

# Mandatory Driver Training and Road Safety: The Quebec Experience

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**Abstract:** In January 1983, the Quebec Government made driver training courses mandatory for any person seeking a first driver's license. Using accident and licensure data over a five-year period, we conducted an evaluation of the impact of the enactment of mandatory driver training on: the risk of accident for newly licensed drivers; the mortality and morbidity of these accidents; the number of new drivers; and the mean age of licensure. Results of our time series analyses show that this legislation had no appreciable effect on the

risk of accident or on the mortality/morbidity rate per accident for newly licensed drivers aged 18 and over. However, since 1983, the number of women under 18 years of age getting their first driver's license has increased by 20 per cent, and their mean age has decreased from over 18 to under 18. Mandatory driver training may have increased the numbers and risks of accidents for young, primarily female, drivers. (*Am J Public Health* 1988; 78:1206-1209.)

## Introduction

Mortality and morbidity due to traffic accidents are among the most important public health hazards in Western societies.<sup>1</sup> Driver training or driver education has been advanced as a measure to tackle this problem.

In 1961, for the first time in the Canadian province of Quebec, 16 years olds were allowed to receive their first driver's licence, provided they had taken a driver training course in a registered driving school.<sup>2</sup> In 1976, this obligation was extended to include 17 years olds, and a program was designed to standardize the training programs of all the driving schools.

The training program includes 30 hours of in-class lessons and 8 or 10 hours of behind the wheel (BTW) practice. Finally, on January 1, 1983, an Article was added to the Quebec Road Safety Act mandating driver training courses given by a registered driving school for anyone applying for a first driver's license. It should be noted that, except for an experimental program in which 100 high school students were registered, High School Driver Education was never subsidized by the Provincial Government or by local School Boards.

The objective of the 1983 change to the Road Safety Act is to ensure that every driver in Quebec will be given a standard preparation in driver training. Given the relatively high price asked for by the private driving schools (the average was close to \$200 US in 1985), the only reasonable ground for such a law is that it can reduce the social costs of traffic accidents on Quebec roads, as well as the heavy burden they put on the general health of the population.

For the last 20 years or so, most of the studies undertaken to evaluate driver education programs in the United States and elsewhere have challenged the alleged beneficial effects those programs may have on road safety,<sup>3-17</sup> when controlling for self-selection factors. Other authors have been able to show that these programs made the first driver's license easily available for teenagers and misled parents to allow licensure at an earlier age because of falsely perceived risk reduction.<sup>18-20</sup> Furthermore, improvements in existing programs do not seem to increase their effectiveness.<sup>21-26</sup>

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Evaluation of the impact of the 1983 Quebec law is important first because it places an extra cost on obtaining a first driver's license and because the effect of driver training programs can be assessed without having to deal with volunteer subjects as had been the case in previous studies.

## Methods

Our study was only concerned with the evaluation of the impact of introducing mandatory driver training for all new drivers on road safety. There is no official record of the number of people who took driver training courses in Quebec prior to 1983, but we know that every driver who obtained his or her driver's license before the age of 18 had to take such training. By subtracting the number of 16-17 year old licensees from the total number of driving school enrollees, it has been estimated that, prior to 1983, approximately 30-40 per cent of newly licensed drivers aged 18 and over did not take a driver training course.\* This proportion seems sufficiently high to permit the testing of our theoretical model.

We used four road safety indicators: the risk of accident (with injuries and without injuries) during the first year of driving experience; the mortality/morbidity rate per accident involving at least one driver in his or her first year of driving experience; the number of newly licensed drivers; and the mean age of licensure. We restricted our analyses to drivers in their first year of experience. It has been shown that the potential impact of driver education would occur during this first year and would disappear in subsequent years,<sup>17</sup> although this conclusion has been criticized on the basis that analyses were made only on the study participants who had obtained a driver's license rather than on all randomized subjects.<sup>10</sup>

