Minimum Purchasing Age for Alcohol and Traffic Crash Injuries Among 15- to 19-Year-Olds in New Zealand

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Objectives. In 1999, New Zealand lowered the minimum purchasing age for alcohol from 20 to 18 years. We tested the hypothesis that this increased traffic crash injuries among 15- to 19-year-olds.

Methods. Poisson regression was used to compute incidence rate ratios for the after to before incidence of alcohol-involved crashes and hospitalized injuries among 18- to 19-year-olds and 15- to 17-year-olds (20- to 24-year-olds were the reference).

Results. Among young men, the ratio of the alcohol-involved crash rate after the law change to the period before was 12% larger (95% confidence interval [CI] = 1.00, 1.25) for 18- to 19-year-olds and 14% larger (95% CI = 1.01, 1.30) for 15- to 17-year-olds, relative to 20- to 24-year-olds. Among young women, the equivalent ratios were 51% larger (95% CI = 1.17, 1.94) for 18- to 19-year-olds and 24% larger (95% CI = 0.96, 1.59) for 15- to 17-year-olds. A similar pattern was observed for hospitalized injuries.

Conclusions. Significantly more alcohol-involved crashes occurred among 15- to 19-year-olds than would have occurred had the purchase age not been reduced to 18 years. The effect size for 18- to 19-year-olds is remarkable given the legal exceptions to the pre-1999 law and its poor enforcement. (*Am J Public Health.* 2006;96:126–131. doi:10.2105/AJPH.2005.073122)

It has been 30 years since the state of Alabama reduced its minimum legal drinking age from 20 to 18 years.[1] Alabama was the last of 29 states of the United States to do so in the period 1970 to 1975 in line with the reduction in voting age laws toward the end of the Vietnam War.[1] All 10 Canadian provinces[1] and 3 Australian states[2] passed similar legislation in this period. Several studies on the effects of those legislative changes reported substantial increases in road traffic crashes involving persons aged 15 to 20 years. In their meta-analytic review, Shults et al.[3] found that lowering the minimum legal drinking age produced a median increase of 10% in youthful crash involvements. Such harmful effects were observed in all 3 countries in which the minimum legal drinking age was reduced. Notably, increased crash involvements were observed among 15- to 17-year-olds (i.e., in persons younger than the age of the target group—so-called trickle-down effects), although the effects were inconsistent across studies.[3] Research evidence suggests that persons in the age group bordering the minimum legal drinking age are able to purchase alcohol or obtain it from friends and siblings.[4,5]

As the research evidence came to be harnessed by public health advocates and citizens groups, several "early adopter" states passed laws in the late 1970s and early 1980s increasing the minimum legal drinking age.[1] Evaluations of these changes showed reductions in alcohol-involved traffic crashes. Consistent with the research evidence, the US federal government passed the Uniform Drinking Age Act in 1984, which provided for withholding a portion of a state's federal highway construction funds for failure to enact a law requiring a minimum legal drinking age of 21. By 1988, all 50 states and the District of Columbia had a minimum legal drinking age of 21, creating a series of natural experiments that provided further opportunity for researchers to quantify the health effects of minimum legal drinking age laws.

In their review of 17 studies from states that raised the minimum legal drinking age, Shults et al.[3] estimated average reductions in underage crash involvements of 16%. In addition to the consistent inverse relation between the minimum legal drinking age and traffic crash involvement across jurisdictions are observations of reduced heavy drinking in those exposed to a lowered minimum legal drinking age[6] and research showing that stricter enforcement of the minimum legal drinking age is associated with greater reductions in harm.[4]

No traffic safety policy, with the possible exception of motorcycle safety helmet laws, has more evidence for its effectiveness than do the minimum legal drinking age laws. Nevertheless, pressure continues in the United States, particularly from liquor industry interests, to reduce minimum legal drinking ages. Notably, at least 5 of the 50 states currently have provisions to reduce the minimum legal drinking age automatically if Congress were to repeal the Uniform Drinking Age Act.

