Do Rural Drivers Pose Greater Alcohol Impaired Driving Risks? Driver Record, Questionnaire, and Interlock BAC Data as Proxies for Risk

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Background
Annually, the rates of crashes in rural areas substantially exceed the rates in urban areas. For example, in 2001 rural fatal crashes were 61% of all fatalities. When calculating fatality rate relative to total travel distance (relative rate base = 100 million vehicle miles traveled) the occurrence of fatalities on rural roads is twice or more that on urban roads (NHTSA, 2001). Who dies and why?

Blatt and Furman (1998) reported on 5 summed years of FARS (Fatality Analysis Reporting System) data to evaluate the prevalence of rural fatalities and to determine the demographic profile of those who are involved. Their study was an attempt to estimate the proportion of all fatal crashes by demographic subgroup adjusted for the base of the population of all drivers over age 15. They used geo-demographic mapping software to categorize drivers into one of five different levels of population density: rural, small town, secondary city, suburban, urban. Secondary, cities were categorized as edge cities that grew up outside of the suburban area.

These investigators calculated an index score that is a simple representation of the rate of crashes relative to the population sampling base. In their system, a fatality rate within a cluster relative to the total population of that cluster yields an index score of 100 when the proportion of the total fatalities is identical to the proportion of the population within that cluster (i.e., when the actual and expected fatality rates are identical). An under-representation of fatalities results in a score less than 100 whereas an overrepresentation results in a score greater than 100. With this system they determined that not only do the highest rates of fatal crashes occur in rural areas, but those crashes kill rural residents. The data in Figure 1 summarize their breakout of index scores by the five demographic groupings.
The data in Figure 2 reveal that this trend begins early. Young rural drivers have an elevated risk of fatal crashes relative to age mates in other demographic clusters. Further, these investigators found that rural males are involved in the greatest proportion of fatal crashes (44%) while only representing 18% of the male population. At 252, this yielded the highest index score for any cluster.

Differences in rural and urban roadway safety engineering such as number of lanes, lighting, guard rails as well as slower emergency response times and other nondriver factors are often cited as explanations for these differences. These factors undoubtedly contribute substantial variance to the problem, but it is not clear to what extent alcohol may play a role in the elevated risk. This is a particularly relevant question to ask considering evidence that young males, the heaviest consumers of alcohol, are also disproportionately represented in the rural fatality statistics.
This possibility gains some credence from the work of Borgialli et al. (2000), who used 1994-1996 Michigan (MI) data to evaluate all MI rural crashes (116,242) against a random sample comprised of 20% of all nonrural crashes (104,197). They used logistic regression to evaluate a survival model with predictors such as age, alcohol status of crash, and gender. In their results, they too found that rural residence predicted a higher likelihood of fatal outcomes. But after controlling for alcohol, age, and gender, they determined that the relative risk of rural as a factor in crashes declined from 1.69 (with 95% CI = 1.2 to 1.9) to 1.26 (with 95% CI = 0.6 to 2.4), a nonsignificant difference. This suggests that alcohol contributes some of the variance to the crash involvement of rural residents.

Our research with alcohol ignition interlock device records has shown that the rate of elevated BAC tests while the interlock is installed on vehicles is a substantial predictor of future DUI events once the interlock is removed and full driving privileges restored (Marques et al., 2001, 2003a, 2003b). This observation has been confirmed in two culturally distinctive, French- and English-speaking Canadian provinces from a combined 24 million breath tests provided by approximately 9,500 offenders who used an interlock between 5 and 18 months. Since the rate of BAC tests relative to all tests taken serves to predict future driver risk as indicated by subsequent DUI convictions, the BAC test results on the interlock can serve as a higher sensitivity proxy measure for alcohol-related driver risk in general since interlock BAC test rates>.02% reflect actual consumption. As safety researchers know well, a new DUI conviction is a 100% high specificity indicator of alcohol risk, but reliance on DUI as an outcome means reliance on a very low sensitivity measure of impaired driving since the chance of any DUI arrest is small relative to episodes of driving while impaired. In this report, we use evidence from Alberta (AB) and Quebec (QC) Canada interlock programs to evaluate the contribution of age and rural residence to help determine if those DUI offenders who use an interlock subsequent to a DUI offense and are from rural locations differ in any meaningful way on their likelihood of elevated BAC or other violations from those who are more urban.

The evaluation of interlock users affords an opportunity to determine if those DUI offenders in rural areas who are required to use (or elect to use) an interlock are themselves a higher risk to the public relative to other known predictors of alcohol-related risk.

**Methodology**

Data sources for this analysis include the driver records and interlock BAC test results of approximately 9,500 DUI offenders from QC and AB. Methodological detail can be found in prior published work as cited above. In Alberta, questionnaire data are available on each of the approximately 2,200 offenders in addition to interlock and driver record data whereas in Quebec the 7,300 offenders can only be characterized by some driver record variables and the interlock data. In Alberta, the offenders represent approximately 8-9% of all DUI offenders during the years 1995-1999 split evenly between first and multiple offenders. In Quebec, the offenders are approximately 25% of all offenders, but 77% are first-time offenders. Accordingly, there are key differences in the datasets. Nonetheless, we have found that, in both of these distinctively different provinces, there are strong similarities in the ability of the interlock data to predict future DUI events.

Among these offenders, 24 million breath tests were logged; less than 1% of these are elevated above 20 mg/dl (.02%). However, the decile with the greatest rates of elevated BAC tests re-offends at 10 times the rate of those in the lowest decile (Marques et al., 2003c). In addition to the rate of elevated breath tests, the past record of DUI offenses (prior DUI) is also a strong predictor of future DUI.
In Canada we are able to distinguish rural from non-rural addresses by using the postal code. The postal code has the structure of alpha, number, alpha, number, alpha, number (e.g., L 5 T 3 C 2). When the first number is zero, the address is deemed rural. This is not a foolproof way to identify rural addresses, but in Alberta we had an opportunity to cross-check the postal code designation with self-report. Among 2,096 offenders, there was 82% concordance on rural by report and rural by postal code. This largely validates the postal code as a proxy for ruralness. We did not have a comparable self-report variable in Quebec, but we do have postal code data there.

