

COSTS OF HOSPITALIZATION OF INJURED MOTORCYCLISTS
IN ILLINOIS: PUBLIC POLICY IMPLICATIONS

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ABSTRACT

Costs of hospitalization of 331 motorcyclists at three regional trauma centers in Illinois showed that those with head injuries incurred greater costs than those without head injuries, and represented about 25% of the cases. Among those who died, 42% received injuries to the head. About 25% of the cases had the hospital costs paid by public aid funds.

An estimate was made of savings in medical and hospitalization costs if all motorcyclists wore helmets.

An improved reporting system for motorcycle collisions is needed including the use or nonuse of helmets. Information on nonfatal disabling injuries is sorely lacking. Helmet legislation would provide increased use from which would be derived large reductions in injuries and costs.

INTRODUCTION

In 1982, approximately 46,000 fatalities and 1,700,000 reported disabling* casualties occurred in the United States as a result of motor vehicle related crashes. This constituted about one-half and one-fourth of the total number of accidental deaths and injuries respectively with an estimated annual cost of \$41.6 million (1). These casualties represent reductions of 11% fatal and 8% nonfatal injuries over 1981; no change has been documented in permanently disabling injuries.

According to the Fatal Accident Reporting System (FARS) in 1981 4,716 motorcyclists were killed in 4,642 collisions that involved 4,774 motorcycles (2). The number of collisions, vehicles involved and riders killed all declined in 1981 after steady increases for the preceding five years, but the number of rider fatalities continued to exceed the number of fatal motorcycle crashes:

* According to the National Safety Council, "disabling" beyond the day of the collision.

1.02 motorcyclist fatalities occurred per involved motorcycle. This is the only vehicle type for which this has been true. Using the mileage death rate, motorcyclists were killed at 25/100 million miles traveled as compared to 2.93/100 million miles for all victims of road trauma.

Of note, about one-half of the involved motorcyclists were less than 25 years old, a particularly significant fact if potential years of life lost (PYLL)* are used as a measure of societal burden.

The National Accident Sampling System (NASS) data for 1981 show that less than 3% of reported collisions involved motorcycles; yet, they accounted for 18% and 10% of the total serious and fatal injuries respectively in the traffic stream. The ratio of head or facial injuries to motorcyclists wearing helmets was 1:26 whereas for helmetless cyclists, it was 1:14 (3). This matches the conclusions of the University of Southern California study which found that in a series of more than 1,000 cases, helmetless cyclists received head or neck injuries almost twice as frequently as did those wearing helmets (4).

The Highway Safety Act of 1966 granted to the US Secretary of Transportation the authority to withhold federal funds for noncompliance with the original 18 highway safety program standards. Standard 3 required that each motorcycle rider wear an approved safety helmet. A decade later, amendments to the Highway Safety Act specific to mandatory helmet use for operators and passengers 18 years or older rescinded the Secretary's sanctioning power. Since 1976, more than 30 states have either repealed or amended helmet use requirements, resulting in a significant increase in serious and fatal head-related trauma.

Several studies funded by the National Highway Traffic Safety Administration were conducted during 1975-76 to investigate the motorcycle crash injury problem with particular emphasis on the effects of repeal of helmet use laws (5-8). Data in four states supported conclusively the benefits of helmet protection. When the legislation was in effect, extremity injuries exceeded head injuries. After repeal, head trauma was overrepresented in the serious to unsurvivable categories (AIS 3-6). These studies did not concentrate extensively on the costs of these injuries.

A summary of the above referenced four state studies contains a brief discussion of the financial consequences of non-wearing of helmets and is a useful addition to the literature (9). Because the treatment costs were calculated using 1978-79 injury data, however, they are an underestimation in 1984 dollars. This limitation notwithstanding, several important conclusions were reached: (a) a substantial percentage of the treatment costs are not paid by the injured parties and are therefore absorbed by other hospital users and the taxpayers generally; (b) motorcyclists who were not wearing helmets at the time of their injuries incurred larger medical bills, spent more time undergoing treatment, and were disabled longer than those with helmets.

* PYLL uses age 65 as the age to which most people can expect to survive. A person who died at age 55 loses 10 years of life; one who dies at 20 loses 45 years of life.

Injured motorcyclists continue to be overrepresented in road-related trauma. Yet, there is a paucity of information in the literature on their medical treatment costs.

