SCHOOL MATTERS: DRINKING DIMENSIONS AND THEIR EFFECTS ON ALCOHOL-RELATED PROBLEMS AMONG ONTARIO SECONDARY SCHOOL STUDENTS

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INTRODUCTION

Alcohol consumption has been linked to a multitude of adverse consequences with respect to health (Rehm et al., 2003) and social harm (Klingemann and Gmel, 2001). While earlier theories have often relied solely on average volume of alcohol consumption as a predictor of public health consequences (Bruun et al., 1975; Edwards et al., 1994), newer perspectives separate at least two different dimensions of alcohol consumption: average volume and patterns of drinking (Rehm et al., 1996), the latter often measured in terms of heavy drinking occasions (Gmel et al., 2003).

It has been shown that relatively stable individual patterns of drinking exist in adolescence (Kerr et al., 2002; Andersen et al., 2003; Wells et al., 2004; Duhig et al., 2005), and that heavy drinking occasions are particularly important for this group and young adults (Wechsler and Issac, 1992; Milgram, 1993; Chassin and DeLucia, 1996; Wechsler et al., 1998; Gmel et al., 2003; Kuntsche et al., 2004). For these age groups, heavy drinking occasions have been linked to the following negative consequences: symptoms of intoxication, such as blackouts or hangovers; school problems, such as missing school classes or getting behind in school work; unplanned and unprotected sexual activities; aggression, ranging from arguments with friends to rape; trouble with authorities at school and outside (e.g. police); injury, including, but not limited to, drunk-driving related consequences (for overviews see Wechsler et al., 1994; Chassin and DeLucia, 1996; Gmel et al., 2003).

The objective of the current paper is to test the influence of volume of drinking and heavy drinking occasions on alcohol-related harm. We hypothesize that both factors independently cause harm, with the following specific hypotheses:

- The higher the volume of alcohol consumption, the higher the alcohol-related harm, even if controlled for heavy drinking.
- The more frequent the heavy drinking occasions, the higher the alcohol-related harm, even if controlled for volume of drinking.

Multi-level research exists with respect to the etiology of substance use and abuse in adolescents. Social bonding is most often used to explain substance use and abuse at the individual level in this age group (Krohn et al., 1984; Burton et al., 1996), but there are both theoretical and empirical grounds to expect that school-level drinking behaviours also contribute to student drinking. Past research in this area has shown that a wide range of school-level factors (size, sociodemographic position, workload expectations, level of order versus disorder) play a role in determining student behaviour and progress (McPartland and McDill, 1977; Pink, 1984). Prevailing theory in this area also assumes that these factors exert control independent of the individual student. Despite such a strong rationale, most multi-level studies have not specifically addressed the influence of school prevalence (Duncan et al., 2002; Bjarnason et al., 2003; Maes and Lieve, 2003). Those studies that have addressed this issue have typically been on cigarette use and have provided mixed results (Norton et al., 1998; Patton et al., 1998; Alexander et al., 2001; Elickson et al., 2003). However, in one of the two multi-level studies that investigated the relationship between school environment and students with respect to drug use, it was found that in a permissive school subculture that supported drug use, increased individual frequency of use was reported among students (Rountree and Clayton, 1999). In the other, it was found that school contributed significantly to the variation in heavy drinking among students and played an important role in predicting heavy drinking among its students (Kairouz and
Adlaf, 2003). Thus, our third hypothesis posits that the drinking culture in a given school will influence alcohol-related harm:
- A higher mean consumption in a school and a higher proportion of heavy drinking occasions will result in greater alcohol-related harm, even if controlled for individual drinking indicators.

In other words, we postulate that, over and above the relationship between individual drinking indicators and alcohol-related harm, there is an influence of the environment on alcohol-related harm (Rehm et al., 2004). Specifically, it is postulated that, ceteris paribus, in heavy drinking environments there is more alcohol-related harm for an individual than in other drinking environments, even under the theoretical assumption that the same individual’s drinking pattern was identical in both environments.

