The negative impact of the repeal of the Arkansas motorcycle helmet law

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
The motorcycle helmet law for adults (over age 18) was examined.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised adult individuals riding motorcycles.

Setting
The setting was a hospital. The economic study was conducted in the state of Arkansas, USA.

Dates to which data relate
The effectiveness and resource use data were gathered 3 years before and 3 years after 1st of July 1997. The price year was 2001.

Source of effectiveness data
The effectiveness evidence was derived from a single study.

Link between effectiveness and cost data
The costing was conducted retrospectively on the same sample of patients as that used in the effectiveness analysis.

Study sample
The use of power calculations was not reported. Individuals included in the study sample were identified at the University of Arkansas Medical Sciences (UAMS) centre for 38 months before and after the 1 July 1997 enactment of the repeal. Patients admitted to the hospital, or who died in the emergency department, were considered in the study. This included those transferred from another acute care hospital after a motorcycle crash. Only 10 patients who were directly admitted after transfer without complete data were excluded. There were 73 patients in the pre-repeal period and 96 patients in the post-repeal period. In the pre-repeal period, the mean age of the patients was 30.7 (+/- 8.7) years and 95% were male. In the post-repeal period, the mean age was 33.2 (+/- 12.3) years and 86% were male. Statewide data, such as the total number of registered motorcycle riders and motorcycle crashes involving riders who were dead at the scene and their helmet status, were also assessed. These figures were estimated from the Arkansas State department.
Study design
This was a retrospective comparative study with historical controls. It was based on a retrospective review of eligible patients identified at a single centre, the UAMS. The length of follow-up was not reported. No loss to follow-up was observed.

Analysis of effectiveness
All the patients included in the initial study sample were accounted for in the effectiveness analysis. The outcomes used were:

- statewide data, such as variations in motorcycle registrations and motorcycle crashes;
- admissions after nonfatal motorcycle crashes;
- the Glasgow Coma Scale (GCS) score;
- the head and neck Abbreviated Injury Scale (AIS) score;
- the Injury Severity Score (ISS);
- stay in the intensive care unit (ICU);
- the total length of stay (LOS);
- disposition on discharge (i.e. home, rehabilitation, or death); and
- the rate of severe head injuries.

Baseline factors significantly associated with the clinical outcomes were identified through a linear regression analysis. The study groups were comparable at baseline in terms of the demographic, clinical and financial characteristics.

Effectiveness results
In the 2 years post-repeal, motorcycle registrations increased by 29% in comparison with the 2 years pre-repeal.

Motorcycle crashes rose by only 3.6% and fatalities rose by 11%, (p non significant).

However, the fatality rate for non-helmeted riders increased significantly, from 39.5% in the pre-repeal period to 75.5% in the post-repeal period, (p=0.0001). The corresponding change for helmeted riders was from 60.4% (pre-repeal) to 24.5% (post-repeal).

The non-helmeted and helmeted fatality ratios per 100,000 registrations were depicted graphically.

Overall, the admissions after nonfatal motorcycle crashes rose by 32% (from 73 to 96) after repeal of the helmet law. It changed from 25% to 54% in non-helmeted riders, (p<0.001), and from 75% to 46% in the helmeted group.

Non-helmeted patients had significantly worse injuries, as measured by the ISS, than helmeted patients (16.4 +/- 11.6 versus 13.2 +/- 12.2; p=0.03). They also had a higher mean head and neck AIS score (2 +/- 1.9 versus 1 +/- 1.6; p=0.0002), and longer ICU stay (3 +/- 5.5 days versus 1.2 +/- 2.9 days; p=0.01).

The total LOS, disposition on discharge, and GCS score were not statistically different between the groups.

The incidence of severe head injuries (AIS score >/=3) was significantly different between the groups, 47% in non-helmeted patients and 20% in helmeted patients.

The regression analysis showed that:
patients with severe head injuries had a significantly lower GCS score, higher ISS, and experienced longer ICU stays; total LOS significantly correlated with ISS, while ICU stay significantly correlated with AIS, ISS and GCS in both the pre- and post-repeat patients populations and in helmeted and non-helmeted populations;

GCS scores correlated with ICU stay in all patients, and strongly correlated with total LOS in helmeted patients.

**Clinical conclusions**
The effectiveness analysis showed that injury rates, fatality rates, and the number or severity of head injuries increased when the motorcycle helmet law for adults was repealed.

**Measure of benefits used in the economic analysis**
The health outcomes were left disaggregated and no summary benefit measure was used in the economic analysis. In effect, a cost-consequences analysis was conducted.