To test the effect of the 1983 Quebec law on these four indicators, we designed an interrupted time series study<sup>27</sup> (see Appendix). This approach has been used successfully to evaluate other road safety measures.<sup>28-31</sup> The major pitfall of this method is the impossibility of eliminating confounders, i.e., events unrelated to the intervention being evaluated, which also have an effect on the dependent variables, making a causal inference spurious.<sup>27,32,33</sup>

Since the law affected the applicants for a first driver's license who are age 18 or older, and since 16 and 17 year old drivers had been under such an obligation since 1976, we defined the first group of newly licensed drivers as the experimental group and the second one (16 and 17 year olds) as a comparison group. We used the series of indicators from

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\*From Laberge-Nadeau C, Lepire H, Potvin L: La problématique de l'enseignement de la conduite automobile au Québec. Rapport non publié présenté à la Régie de l'assurance-automobile du Québec, Septembre 1983.

**TABLE 1—Effects of Mandatory Driver Training on the Risk of Accidents without Injury per 1,000 Drivers for 12 Categories of Drivers. Point Estimates and Percentage Changes, 1980–82 to 1983–August 1984**

Experience	Sex	Comparison Group		Experimental Group	
		Point Estimate	95% CI	Point Estimate	95% CI
0–6 months	Males	0.42 (7.1%)	-0.10, 0.94 (-1.7%, 16.0%)	0.09 (0.7%)	-0.22, 0.40 (-1.6%, 2.9%)
	Females	0.13 (4.7%)	0.04, 0.22 (1.5%, 8.0%)	0.38 (9.5%)	-0.24, 1.00 (-5.5%, 22.9%)
7–12 months	Males	0.46 (19.6%)	-0.07, 0.98 (-3.0%, 42.0%)	0.37 (7.0%)	-0.88, 1.62 (-16.7%, 30.1%)
	Females	0.18 (16.3%)	0.01, 0.34 (0.9%, 31.7%)	0.54 (36.9%)	0.14, 0.95 (9.5%, 64.6%)
0–12 months	Males	0.46 (11.2%)	-0.07, 0.98 (-1.7%, 24.0%)	0.16 (1.7%)	-0.07, 0.39 (-0.8%, 4.2%)
	Females	0.40 (21.2%)	0.21, 0.59 (11.1%, 31.2%)	0.30 (11.2%)	-0.32, 0.93 (-11.7%, 33.9%)

Comparison Group: Newly licensed drivers 16–17 in first year of driving experience.  
 Experimental Group: New licensed drivers 18–25 in first year of driving experience.

the latter group in a set of preliminary analyses to determine if one or more events occurred in 1983 and resulted in an altered trend in an age group not directly affected by the change in policy.

We obtained two sets of data from the Quebec agency responsible for road safety:

- monthly reports on the number of accidents and injuries involving drivers in their first year of experience tabulated by sex, age, experience (from 0 to 6 months versus from 7 to 12 months), and type of vehicle (only accidents involving at least one newly licensed driver driving a private car were kept for analysis);
- monthly reports on the number of newly licensed drivers and their mean age, tabulated by sex and by age.

All these monthly reports start in January 1980 and end in August 1984. Each indicator is observed for 56 months leading to 56 observations in the time series. Risk of accident is expressed as the number of crashes per licensed driver of specified age, sex, and experience.

Each of these time series was analysed with ARIMA models<sup>34,35</sup> using first order intervention models, as developed

by Box and Tiao<sup>36</sup> (see Appendix). On the average, our analyses were powerful enough to detect 10 per cent reductions.

*Results*

We performed six comparative analyses for the risk of accidents without injury (the 2 × 3 combinations of two sex categories and three experience categories). Tables 1 and 2 present the point estimates and 95 per cent confidence intervals of the difference between the level of the series after January 1983 and the level prior to that date, for six categories of drivers in the comparison (16–17 year olds) and experimental (18–25 year olds) groups.

The risk of accidents without injury increased after January 1983 for all categories of newly licensed drivers (Table 1). For males, this increase is greater in the comparison group of 16–17 year old drivers than in the experimental group of 18–25 year old drivers. For newly licensed female drivers, increases in the comparison group are also usually smaller than increases in the experimental group.

