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Effect on Traffic Safety of Introducing a 0.05% Blood Alcohol Level in Queensland, Australia

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ABSTRACT

A 0.08% maximum legal blood alcohol level (BAL) for drivers in Queensland was replaced by a 0.05% BAL. As alcohol is especially likely to be a factor in night-time accidents, the evaluation focused on the extent to which night-time accidents decreased in comparison to daytime accidents. It appeared that most, if not all, of the significant 8.2% reduction in night-time hospitalization and 5.5% reduction in property damage accidents in the first year after the legislative change could be attributed to the lower BAL. The evaluation showed that the 0.05% BAL had an accident-reducing effectiveness beyond its first year of operation, although some of the accident reductions in the second and third years may have been partly the result of increased enforcement.

INTRODUCTION

The Grand Rapids study (Borkenstein et al., 1974) showed that drivers with a blood alcohol level (BAL) of 0.08% (80mg/100 ml) had an Accident Involvement Index of 33.02, compared to only 6.99 for drivers with a BAL of 0.05%. Partly as a result of these findings, Queensland, one of the six Australian states, lowered its maximum BAL from 0.08% to 0.05% as from December 20, 1982. The purpose of this paper is to evaluate the accident reducing effectiveness of the lower BAL. Particular attention will be given to possible confounding variables, as previous studies of the introduction of lower BALs have been difficult to interpret due to a concomitant increase in enforcement (Noordzij, 1979), or the occurrence of other relevant legislative changes in close proximity (Warren et al., 1977).

Studies of the times at which people consume alcoholic beverages have shown that considerably more alcohol is consumed at night-time than in the daytime. As a consequence, alcohol is especially likely to be a factor in night-time traffic accidents (Douglass, 1980). The comparisons therefore focused on the extent to which night-time accidents decreased in comparison to daytime accidents after the new BALs became operative. This type of analysis was suggested by the study of Williams et al. (1983) in which the effect on traffic accidents of raising the legal minimum drinking age was determined by using daytime accidents as control data.

Where the necessary data were available, out-of-State control comparisons were also made in order to determine whether a decrease in the number of night-time accidents was restricted to the experimental State or part of a general decrease in night-time accidents.

The study included property damage, injury and fatal accidents as the introduction of a 0.05% BAL may have had varying effects for accidents of different severity. For instance, due to the very high BALs frequently found in drivers killed in alcohol-related accidents, a 0.05% BAL may have had less effect on fatal than on injury accidents.

METHOD

A three-year before period (1 January 1980–31 December 1982) and a three-year after period (1 January 1983–31 December 1985) were used for the analyses. Night-time (6 pm–6 am)/daytime (6 am–6 pm) comparisons for the before and after periods were conducted for the number of (a) fatal accidents, (b) accidents for which one or more persons were admitted to hospital, (c) accidents in which one or more persons were injured, but not admitted to hospital, and (d) reported property damage accidents. As from 1 October 1978 all property damage accidents which resulted in damage of A$1000 or more were required to be reported in Queensland. Inflation

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would have decreased the real value of the A$1000 during the six years of the study, but the effect should have been the same for daytime and night-time accidents. For each of the four categories of accidents chi-square tests, with a correction for continuity (Siegel, 1956) were made. As from 4 March 1985 a 0.02% BAL for drivers under 18 years of age was introduced in Queensland.

Western Australia was used as the out-of-State control area as New South Wales, South Australia and Victoria had random breath testing, and the casualty accident numbers in the Australian Capital Territory, Northern Territory and Tasmania were too small for meaningful analysis. A 0.02% BAL was introduced for first-year drivers in Western Australia as from 9 December 1982 (Smith, 1986). Otherwise a 0.08% BAL applied to all drivers in Western Australia from 1980 to 1985. Data for property damage accidents by time of day were not obtained for Western Australia as the reporting threshold was only A$300.

The accident data for Queensland and Western Australia were taken from published and unpublished tables of the Australian Bureau of Statistics in the two States.

Details were obtained of the breathalyser or blood-alcohol analyses performed on road users involved in road traffic accidents in Queensland from 1 January 1980 to 31 December 1985. These statistics included readings for persons killed. The Australian Bureau of Statistics publication containing the figures stated:

> Where possible, blood analysis is carried out on all road users fatally injured, while breathalyser or blood tests may be conducted on drivers and riders of vehicles who were involved, but not fatally injured, in accidents. Breathalyser tests are usually conducted only after a preliminary test has indicated the presence of alcohol.