METHODS

Sample
We used the data derived from the 2003 cycle of the Ontario Student Drug Use Survey (OSDUS), a repeated cross-sectional survey of Ontario students enrolled in grades 7 through 12 (Adlaf and Paglia, 2003). The OSDUS, conducted every 2 years since 1977 by the Centre for Addiction and Mental Health (CAMH), is the longest ongoing school survey in Canada. The 2003 cycle employed a regionally stratified two-stage cluster design (school, class) and surveyed 6616 students from 126 schools between January and June 2003. The student completion rate was 72%. Reasons for non-completion included absenteeism (~12%) and absence of parental consent (~16%). Self-administered questionnaires, which promote anonymity (Gfroerer, 1985; Rootman and Smart, 1985; Aquilino, 1997), were administered by the staff of the Institute for Social Research, York University during a single class period. The joint Research Ethics Board of the CAMH and the University of Toronto approved this study. See http://www.camh.net/research/population_life_course.html for further details regarding the study.

For the current analysis, the sample was restricted to 2455 secondary school students (grades 9–12) from 74 schools, who were asked the Alcohol Use Disorders Identification Test (AUDIT) items; by design, only a random half received these items. The average sample size per school was 32.7 (SD 12.6) and ranged from 5 to 82 students. The sample size was further reduced to 2421 cases due to listwise deletion of missing data for the other covariates used in the model.

Outcome
The main outcome was alcohol-related problems derived from the AUDIT (Saunders et al., 1993). The AUDIT can be segmented into two distinct sections: three questions on consumption (i.e., frequency, quantity per occasion, and heavy drinking occasions) and seven items on alcohol-related problems, either indicators of dependence or harmful use/abuse—(i) unable to stop drinking, (ii) failed to do what was expected, (iii) needed more than the same amount of alcohol, (iv) drinking is causing more impairment than in other drinking environments, even under the theoretical assumption that the same individual’s drinking pattern was identical in both environments.

Independent variables
Student level. Conceptually, the independent variables at the student level were volume of alcohol consumption and patterns of drinking. The former was measured in drinks per week and was derived from the OSDUS survey (Adlaf et al., 1999), as the product of frequency of drinking occasions and the quantity consumed per occasion. Heavy drinking, derived from the third AUDIT item, was represented by four dummy variables indicating less than monthly, monthly, weekly, and daily heavy drinking occasions (defined as five or more drinks per occasion), with never having a heavy drinking occasion serving as the reference group. The variables selected on the individual level as potential confounders of the relationship were gender (1 = male, 0 = female), age (in years), SES (from 0 to 10, 10 being the highest class; Currie et al., 1997), and birthplace (whether the subject was born in Canada or not).

School level. ‘Culture of drinking’ at the school level was indicated by the mean volume of alcohol consumed in a week by all students and the proportion of students that engage in heavy drinking occasions weekly or more frequently. The actual volume of alcohol consumed weekly was group-centred (calculated by subtracting the corresponding school mean alcohol volume from the individual’s alcohol volume consumption) and modelled as a random slope i.e. its slope on the score for alcohol-related problems was allowed to be estimated differently by each school (Raudenbush and Bryk, 2002).

Statistical analysis
Our hierarchical model was developed using HLM 5.05 (Raudenbush et al., 2000), with students grouped by schools. Thus, both individual-level (level 1) and school-level (level 2) effects for a student’s score on the alcohol-related problems can be estimated by

\[
Y_{ij} = \beta_0 + \beta_1 x_{1ij} + \beta_2 x_{2ij} + \cdots + \beta_p x_{pij} + r_{ij},
\]

where \(Y_{ij}\) is the score of alcohol-related problems for student \(i\) at school \(j\), \(\beta_0\) is the grand mean, \(\beta_1, \beta_2, \ldots, \beta_p\) are coefficients for the individual-level predictors, \(x_{1ij}, x_{2ij}, \ldots, x_{pij}\) are individual-level predictors, and \(r_{ij}\) is the residual error term.
where $Y_{ij}$ is the individual score on alcohol-related problems scale outcome; $\beta_{0j}$ is the random intercept (varies by school); $\beta_{1j}$ is the random coefficient slope for volume of alcohol/week (of schools); $\beta_2 \cdots \beta_p$ are the fixed slopes on the outcome (e.g. sex and age); $i$ denotes individuals, $j$ denotes schools; $p - 1$ is the number of estimated fixed slope predictors, i.e. predictors where the influence was not estimated as school specific; $x_{1ij}$ is the alcohol volume consumed by the individual, in drinks/week; $x_{2ij} \cdots x_{pij}$ are the predictors on individual level (e.g. sex and age); $\tau_{ij}$ is the mean of alcohol volume consumed per week within school $j$; $r_{ij}$ is the individual-level model residual error.