The purpose of this present study was to determine the cost of hospitalization of injured motorcyclists in the State of Illinois with particular emphasis on those features of the findings that are related to head injuries and the use of helmets, and the extent to which public funds are used to pay the expenses. This type of data, not previously gathered in Illinois, would be valuable since Illinois is a state which currently does not require the use of helmets for riders 18 years of age or older.

ILLINOIS MOTORCYCLE CRASH AND INJURY DATA (10)

In 1982 motorcycle collisions in Illinois accounted for 1.7% of all motor vehicle crashes, but were responsible for 12.3% of all fatalities. Of the 187 motorcyclists killed, 70.6% were in the 20-34 year age range. About half (51.4%) of the fatal motorcycle crashes involved another vehicle; the other half resulted from collisions into fixed objects, parked vehicles, and noncrash events such as vehicle overturn. About 41% of the killed motorcyclists registered a positive blood alcohol concentration.

Reported nonfatal casualties totalled 6,792 in 1982, about a 9% reduction from 1981. Unfortunately, definitive information is not available on the incidence of levels of severity or permanent disability since this information is gleaned from police reports which use a rather unsophisticated injury assessment system (fatal, incapacitating, non-incapacitating, possible injury).

STUDY METHODOLOGY

Data from 1981-82 for injured motorcyclists were collected from the hospital records of three designated regional trauma centers in different cities of the state using the International Classification of Diseases (ICD-E codes) (11). The data collection form consisted of the following information: age; sex; collision type; seating position (operator or passenger); type of injury; duration of hospital stay; post-hospitalization care if any; treatment costs; and source of payment. Information regarding helmet use or nonuse was not available in the medical record, and could not be obtained.

RESULTS

The hospital records provided information which allowed the following variables to be investigated: identification of who paid the hospital bill (insurance, public aid or payment made by the injured person); the total amount of the hospital bill; length of hospital stay; the age of the injured motorcycle rider or passenger; type of event (a collision which occurred on the road or a noncollision event); the person who was injured, either the motorcycle operator or passenger; the character of the injury (not involving the head, or involving the head and other parts of the body); and the disposition of the person (transferred to a skilled nursing facility or another

hospital, or the individual died before leaving the hospital).

A total of 331 hospital records were used in this study from three participating hospitals: Burnham City Hospital in Urbana-Champaign, St. John's Hospital in Springfield, and Cook County Hospital in Chicago. For both Burnham City Hospital and St. John's, the 1981 and 1982 records were obtained, with 135 cases from Burnham and 153 cases from St. John's. It had been hoped to obtain a large number of similar cases from Cook County, but only 43 cases were obtained. Thus, the bulk of the cases are from the central Illinois areas surrounding Urbana-Champaign and Springfield.

Age - The age distribution of those injured in this sample of motorcycle collisions had a minimum age of 4 years and a maximum of 63, with a median of 23.8 years.

Sex - Of the 331 cases, 89.4% were male and 10.6% were female.

Collision Type - The collisions which occurred on the road represented 42.3% of the sample while 28.1% were non-collision crashes. The remaining 29.6% were unclassified.

Person Injured - The operator of the motorcycle represented 89.4% of all the persons injured while passengers represented 10.6% of the sample.

Days Hospitalized - The minimum hospital stay was one day and the maximum was 193 days with a median stay of 5.3 days and a mean of 14.1 days.

Type of injury - 75.5% of all injuries in this sample did not involve the head; 24.5% of the sample suffered injuries to the head and other body parts.

Disposition of the Patients - The hospital which provided the initial treatment also completed treating 95.8% of the patients. One case (0.3%) was sent to a skilled nursing facility for additional rehabilitation, six (1.8%) were sent to another hospital, and seven (2.1%) of the sample died.

Payer - 63.4% of the payments were made by insurance, 25.1% by public aid funds and 11.5% by individuals.

Hospital Charges - The charges made by the hospitals for their services did not include those rendered by physicians, anesthesiologists, or other specialized staff, but did include the cost of hospital room and board, emergency room services, and other general hospital services rendered by nursing staff and physical therapists. The distribution of charges involved a minimum of \$130 to a maximum of \$79,465 in this sample. The median hospital bill was \$2507, with a mean of \$6222.

A cross tabulation among some of these variables revealed additional information to provide indications of the combined effects of some of these variables.