**Direct costs**
Discounting was not conducted since the costs per patient were incurred during a short time. The unit costs and the quantities of resources used were not presented separately. The cost items were not broken down, but it appears that all hospital-related costs relevant to the service payers have been considered in the analysis. The authors stated that professional fees, rehospitalisations, and rehabilitation or outpatient services were not included. The costs were grouped in three categories. More specifically, methods of payment, total charges, and total reimbursement (total amount paid toward the bill at the time of the study). Thus, the unreimbursed charges were calculated by subtracting the reimbursement from the total charge. Financial information was obtained from the UAMS Department of Financial Management on each patient included in the effectiveness analysis. However, one patient in each group was excluded due to the lack of economic data. The price year was 2001. The patients were comparable in terms of the method of payment (no insurance, government-sponsored programmes, or private insurance).

**Statistical analysis of costs**
Statistical analyses were conducted to test the statistical significance of differences in the estimated costs.

**Indirect Costs**
The indirect costs were not included in the economic evaluation.

**Currency**
US dollars ($).

**Sensitivity analysis**
Sensitivity analyses were not conducted.

**Estimated benefits used in the economic analysis**
See the 'Effectiveness Results' section.

**Cost results**
The reimbursement rates were low for patients without insurance (3%) versus those with government-sponsored programmes (10%) or with private insurance (43%), (p<0.001).
After excluding data for one obvious outlier with no insurance but with total charges of $60,079 and reimbursements of $34,289 (55%):

the hospital charges were $42,515 (+/- 54,237) in the non-helmeted group and $30,947 (+/- 33,244) in the helmeted group;

the reimbursements were $5,386 (+/- 11,083) in the non-helmeted group and $8,058 (+/- 14,563) in the helmeted group; and

the unreimbursed charges were $37,129 (+/- 52,734) in the non-helmeted group and $22,889 (+/- 28,810) in the helmeted group, (p<0.04).

Thus, the total deficit was $2,561,901 in the non-helmeted group and $2,243,122 in the helmeted group.

**Synthesis of costs and benefits**

A synthesis of costs and benefits was not relevant since, in effect, a cost-consequences analysis was conducted.

**Authors' conclusions**

The repeal of the motorcycle helmet law for adults increased the financial burden of trauma care for non-helmeted motorcyclists, owing to an increase in the admission rates for non-helmeted survivors of motorcycle crashes.

**CRD COMMENTARY - Selection of comparators**

The rationale for the choice of the comparators was clear, as the pre- and post-repeal periods of the motorcycle helmet law for adults were considered. Thus, the selection of the comparators was appropriate. You should decide whether they are valid comparators in your own setting.

**Validity of estimate of measure of effectiveness**

The analysis of effectiveness was based on a retrospective comparative study. The two groups of patients were identified in two different periods of time and, although baseline comparability was demonstrated, the authors admitted that the two groups were quite heterogeneous. Further, time-dependent differences could not be excluded. Thus, some bias might have affected the results of the analysis. It was also noted that other factors, which were not explicitly accounted for in the analysis, could have had an impact on differences between the groups. The length of follow-up was not reported and the method used to select the sample was unclear. Similarly, there was no evidence that the sample size was appropriate.

**Validity of estimate of measure of benefit**

No summary benefit measure was used in the analysis because, in effect, a cost-consequences analysis was conducted.

**Validity of estimate of costs**

The perspective adopted in the study was not explicitly stated, but it appears to have been that of the payer. A detailed breakdown of the cost items was not provided. Information on the unit costs and the quantities of resources used was not presented separately. This limits the possibility of replicating the study in other settings. The price year and the source of data were reported. Large variances in the estimated costs were observed, and statistical tests were conducted when the costs were compared. The costs were specific to the study setting and no sensitivity analyses were conducted. The authors stated that the inclusion of the indirect costs would further increase the cost-difference, as the study population comprised mainly young individuals, resulting in substantial productivity losses. Finally, charges rather than costs were used in the analysis.
Other issues
The authors compared their findings with those from other studies and found similar results. The authors also stated that whether helmet laws actually yield significant reductions in fatality rates is a contentious argument by anti-helmet law groups. The issue of the generalisability of the study results to other settings was not explicitly discussed, although it was noted that the cost estimates may not be representative of other institutions.

Implications of the study
The authors stressed that states currently debating whether to repeal their motorcycle helmet laws should carefully consider the additional resources required to cover the increased health care costs.

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