The random intercept $\beta_{0j}$, which varies by school, is further modelled by

$$\beta_{0j} = \gamma_{00} + \gamma_{01} W_{1j} + \gamma_{02} W_{2j} + u_{0j},$$  \hspace{1cm} (2)

where, $W_{1j}, W_{2j}$ are predictors at the school level: the proportion of students in the school who drink heavily at least weekly, and the mean volume of alcohol consumed in a week per school; $\gamma_{00}$ is the mean score on alcohol-related problems scale overall when all covariates in the model equals zero (i.e. specifically for females born in Canada, who never drink heavily); $\gamma_{01}, \gamma_{02}$ are fixed slope estimates of the effect of $W$ on its outcome, $u_{0j}$ is the school specific variation on the score for alcohol-related problems (the second level error term for intercepts).

The random slope coefficient $\beta_{1j}$ indicating the impact of alcohol volume is further determined by

$$\beta_{1j} = \gamma_{10} + u_{1j},$$  \hspace{1cm} (3)

where $\gamma_{10}$ is the mean slope of individual deviations from the school group mean of volume and $u_{1j}$ is the school specific variation on alcohol volume consumed per week (the second level error term for intercepts).

The most significant advantage of constructing this model is that we can ascertain not only which individual factors influence the score on the alcohol-related problems scale, but also whether a school culture of drinking, measured by either the volume consumed (per week) or instances of heavy drinking, can influence an individual’s level of alcohol-related problems. For sensitivity analyses, weighted regressions were conducted, taking into account the sampling probabilities related to grade and region in the province. In addition, we tested the model without group-centring (for different interpretations of group-centred vs uncentred models see Kreft et al., 1995).

**RESULTS**

**Descriptive characteristics of the OSDUS sample**

Table 1 presents the means and standard deviations of the individual-level and school-level variables used in the analysis. Looking at the entire sample, the mean age was ~16 years, 47% of the sample was male, the average SES level was 6.8, and 15% of the students were born outside of Canada. The mean alcohol volume consumed by students was ~4.3 drinks per week (ranging from 0 to 147 drinks per week), and in terms of drinking heavily the values were as follows: 52% never drank heavily, 20% did so less than monthly, 16% monthly, 11% weekly, and <1% daily. The mean score on the alcohol-related problem score was ~1.9 (empirically ranging from 0 to 25).

For all schools combined, the mean alcohol volume consumed was 4.3 drinks per week (ranging from ~1 to 11 per week), and 11% of all students reported drinking heavily at least once weekly. Please note that the mean alcohol volume for schools differs slightly from the individual level mean because of different sample sizes between schools.

**Hierarchical linear model analysis**

Table 2 shows the results of the analysis for individual-level and school-level effects. Variables at both the student level and school level were used to model the effects of student and school on an alcohol-related problems scale for a student. The model was first developed as a random effects ANOVA (a null model) in order to compare the intraclass correlation coefficient (ICC) with the full model. The ICC comparison of the null vs full model showed that the full model decreased the variation in problems across schools (3.7–1.9%) when adjusted for influencing factors at the student and school level. However, for both models, variation between schools was highly significant, meaning that explanatory variables did not fully account for between-school variation.

**Individual student effects.** The model was adjusted for age, gender, SES, and birthplace, of which only gender significantly predicted the outcome. It was found that males, after adjusting for other variables in the model, reported fewer alcohol problems than females ($\beta = -0.32, t = -2.99, P < 0.01$). It is important to note that this effect only appeared after adjustment for alcohol consumption variables. The unadjusted model showed that females reported fewer alcohol-related problems than males, although this effect was not significant.

The average volume of alcohol consumption was significantly associated with alcohol-related problems ($\beta = 0.08,$
Table 2. Regression coefficient estimates