Details of the number of drink-driving convictions in Queensland and Western Australia were obtained for the period 1 July 1980 to 30 June 1985. These data were available only for the years ended 30 June rather than for calendar years.

RESULTS

Table I shows that in comparison to Queensland daytime accidents, after the introduction of the 0.05% BAL in Queensland there were significant reductions of 11.3% in night-time accidents in which at least one person was admitted to hospital, and 15.9% in night-time injury accidents not resulting in a hospital admission. In comparison to Western Australian night-time injury accidents, only the admitted to hospital analysis gave a significant result (Table II). Neither of the fatal accident comparisons in Tables I or II gave a

Table I Number of daytime and night-time traffic accidents in Queensland before and after the introduction of a 0.05% BAL as from 20 December 1982

Type of accident	Night-time (6 pm – 6 am)		Daytime (6 am – 6 pm)		x^2
	Before	After	Before	After	
Fatal	780	663	760	674	0.281
Admitted to hospital	4722	3832 (−11.3%)	6202	5732	20.795***
Injured, but not admitted to hospital	3393	3160 (−15.9%)	7092	7732	28.020***
Property damage	9341	8900 (−11.5%)	17060	18215	38.847***

*** $p < 0.001$

Before period: 1 January 1980 – 31 December 1982
After period: 1 January 1983 – 31 December 1985

Figures in brackets are the annual percentage decreases, after allowing for the changes in the number of daytime accidents.

Table II Number of night-time fatal and injury traffic accidents in Queensland and Western Australia before and after the introduction of a 0.05% BAL in Queensland as from 20 December 1982

Type of accident	Queensland (6 pm – 6 am)		West Australia (6 am – 6 pm)		χ^2
	Before	After	Before	After	
Fatal	780	663	349	313	0.274
Admitted to hospital	4722	3832 (–8.1%)	2799	2498	7.254**
Injured, but not admitted to hospital	3393	3160	3333	3317	3.562

** $p < 0.01$

Before period: 1 January 1980 – 31 December 1982
After period: 1 January 1983 – 31 December 1985

significant finding.

Additional analyses revealed that for each of the three years in the after period, the number of Queensland night-time accidents resulting in a hospital admission was significantly less than for the total of the before period (1983: $\chi^2=5.651$, df=1, $p<0.05$, – 8.2%; 1984: $\chi^2=11.164$, df=1, $p<0.001$, – 12.0%; 1985: $\chi^2=13.669$, df=1, $p<0.001$, – 13.6%). A similar comment also applies to the other Queensland night-time injury accident variable (1983: $\chi^2=15.478$, df=1, $p<0.001$, – 16.7%; 1984: $\chi^2=14.289$, df=1, $p<0.001$, – 15.9%; 1985: $\chi^2=11.968$, df=1, $p<0.001$, – 15.0%). The percentages were calculated as the decrease in the number of night-time accidents in the year in question as compared to the annual mean of the before period, and after allowing for the change in the number of daytime accidents.

The number of property damage night-time accidents in Queensland during the three-year after period was 11.5% less than expected (Table 1). In comparison to the three-year before period, for 1983 the reduction was only 5.5% ($\chi^2=4.826$, df=1, $p<0.05$. By contrast, for 1984 the reduction was 13.8% ($\chi^2=28.158$, df=1, $p<0.001$), and for 1985 15.1% ($\chi^2=30.875$, df=1, $p<0.001$).

Using a two-sample, two-tail Kolmogorov–Smirnov test (Siegel, 1956) it was found that the BAL distribution of all drivers and motorcyclists involved in accidents in Queensland during the three-year after period was significantly different from that of the before period (D=0.0441, $p<0.001$). The maximum difference between the two distributions in Table III occurred at a BAL of 0.08%. Further analyses revealed that the BAL distribution for 1983 was not significantly different from that for 1984 (D=0.0293) or 1985 (D=0.0350), while the distributions for 1984 and 1985 were also not significantly different (D=0.0360). However, the distributions for each of the three after years were significantly different from those of the total before period (1983: D=0.0417, $p<0.05$; 1984; D=0.0475, $p<0.01$; 1985: D=0.0507, $p<0.01$).

