

The Early Effects of Ontario's Administrative Driver's Licence Suspension Law on Driver Fatalities with a BAC > 80 mg%

Robert E. Mann, PhD^{1,2}

Reginald G. Smart, PhD¹

Gina Stoduto, MEd¹

Douglas Beirness, PhD³

Robert Lambie, PhD⁴

Evelyn Vingilis, PhD⁵

ABSTRACT

Background: On November 29, 1996, Ontario introduced an Administrative Driver's Licence Suspension (ADLS) law, which required that anyone charged with driving with a blood alcohol concentration (BAC) over the legal limit of 80 mg% or failing to provide a breath sample would have their licence suspended for a period of 90 days at the time the charge was laid. This study evaluates the early effects of Ontario's ADLS law on alcohol-involved driver fatalities.

Methods: Interrupted time series analysis with ARIMA modelling was applied to the monthly proportion of drivers killed in Ontario with a BAC over 80 mg% for the period Jan. 1, 1988 to Dec. 31, 1997.

Results: A significant intervention effect was found, with ADLS being associated with an estimated reduction of 17.3% in the proportion of fatally injured drivers who were over the legal limit.

Conclusion: These data provide an early indication that the law resulted in some success in reducing alcohol-related driver fatalities.

La traduction du résumé se trouve à la fin de l'article.

1. Social, Prevention and Health Policy Research Department, Centre for Addiction and Mental Health, Toronto, ON
2. Department of Public Health Sciences, Faculty of Medicine, University of Toronto
3. Traffic Injury Research Foundation, Ottawa, ON
4. Road Safety Program Office, Road User Safety Branch, Ontario Ministry of Transportation, Downsview, ON
5. Population and Community Health Unit, Faculty of Medicine and Dentistry, University of Western Ontario, London, ON

Correspondence and reprint requests: Robert E. Mann, Social, Prevention and Health Policy Research Department, Centre for Addiction and Mental Health, 33 Russell Street, Toronto, ON, M5S 2S1, Tel: 416-535-8501 ext. 4496, Fax: 416-595-6899, E-mail: robert_mann@camh.net

Acknowledgements: This research was supported by grants from the Alcohol Beverage Medical Research Foundation and from AUTO21, a member of the Networks of Centres of Excellence (NCE) programme which is administered and funded by the Natural Sciences and Engineering Research Council (NSERC), the Canadian Institutes of Health Research (CIHR) and the Social Sciences and Humanities Research Council (SSHRC), in partnership with Industry Canada. The Traffic Injury Research Foundation fatality database is funded by the Canadian Council of Motor Transport Administrators and Transport Canada. We are thankful to Manon DeGroseilliers for her assistance with the fatality database.

According to Transport Canada, about 1,350 people die in alcohol-related collisions in Canada every year.¹ Drinking-driving collisions are one of the leading causes of person-years of life lost in Canada, and among adolescents and young adults are one of the leading causes of death and serious injury.²⁻⁴ Several federal and provincial legislative initiatives have been directed to reducing this serious problem in recent years, with strong support from health and advocacy groups (for example, refs. 5-7). In Ontario, the government introduced an Administrative Driver's Licence Suspension (ADLS) law which came into effect on November 29, 1996. Prior to the ADLS law, a driver in Ontario who was charged under the Criminal Code of Canada for driving a motor vehicle while over the legal blood alcohol limit (80 mg%) could have his or her licence suspended for 12 hours at the time the charge was laid. Under Ontario's ADLS law, drivers charged with refusing to provide a breath sample or driving with a blood alcohol level over 80 mg% have their driver's licence suspended by the Registrar of Motor Vehicles for a period of 90 days at the time the charge is laid.