The same pattern is observed for accidents involving an injury for both males and females for each category of drivers. Increases in the risk of accidents after January 1983 are consistently higher for the comparison group than for the

**TABLE 2—Effects of Mandatory Driver Training on the Risk of Injury Accidents per 1,000 Drivers for 12 Categories of Drivers. Point Estimates and Percentage Changes, 1980–82 to 1983–August 1984**

Experience	Sex	Comparison Group		Experimental Group	
		Point Estimate	95% CI	Point Estimate	95% CI
0–6 months	Males	0.01 (0.6%)	-0.03, 0.05 (-2.0%, 3.3%)	-0.23 (-5.8%)	-1.04, 0.62 (-26.4%, 15.7%)
	Females	0.13 (19.0%)	0.04, 0.21 (5.9%, 31.0%)	0.13 (11.5%)	-0.33, 0.60 (-27.9%, 50.8%)
7–12 months	Males	0.05 (9.2%)	-0.02, 0.11 (-4.0%, 22.2%)	0.02 (1.5%)	-0.05, 0.08 (-4.1%, 6.6%)
	Females	0.09 (36.7%)	0.03, 0.15 (12.2%, 61.2%)	0.00 (0.0%)	-0.02, 0.02 (-5.9%, 5.9%)
0–12 months	Males	0.07 (6.8%)	-0.06, 0.20 (-0.6%, 20.0%)	0.05 (2.2%)	-0.01, 0.11 (-0.4%, 4.4%)
	Females	0.18 (39.2%)	0.08, 0.27 (17.6%, 59.4%)	0.02 (3.1%)	-0.01, 0.04 (-1.4%, 5.6%)

Comparison Group, see Table 1  
 Experimental Group, see Table 1

**TABLE 3—Effects of Mandatory Driver Training on the Number of New Drivers. Percentage change 1980–82 to 1983–August 1984**

Age (years)	Sex			
	Males		Females	
	Estimate	95% CI	Estimate	95% CI
All ages	+4.04%	-9.32, +17.40	+9.16%	-2.16, +20.49
18 and more	-2.50%	-17.60, +12.60	+3.08%	-15.14, +21.30
18 to 25	-0.98%	-17.92, +15.96	-1.65%	-21.16, +17.86
16 and 17	+12.24%	-5.65, +30.13	+19.49%	+0.80, +38.18

experimental group, particularly for female drivers with 7 to 12 months of experience. We estimate that the deficit in the number of injury accidents for females aged 18–25 with 7 to 12 months of experience is 1.34 accidents per 1,000 drivers per year.

Our analyses also show that the law had no effect on the mortality/morbidity rate per accident, regardless of the category of newly licensed drivers (data available on request to author).

For the analyses concerning the number of newly licensed drivers and the mean age of licensure, we used a simple interrupted time series design. In order to refine our analyses on licensure, we divided the newly licensed drivers into eight categories computed for two sex classes (males and females) and four age classes (16 and more, 18 and more, 18 to 25, and 16 and 17).

Table 3 shows that the number of newly licensed male and female drivers of 16 and 17 years of age increased after 1983 with the increase in female drivers being more marked.

Analysis of the mean age of licensure confirms the fact that 20 per cent more women now obtain their first driver's license before the age of 18 (data available on request to author).

*Discussion*

The only effects the 1983 Quebec law seems to have had is to dampen any increase in the risk of accidents with injuries among 18–25 year old drivers, particularly among females with 7 to 12 months experience, and to increase the number of newly licensed female drivers aged 16 to 17 thus decreasing the mean age of licensure for females. The risks of accident with or without injury rose for the 16–17 year olds.

The increase in the number of newly licensed drivers aged 16 and 17 may be due to the fact that after January 1983 there is no further economic advantage to waiting to be 18 years old before obtaining a first driver's license. Before 1983, teenagers could postpone licensure to spare the cost associated with driver's training. The new law has made postponement impossible. By comparison with the previous years, 20 per cent more female and 12 per cent more male teenagers decided after 1983 not to delay obtaining their first driver's license until they were 18 years old. According to one study, those who would have waited instead of taking driving lessons are less safety-oriented than those who elected to take such a course.<sup>10</sup> This could explain the observed increase in the risk of accidents for both males and females aged 16 and 17.