From Table IV it can be seen that during the middle two years of the after period there was a 22.1% increase in the mean annual number of drink-driving convictions in Queensland, in comparison to the middle two years of the before period. For Western Australia the corresponding increase was 6.9%.

DISCUSSION

Many factors can influence the number of traffic accidents which occur and are subsequently recorded by the traffic authorities. Before considering the results, the methodology of the study will therefore be reviewed with the aim of determining the degree to which the experimental design permits one to attribute causality for the decrease in night-time accidents during the after period to the introduction of the 0.05% BAL.

When evaluating the effect of an alcohol-related legislative change, some researchers have used a within-State control area. Others have

Table III Blood alcohol levels of drivers and motorcyclists involved in traffic accidents in Queensland, 1980 to 1985

BAL (%)	1980 – 1982	1983 – 1985
0.0	542 (9.8%)	638 (12.3%)
0.01 – 0.04	177 (3.2%)	243 (4.7%)
0.05	87 (1.6%)	75 (1.5%)
0.06	103 (1.9%)	106 (2.0%)
0.07	163 (3.0%)	130 (2.5%)
0.08	106 (1.9%)	145 (2.8%)
0.09 – 0.10	372 (6.7%)	308 (5.9%)
0.11 – 0.12	479 (8.7%)	426 (8.2%)
0.13 – 0.14	561 (10.1%)	523 (10.1%)
0.15+	2929 (53.1%)	2592 (50.0%)
Total	5519 (100%)	5184 (100.0%)

Table IV Number of drink-driving convictions in Queensland and Western Australia from 1 July 1980 to 30 June 1985

Year	Queensland	Western Australia
1980 – 81	17550	10625
1981 – 82	18942	11809
1982 – 83	19046	11646
1983 – 84	23178	11081
1984 – 85	21370	12911
Mean per year for the two years ended:		
30 June 1982	18246	11217
30 June 1985	22274 (+22.1%)	11996 (+6.9%)

Figures in brackets are the percentage increases from the two years ended 30 June 1982 to the two years ended 30 June 1985

used a similar out-of-State area. Only occasionally has a researcher used both types of control, as was the case for this study. The use of a within-State control area enabled a wide variety of possible confounding factors, such as changes in the weather, economic conditions and number of vehicles to be monitored (Reichardt, 1979). The out-of-State control area permitted any general change in the number of night-time accidents to be controlled for (Campbell and Stanley, 1966). The simultaneous use of both types of control in traffic accident studies can provide the necessary information to effectively rule out alternative explanations of significant changes in dependent variables (Wagenaar, 1983).

While it is true that most alcohol-related accidents occur at night-time, not all do. The 0.05% BAL could therefore have been expected to slightly reduce daytime accidents, in addition to its main effect on night-time accidents. This means that the night-time–daytime comparisons would have been slightly conservative as the decrease in night-time accidents had to be over and above any decrease in daytime accidents in order to give a significant finding.

Following the introduction of the 0.05% BAL in Queensland there was an immediate reduction of 8.2% in night-time hospitalization accidents. In

the following years the percentage decreases became 12.0% and 13.6%, a factor possibly related to the increased number of drink-driving convictions in these years (see Table IV). The number of daytime hospitalization accidents for the after period was slightly less than for the period before (Table I), meaning that the above reductions in night-time accidents were over and above the daytime reductions. Also, the out-of-State comparison gave a significant reduction of 8.1% for the three years of the after period (Table II).

For non-hospitalization accidents the percentage reductions for each of the three after years were all highly significant and of approximately the same magnitude (1983 – 16.7%; 1984 – 15.9%; 1985 – 15.0%). However, the significant results were as much due to an increase in daytime accidents in Queensland for each of the three after years as a decrease in night-time accidents (Table I). The importance of this was shown in Table II where the result of the out-of-State night-time comparison only occurred with a probability of less than 0.10. Some idea of the extent to which the above three percentage decreases were possibly inflated is to be gained from a comparison of the number of night-time accidents in Queensland during the three-year before and after periods (Table I). The reduction from 3393 to 3160 represented only a 6.9% decrease.