Licence suspensions have important specific deterrent effects, in that they reduce offenders' driving and collisions during the period that they are applied.^{8,9} However, a desired impact of such a measure is a general deterrent effect, where people who might otherwise drink and drive are deterred from doing so by knowledge of the law.^{10,11} Research demonstrates that legal initiatives can have important public health effects that are more dramatic and immediate than voluntary programs.^{12,13} Analyses of changes to drinking-driving laws in several jurisdictions have reached this conclusion, although the extent of impact appears to depend on factors such as type of change introduced, levels of enforcement of the law and the public's awareness of and support for the law.^{10,14-16} Evaluations of the effects of administrative suspension laws in the U.S. have found some evidence for a general deterrent effect, although only a small number of investigations involving aggregate collision and fatality data have been reported.¹⁷⁻¹⁹ In the only Canadian data available, Beirness et al.²⁰ found that the joint introduction in Manitoba in 1989 of laws permitting

administrative suspensions and seizure of vehicles (from drivers caught driving while suspended) was associated with a 27% reduction in drinking driver fatalities during the 6 years following the law's introduction.

Previous research has suggested that a specific chain of events, which requires both publicity and law implementation, is required to establish the potential for effective general deterrence.^{10,11,14,21,22} Public awareness plays an important preventive role. In order for drivers to modify their behaviour, they must be aware of the new law. In at least one previous instance, the collision-reducing potential of an earlier drinking-driving law in Ontario may have been muted by low levels of public awareness.¹⁴ The ADLS implementation plan included major efforts to inform the public of the new law, although government budgets for advertising only allowed for free public service announcements. In evaluations of administrative suspension laws, the present study is unique in measuring the knowledge and behaviour components of the causal chain, which are considered necessary for general deterrence and hence reduced collisions to occur. We previously reported that the public's awareness of Ontario's new ADLS sanction increased and self-reported drinking-driving decreased after the law was introduced.²³ We thus predicted that, with public awareness of the new law and a reduction in self-reported driving after drinking, alcohol-related collisions should decline in the province over the year following implementation of the law. We describe here the impact of the law in Ontario on fatally injured drivers with a BAC over the legal limit of 80 mg%.

METHODS

Data on fatally injured drivers in Ontario between Jan. 1, 1988 and Dec. 31, 1997 (n=6486) were obtained from the Traffic Injury Research Foundation (TIRF). The TIRF Fatality Database has been widely recognized as among the most complete for alcohol in the world. Drivers of off-road vehicles, motorized snow vehicles, farm tractors, construction equipment, trains, streetcars, bicycles, and other non-motor vehicles or unknown vehicle types were excluded. Also, drivers who died and

TABLE I

Summary of Interrupted Time Series Analysis of Percent of Fatally Injured Drivers with a BAC Over 80 mg%†

Noise Parameter:	Coefficient (SE)
Seasonal Moving Average	0.728 (0.104)*
Step Intervention Effect:	
Introduction of ADLS	-0.190 (0.074)*
Durbin-Watson	1.91
Attributable Fraction	0.173

* p<0.01

† Dependent measure was log-transformed and differenced.

from whom a sample was drawn more than 6 hours following the collision were excluded from the dataset. The overall rate of testing of alcohol was 80.1% and the drivers not tested (16.1% who were untested and 3.8% for whom the result could not be determined) were excluded from analyses, resulting in a total sample of 5,198 drivers. These data were aggregated by month of collision with a mean number of fatalities per month of 54.1 (SD=13.3, range 24-95). For each month of data, drivers were classified as BAC ≤ 80 mg% versus BAC > 80 mg%.

RESULTS

Figure 1 presents the monthly proportions of fatally injured drivers with a BAC > 80 mg% in Ontario. Across months, the average proportion of fatally injured drivers with a BAC over the legal limit was 33.6% (SD=9.4). There is a clear pattern of seasonal variation in the data. For both measures, the level of alcohol involvement tends to be lowest in December and January, and highest in the spring and summer months. As well, some tendency for changes over time is observed. Thus, any estimation of the impact of ADLS must consider variation due to these sources.