Why did the Quebec 1983 law have a stronger effect on female teenagers? According to Bourbeau, *et al.*,<sup>37</sup> most of the male teenagers in the population in the early 1980s had already obtained their first driver's license by the time they

were 18 years old. The modal age for the newly licensed female drivers was still 18 years old, although it was as low as 16 years old for the males. Thus, if the 1983 Quebec law had a weaker effect on the licensure of males, it could be simply because the proportion of males over 18 years old who did not have a driver's license was too small.

This interpretation of our results is in agreement with the results of most major studies undertaken to evaluate driver training programs. Robertson<sup>38</sup> has already discussed the fact that among all possible measures to improve road safety, driver training programs are among the least efficient in terms of accident reduction. Our study shows the validity of that statement outside the United States and for a non-volunteer population.

Despite all the evidence shown by worldwide studies, driver training programs are still very popular. Governments cut into these budgets reluctantly, when at all, and citizens consider these programs valuable. A public opinion survey conducted a year after the Quebec enactment of mandatory driver training estimated that approximately 80 per cent of the Quebec population think that professional teaching is the best way to learn how to drive, that it helps to prevent accidents, and that private driving schools produce better drivers. This may well be because no clearly effective alternative has yet appeared. Since road accidents represent one of the major causes of death among teenagers and young adults, the elaboration and evaluation of new safety measures must be a public health priority.

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**APPENDIX**

ARIMA Modeling

The main purpose of ARIMA modeling is to adjust a mathematical model of a time series. The general form of this model ARIMA (p,d,q) (P,D,Q)s defines three structural parameters:

1. p is the order of the autoregressive component
2. d is the number of time the series has to be differentiated to be stationary
3. q is the moving average component

The capital letters between the second set of parentheses represent the same components for a series showing seasonal variations with a cycle of length s. For example, a common model in our analyses of monthly traffic accidents involving newly licensed drivers was of the form ARIMA (1,0,0) (0,1,1)<sub>12</sub>. This model indicates that the serie has a cycle of 12 months (s = 12) and that it has to be differentiated seasonally (D = 1) such that:

$$Z_t = Y_t - Y_{t-12}$$

It also indicates that each Z<sub>t</sub> has an autoregressive component of order 1 (p = 1) and a seasonal moving average of order 1 (Q = 1). This model corresponds to the following equation:

$$(1 - \phi_1 B) Z_t = \theta_0 + (1 - \theta_{12} B^{12}) a_t$$

where:

$$Z_t = Y_t - Y_{t-12}$$

B = backward shift operator

φ<sub>1</sub> = autoregressive parameter

θ<sub>12</sub> = moving average parameter

θ<sub>0</sub> = the mean of the series, usually equals 0 after differentiation

a<sub>t</sub> = random error or white noise

This equation indicates that any deseasonalized value Z<sub>t</sub> of Y<sub>t</sub> is a fonction of three components:

1. the mean θ<sub>0</sub> of the series
2. a fraction φ<sub>1</sub> of Z<sub>t-1</sub> and
3. a fraction θ<sub>12</sub> of the random error associated with the twelfth preceding observation

Having obtained a parsimonious model that explains the variance of the series, the final step of the analysis is to introduce in the model an intervention component I<sub>t</sub> in the form of a dichotomous variable. This variable equals 0 prior

to the enactment of the law ( $t \leq 36$ ) and 1 afterward ( $t \geq 37$ ). Because the total number of available observations was rather small ( $n = 56$ ) and because the introduction of a complex intervention component (like testing for gradual change) would have reduced the power of the analysis, a simple abrupt change of the level of the series was tested. This is done by adding in the equation a component of the form  $\omega_1 I_t$ , when  $I_t$  is as defined above, and  $\omega_0$  is the difference of level between the post-intervention and the pre-intervention sections of the series. A parameter significantly different from zero for the intervention component means that the variance explained by the enactment of the law is greater than the random variation of the series.

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