI), the Tucker–Lewis Index (TLI) and the Root Mean Square Error of Approximation (RMSEA). CFI and TLI values >0.95 indicate acceptable model fit (Tabachnik and Fidell, 1996; Streiner, 2006). For the RMSEA, values <0.08 indicate a reasonable fit and values <0.05 indicate a good fit (Streiner, 2006).

We investigated the relationship between socio-demographic variables and both specifications of the AUDIT latent factors model by fitting structural equation models (SEMs) with age, education, marital status employment, amenity index and smoking as explanatory variables (Bollen, 1989). The latent factors were expressed in standard deviation (SD) units.

Analyses were carried out in Stata 11(StataCorp., 2009) and Mplus 5(Muthèn and Muthèn, 1998–2007).

RESULTS

The number of participants at each stage of the study is shown in Fig. 1. Of the 1515 subjects re-interviewed in 2008–2009, 510 did not fill out the self-completed questionnaire, almost all because they did not take part in the health check examination. There was no evidence of a difference in age ($P = 0.62$), employment ($P = 0.13$), education ($P = 0.57$) or smoking status ($P = 0.44$) between the 1005 subjects for whom complete AUDIT scores were available from the self-completed questionnaire, and the 510 subjects who did not have this information. However, those with complete AUDIT scores were more likely to be married (81.0 vs. 75.7%, $P = 0.04$) and more likely to have both a car (53.9 vs. 46.5%, $P = 0.006$) and central heating (87.7 vs. 80.8%, $P < 0.001$). There was no evidence of a difference in the median total volume of ethanol consumed from beer, wine and spirits based on responses to the interview-administered questionnaire ($P = 0.66$) between men who completed the AUDIT and men who did not.

The mean age of the subjects included was 48.5 years (SD = 8.0). The median AUDIT score was 6 (inter-quartile range 3–12). The frequency distribution of age, GGT, marital status, employment, education, amenity index and smoking status and their corresponding median AUDIT scores are

shown in Table 1. Median AUDIT increased across fourths of GGT (test for trend $P < 0.001$).

Latent dimensions of AUDIT

The factor loadings and model fit indices for the two proposed CFA models are shown in Table 2. Both fit the data
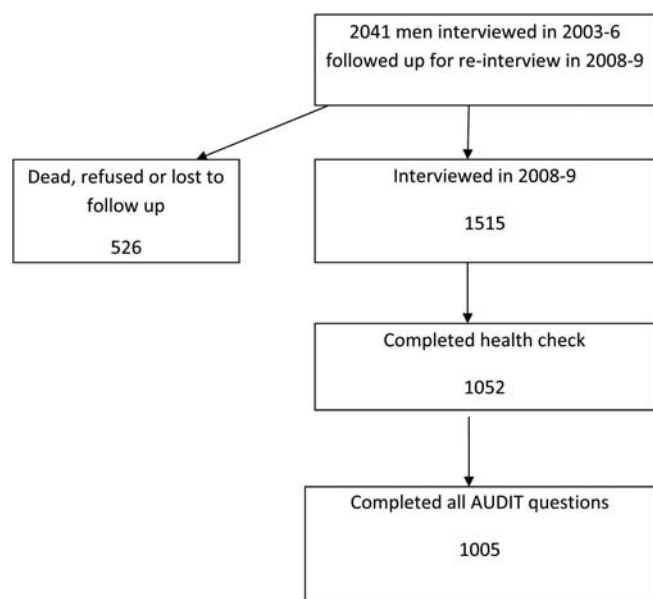

Fig. 1. Flow chart of participants.

very well. However, factors 2 and 3 in Model 1 were highly correlated ($r = 0.93$) therefore the two factor solution, leading to the two dimensions of alcohol consumption and alcohol-related problems was adopted when relating socio-demographic factors to the AUDIT using an SEM approach.