Interrupted time series analysis, with ARIMA (auto-regressive integrated moving average) modelling, has been developed for use with these forms of data.^{24,25} Time series analysis offers a statistical procedure with very high levels of internal validity approaching that of randomized trials^{26,27} for isolating the critical effects of an intervention and for ruling out a number of rival hypotheses, such as changes due to instability of data, seasonal variation or to long-range trends already occurring prior to the intervention.^{28,29} A non-stationary series involves trends or components which

may be unrelated to the effect of interest and which, if not taken into account, can cause a spurious estimation of the effect of an intervention like ADLS. ARIMA modelling involves an iterative process to achieve a stationary series, by taking into account noise parameters such as auto-regressive and moving average terms in the data.³⁰ The estimated attributable fraction corresponding to significant intervention effects can be calculated using a formula derived by Norström ($(e^{\beta}-1)100$).³⁰

The fatal collision series of percent of drivers with BACs > 80 mg% was seasonally differenced and log-transformed. These data were then subjected to interrupted time series analysis with ARIMA modelling. The results of this analysis are summarized in Table I. In the final model, a significant seasonal moving average parameter was observed and incorporated. The step intervention function for the introduction of ADLS was tested and found to be significant ($p < 0.01$). Analysis of the residuals is a diagnostic step to determine if the final model is subject to potential biasing effects of autocorrelation in the data. Application of the Durbin-Watson test for autocorrelation to the residuals resulted in a nonsignificant value (1.91), which indicates that no significant autocorrelation could be detected in the residuals. Based on the estimated etiological fraction for the intervention effect, introduction of the ADLS law was associated with a reduction of 17.3% in the proportion of driver fatalities with a BAC over 80 mg% in the period between Dec. 1, 1996 and Dec. 31, 1997.

This intervention effect is illustrated in more detail in Figure 2. This figure contains the observed proportion of drivers with a BAC over 80 mg% after ADLS was introduced, along with the proportion that would be projected if no intervention had occurred. This figure shows that the effects