Frequency of Head Injuries Incurred by Patients in the Three Hospitals - There was a significant difference in the percent of motorcyclists who incurred a head injury in the three hospitals. The percent of patients with head injuries at Burnham City Hospital was 5.2%; at St. John's, 32.7%, and

at Cook County Hospital, 55.8%. This significant difference in the distribution of head injuries by hospital might suggest differential use of helmets among motorcyclists in these three regions. However, observation of motorcyclists in these three areas in April 1984 found no difference in the proportions wearing helmets.

The difference might also be a precursor of a revised system of categorization of trauma centers in some parts of the US, including Illinois. Since no alterations in the system have been formally made as yet, however, no definitive conclusions can be reached on this hypothesis.

Type of Injury and the Hospital Charge - The total costs associated with the type of injury sustained differed significantly. Injuries which involved the head produced higher hospital charges (mean = \$7852/case) than those not involving the head (mean = \$5694/case).*

Type of Injury and Days in Hospital - There was no significant association between the number of days spent in the hospital by those who had head injuries (mean = 14.3 days) and those without head injuries (mean = 14.0 days).*

Since the costs of those involving head injuries were greater than those not involving head injuries, as just described, it is clearly suggestive that more expensive hospital services were utilized by those who suffered head injuries in their crashes than those who did not. (It should be remembered, as already stated, that the charges that are involved in this study are only those paid to the hospital and do not include physician and post-hospitalization expenses.)

Type of Injury and Age of Motorcyclist - There was a significant association between the type of injury and the age of the motorcyclist. Head injuries were received by 15.6% of those 20 years of age or less, by 25.8% of those 21-30 years, and by 33.3% of those over 30 years of age.

Type of Injury and Disposition of the Patient - Out of the 331 cases only 14 cases were sent to another hospital or a skilled nursing facility, or died. However, these fourteen cases represented the most serious injuries. Among those in which no head injury was involved, 3.2% were disposed either to another hospital, skilled nursing facility or died whereas 11.8% of those who did incur a head injury were similarly disposed. This shows that injuries involving the head are relatively more serious and the effects longer lasting to those who incurred them than injuries which did not involve the head.

Type of Payer and Hospital - None of the patients at Burnham City Hospital in Urbana-Champaign paid the bill themselves whereas 58% of those at Cook County settled the bill themselves. Public aid funds paid 34.1% of cases at Burnham, 27.9% of cases at Cook, and 16.3% of the cases at St. John's. The reason for these differences in the modes of payment are not clear at this time.

* The *mean* rather than the *median* was used in order to compare these findings on cost and length of stay with the earlier Kansas study (6) that used the *mean* for these variables.

Payer and Total Charge - There were no significant differences in the distribution of the hospital charges associated with the different forms of payment (ie, insurance, public aid and injured party). The mean charge paid by insurance was \$6311, by public aid it was \$5885 and by self-payment it was \$6460.

Hospital Charges and Number of Days Hospitalized - There was, as would be expected, a highly significant association between the total hospital charge and the number of days spent in the hospital. The Pearson Product-Moment correlation coefficient was 0.85 between these two variables.

Hospital Charge and Person Injured - There was a significant association between the hospital expense and the person injured, namely whether the injured was the operator or the passenger of the motorcycle. The mean expense for operators of the motorcycle was \$5672 while for passengers it was \$10,871 or about twice that for operators.

Mean Cost per Patient by Disposition and Type of Injury - Table I shows the mean cost per case by the disposition of the patient and type of injury. Table I shows that in every comparison, the mean costs were greater if any injury to the head was involved than if only other body parts were injured. In particular the mean hospital costs of those moved to another hospital were about double for those involving a head injury than those not involving a head injury; and those patients who died incurred hospital costs which were 1.6 times greater for those which involved a head injury than those not involving a head injury. In addition, there was one case in which a patient was moved to a skilled nursing facility. The hospital cost of that patient who received injuries to the head was \$35,000. For those patient who were treated in the hospital to which they were initially admitted, those who incurred head injuries had charges which were 1.3 times those which did not involve an injury to the head.

TABLE 1
Mean Cost (\$)/Patient by Disposition and Type of Injury
(N=331)

	Disposition of Patient			
	Same Hospital	Other Hospital	Nursing Facility	Died
Not Head	\$5,557 N=242	\$7,500 N=4	-	\$12,125 N=4
Head and Other	\$6,847 N= 75	\$15,000 N=2	\$35,000 N=1	\$19,166 N=3

DISCUSSION

There are three major findings from this analysis of 331 records of motorcyclists injured in traffic collisions, primarily in central Illinois. Firstly, about 25% of the motorcyclists, either operators or passengers, did not pay their hospital bills but relied upon public aid payments to reimburse the hospitals. The degree to which this sample is representative of motorcyclists injured throughout the state of Illinois cannot be fully determined from this limited sample, although there is little reason to suppose that persons living in the central Illinois areas which consist of some moderately large cities and extensive rural areas should differ from many other areas in the state which have similar characteristics, except those in the Chicago area. Unfortunately, the sample obtained from Cook County Hospital consisting of only 43 cases clearly underrepresents that potentially large area. Nevertheless, the study has shown that it is likely that a significant proportion of motorcyclists who are injured and treated for their injuries rely upon public aid to pay the hospitalization costs.

