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

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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 (Couthard 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 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.

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 mort-
tality 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 col-
clected 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 conse-
quences 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 unal-
terred. (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 anal-
yses 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 dis-
tribution 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;
Gil 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 cat-
egories 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 (Muthén and Muthén, 1998–
2007; Flora and Curran, 2004). Model 1 specified the three
factors the AUDIT was designed to measure—alcohol con-
sumption (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 devi-
ation (SD) units.

Analyses were carried out in Stata 11 (StataCorp., 2009)

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 question-
aire, 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%,
$P < 0.001$) and more likely to have both a car (53.9 vs. 46.5%,
$P = 0.04$) 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 question-
aire ($P = 0.66$) 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 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

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

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

*Data missing on GGT for 24 participants, on marital status for 1 participant and on smoking status for 1 participant.*
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...
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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Conflict of interest statement. None declared.

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