Socio-demographic predictors of dimensions of the AUDIT score

The associations of age, marital status, employment status, education level and, amenity index with each of the two latent dimensions of the AUDIT (consumption and alcohol-related problems) are shown in Table 3. This reports the regression coefficients estimated using a series of SEMs for two models: adjusted for age alone and then adjusted for all other variables in the table. Age was inversely associated with both AUDIT dimensions. There was little evidence for marital status being related to either AUDIT dimension, although it is notable that in nearly all instances those living in a registered marriage had the lowest levels of both consumption and alcohol-related problems. In contrast, there was strong evidence that men who were unemployed and seeking work had higher levels of both alcohol consumption and alcohol-related problems than men in regular paid employment. The two measures of socio-economic position (education and amenities) showed similar patterns. In the models adjusted for age alone, while neither showed an association with the consumption dimension, both showed an inverse association with alcohol-related problems. Similar patterns were seen for the fully adjusted models, although the effects

Table 1. Distribution of age, GGT, marital status, employment, education, amenity index and smoking status and category-specific median AUDIT score

Variable	Categories	*n* (%)	Median AUDIT score
Age	25–29	14 (1.4)	11
	30–34	73 (7.3)	7
	35–39	91 (9.1)	7
	40–44	115 (11.4)	7
	45–49	189 (18.8)	6
	50–54	246 (24.5)	6
	55+	277 (27.6)	6
Fourth of GGT* (u/l)	First fourth (<20)	255 (26.0)	4
	Second fourth (20–29.7)	235 (24.0)	6
	Third fourth (29.8–45.7)	236 (24.1)	7
	Fourth fourth (>45.7)	255 (26.0)	9
Marital status*	Living together with a partner in a registered marriage	813 (80.9)	6
	Living together with a partner but not in a registered marriage	93 (9.3)	7
	Divorced or separated	54 (5.4)	7.5
	Widower	8 (0.8)	10.5
	Never married	36 (3.6)	6
Employment	In regular paid employment	844 (84.0)	6
	In irregular paid employment	47 (4.7)	8
	Unemployed seeking work	43 (4.3)	12
	Unemployed not seeking work	63 (6.3)	5
	Other	8 (0.8)	4
Education	Incomplete secondary or less	43 (4.3)	7
	Secondary	733 (72.9)	6
	Higher and incomplete higher	229 (22.8)	6
Amenity index	Neither car or central heating	60 (6.0)	7.5
	Either car or central heating	467 (46.5)	7
	Both car and central heating	478 (47.6)	6
Smoking status*	Never smoked	196 (19.5)	5
	Ex smoker	183 (18.2)	5
	Current smoker	625 (62.2)	7
Total		1005 (100)	6

*Data missing on GGT for 24 participants, on marital status for 1 participant and on smoking status for 1 participant.

Table 2. Standardized factor loadings (standard errors) for two and three confirmatory factor models of AUDIT[a] and latent factor correlations

Latent dimensions	Model 1			Model 2	
	Alcohol consumption	Dependence	Alcohol-related harm	Alcohol consumption	Alcohol-related problems
AUDIT questions					
Q1. How often do you have a drink containing alcohol including substances not intended to be drunk?	0.76 (0.02)			0.76 (0.02)	
Q2. How many drinks (portions) containing alcohol do you have on a typical day when you are drinking?	0.75 (0.02)			0.75 (0.02)	
Q3. How often do you have 6 or more drinks on one occasion?	0.96 (0.01)			0.96 (0.01)	
Q4. How often during the last 3 months have you found you were not able to stop drinking once you had started?		0.84 (0.02)			0.82 (0.02)
Q5. How often during the last 3 months have you failed to do what was expected of you because of drinking		0.83 (0.02)			0.81 (0.02)
Q6. How often during the last 3 months have you needed a drink first thing in the morning to get yourself going after a heavy drinking session?		0.85 (0.02)			0.82 (0.02)
Q7. How often during the last 3 months have you had a feeling of guilt or remorse as a result of your drinking?			0.85 (0.02)		0.84 (0.02)
Q8. How often during the last 3 months have you been unable to remember what happened the night before because of your drinking?			0.85 (0.02)		0.84 (0.02)
Q9. Have you or someone else been injured because of your drinking?			0.41 (0.04)		0.41 (0.04)
Q10. Has a relative, friend, doctor or other health worker been concerned about your drinking or suggested you cut down?			0.76 (0.02)		0.76 (0.02)
Latent factor correlations					
Factor 1	1.00			1.00	
Factor 2	0.65 (0.03)	1.00		0.69 (0.03)	1.00
Factor 3	0.70 (0.03)	0.93 (0.02)	1.00		
Goodness of fit indices					
CFI	0.97			0.97	
TLI	0.99			0.99	
RMSEA	0.067			0.069	