Perhaps surprisingly, given the strength and volume of evidence published in the 1980s and 1990s, the New Zealand government passed the Sale of Liquor Amendment Act, which brought into effect a reduction in the minimum purchase age from 20 to 18 years, effective December 1, 1999. This occurred despite strong submissions from researchers and public health advocates for a retention of the status quo and tougher enforcement of laws pertaining to the supply of alcohol to persons younger than 20 years.[7]

Notably, the changes in the minimum legal drinking age in the 1970s occurred at a time of comparatively high and increasing aggregate alcohol consumption in many developed countries. Average consumption per person aged 15 years and older reached its postwar peak between 1978 and 1982 in the United States, Canada, Australia, and New Zealand[8] before declining steadily and reaching a plateau in the late 1990s. At

the time of the law change in New Zealand, aggregate consumption in these countries had declined by about 20% from its late 1970s levels.[8]

Against this backdrop of reduced overall consumption, a change in young people's drinking patterns was evident—toward heavier episodic consumption, or binge drinking. National survey data from the United States documented a 17% increase from 1993 to 2001 in binge-drinking episodes per person in the adult population.[9] Notably, among those who consumed alcohol in 2001, 51% of 18- to 20-year-olds had consumed 5 or more drinks (>60 g ethanol) on at least one occasion in the last 30 days.[9] Also, a gender convergence in drinking behavior was seen,[10] with the proportion of young women habitually drinking to intoxication in New Zealand increasing and approaching the level for young young men.[11,12]

The New Zealand law change created an opportunity to test the drinking age hypothesis in yet another society and in a new era. This study included an age comparison group (20- to 24-year-olds) as a control for the effects of increased availability of alcohol in supermarkets[13] and Sunday trading[14] and other coincident road safety interventions that could have affected the likelihood of road traffic crashes. Our aim was to test the hypothesis that the reduction in the minimum purchasing age increased alcohol-involved traffic crashes among 15- to 19-year-olds. We examined changes in traffic crashes involving alcohol and injuries resulting in hospitalization separately, by gender, in 3 age groups—15 to 17, 18 to 19, and 20 to 24 years—in the 4 years before and after the law change.

METHODS

Setting

In New Zealand, road traffic crashes account for more than half of all fatalities[15] and are second only to pregnancy as a cause of hospitalization[16] in persons aged 15 to 19 years, a pattern similar to that in the United States.[17] Alcohol impairment is the largest contributing cause of serious road traffic crashes in this age group.[18]

As in many other developed countries, legal countermeasures to alcohol-impaired driving have been increased gradually since the late 1960s, including breath and blood alcohol tests (1969), evidential breath testing and a legal blood alcohol limit of 0.08 g/100 mL (1978), graduated driver licensing with reduced blood alcohol limits (1987), a 0.03 g/100 mL blood alcohol concentration limit for all drivers younger than 20 years (1992), and compulsory (random) breath testing (1993). Evidence shows that these countermeasures were effective in reducing the prevalence of alcohol-impaired driving over the past 10 to 15 years.[19] Our investigation took place against this backdrop of a falling road toll, although note that no major policy changes that might have differentially affected the age groups in this study took place during the study period (1995–2003).

In contrast to the tightening road safety countermeasures, New Zealand drastically increased the availability of alcohol over the same period. The Sale of Liquor Act of 1989 effected a marked liberalization of the previous alcohol control policy.[20] Changes included the introduction of wine in supermarkets, longer opening hours for liquor outlets, and easing of conditions for obtaining a liquor license. An example of the effect these changes had is illustrated by the subsequent growth in the number of liquor licenses. From 1990 to 1995, the number of liquor licenses almost doubled,[21] and New Zealand now has more licensed premises than all of Australia, despite having only one-fifth its population.[22]

Design

The study design was a pre–post comparison with 3 age groups: the target group (18–19 years), a younger group who may be affected by "trickle down" (15–17 years), and an age control group (20–24 years), akin to the within-state comparison used in the studies by Smith and Burvill.[2,23] The prechange period was the 4 years before the December 1, 1999, reduction in the minimum purchase age—namely, December 1, 1995, through November 30, 1999. The postchange period was December 1, 1999, through November 30, 2003.

The principal challenge to the design was the simultaneous provision in the Sale of Liquor Amendment Act law for the reduction in the minimum purchase age, the introduction of beer sales in supermarkets, and the initiation of liquor sales on Sundays. The rationale for including the 20- to 24-year age group was to control for the trend in crash outcomes that would have occurred irrespective of the change in minimum purchase age. In the period under study, those aged 20 to 24 years were probably exposed to equivalent economic conditions, police enforcement levels, and other alcohol availability variables that may have influenced road traffic crashes in the younger age groups.