In the two provinces, we were able to scale the relationship between a predictor of alcohol risk (e.g., multiple offender status, rural residence, age under 35, male) and several measures of alcohol-related risk (e.g., whether someone was re-convicted of DUI after the interlock was removed, rate of interlock BAC tests >.02%, >.04%, >.08%). In order to compare the predictors on a common metric, the effect size magnitude statistic for crosstab data, the phi coefficient, was employed.

The AB and QC data sets have several differences, but both provinces have some data elements available in common (gender, rural, age, prior DUI offense status). In Quebec, interlock users have the option to bypass the interlock in extreme situations. This option was selected at least once by 22% of interlock users. We did show earlier (Marques et al., 2003c) that the decision to bypass was predictive of future repeat offenses. In Alberta, moving violations (MVL) in the driver record was available as was additional demographic information such as poverty, job classification, and racial group.

Results
The graphic in Figure 3 portrays the effect size estimates that both QC and AB had in common while the data in Table 1 compare all the effect size estimates including ones that are unique to one or the other province. These include using the interlock bypass option, have 5 or more moving violations, being White, poor, or blue collar. In Figure 3, it is evident from the strength of relationship between the predictors (in the legend box) and the magnitude of the Y axis effect size measure (phi coefficient) that, for each of the X axis outcome categories, rural address is the weakest predictor in both provinces among the four evaluated jointly. The stronger prediction of multiple offense status in AB reflects the larger proportion of multiple offenders in the AB sample. QC was 70% first offenders. In both provinces, younger age is associated with much alcohol-related risk as shown by the high sensitivity of this in predicting the various risk criteria marked by interlock tests.
The use of univariate nonparametric statistics does not allow for a look at interactions between age, rural status and other factors. For example we know that among the interlock using groups, rural DUI offenders are younger in AB than urban/nonrural drivers, and in both provinces rural drivers have more prior DUI offenses than nonrural drivers. So is it possible that some of the rural effects are buried in interactions?

TABLE 1. Effect size estimates for alcohol risk by province.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Criterion (columns)</th>
<th>Alberta</th>
<th>Quebec</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DUI post-interlock</td>
<td>1+ BAC tests &gt;= .08%</td>
<td>2+ BAC tests &gt;= .04%</td>
</tr>
<tr>
<td>Male</td>
<td>0.027</td>
<td>0.012</td>
<td>0.012</td>
</tr>
<tr>
<td>Age under 35</td>
<td>0.006</td>
<td>0.029</td>
<td>0.054</td>
</tr>
<tr>
<td>Multiple</td>
<td>0.132</td>
<td>0.065</td>
<td>0.058</td>
</tr>
<tr>
<td>Rural address</td>
<td>0.003</td>
<td>0.004</td>
<td>0.02</td>
</tr>
<tr>
<td>Bypassed &gt;4 MVL</td>
<td>0.026</td>
<td>0.017</td>
<td>0.049</td>
</tr>
<tr>
<td>White</td>
<td>-0.01</td>
<td>0.006</td>
<td>0</td>
</tr>
<tr>
<td>Poor</td>
<td>0.021</td>
<td>-0.007</td>
<td>-0.03</td>
</tr>
<tr>
<td>Blue collar</td>
<td>0.057</td>
<td>0.029</td>
<td>0.015</td>
</tr>
</tbody>
</table>

Future repeat DUI convictions and rate of interlock BAC tests ≥.04% were combined as a multivariate dependent measure representing alcohol-related risk. This allowed demographic variables to be compared for an overall ability to predict this composite alcohol risk measure. Among the predictors tested are: family income, education, blue-collar vs non-blue-collar work status, rural vs nonrural addresses, gender, as well as the interaction between rural and the other factors. Only age and blue-collar status were significantly predictive of one or more components of the dependent measure, while only blue-collar was significant in the multivariate tests (F=5.4, df=2 and 1947, P=.004). No interactions were of interest.
In Quebec, rural status, age, and gender can be compared in a similar fashion, and there too, rural is not a factor in predicting alcohol risk, whereas choosing to bypass the interlock and driver age less than 35 are significant multivariate predictors, respectively (F=15.1, df=2 and 7133, P=.000; and F=7.39, df=2 and 7133, P=.001).

Discussion
The proportion of all rural DUI offenders who enter an interlock program is not necessarily representative of the average alcohol offender as there are always self-selection factors operating in interlock programs. Nonetheless, the interlock data do afford an opportunity to examine a high sensitivity indicator of drinking and driving, one that scales risk of first-time offenders as well as it does for multiple offenders. When using these criterion measures of alcohol-related risk, it does not appear that rural DUI offenders carry any greater alcohol-related risks than those whose addresses are not rural.

The present analysis evaluated rural residence relative to other known demographic and behavioral profiles associated with alcohol-related driver risk. No evidence could be adduced to suggest that alone or in combination with other demographic factors rural residence in itself is a contributing factor to alcohol-related risks on the highways. These findings are in accord with evidence from NHTSA that shows the BAC distribution of drivers involved in rural and urban fatal crashes do not differ.

Since alcohol is one of the largest behavioral factors that contributes to driver risk and public costs, this suggests that the higher rates of crash involvement and fatalities in rural areas may in fact be more related to roadway condition and similar factors related to safety engineering that are external to the driver.

References