<table>
<thead>
<tr>
<th>Fixed effects</th>
<th>Coefficient</th>
<th>SE</th>
<th>T-ratio</th>
<th>df</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model for individual level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.003</td>
<td>0.04</td>
<td>-0.07</td>
<td>2409</td>
<td>0.95</td>
</tr>
<tr>
<td>Gender*</td>
<td>-0.32</td>
<td>0.11</td>
<td>-2.99</td>
<td>2409</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Born outside of Canada?</td>
<td>0.09</td>
<td>0.14</td>
<td>0.65</td>
<td>2409</td>
<td>0.51</td>
</tr>
<tr>
<td>SES</td>
<td>-0.04</td>
<td>0.03</td>
<td>-1.35</td>
<td>2409</td>
<td>0.18</td>
</tr>
<tr>
<td>Heavy drinking occasionsb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than monthly</td>
<td>1.23</td>
<td>0.14</td>
<td>8.80</td>
<td>2409</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Monthly</td>
<td>2.21</td>
<td>0.18</td>
<td>12.18</td>
<td>2409</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Weekly</td>
<td>4.11</td>
<td>0.37</td>
<td>11.04</td>
<td>2409</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Daily</td>
<td>6.63</td>
<td>1.55</td>
<td>4.27</td>
<td>2409</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol volume-alcohol problems :</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>random slopec</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.08</td>
<td>0.02</td>
<td>5.52</td>
<td>73</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Model for school mean score on</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>alcohol-related problems scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(random intercept)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.51</td>
<td>0.76</td>
<td>0.67</td>
<td>71</td>
<td>0.50</td>
</tr>
<tr>
<td>Heavy drinking occasions:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>weekly or daily pooled</td>
<td>0.77</td>
<td>0.85</td>
<td>0.90</td>
<td>71</td>
<td>0.37</td>
</tr>
<tr>
<td>Mean alcohol volume consumed by</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>school</td>
<td>0.16</td>
<td>0.03</td>
<td>4.71</td>
<td>71</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*The reference group consists of females.
*bThe reference group is the never-drinking heavily group.
*cThe random slope of alcohol volume consumed was group-centred.

Table 3. Random effects estimates for intercept and slope

<table>
<thead>
<tr>
<th>Random effects</th>
<th>Variance component</th>
<th>df</th>
<th>Chi square</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>School mean score on alcohol-related</td>
<td>0.119</td>
<td>71</td>
<td>99.76</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>problems scale: random intercept</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean alcohol volume–alcohol problems:</td>
<td>0.007</td>
<td>73</td>
<td>249.97</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>random slope</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1 effect</td>
<td>6.116</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$t = 5.52, P < 0.001$). This slope was school specific and later analyses found that there were significant differences between schools (see Table 3, and below). Of particular interest is that the likelihood of students reporting greater alcohol-related problems increased cumulatively as the frequency of heavy drinking occasions increased. Specifically, having such occasions less than monthly led to, on average, a score that was 1.2 points higher (on the 28 point scale) compared with never experiencing such occasions. Having monthly heavy drinking occasions resulted in problem scores ~2.2 points higher, having weekly occasions resulted in scores ~4.1 points higher, and having daily occasions resulted in scores ~6.6 points higher. These effects were found after adjusting for all other variables, including average volume of consumption.

School-level effects. At the school level, it was found that the mean volume of alcohol consumed within a school was positively associated with greater alcohol-related problems, while adjusting for the school level of having heavy drinking occasions at least weekly and all other indicators in the model ($\gamma = 0.16, t = 4.71, P < 0.001$). The proportion of students having heavy drinking occasions at least weekly did not predict alcohol-related problems ($\gamma = 0.77, t = 0.90, P = 0.37$). However, when this variable was included as a sole level 2 predictor (i.e. when mean volume of alcohol consumed within a school was dropped from the model), the proportion of students with heavy drinking occasions was highly significant (details not shown).

Sensitivity analyses. Weighted analyses revealed practically identical results, where all significant effects remained significant with about the same effect size, but the influence of gender at the student level changed from significance to marginal significance ($\beta = -0.23, t = -1.86, P = 0.062$).

The models using uncentred volume of alcohol consumption did not yield any substantively changed results i.e. all the significant effects stayed significant, with similar effect sizes, and all the non-significant remained non-significant (details not shown).

Variance explained at level 2, and reliability of coefficients

Table 3 presents the estimated variances of the random effects and the test of the hypothesis that these variances were null. Specifically, the estimated variance for the random effect on the alcohol-related problem scores between schools (the random intercept) was ~0.12, which was significant ($\chi^2_{71} = 99.76; P < 0.01$) after adjusting for the level 2 predictors. This provides evidence against the null hypothesis and indicates that schools do vary significantly amongst each other in terms of mean alcohol-related problems. Also, it can be seen that the mean alcohol volume per week consumed also varies significantly by school at the P < 0.001 level, with a variance estimate of 0.01.