The outcome measures for the study were (1) alcohol-involved road traffic crashes resulting in injury and (2) hospitalizations resulting from injury sustained in road traffic crashes.

Alcohol-Involved Traffic Crashes

When a road traffic crash involving a motor vehicle occurs and results in someone being injured or killed, the law requires that the crash be reported to the police. If a police officer attends the crash, the officer is required to complete a traffic crash report. The information from traffic crash reports is collated in a database maintained by the Land Transport Safety Authority. Traffic crash reports include details of the crash event (e.g., location, time, number of vehicles involved), severity of the victim's injuries (fatal, serious, minor), and the attending police officer's assessment of alcohol involvement. Evidence indicates that this is a reasonably accurate indicator of alcohol involvement.[24]

Hospitalizations for Road Traffic Crash Injuries

New Zealand is one of a few countries in the world to have an *International Classification of Diseases*–coded national morbidity database. The National Minimum Dataset is collated by the New Zealand Health Information Service and includes records of all persons discharged from hospitals after injuries occurring in New Zealand that resulted in publicly funded inpatient treatment.[25] The vast majority of injury discharges are from publicly funded hospitals. The most recent year for which published data are available for private hospitals indicated that in 1995, there were 1296 injury and poisoning discharges.[26] The comparable figure for public hospitals was 66 054.[27]

The nature and circumstances of injury were coded according to *International Classification of Diseases and Related Health Problems, Ninth Revision, Australian Modification (ICD-9-AM),* for the period December 1995 to June 1999 and *International Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM),* from July 1999 to November 2003. We identified all persons aged 15 to 24 years discharged from public hospitals with a principal diagnosis of injury in the period December 1995 to November 2003. Readmissions and those patients discharged the same day that they were admitted were excluded. The rationale and methods used are described in detail elsewhere.[28]

The circumstances of injury were coded according to the *ICD-9-AM* "Supplementary Classification of External Cause of Injury and Poisoning"[29] and *ICD-10-AM* "External Causes of Morbidity and Mortality,"[30] both referred to here as *E-codes*. For the analysis of road traffic crash hospitalizations, we used E-codes in the ranges recommended by the International Collaborative Effort on Injury Statistics.[31] Because approximately one third of serious road traffic crashes in New Zealand are alcohol involved,[18] the hospitalization data, which include injuries arising from road traffic crashes, without any indication of whether they were alcohol involved, likely provide a less sensitive test of the minimum purchasing age effects than do the crash data.

Note that the age to obtain a driver's license is relatively young in New Zealand. A restricted license, issued on passing a driving test, can be obtained at age 15 years 6 months. It must be held for a minimum of 12 months before another practical driving test can be taken for a full license.

Analysis

Given the different effects of drinking age laws by gender reported in previous studies, the analyses were conducted separately for each gender. Estimated populations from census data were used to produce incidence rates. Poisson regression was used to model the before to after change in incidence rates in each target age group (15–17, 18–19) relative to the comparison age group (20–24); hence, the exponents of the fitted coefficients are equivalent to incidence rate ratios.

TABLE 1—Alcohol-Involved Crash Injuries Before and After Lowering the Minimum Purchasing Age

		Rate per 10 000 Population[a]				
	Age Group, y	Before Lowering of Purchase Age	After Lowering of Purchase Age	After-to-Before Incidence Rate Ratio (95% CI)	Relative After-to-Before Incidence Rate Ratio (95% CI)	*P*
Young men						
	20–24	150.3	121.7	0.81 (0.76, 0.86)	1.00 Reference	
	18–19	180.0	163.5	0.91 (0.83, 0.99)	1.12 (1.00, 1.25)	.04
	15–17	76.1	70.6	0.93 (0.83, 1.04)	1.14 (1.01, 1.30)	.04
Young women						
	20–24	29.9	20.2	0.68 (0.58, 0.79)	1.00 Reference	
	18–19	35.4	36.1	1.02 (0.83, 1.24)	1.51 (1.17, 1.94)	.002
	15–17	27.4	22.9	0.84 (0.69, 1.02)	1.24 (0.96, 1.59)	.10

Note. CI = confidence interval.
[a]From traffic crash reports.