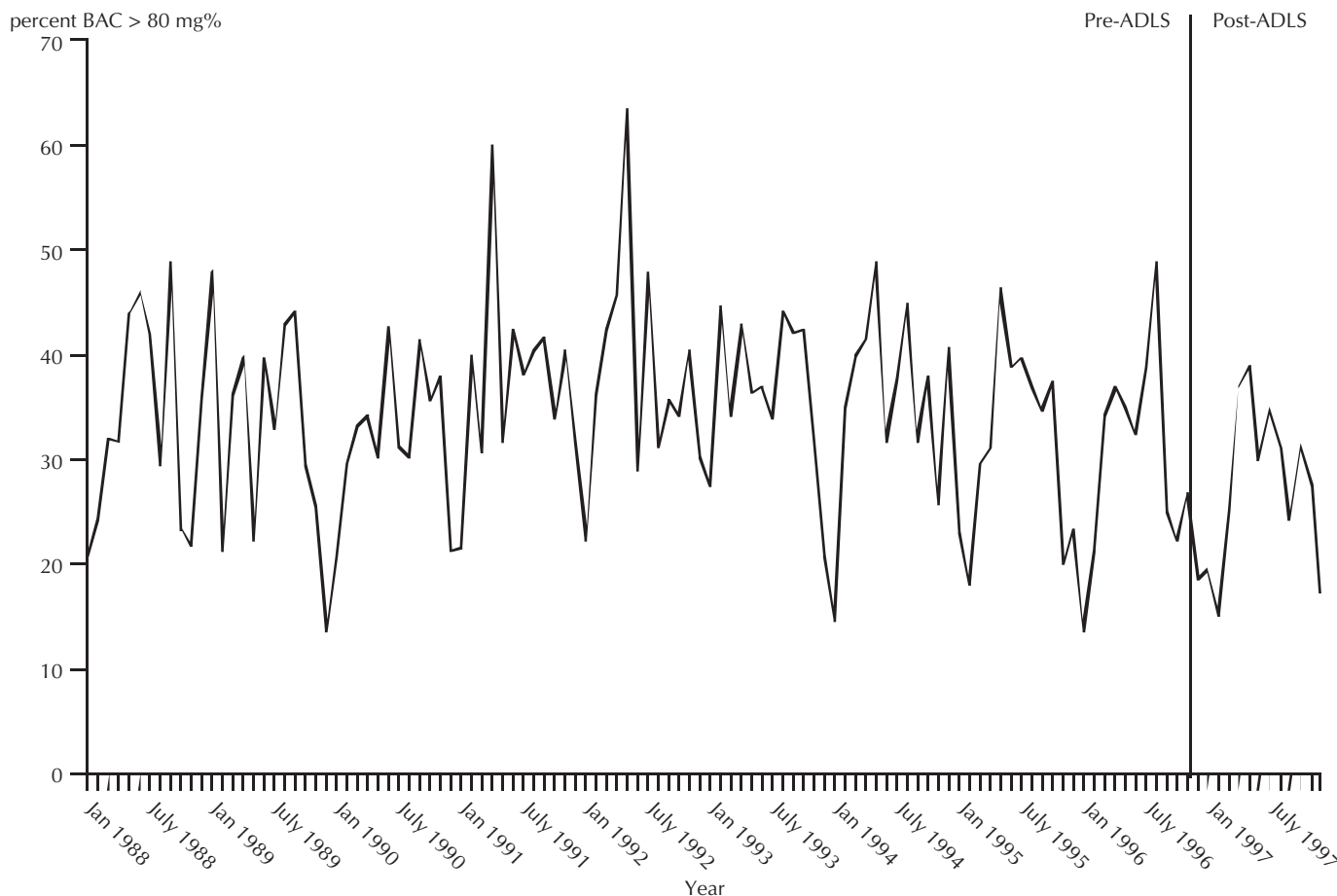


Figure 1. Percentage of Ontario driver fatalities with BAC > 80 mg%, before and after introduction of Administrative Driver's Licence Suspensions.

of the law varied over months. In some months, the effect was very large; for example in December 1996, February 1997 and December 1997, the proportion was reduced by about 40%. In other months, a smaller reduction was observed, and in still other months, little or no impact is apparent (such as in January, October and November 1997). There does not appear to be any consistent pattern in these differences between observed and projected data, such as would be expected if previous findings of a large initial effect followed by a gradual decline in general deterrent effects were replicated here.^{10,14}

DISCUSSION

While drinking-driving remains a serious cause of injury and death in Ontario, the results of this research suggest that some success in reducing this problem has been achieved with Ontario's Administrative Driver's Licence Suspension law. However, there are important restrictions to keep in

mind when interpreting these results. First, these data are restricted to the effects of the law in the first 13 months following its introduction. Previous research has suggested that the impact of legal initiatives can be reduced over time,^{10,14} and thus an evaluation of this initiative over a longer period is necessary before we can determine whether any effects observed here are sustained. Second, the research involves a quasi-experimental design and so alternative explanations of the results cannot be entirely ruled out. For example, we cannot be certain that enforcement levels did not increase with introduction of the new law. However, the time series approach employed here is considered to be the strongest method for examining policy initiatives such as the ADLS law^{10,27-29} and approaches randomized studies in the ability to rule out confounding.²⁸ Third, these data are derived from administrative databases, and thus the quality of the data may be influenced by factors not under the control of the researchers. Despite these limi-

tations, these data permit an evaluation of the early effects of ADLS on alcohol-related driver fatalities.