To look at the effect sizes of the different variance components, the procedures provided by Raudenbush and Bryk (2002) were applied. Overall, in the basic model with random intercept, schools accounted for 3.7% of the overall variance. This effect is highly significant, but small in size. Adding the school-level drinking as the only explanatory variable to this model, we can see that 89.0% of the variance between schools was explained by mean school drinking.

The reliability estimate of the random intercept and the alcohol volume consumed per week random slope were both adequate at 0.38 and 0.60, respectively (Raudenbush and Bryk, 2002).

**DISCUSSION**

Our main hypotheses were confirmed: patterns of drinking and average volume of alcohol consumption, each independently predicted alcohol-related problems at the student level. At the school level, average volume of drinking in a school was a significant influencing factor independent of the proportion of students with heavy drinking occasions. Testing for the influence of the proportion of students with heavy drinking occasions as a school factor, this variable was also significant, but only if it was the only school factor in the model. Average volume of drinking in a school correlated quite substantially with the proportion of students with heavy drinking occasions. Testing for the influence of the proportion of students with heavy drinking occasions in our model, we can see that 89.0% of the variance between schools was explained by mean school drinking.

Before discussing these implications further, we would like to point out the limitations of the study. The main limitation is the cross-sectional nature of the study. We cannot be sure that
the level and patterns of drinking measured at the time of the survey are a good operationalization of the drinking style that caused the alcohol-related problems. We assume that they are, and we find significant relations, but we cannot exclude measurement error or other systematic relationships between the variables, e.g. when drinking led to problems and was consequently reduced. However, the latter relationship would have worked against our hypotheses. Secondly, the operationalization of school drinking culture certainly could be improved. Future research should try to capture indicators for school drinking culture that are recorded independently from the students’ responses. While this limitation needs to be acknowledged, it could not alternatively explain the main results.

Another limitation of our results is self-reports. Although we used validated questions from the AUDIT for outcome and validated questions for alcohol consumption for the main independent variable, we cannot exclude that for some respondents the co-variation between them reflects attitudes or preconceptions about alcohol rather than a true relationship (Rehm et al., 1999). However, it is very unlikely that this explanation could explain all of our results. Another limitation of our analysis is the absence of a 3-level model, we cannot be sure that the school effects identified are not neighbourhood effects. Also, as the AUDIT was originally designed with an adult population in mind, there has been some concern of its applicability to an adolescent population. However, previous research has shown that the AUDIT can be used among adolescents (Chung et al., 2000; Kelly et al., 2002; Knight et al., 2003).

With respect to theory, it becomes more evident that average volume or volume alone is not sufficient to predict social or medical harms. This statement seems to be true for adults as well as adolescents. Thus, given the strong effects of frequency of heavy drinking occasions on alcohol-related problems, future epidemiological research, including social epidemiological research, should always include at least one indicator for patterns of drinking (Dawson and Room, 2000). However, simply adding a variable for patterns of drinking may be insufficient. To substantially predict alcohol-related problems and harm, indicators for the environment and interaction terms between consumption indicators and key environmental variables must be included (Rehm et al., 2004) in future research in this area. In our models there were substantial differences between schools in terms of alcohol-related problems, even after adjusting for individual-level variables and environmental (school level) variables. This finding is an important addition to the existing body of work, especially to that of Kairouz and Adlaf (2003), who found that both school-level and student-level variables are important determinants of heavy drinking behaviour. In addition, these findings add weight to the argument that the school setting is a fixed attribute of adolescent alcohol use and abuse (Rountree and Clayton, 1999; Kairouz and Adlaf, 2003), regardless of individual-level variables.

Future research in this area may focus on the ‘contextual make-up’ of schools. In this study, drinking culture within a school was measured from aggregated individual-level attributes, but determining those school specific features that contribute to its unique culture are important in uncovering real school-level effects in adolescent substance use.

The fact that the culture in schools is important in influencing alcohol-related harm, over and above individual drinking levels, offers important avenues for prevention. On the other hand, student-level educational programmes often show none or very modest effects in changing long-term behaviour (Babor et al., 2003; Foxcroft et al., 2003), measures to change the drinking culture or drinking environment in schools may be more effective. This may include policies for school events and parties, as well as strict enforcement of rules with respect to alcohol in schools. The drinking environment may also be influenced by the availability of alcohol for students around schools (Maes and Lievens, 2003), e.g. whether age limits are enforced in public sales places and bars.

REFERENCES