The significant decrease of 5.5% in night-time property damage accidents during the first after year in Queensland was considerably less than for the second (13.8%) and third (15.1%) after years. The highly significant results for the latter two years were due more to an increase in daytime accidents, than to larger reductions in night-time accidents. By contrast, the number of daytime property damage accidents in Queensland during 1983 (5571) was slightly less than the annual mean of the before period (5686.7, Table I).

One of the requirements for the attribution of causality in drink-driving studies is that there should be a close temporal relationship between the implementation of the legislation and the change in the dependent variables. For both the injury accident variables and the property damage accident variable this condition was satisfied, as the number of night-time accidents in 1983 was significantly less than for the before period, using daytime accidents as the control data. From Table IV it can be seen that the change in the number of drink-driving convictions did not commence until some time after the 0.05% BAL was introduced. It would therefore appear reasonable to attribute most of the significant reduction in hospitalization and property damage accidents in 1983 to the 0.05% BAL. The significant result for non-hospitalization accidents may also have been due to the 0.05% BAL, but the change in the number of daytime non-hospitalization accidents means that some caution has to be exercised in interpreting the apparent decrease. Such a qualification is not applicable to the hospitalization and property damage accident variables as the 1983 daytime data were approximately the same as the mean of the three-year before period, and so provided the basis for a valid comparison of the introduction of the 0.05% BAL.

From Table IV it is apparent that the Queensland police increased the number of drink-driving convictions during the after period, but that the increase was only approximately 12% more than the police increased drink-driving enforcement in Western Australia. The short-term effect of traffic law enforcement blitzes on alcohol-related accidents has been previously documented (Hurst and Wright, 1981). Thus, if the significant decreases in night-time injury and property damage accidents in Queensland were due to increased enforcement rather than to the introduction of the 0.05% BAL, one would have expected the accident reductions to be of relatively short duration. This was clearly not the case, as for all three of the after years the night-time injury and property damage accident variables had significant decreases in comparison to Queensland daytime accidents.

The greater percentage reductions in night-time hospitalization and property damage accidents in 1984 coincided with an increase in daytime accidents, and causes one to question the extent to which the increased enforcement in 1983–84 (Table IV) did in fact influence night-time accidents. If the numbers of daytime accidents for 1984 had been the same as for the before period and for 1983, the percentage reductions in night-time hospitalization and property damage accidents in 1984 would have been very similar to those for 1983.

Additional support for the above conclusion of the effectiveness of the 0.05% BAL in Queens-

land is to be found in Table III. The BAL distributions of drivers involved in accidents for 1983, 1984 and 1985 were not significantly different, yet each of these three years was significantly different to the before period. Exactly the same pattern of results applies to the two injury accident variables, and so highlights the finding of Borkenstein et al. (1974) of how the probability of an accident increases with the BAL of the driver. From Table III it can be seen that during the three-year before period only 14.6% of the drivers involved in accidents had a BAL of 0.05% or less. The corresponding figure for the after period was 18.5%. By contrast, at the other end of the distribution, the percentage of drivers with a BAL of 0.15% or more decreased from 53.1% in the before period to 50.0% during the after period. The effect of the 0.05% BAL was to shift the distribution towards the lower BALs. Furthermore, as the total for the after period was 335 less than for the before period, it would seem that the BAL distribution was shifted to such an extent that there was a reduction in the number of drivers involved in accidents, as was shown in Tables I and II.

Insignificant results were obtained for all the fatal accident comparisons. This is not really a surprising finding as many of the drivers and motorcyclists killed in alcohol-related accidents in Australia have very high BALs. A 0.05% BAL may be ignored in much the same way as a 0.08% BAL, although all the fatal accident comparisons had a tendency to be in the predicted direction. Possibly there was a modest deterrent effect for fatal accidents, but the relatively small numbers in the fatal accident comparisons meant that the analyses lacked the power of the injury accident comparisons, especially as the percentage changes were noticeably smaller for the fatal accident analyses.

In response to Hurst's (1985) question 'Blood alcohol limits and deterrence: Is there a rational basis for choice?' it appears from the Queensland experience that a 0.05% BAL will significantly reduce injury and property damage accidents over and above the presumed accident reducing effectiveness of a 0.08% BAL. Furthermore, the evaluation showed that in contrast to many other alcohol-related countermeasures, the 0.05% BAL apparently had an accident reducing effectiveness beyond its first year of operation.

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