[a]Sample of 1005 men.

were attenuated, and in the case of the amenity index no longer reached statistical significance (test for heterogeneity $P = 0.32$; test for linear trend $P = 0.13$).

Smoking was strongly associated with both dimensions of the AUDIT after adjusting for age and the socio-economic variables (test for heterogeneity $P < 0.001$ for both alcohol consumption and alcohol-related problems).The alcohol consumption dimension was greatest in men who were current smokers (0.36 SD increase relative to men who had never smoked, 95% confidence interval (CI) 0.19, 0.54). The alcohol-related problems dimension was also highest in men who were current smokers (0.50 SD increase relative to men who had never smoked, 95% CI 0.30, 0.70) but was also higher in ex-smokers (0.27 SD increase relative to men who had never smoked 95% CI 0.03, 0.52).

We checked whether the patterns observed above with the socio-demographic variables were similar if we used a three factor structure. Splitting the alcohol-related problems dimension into two dimensions (alcohol dependence and alcohol-related harm) did not lead to substantively different results to using the combined alcohol-related problems dimension.

Sensitivity of the AUDIT

We compared the number of drinks reported in AUDIT Question 2 (obtained from the self-completed questionnaire) with the usual quantity of beer, wine and spirits reported in the interviewer-administered questionnaire (Table 4). For

spirits, the number of drinks reported in AUDIT Question 2 was much lower than the equivalent number reported in the interviewer-administered questionnaire. The same level of discrepancy was not found for wine or beer (data not shown). To examine whether this discrepancy may influence the results, we calculated a 'corrected' AUDIT score by replacing responses to Question 2 in the AUDIT questionnaire with the equivalent number of drinks using the interviewer-administered questionnaire on usual quantity of spirits, except for subjects who never drank spirits according to the interviewer-administered questionnaire (for whom the original score was left unchanged). As a result, the distribution of this 'corrected' score was shifted upward, with a median of 7 (inter-quartile range 4–13) instead of 6 (inter-quartile range 3–12) found with the original score. Using this 'corrected' version, however, did not change the factor structure of the AUDIT, or substantively change the relationship found between the AUDIT dimensions and age, education, marital status employment, amenity index and smoking.

DISCUSSION

The AUDIT questionnaire has not been used very much in either clinical or epidemiological studies of alcohol problems in Russia, despite the fact that heavy and hazardous drinking is relatively common there (Popova *et al.*, 2007). Our paper is the first to investigate whether the AUDIT was best

Table 3. The relationship between age, marital status, employment, education and amenity index and the two latent factors of the AUDIT (consumption and alcohol-related problems)[a]

