EFFICACY OF THE NEW YORK STATE SEAT BELT LAW: PRELIMINARY ASSESSMENT OF OCCURRENCE AND SEVERITY*

JEROME I. BARANCIK, SC.D.[1,2], CAROLINE F. KRAMER, R.N., B.S.[1], HENRY C. THODE, JR., PH.D.[1,2], DAVID HARRIS, M.D., M.P.H.[2,3]

USE of seat belts is known appreciably to reduce death and injury to motor vehicle occupants.[1] To date, 37 countries have seat belt use laws,[2] and their collective experience varies from high to low compliance within and among jurisdictions.[3] Following enactment of a mandatory restraint law, there is typically a sharp initial increase in seat belt use, but usage generally decreases. Thereafter, during periods of vigorous police enforcement, however, usage rates again increase, while death and injury rates decline, but usually not proportionately.[3] A notable exception to this pattern is the United Kingdom, where compliance rates have remained consistently high (about 95%) since passage of the British law.[4]

On January 1, 1985 New York State became the first state in the United States to enforce a seat belt law requiring all drivers and front seat passengers as well as all children under 10 years of age to use safety restraints in passenger vehicles and light trucks.[5] This report is based on the preliminary findings of a population-based epidemiologic study to test the hypothesis that a seat belt law in an American population can result in a measurable change in both nonfatal and fatal vehicular injury patterns. Periods covered in this report are the first and second quarters of calenders years 1984 (pre-law) and 1985 (post-law).

For external control purposes, the findings of this investigation are compared with those obtained using a similar and compatible protocol in the State

*Presented in a panel, Seat Belt Use Laws, as part of a *Symposium on Motoehicle Injuries*, held by the Committee on Public Health of the New York Academy of Medicine on December 7, 1987.

[1]Associate Professor and Director, Injury Epidemiology Program, SUNY Stony Brook School of Medicine and Group Leader, Injury Prevention and Analysis Group, Department of Applied Science, Brookhaven National Laboratory, Upton, New York. [2]Injury Epidemiology Program, Department of Community and Preventive Medicine, State University of New York, School of Medicine, Stony Brook, New York. [3]Suffolk County Department of Health Services, Hauppauge, New York.

This work is being supported by the United States Department of Transportation National Highway Traffic Safety Administration (#IAG DTNH22-85-C-00011) and the New York State Governor's Traffic Safety Committee (#TR86-012).

Address for reprints: Dr. J. I. Barancik, Injury Prevention and Analysis Group, Building 475, Brookhaven National Laboratory, Upton, New York 11973.

of Rhode Island,[6] a jurisdiction without a seatbelt law in effect during the study period.

METHODS

The data were collected in Suffolk Country, Long Island, New York (population 1.3 million), which is bordered on three sides by water and to the west by Nassau County. The epidemiologic study design was based on the Northeastern Ohio Trauma Study methodology, including sampling, case-ascertainment, and quality-control procedures; these methods are described in detail in other publications[7-9]. Sampling was conducted at all hospitals with emergency departments located in the county.

The sampling scheme required examination of every case entered in the emergency department log of each hospital on 7 randomly selected days for each 13-week quarter of each year. Within each quarter each day of the week was selected once, yielding a 7.7% sample. For each hospital a different set of 7 random days was selected for each quarter and each study year. This provided assurance of representation of cases by time of day, day of week, and quarter. The sampling procedure was divided into two parts, a primary and a secondary sample.

For the primary sample, cases were abstracted which met one or more of the following criteria: Any case stated as "motor vehicle accident," "automobile accident," or equivalent; any case stated as "no fault" or equivalent; any case listed as head, face, neck, chest, or multiple trauma; any group of cases coming into the emergency department at approximately the same time; and any trauma case resulting in hospital admission, regardless of cause.

Twenty-two cases in 1984 and 1985 which were designated "MU" in the ED logs, could not be located; these cases are included in the incidence counts and other analyses to the extent that the data are available. In addition, an estimated 10 cases in both years combined, which were not specified as being motor vehicle related, but which met other primary selection criteria, as yet have not been verified.