RESULTS

Alcohol-Involved Traffic Crash Injuries

Table 1 presents the incidence rates for young men injured in alcohol-involved traffic crashes, before and after the reduction in minimum purchasing age. Relative to 20- to 24-year-olds, the ratio of the alcohol-involved crash rate after the minimum purchasing age was lowered to the period before was 12% larger (95% confidence interval [CI]=1.00, 1.25) for 18- to 19-year-olds and 14% larger (95% CI=1.01, 1.30) for 15- to 17-year-olds. Also presented in Table 1 is the equivalent comparison for young women. Relative to 20- to 24-year-olds, the incidence rate ratios were 51% larger (95% CI=1.17, 1.94) for 18- to 19-year olds and 24% larger (95% CI=0.96, 1.59) for 15- to 17-year-olds.

Hospitalizations for Road Traffic Crash Injuries

Table 2 shows the incidence rates for young men hospitalized because of road traffic crashes (regardless of whether alcohol was

TABLE 2—Hospitalizations Because of Traffic Crashes Before and After Lowering the Minimum Purchasing Age

		Rate per 10 000 Population[a]				
	Age, y	Before Lowering of Purchase Age	After Lowering of Purchase Age	After-to-Before Incidence Rate Ratio (95% CI)	Relative After-to-Before Incidence Rate Ratio (95% CI)	*P*
Young men						
	20–24	232.0	150.9	0.65 (0.61, 0.70)	1.00 Reference	
	18–19	189.2	135.9	0.72 (0.65, 0.79)	1.10 (0.98, 1.24)	.09
	15–17	85.9	69.8	0.81 (0.75, 0.89)	1.25 (1.12, 1.40)	<.001
Young women						
	20–24	103.0	76.9	0.75 (0.67, 0.83)	1.00 Reference	
	18–19	93.4	66.0	0.71 (0.62, 0.81)	0.95 (0.80, 1.12)	.50
	15–17	52.9	44.2	0.84 (0.75, 0.93)	1.12 (0.96, 1.30)	.10

Note. CI = confidence interval.
[a]From hospitalization data.

involved) before and after the reduction in minimum purchasing age. Among young men, relative to 20- to 24-year-olds, the incidence rate ratios were 25% larger (95% CI=1.12, 1.40) for 15- to 17-year-olds and trended in the same direction for 18- to 19-year-olds (incidence rate ratio=1.10; 95% CI=0.98, 1.24). Among young women, the differences in incidence rate ratios were nonsignificant for 18- to 19-year-olds (incidence rate ratio=0.95; 95% CI=0.80, 1.12) and 15- to 17-year-olds (incidence rate ratio=1.12; 95% CI=0.96, 1.30).

DISCUSSION

The 1999 reduction in the minimum purchasing age occurred amid a falling overall road toll among 15- to 24-year-olds. Evidence of a deleterious effect of reducing the minimum purchasing age requires a lower rate of decline (or a higher rate of increase) in incidence among those exposed to the law change (18–19 years) relative to those not exposed (20–24 years). This finding was observed in the current study: against large reductions in the incidence of alcohol-involved traffic crashes among 20- to 24-year-olds, only small reductions (in one case, an increase) in incidence occurred among 18- to 19-year-old young men and young women. For traffic crash hospitalizations, the effect was significant for young men but not for young women. In addition, evidence indicated a trickle-down effect on alcohol-involved traffic crashes involving 15- to 17-year-olds of both genders.

The effect sizes were similar to those observed in studies conducted in the United States, Canada, and Australia.[3] The deleterious effects were surprisingly large given the relatively weak test of the drinking age hypothesis presented by the circumstances in New Zealand, including the fact that numerous exceptions to the age 20 restriction were in place prior to the 1999 law change and that the law was poorly enforced.[20,32]

The results of this study confirmed those of other New Zealand research. Guria et al.[33] used cumulative sum charts[34] to contrast traffic crash trends in 15- to 17-year-olds compared with the whole population from 1996 to 2001. They concluded that "it is highly likely that the [minimum purchasing age] law change resulted in an increase in the number of alcohol-involved crashes involving 15–17 year-old drivers."[33(p188)] Everitt and Jones[35] found increases in emergency department admissions for intoxication in 18- to 19-year-olds relative to persons aged 20 years and older.

The results differed somewhat by gender and outcome. Young men in both of the younger age groups were negatively affected in terms of both outcome measures: alcohol-involved injury crashes and traffic crash hospitalizations. In contrast, among young women, both the 18- to 19-year-olds and the 15- to 17-year-olds had relative increases in alcohol-involved crashes; however, only the latter had a trend toward increased traffic crash hospitalizations (P=.10), whereas for the former, there was essentially no effect. We have been unable to identify any plausible explanation for why the increased alcohol-involved crash risk for young women did not translate into an increased incidence of traffic crash hospitalizations.