The results suggest that alcohol-related driver fatalities declined significantly when the Administrative Driver's Licence Suspension law was introduced. We previously observed a high level of awareness of the law with its introduction, and also that self-reported driving after drinking (in the previous 30 days) declined by about 30%.²³ These data thus provide support for the deterrence model described earlier, in suggesting that appropriate increases in knowledge and changes in behaviour are important prerequisites for collision reductions due to general deterrence to occur.^{10,14-16}

These data also support and strengthen the results of other evaluations of administrative suspension laws. In the only previous analysis of an administrative suspension law in Canada, Beirness and colleagues²⁰ observed that introduction of an administrative suspension law in Manitoba was associated with significant declines in

alcohol-related driver fatalities. The smaller reduction observed in Ontario compared to Manitoba could be due to several factors. A law permitting vehicle impoundment was introduced at the same time as the administrative suspension law in Manitoba, and thus some effects of the two measures could not be separated. In Ontario in recent years, there have been other legal initiatives to reduce drunk driving, but none occurred in the 16 months prior to or following the introduction of administrative suspensions. The two studies also differed in the length of the pre- and post-intervention period examined and the variable assessed, i.e., the number of fatalities with any alcohol in Manitoba versus the proportion of fatalities with BACs over 80 mg% in our study.

It is important to note that there appeared to be variation across months in the effect of the law. In several previous studies, the introduction of a legal initiative resulted in a large initial reduction in alcohol-related collisions followed by a gradual reduction in the effect.^{10,14} However, this pattern does not seem to be observed here, and instead no particular pattern can be described as yet. This may be due to the relatively short follow-up interval examined here, and underscores the need for continued evaluation of the impact of this law.

These findings are early indications of the success of Ontario's ADLS law in reducing drinking-driving and appear to provide evidence of general deterrence. Associated with public awareness of the law and a reduction in self-reported driving after drinking²³ was a significant reduction in driver fatalities with a BAC over the legal limit. These data support the use of legislative initiatives to combat the problem of drunk driving, and provide a valuable indication of the impact on this destructive and deadly behaviour that can be achieved with legislative change. It will be important, however, to examine the effects of this law over the longer term to see if these gains are maintained. Further evaluations should also assess the impact of enforcement levels and the drivers' characteristics associated with response to this law. It is also important to note that while a portion of the drinking-driving problem in Ontario appears to have been affected by this law, it still remains a serious cause of injury and death.