To ensure representation of other motor vehicle trauma cases in the records that did not meet the primary sample criteria, a secondary sample was drawn of 5% of all other trauma cases for the selected days. The secondary sampling procedure resulted in the initial identification of 507 cases; 19 of these (3.7%) were confirmed as first hospital reports of motor vehicle trauma for the first half of 1984 and 1985 combined. An additional 4 cases in 1984 and 5 cases in 1985 could not be located for confirmation. It is not known how many of these 9 cases are motor vehicle related.

From each retrieved record identified as a motor vehicle trauma case

(ICD-9-CM E810-E825) information was recorded as to personal and demographic characteristics (e.g., age, sex, address), time and place of injury, time and date of admission to the emergency department, cause and nature of injury using ICD-9-CM E and N Codes,[10] respectively, injury severity using the Abbreviated Injury Scale 1985 Revision,[11] and emergency department discharge status (e.g., treated and released, admitted, died). Records indicating previous hospital treatment for the same injury event or "normal examination" were abstracted but excluded from this preliminary analysis. Individuals with more than one motor vehicle injury event during the study period may have been included more than once in the sample.

Occurrence was defined as the number of resident and nonresident cases combined that received first hospital treatment for a motor vehicle injury event. The 1984 and 1985 age and sex specific population estimates used to compute occurrence rates were obtained from the New York State Department of Health.[12]

A case-fatality ratio was defined as the total number of fatal vehicular injury cases divided by the estimated total number of fatal and nonfatal cases. Motor-vehicle related trauma death enumerations for the County were obtained from official reports issued by the Suffolk County Medical Examiner's Office.[13] Data on deaths were considered a census and no sampling expansion factors were used.

Preliminary Results

For the first half of 1984 and 1985 combined, the primary sample identified 1,510 motor vehicle trauma cases, of which 37 were classified as having prior hospital treatment. The remaining 1,473 cases are discussed in this report.

During the pre/post-law observation periods, an estimated 155,000 trauma cases from all causes were seen in emergency departments of Suffolk County hospitals, about equally divided between 1984 and 1985. Motor vehicle trauma comprised approximately 16% of all trauma.

Motor vehicle trauma occurrence rates per 1,000 population for the first quarter of each year were 4.5 in 1984 and 3.7 in 1985. For the second quarter, they were 5.0 and 5.4 per 1,000 population, respectively. For both sexes combined, a 19% decrease in occurrence rates was seen in the first quarter of 1985 compared to 1984, a statistically significant decline ($p<0.05$). In males a 12% decrease was seen and in females a 22% decrease, which was statistically significant ($p<0.05$). However, for the second quarter, increases in vehicular injury occurrence rates were observed for males and both sexes combined; female rates were the same (Table I).

Generally, the highest occurrence rates were seen in the 16-24 year age group. The only age groups which did not show a decrease in occurrence

TABLE I. PRELIMINARY ESTIMATED MOTOR VEHICLE TRAUMA OCCURRENCE RATES PER 1,000 POPULATION BY AGE AND SEX FOR PERSONS TREATED IN HOSPITAL EMERGENCY DEPARTMENTS, SUFFOLK COUNTY, NEW YORK, FIRST AND SECOND QUARTERS, 1984 AND 1985

	1984			*1985*		
Age (years)	*Both sexes*	*Male*	*Female*	*Both sexes*	*Male*	*Female*
First quarter						
<16	1.5	0.8	2.2	2.0	2.0	2.0
16–17	7.6	10.8	4.2	7.3	8.9	5.7
18–24	12.5	13.0	11.9	9.5	10.4	8.9
25–44	5.5	5.5	5.5	4.1	4.4	3.9
45–64	3.2	2.1	4.3	2.2	1.9	2.5
65+	1.1	1.7	0.6	1.9	1.0	2.5
All ages	4.5	4.4	4.6	3.7	3.9	3.6
Second quarter						
<16	2.3	2.7	1.8	2.4	3.0	1.7
16–17	10.3	10.1	10.5	11.9	15.1	8.5
18–24	13.8	12.1	15.4	16.3	16.1	16.5
25–44	4.8	5.1	4.5	5.5	6.3	4.8
45–64	3.9	4.1	3.6	2.8	3.1	2.5
65+	1.9	3.4	0.9	2.0	2.6	1.6
All ages	5.0	5.2	4.7	5.4	6.1	4.7

rates for the first quarter of 1985 compared to 1984 were people younger than 16 and those 65 years and older.