The inclusion of an age comparison group (20–24 years) was intended to control for a range of trends or secular events that might have affected drinking levels or the incidence of road traffic crashes but were unrelated to the minimum purchasing age. The choice of prechange and postchange periods helped exclude some age-related road traffic interventions that occurred in the early 1990s (e.g., in 1992, a 0.03 g/100 mL blood alcohol limit was introduced for all drivers younger than 20 years). Importantly, no similar age-related changes in legislation or enforcement occurred in this study period. In addition, the use of population incidence rates controlled for changes in age structure of the population groups before and after the law change.

The coding system for hospitalization data was changed from *ICD-9-AM* to *ICD-10-AM* in 1999. Although this represented a substantial change in the manner injury events were coded at the third and fourth digit level, it had no effect on the analysis conducted, which was based on case selection at a higher level—namely, all events classified as motor vehicle traffic crashes. Note that approximately one third of crashes resulting in injury requiring hospital inpatient treatment are not reported to police and thus do not result in a traffic crash report.[36] Evidence indicated only a small, nonsignificant difference in reporting rates between 15- to 19-year-olds (61%) and 20- to 24-year-olds (64%),[36] such that the results of the current study were unlikely to be biased by differential underreporting by age group over time.

The validity of the conclusion—that the observed differences in crashes and injuries are attributable to the change in minimum purchasing age—rests in part on the assumption that the other law changes that occurred at that time (i.e., introduction of Sunday trading and beer sales in supermarkets) did not affect the age groups differently. In the unlikely event that either of these legislative changes increased the consumption of alcohol in the younger age groups to a much greater extent than in the 20- to 24-year-olds, the apparent effect sizes might have been overestimated. Conversely, if the consumption in 20- to 24-year-olds increased to a greater extent than that in the younger persons because of the legislative changes, the effects attributable to the minimum purchasing age might have been underestimated.

To test the hypothesis that supermarket beer sales increased consumption in the younger age groups to a greater extent than among the 20- to 24-year-olds, one would need beverage-specific survey data before and after December 1, 1999. Such data were not available to us. We were not aware of any data that could assist in the determination of whether Sunday trading influenced the age groups differentially. Therefore, these other aspects of increased availability of alcohol may have contributed to the observed differences in crash injury incidence, assuming that their effects were differential by age and across the study period.

Road traffic crashes are only part of the total picture of alcohol-related harm among young people. Other effects attributed to reducing the drinking age observed in other countries include increases in noninjury hospitalizations,[37] suicide,[38] and juvenile crime.[23] Recent neuroimaging studies showed that the brain is still developing into the early 20s and that exposure to binge drinking in adolescence produces anatomical changes in the brain[39] and

neuropsychological dysfunction.[40,41] Outside the laboratory, the cognitive and behavioral effects of such neurological damage may be subtle, but given the early onset of drinking and the pervasiveness of drinking to intoxication in New Zealand adolescents,[11] the health and social burden may be considerable.

In New Zealand, as in other developed countries, the bulk of alcohol-related harm is borne by young people.[42,43] The drinking or purchasing age is now widely recognized as a potent means of reducing alcohol-related harm, but it is only 1 of a range of effective strategies.[44] Other strategies include increasing taxes on alcohol, reducing the number and density of liquor outlets, and reducing the opening hours of liquor outlets. All of these strategies have the sometimes politically unpalatable consequence of curtailing the freedoms of older drinkers, and partly as a consequence of that, they have fallen out of favor in recent years. In contrast to these strategies, increasing the minimum purchasing age to 20 or 21 targets the segment of the population with the greatest consumption of alcohol[11] and the highest prevalence of hazardous drinking.[45] Therefore, this strategy should be considered along with other effective measures as a policy option. ■

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This research article was accepted August 8, 2005.

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Acknowledgments

This work was supported by the National Institute on Alcohol Abuse and Alcoholism (grants R21 AA01595 and K05 AA014260).

We gratefully acknowledge the New Zealand Health Information Service for providing hospitalization data and the Land Transport Safety Authority for providing traffic crash data.

Human Participant Protection

Ethical approval was given by the Otago District Health Board Ethics Committee.

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