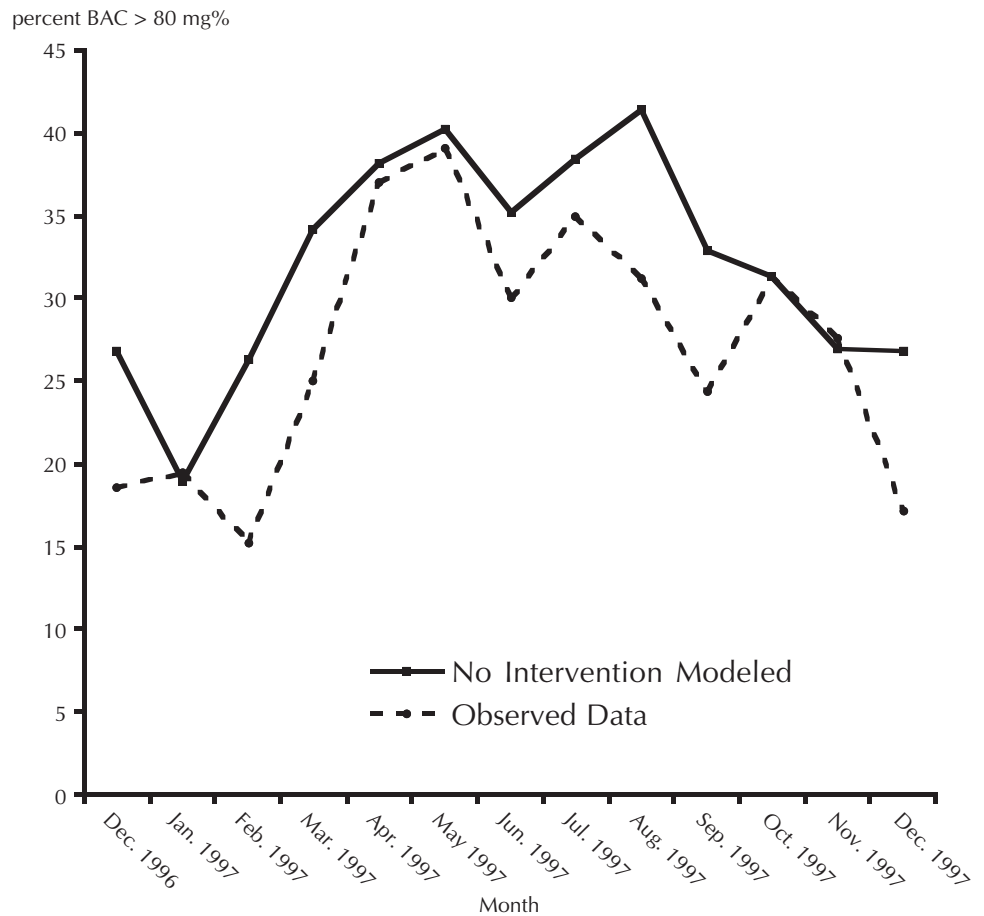


Figure 2. Percentage of Ontario driver fatalities with BAC > 80 mg% following introduction of Administrative Driver's Licence Suspensions: Observed percentages and percentages projected without an intervention effect (introduction of ADLS).

REFERENCES

1. Transport Canada. Statistical data. Ottawa: Transport Canada; 2000. www.tc.gc.ca/pol/en/t-facts_e/Safety_Data_Menu.htm.
2. Xie X, Rehm J, Single E, Robson L. *The Economic Costs of Alcohol, Tobacco and Illicit Drug Abuse in Ontario: 1992*. Toronto: Addiction Research Foundation, 1996.
3. Single E, Robson L, Rehm J, Xie X. Morbidity and mortality attributable to alcohol, tobacco, and illicit drug use in Canada. *Am J Public Health* 1999;89:385-90.
4. National Cancer Institute of Canada. *Canadian Cancer Statistics 1991*. Toronto: National Cancer Institute of Canada, 1991.
5. Canadian Medical Association. *Substance Abuse and Driving: A CMA Review*. Ottawa: Canadian Medical Association, 1989.
6. Ontario Medical Association. *An OMA Position Paper on Drinking and Driving*. Toronto: Ontario Medical Association, 1994.
7. MADD Canada. *Rating the Provinces: The 2000 Report Card*. Mississauga: Mothers Against Drunk Driving, 2000.
8. Mann RE, Vingilis ER, Gavin D, Adlaf E, Anglin L. Sentence severity and the drinking driver: Relationships with traffic safety outcome. *Accid Anal Prev* 1991;23:483-91.
9. Homel R. *Policing and Punishing the Drinking Driver: A Study of General and Specific Deterrence*. New York: Springer-Verlag, 1988.
10. Ross HL. Law, science and accidents: The British Road Safety Act of 1967. *J Legal Stud* 1973;2:1-78.
11. Vingilis ER. A new look at deterrence. In: Wilson RJ, Mann RE (Eds.), *Drinking and Driving: Advances in Research and Prevention*. New York: Guilford Press, 1990;99-115.
12. Cohen JE, de Guia NA, Ashley MJ, Ferrence R, Studlar DT, Northrup DA. Predictors of Canadian legislators' support for public health policy interventions. *Can J Public Health* 2001;92:188-89.
13. Edwards G, Anderson P, Babor TF, Casswell S, Ferrence R, Giesbrecht N, et al. *Alcohol Policy and the Public Good*. Oxford: Oxford University Press, 1994.
14. Vingilis E, Blefgen H, Lei H, Sykora K, Mann RE. An evaluation of the deterrent impact of Ontario's 12-hour licence suspension law. *Accid Anal Prev* 1988;20:9-17.
15. Homel R. Random breath testing and random stopping programs in Australia. In: Wilson RJ, Mann RE (Eds.), *Drinking and Driving: Advances in Research and Prevention*. New York: Guilford Press, 1990;159-202.
16. Mann RE, Macdonald S, Stoduto G, Bondy S, Jonah B, Shaikh A. The effects of introducing or lowering legal per se blood alcohol limits for driving: an international review. *Accid Anal Prev* 2001;33:569-83.
17. Williams A, Weinberg K, Fields M. The effectiveness of administrative suspension laws. *Alc Drugs Driving* 1991;7:55-62.