Vehicular fatalities per 1,000 injury cases decreased for the first and second quarters in 1985 compared to 1984. For both sexes combined a 21% drop in the case-fatality ratio was seen during the first half of 1985. Fatality reductions were seen in each quarter for both sexes (Table II).

By Abbreviated Injury Scale body region, the proportion of cases with one or more injuries to the head decreased 16% ($p<0.05$) during the first half of 1985. Cervical strain, coded to the anatomical region "spine," was analyzed separately, showing a slight decrease for males and a significant ($p<0.05$) increase for females (Table III).

The overall proportion of males with one or more facial injuries decreased slightly from 1984 to 1985, while there was a significant decrease ($p<0.05$) for females (Table III). However, the proportion of cases with one or more nasal or mandible fractures nearly doubled during the first half of 1985; during the first quarter of 1985 this proportion nearly tripled.

DISCUSSION

During October of 1984 pre-law observed seat belt usage in Suffolk County was 16%.[14] A nearly fourfold increase in usage to 62% was observed in January 1985, when the law was first enforced; in April of that year observed

TABLE II. PRELIMINARY ESTIMATED MOTOR VEHICLE TRAUMA FATALITIES PER 1,000 HOSPITAL EMERGENCY DEPARTMENT TREATED CASES BY CALENDAR PERIOD AND SEX, SUFFOLK COUNTY, NEW YORK, FIRST AND SECOND QUARTERS, 1984 AND 1985

	1984			*1985*		
Period	*Both sexes*	*Male*	*Female*	*Both sexes*	*Male*	*Female*
First quarter	7.3	10.8	4.2	5.4	7.9	2.9
Second quarter	9.1	11.8	6.3	7.4	9.3	5.0
Total, first half	8.3	11.4	5.3	6.6	8.8	4.1

TABLE III. PRELIMINARY PERCENT DISTRIBUTION OF MOTOR VEHICLE INJURY CASES BY BODY REGION* AND SEX FOR CASES TREATED IN HOSPITAL EMERGENCY DEPARTMENTS, SUFFOLK COUNTY, NEW YORK, FIRST HALF, 1984 AND 1985

AIS-85	*1984*			*1985*		
Body region	*Both sexes*	*Male*	*Female*	*Both sexes*	*Male*	*Female*
Head	33.0	36.3	29.8	27.6	27.1	28.2
Face	32.6	33.6	31.6	27.2	30.5	23.5
Nasal/ jaw fractures	1.5	1.6	1.3	2.5	2.6	2.3
Neck	1.8	1.9	1.6	1.4	1.8	0.9
Thorax	7.5	7.9	7.2	9.7	10.6	8.7
Abdomen	1.9	2.2	1.6	2.5	2.6	2.3
Spine	25.6	24.0	27.1	26.5	20.9	32.8
Cervical strain	19.4	18.0	20.7	21.8	16.8	27.3
All other	9.4	9.3	9.6	7.3	7.2	7.3
Upper extremities	21.6	21.6	21.5	20.0	21.4	18.3
Lower extremities	27.8	24.3	31.1	29.5	30.7	28.2
General/external	10.8	10.9	10.6	10.8	10.3	11.3

*A modified verson of AIS-85 was used which increases anatomic site specificity of coding.[22]

usage declined to 54%.[15] The initial sharp increase in usage patterns during the first quarter of 1985 was coupled with an estimated 17% decline in overall vehicular injury occurrence rates. A smaller cumulative decline of 4% in vehicular occurrence rates was observed for the first half of 1985 compared to 1984. Case-fatality ratios (number of deaths per 1,000 injury cases) decreased more than 27% for the first quarter and 21% for the first half of 1985.

These initial findings are consistent with the hypothesis that restraint use laws can effectively reduce the occurrence and severity of vehicular injuries. A number of these findings are also consistent with those reported by Rutherford, Hayes, and their colleagues in the United Kingdom,[16] especially reduction in head injuries and increase in facial fractures.