Latent variables		Consumption		Alcohol-related problems	
Predictors		Age-adjusted coefficient (95% CI)	Fully adjusted coefficient[b] (95% CI)	Age-adjusted coefficient (95% CI)	Fully adjusted coefficient[b] (95% CI)
Age (5-year groups)	25–29	0.69 (0.13, 1.25)	0.68 (0.11, 1.24)	0.57 (−0.04, 1.17)	0.52 (−0.08, 1.13)
	30–34	0.27 (−0.01, 0.54)	0.23 (−0.06, 0.51)	0.36 (0.07, 0.66)	0.37 (0.06, 0.68)
	35–39	0.13 (−0.12, 0.38)	0.12 (−0.13, 0.38)	0.26 (−0.01, 0.54)	0.29 (−0.02, 0.57)
	40–44	0.10 (−0.14, 0.33)	0.08 (−0.16, 0.31)	0.28 (0.03, 0.53)	0.31 (0.05, 0.57)
	45–49	−0.09 (−0.29, 0.11)	−0.10 (−0.30, 0.10)	0.14 (−0.08, 0.36)	0.18 (−0.04, 0.40)
	50–54	0.01 (−0.17, 0.19)	0.02 (−0.17, 0.20)	0.05 (−0.15, 0.26)	0.10 (−0.11,0.30)
	55–59	Reference	Reference	Reference	Reference
	Linear trend	$P = 0.01$	$P = 0.03$	$P = 0.001$	$P = 0.001$
Marital status	Living together with a partner in a registered marriage	Reference	Reference	Reference	Reference
	Living together with a partner but not in a registered marriage	0.04 (−0.19, 0.27)	−0.02 (−0.25, 0.21)	0.28 (0.04, 0.53)	0.19 (−0.06 , 0.43)
	Divorced or separated	0.23 (−0.07, 0.52)	0.21 (−0.09, 0.50)	0.18 (−0.14, 0.50)	0.08 (−0.25, 0.40)
	Widower	0.20 (−0.55, 0.96)	0.11 (−0.64, 0.86)	0.33 (−0.49, 1.14)	0.13 (−0.68, 0.95)
	Never married	0.03 (−0.33, 0.37)	0.10 (−0.27, 0.46)	0.08 (−0.31, 0.47)	0.09 (−0.30, 0.48)
	Test for heterogeneity	$P = 0.64$	$P = 0.70$	$P = 0.17$	$P = 0.66$
Employment	In regular paid employment	Reference	Reference	Reference	Reference
	In irregular paid employment	0.07 (−0.24, 0.38)	0.03 (−0.29, 0.35)	0.20 (−0.13, 0.53)	0.11 (−0.23, 0.44)
	Unemployed seeking work	0.59 (0.27, 0.92)	0.59 (0.26, 0.91)	0.73 (0.39, 1.07)	0.66 (0.31, 1.00)
	Unemployed not seeking work	−0.26 (−0.53, 0.01)	−0.27 (−0.55, −0.01)	−0.06 (−0.37, 0.25)	−0.11 (−0.43, 0.20)
	Other	−0.44 (−1.18, 0.31)	−0.47 (−1.21, 0.28)	−0.36 (−1.25, 0.52)	−0.34 (−1.21, 0.54)
	Test for heterogeneity	$P < 0.001$	$P = 0.001$	$P < 0.001$	$P = 0.003$
Education	Incomplete secondary or less	0.03 (−0.29, 0.36)	0.09 (−0.24, 0.42)	0.11 (−0.24, 0.47)	0.13 (−0.23, 0.49)
	Secondary	Reference	Reference	Reference	Reference
	Higher and incomplete higher	−0.01 (−0.16, 0.15)	−0.01 (−0.18, 0.15)	−0.21 (−0.39, −0.04)	−0.17 (−0.35, 0.02)
	Test for heterogeneity	$P = 0.97$	$P = 0.85$	$P = 0.06$	$P = 0.14$
	Linear trend	$P = 0.86$	$P = 0.67$	$P = 0.01$	$P = 0.05$
Amenity index	Neither car or central heating	0.14 (−0.15, 0.42)	0.11 (−0.17, 0.40)	0.28 (−0.03, 0.59)	0.18 (−0.13, 0.50)
	Either car or central heating	−0.06 (−0.19, 0.08)	−0.08 (−0.22, 0.06	0.17 (0.02, 0.32)	0.10 (−0.05, 0.26)
	Both car and central heating	Reference	Reference	Reference	Reference
	Test for heterogeneity	$P = 0.39$	$P = 0.30$	$P = 0.04$	$P = 0.32$
	Linear trend	$P = 0.95$	$P = 0.81$	$P = 0.01$	$P = 0.13$

[a]Sample of 1005 men.
[b]Mutually adjusted for age, marital status, employment, education and amenity index.