18. Ross HL. *Administrative Revocation for Drunk Drivers: Options and Choices in Three States*. Washington, DC: AAA Foundation for Traffic Safety, 1991.
19. Zador PL, Lund AK, Fields M, Weinberg K. Fatal crash involvement and laws against alcohol-impaired driving. *J Public Health Pol* 1989;10:467-85.
20. Beirness DJ, Simpson HM, Mayhew DR, Jonah B. The impact of administrative licence suspension and vehicle impoundment for DWI in Manitoba. In: Mercier-Guyon C (Ed.), *Alcohol, Drugs and Traffic Safety - T'97*. Nancy, France: Centre d'Études et de Recherche en Médecine du Traffic, 1997;919-25.
21. Gibbs JP. *Crime, Punishment and Deterrence*. New York: Elsevier, 1975.
22. Vingilis E, Salutin L. A prevention programme for drinking driving. *Accid Anal Prev* 1980;12:267-74.
23. Mann RE, Smart RG, Stoduto G, Adlaf EM, Vingilis E, Beirness D, Lambie R. Changing drinking-and-driving behaviour: The effects of Ontario's administrative driver's licence suspension law. *CMAJ* 2000;162:1141-42.
24. Box GEP, Jenkins GM. *Time Series Analysis: Forecasting and Control*. San Francisco: Holden-Day, 1976.
25. Box GEP, Tiao GC. Intervention analysis with applications to economic and environmental problems. *J Amer Stat Assoc* 1975;70:70-79.
26. Campbell DT, Stanley JC. *Experimental and Quasi-experimental Designs for Research*. Chicago: Rand McNally, 1967.
27. Rossi PH, Freeman HE. *Evaluation: A Systematic Approach*. Newbury Park, California: Sage, 1993.
28. Cook TD, Campbell DT. *Quasi-experimentation: Design and Analysis Issues for Field Settings*. Boston: Houghton Mifflin, 1979.
29. Skog OJ. Testing causal hypotheses about correlated trends: Pitfalls and remedies. *Contemp Drug Prob* 1988;15:565-606.
30. Norström T. Deriving relative risks from aggregate data. *J Epidemiol Community Health* 1988;42:333-35.

Received: April 13, 2001
 Accepted: December 20, 2001

RÉSUMÉ

Contexte : Le 29 novembre 1996, l'Ontario déposait une réglementation sur la suspension administrative des permis de conduire aux termes de laquelle toute personne conduisant un véhicule automobile alors que son alcoolémie dépasse la limite légale de 80 mg/100 ml ou refusant de fournir un échantillon d'haleine perdait son permis de conduire pour une durée de 90 jours, dès son inculpation. Cette étude évalue les premières répercussions de la réglementation ontarienne sur la proportion d'accidents mortels liés à l'alcool.

Méthode : Une analyse interrompue des séries chronologiques à l'aide du modèle ARMMI a été appliquée à la proportion mensuelle de conducteurs ayant été tués en Ontario entre le 1er janvier 1988 et le 31 décembre 1997 et dont l'alcoolémie dépassait 80 mg/100 ml.

Résultats : Les chercheurs ont constaté que la réglementation avait un effet significatif, car elle était associée à une réduction approximative de 17,3 % des décès parmi les conducteurs ayant une alcoolémie supérieure à la limite légale.