However, these findings must be viewed as preliminary for many reasons.

The study protocol was designed to obtain and to compare data for a two-year pre-law period (1983 and 1984) with data for a one-year post-law period (1985). Present findings are based on total observations for road users in vehicles covered (e.g., passenger cars) and not covered (e.g., motorcycles) by the law and for pedestrians; identification of the subsets of cases involving occupants and motor vehicles covered by the law is planned for the final analyses. Not all records for all cases are available for confirmation at this time. The occurrence rates reported above do not include first treatment cases from hospitals located in adjacent Nassau County (future inclusion is planned).

No adjustments were made for a number of other factors that can potentially affect the findings. For example, important exposure indices increased from pre-law 1984 to post-law 1985, including traffic counts (2.5% and 5% by area),[17] motor vehicle registrations (5%),[18] and operator licenses (2%).[19] Resource allocation for police enforcement of traffic laws including driving while intoxicated and speed limits remained at about the same level for both years.[20] Average vehicle speeds in New York State remained essentially the same for both years (55.8 MPH in 1984 and 56.4 MPH in 1985).[21] In the aggregate these patterns would increase the size of the population-at-risk in post-law 1985 compared to pre-law 1984. They would tend to decrease the observed differences in rates and ratios between the study years. Thus, the findings reported here should be viewed as lower bound estimates of the differences. Such potential confounding factors will be considered and adjustments made as appropriate in the final analyses.

In contrast to the Suffolk County findings, Rhode Island State showed a clear increase in hospital emergency department reported vehicular injury incidence rates and case-fatality ratios during the first 6 months of 1985 compared to the same period in 1984.[6] These Rhode Island data suggest that the effect of the New York law may actually have had a greater impact than is reflected in the reductions in morbidity and mortality reported here. It may very well have been that New York State would have experienced an increase in injury occurrence rates or case-fatality ratios in the first half of 1985 had there been no seat belt law and had New York followed the same pattern as Rhode Island. This is further supported by the observation that when New York seat belt usage began to decline during the second quarter of 1985 similar reductions in injury occurrence rates in Rhode Island were not seen.

It is anticipated that the final results will provide health and safety decision makers in the public and private sectors with population representative baseline information on the incidence and outcome of vehicular injuries before and after promulgation of a restraint use law. The results will also provide a

data base for conducting follow-up investigations on important topics such as estimating the reductions in direct and societal costs. The need for this type of information has important legislative and public health policy implications in view of the repeal of restraint use laws in Massachusetts and Nebraska and the introduction of repeal bills in 7 of the 24 remaining states with such a law.

SUMMARY

This analytic epidemiologic study is designed to measure how effectively mandated seat belt use reduces both morbidity and mortality from vehicular collisions occurring in a well defined United States population. Case ascertainment is based on a probability sample of vehicular trauma cases treated in hospital emergency departments taken during the first half of post-law 1985 and compared to the same period in pre-law 1984. Preliminary findings show that increased seat belt usage was coupled with a 21% decrease in the overall case-fatality ratio, a 4% decrease in the overall vehicular injury occurrence rate, and changes in selected anatomic injury patterns. Decreases were observed in the proportion of cases with one or more injuries to the head, while increases were seen in the proportion with one or more facial fractures, primarily of the nose and mandible. These preliminary findings are consistent with the hypothesis that seat belt use laws can be effective in reducing the occurrence and severity of vehicular injuries.

ACKNOWLEDGMENTS

The authors thank the following for their advice and encouragement: Robert Schweitz, Michael M. Finkelstein, William G. Rourke, Kenneth Carpenter, Debra H. Rood, Andre O. Varma, and Bernard Manowitz; Jan Collinson, Nanette Connor, Mary Franchi, Anne E. Smith, and the entire field unit for their conscientious abstracting and coding; administration and staff of the participating hospitals for their continued dedicated efforts; and our office staff and student assistants for their continued dedication to this project.