Table 4. Usual quantity of spirits reported in interview compared with number of typical drinks reported (AUDIT Question 2)

	Number of drinks on a typical drinking day (from AUDIT Question 2)[b]				
	1–2	3–4	5–6	7–9	10+
Usual quantity of spirits[a] (corresponding drinks by AUDIT criteria)[c]	n (%)	n (%)	n (%)	n (%)	n (%)
Never drinks spirits	53 (20.5)	24 (7.9)	7 (5.1)	1 (1.4)	2 (2.1)
Up to 50 g (1–2 drinks)	17 (6.6)	5 (1.7)	1 (0.7)	0 (0.0)	1 (1.0)
50–100 g (3–4 drinks)	**35 (13.5)**	31 (10.3)	10 (7.2)	3 (4.0)	3 (3.1)
100–200 g (5–8 drinks)	**69 (26.6)**	**96 (31.8)**	49 (35.5)	19 (25.3)	14 (14.6)
200–300 g (9–12 drinks)	**61 (23.6)**	**101 (33.4)**	**45 (32.6)**	35 (46.7)	31 (32.3)
300–400 g (13–16 drinks)	**9 (3.5)**	**19 (6.3)**	**10 (7.2)**	**5 (6.7)**	12 (12.5)
400g–500 g (17–20 drinks)	**13 (5.0)**	**26 (8.6)**	**15 (10.9)**	**10 (13.3)**	28 (29.2)
More than 500 g (20+ drinks)	**2 (0.8)**	**0 (0.0)**	**1 (0.7)**	**2 (2.7)**	5 (5.2)
Total	259 (100)	302 (100)	138 (100)	75 (100)	96 (100)
Underreporting of drinks for AUDIT Question 2	**189 (73.0)**	**242 (80.1)**	**71 (51.4)**	**17 (22.7)**	0 (0.0)

Bold text indicates drinks assumed under estimated in AUDIT question.
[a]Quantity of spirits was measured using grams of spirits not grams of pure ethanol.
[b]Not answered by men who say they never drink alcohol in AUDIT Question 1 ($n = 131$).
[c]Data missing on usual quantity of spirits for four participants.

represented by two or three latent dimensions in a general population sample in Russia. We found that in our study population of working-age men living in a typical medium-sized Russian city, a two-dimension model provided the best fit with these dimensions corresponding to consumption and alcohol-related problems. This is consistent with what has been found in a group of tuberculosis patients in Russia (Mathew *et al.*, 2010) and in other general population samples elsewhere (Bergman and Kallmen, 2002; Lima *et al.*, 2005; Shevlin and Smith, 2007).

The strongest and most consistent associations we observed were for employment status, with those who were unemployed but seeking work having high scores for consumption and alcohol-related problems relative to those in employment. The only other study of AUDIT dimensions in relation to employment we have found was from the UK. This reported an association with employment status measured by economic activity and inactivity and the alcohol-related problems domain of the AUDIT but not the consumption domain (Smith *et al.*, 2010). However, studies using other measures of alcohol consumption patterns have shown higher levels of both alcohol consumption and problem drinking in men who are unemployed (Lee *et al.*, 1990; Montgomery *et al.*, 1998; Bobak *et al.*, 1999; Halme *et al.*, 2008; Virtanen *et al.*, 2008). Moreover, our results are consistent with analyses of a previous survey of the Izhevsk population which found a strong association between unemployment and other markers of hazardous drinking such as frequent hangover, drinking spirits daily and continuous drunkenness lasting two or more days (Tomkins *et al.*, 2007). The cross-sectional nature of our study does not allow us to disentangle the direction of causality underlying these associations. It is conceivable that unemployment may result in the onset of problem drinking (Claussen, 1999) or vice versa, (Kriegbaum *et al.*, 2010) although both pathways could be operating simultaneously.

In contrast to employment status, marital status showed no evidence of an association with either AUDIT dimension in this study. This is striking as there is evidence that not being married is associated with drinking problems both in Russia (Stack and Bankowski, 1994; Vannoy *et al.*, 1999) and in other populations (Temple *et al.*, 1991; Helasoja *et al.*, 2007; Halme *et al.*, 2008). In addition, recent analyses of the original Izhevsk case–control study found that being married was associated with the lowest relative risk of death from both alcohol-related causes of death as well as all other causes of death combined (Pridemore *et al.*, 2010). There are a number of potential explanations for this negative finding. First, there is the play of chance, with only 54 men included who were divorced or separated. Secondly, our cross-sectional analyses may have been subject to selection bias as men who were not married were less likely to take part in the health check examination and complete the AUDIT questionnaire. This could dilute any association of alcohol consumption with marital status. However, it may also be that neither dimension of the AUDIT score is picking up those aspects of drinking behaviour that may be associated with serious relationship problems. We have not found any other investigations of marital status in relation to the AUDIT score in the literature. The link between marital status and AUDIT scores and other measures of problem drinking thus deserves further attention.