Conclusion : Ces données préliminaires indiquent donc que la suspension administrative des permis de conduire peut réduire, dans une certaine mesure, le nombre d'accidents mortels reliés à l'alcool.

Directives de rédaction de la RCSP

La *Revue canadienne de santé publique* publie des articles originaux sur tous les aspects de la santé publique, de la médecine préventive et de la promotion de la santé qui ont été évalués par des pairs. Tous les manuscrits soumis pour publication dans ses colonnes doivent respecter les Directives de rédaction de la RCSP. On trouvera une version complète sur le site Web de l'ACSP à l'adresse suivante < www.cpha.ca/francais/cjph/stylereq/style.htm >. Les auteurs qui n'ont pas accès à Internet peuvent se reporter aux pages 7-8 du numéro de janvier/février 2002 (Vol. 93, No. 1) de la *Revue canadienne de santé publique* ou se mettre en rapport avec le bureau de la rédaction pour en recevoir un exemplaire par télécopieur.

La Rédaction doit recevoir un exemplaire imprimé de l'original et deux copies pour l'évaluation par les pairs (dactylographié à double interligne, sur un seul côté de la feuille) avec toutes les figures et tous les tableaux, et accompagné d'une version électronique. Veuillez numéroter les pages les unes à la suite des autres, y compris le résumé et sa traduction (le cas échéant), le texte, les remerciements, les références, les tableaux et les figures.

Les articles originaux ne doivent pas dépasser **2 000 mots**. Veuillez indiquer le nombre de mots de votre article. Les brefs comptes-rendus peuvent être soumis et doivent inclure des résumés structurés (voir le paragraphe « Les documents sont... »)

La Revue a adopté une politique d'évaluation des articles par des pairs, en double aveugle. Auteurs et évaluateurs restent anonymes. Afin d'assurer l'anonymat de cette évaluation par des pairs, les auteurs doivent s'assurer de ne donner les renseignements les identifiant que sur la page titre de l'**original seulement**; seul le titre doit apparaître sur les deux copies à l'intention des évaluateurs.

La page titre de l'original doit comporter : 1) le titre; 2) un bref sous-titre de 40 caractères au maximum (y compris les blancs); 3) les noms, prénoms et initiales du milieu (le cas échéant) des auteurs, accompagnés de leurs diplômes d'études de plus haut niveau avec les noms du service et de l'organisme dans le cadre duquel le travail publié a été effectué; 4) le nom, l'adresse, le numéro de téléphone, le numéro de télécopieur et l'adresse électronique de l'auteur à qui adresser toute correspondance; 5) le nom et l'adresse de l'auteur à qui les demandes de réimpression doivent être envoyées (s'il s'agit de la même personne, regroupez 4 et 5 ensemble).

Les déclarations relatives aux limites de responsabilité et les mentions concernant l'aide reçue doivent aussi figurer sur la page titre. Une lettre signée par tous les auteurs comme quoi ils acceptent d'être publiés doit être incluse.

Les documents sont acceptés en anglais ou en français. La page deux doit présenter un résumé structuré pouvant avoir jusqu'à 250 mots, avec les titres : Objectif, Méthodes, Résultats, Discussion (ou Interprétation). En outre, la *RCSP* demande une traduction professionnelle du résumé. Pour garantir une qualité constante de la traduction de la Revue, la *RCSP* se réserve le droit de faire retraduire les résumés soumis, aux frais des auteurs après les en avoir avisés. S'ils le préfèrent, les auteurs peuvent demander de faire traduire directement leurs résumés par le traducteur officiel de la Revue à raison de 22 cents le mot plus la TPS de 7 %.

Nous vous encourageons à écrire à la Rédaction, en vous priant d'envoyer des lettres aussi courtes que possible.

La Rédaction se réserve le droit de modifier les articles.

Les documents à publier doivent être soumis au rédacteur scientifique de la *Revue canadienne de santé publique*, 1565 avenue Carling, bureau 400, Ottawa, Ontario (Canada) K1Z 8R1.