REFERENCES

1. Vaage, T: *Safety Belt Usage Laws in Various Countries, in Effectiveness of Safety Belt Use Laws: A Multinational Examination*. US Dept of Transportation publication HS-807-018. Washington, D.C., National Highway Traffic Safety Administration, 1986.
2. Grimm, A.C.: Restraint use laws by country, as of August, 1984. University of Michigan Research Institute, *Res. Rev. 1*: 1985.
3. Insurance Institute for Highway Safety: *Highway Loss Reduction Status Report*. 14. 1984.
4. Hayes, H.R.M. (Child Accident Prevention Trust, London): Personal communi-

cation, April 6, 1987.
5. *Vehicle & Traffic Law*, 1985-86 edition (Sec. 1229-c). Albany, State of New York Dept. of Motor Vehicles.
6. Rockett, I.R.H., Hollinshead, W.H., and Lieberman, E.S.: A preliminary assessment of change in motor vehicle trauma incidence and outcome: Rhode Island, 1984-1985. *Bull. N.Y. Acad. Med. 64*:750-56, 1988.
7. Barancik, J.I., Chatterjee, B.F., Greene, Y.C., et al.: Northeastern Ohio Trauma Study: I. Magnitude of the problem. *Am. J. Public Health 73*:746-51, 1984.
8. Barancik, J.I., Chatterjee, B.F., Greene-Cradden Y.C., et al.: Motor vehicle trauma in Northeastern Ohio. I: Incidence and outcome by age, sex, and road use category. *Am. J. Epidemiol. 123*:846-61, 1986.
9. Barancik, J.I. and Fife, D.: Discrepancies in vehicular crash injury reporting: Northeastern Ohio Trauma Study IV. *Acc. Anal. Prev. 17*:147-54, 1985.
10. *ICD-9-CM International Classification of Diseases*, 9th revision. U.S. Dept. of Health and Human Services publication (PHS) 80-1260. Washington, D.C., Public Health Service, Health Care Financing Administration, 1980.
11. *The Abbreviated Injury Scale* (AIS), 1985 revision. Arlington Heights, IL, American Association for Automotive Medicine, Joint Committee on Injury Scaling, 1986.
12. *Population Estimates by Age and Sex for New York State Counties* (1984, 1985). Albany, N.Y.,State of New York Dept of Health, Bureau of Biostatistics.
13. *Annual Report of Motor Vehicle Accident Fatalities* (1984, 1985). Suffolk Co., N.Y., Suffolk County Dept of Health Services, Office of Medical Examiner.
14. Rood, D.H. and Kraichy, P.P.: *Evaluation of New York State's Mandatory Occupant Restraint Law Observational Survey of Restraint Use in New York State*: 1984. Albany,N.Y., Institute for Traffic Safety Management and Research, 1984.
15. Rood, D.H., Kraichy, P.P., and Carubia, J.: *Evaluation of New York State's Mandatory Occupant Restraint Law*, volume I. *Observational Surveys of Safety Restraint Use in New York State*. US Dept of Transportation publication HS-806-950. Washington, D.C., National Highway Traffic Safety Administration, 1985.
16. Rutherford, W.H., Greenfield, T., Hayes, H.R.M., et al.: *The Medical Effects of Seat Belt Legislation in the United Kingdom*. Research Report No. 13. London, Dept. of Health and Social Security, Office of the Chief Scientist, 1985.
17. Strang R. (Suffolk County Dept of Public Works, Traffic Safety): Personal communication, February 25, 1987.
18. *New York State Registrations Issued (MV 213) (1984, 1985)*. Albany, N.Y., State of New York Dept of Motor Vehicles, Division of Research and Development.
19. *New York State Licenses on File (1984, 1985)*. Albany, N.Y., State of New York Dept of Motor Vehicles, Division of Research and Development.
20. Kremers, E. (Suffolk County Executive's Office, Suffolk County Stop DWI): Personal communication, 1986.
21. *Speed Summary Report (1984, 1985)*. Albany, N.Y., New York State Dept. of Transportation, Office of Highway Planning.
22. Kramer, C.F. and Barancik, J.I., Modification of AIS-85 to Measure Anatomic Site/Severity Patterns. *Annual Meeting, American Public Health Association*. New Orleans, October 1987.