We analysed two measures of socio-economic position: education and an amenity index. While there was good evidence of an association of both with the dimension of alcohol-related problems, there was only weak evidence of an association with the consumption dimension. These results are parallel to findings from a previous survey in Izhevsk. This identified a strong association between both education and amenity index with hazardous drinking behaviours such as continuous drunkenness lasting two or more days and frequent hangover but not daily consumption of spirits (Tomkins *et al.*, 2007). Our findings for education also parallel those from a population-based study in Arkhangelsk, Russia which did not find an association between educational level and the AUDIT sub-score based on the first three AUDIT questions (the consumption dimension) (Nilssen *et al.*, 2005). The relationship between AUDIT Questions 4–10 (the alcohol-related problems dimension) was not investigated in the Arkhangelsk study, although interestingly this study failed to find an association of the total AUDIT score with education. These findings are intriguing and deserve further investigation. It may be that while on average usual frequency and amount of alcohol consumed does not vary very much by educational level in Russia, the pattern of consumption does. However, what is clear is that in the Russian setting, at least, when using the AUDIT as an epidemiological outcome (as distinct from a clinical screening tool), it is important to look separately at associations with the two latent dimensions of consumption and alcohol-related problems. Using the total AUDIT score may obscure more complex relationships with socio-demographic and behavioural factors. This conclusion parallels that from other recent research that also emphasizes the need to look separately at multiple dimensions of the AUDIT when investigating issues of aetiology (Smith *et al.*, 2010).

Aside from these substantive findings, unlike many studies using the AUDIT questionnaire, we were able to investigate an aspect of the validity of this instrument. We have concluded that there may be considerable misclassification in the response given to AUDIT Question 2 about the typical number of drinks. This is likely to be due to cultural understanding of what a 'drink' or 'portion' of spirits represents. While a 'drink' as used in the AUDIT is intended to refer to the equivalent of 10–12 g of ethanol, some Russian respondents appear to have interpreted 'a drink' of vodka as referring to a large glass containing 200 g or more of spirits (80 g ethanol). The same level of misclassification was not observed for wine and beer.

Some element of misclassification of number of drinks is to be expected and previous studies have shown that people commonly underestimate their drink sizes compared with a 'standard' drink (Lemmens, 1994; Kaskutas and Graves, 2000; Gill and Donaghy, 2004). However, the high level of underestimation of drinks compared with measurement of spirits in grams indicates that there may be specific problems with AUDIT Question 2 in the Russian context, related to the way spirits are purchased and consumed. Our results suggest caution when using the AUDIT in Russia. Our study has some general limitations. While Izhevsk has a typical demographic profile for a medium-sized Russian city, our findings cannot be automatically generalized to Russia as a whole. Moreover, the initial sample required that proxy informants should be living in the same house as the men therefore our study population excludes those living alone in 2003–2006. To this extent, we have probably underestimated the prevalence of hazardous drinking, as those living alone are likely to include a disproportionate number of men with serious drinking problems, although such men also tend to be excluded from other population surveys.

In summary, education and amenity index, both measures of socio-economic position, were inversely associated with the alcohol-related problems dimension of the AUDIT but not with the consumption dimension. This discordance suggests that self-reported questions on frequency and volume may be less sensitive markers of socio-economic

variation in hazardous drinking than are questions about dependence and harm. Further investigation of the validity of the consumption component of AUDIT in Russia is warranted as it appears that the concept of a standard 'drink' as used in the instrument is not understood. Further research should examine whether problems could be overcome either by using AUDIT face to face or giving more guidance on the meaning of the word 'drink'.

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