This means that the taxpayers in Illinois are supporting the hospitalization and treatment of about one-quarter of injured motorcyclists in that state.

Secondly, among those motorcyclists who are more seriously injured, the incidence of head injuries was also substantially elevated. For example, while 24.5% of the motorcyclists received injuries to the head, among those who died as a result of their injuries, 43% were head-injured, clearly indicating the vulnerability of the head in serious and fatal injuries. The treatment costs of those who received fatal head injuries was substantially greater than those who died from injuries other than to the head. In addition, although there was only one case in this sample which was referred to a skilled nursing facility, presumably for more extensive rehabilitation, that individual sustained a serious head injury. The cost for hospitalization alone for that one case was \$35,000. Similarly, among those individuals who were transferred to another hospital, the hospitalization costs of those who received head injuries were double those who received only injuries to other parts of the body.

Thirdly, the study provides information about the costs of the hospitalization charges that are involved in the treatment of injured motorcyclists and their passengers. Overall, the mean hospitalization cost was \$6222. Of particular interest are the analyses which related differences in costs and other variables of those who incurred injuries to the head compared with those in which head injuries were not involved.

In every comparison injuries to the head produced substantially larger hospitalization charges. There can be little question that the attendant costs of surgical and other procedures, which were not obtained in this study, will be larger than those for hospitalization alone. In one study, total treatment costs including hospitalization were three times those of the costs of hospitalization alone (6).

Unfortunately, this study was not able to obtain information concerning which of the patients were wearing helmets, so that an analysis was not possible of the injuries received by persons wearing helmets for comparison with those who were not wearing them. However, in Illinois and many other states which do not have a helmet law, observations have indicated that helmets are used by

approximately 43% to 57% of motorcyclists (4, 5, 8, 12). This finding was substantiated in the April 1984 observational surveys as well. Thus it would have been expected that the present sample also consisted of approximately that proportion who were wearing helmets. However, the study by Hurt et al (4) showed that, whereas 50% of motorcyclists in the area of the study were wearing helmets, among those with more serious injuries only 40% were wearing helmets. Thus, an estimate of 50% helmeted in this sample of *injured* motorcyclists may be an overestimate.

With the data at hand, there is no way to show whether those who were wearing helmets received fewer injuries to the head than those not wearing helmets. But reliance can be placed on prior studies which have consistently shown that helmets are effective in reducing injuries to the head (4, 5, 6, 15).

The 1977 study done in Kansas (6) showed that the mean hospital expense of helmeted riders was \$2306 and unhelmeted riders \$6666, or 2.9 times that of helmeted riders. The mean for hospitalization costs for all injured motorcyclists (with or without helmet) are about 25% lower than the mean of \$6222 in this study for 1981-82 Illinois cases, indicating the increased costs of hospitalization in the intervening years.

Similarly, total medical treatment and hospitalization costs in Kansas were \$5976 for helmeted riders and \$17,886 for unhelmeted riders, or 3.0 times the cost of helmeted riders. If the 1977 cost data from the Kansas study are increased by about 25%, then the mean hospital and medical treatment costs of helmeted motorcyclists are estimated at \$7470 and \$22,357 for the unhelmeted.

In 1982 in Illinois there were 6792 injured in motorcycle collisions and 187 deaths (operators and passengers) (10). If all motorcyclists wore helmets, and assuming that approximately 50% of them now do and are as likely to be in a crash as those not wearing helmets, the costs of those injured would be the same as for those now wearing helmets.

Present costs of hospitalization and medical treatment for the 6792 injured and 187 killed in motorcycle crashes in Illinois would therefore be estimated as follows:

	Injured Helmeted Riders	Injured Unhelmeted Riders
	<u>N=3489 @ \$7470</u>	<u>N=3489 @ \$22,357</u>
<u>Subtotal:</u>	$\$26 \times 10^6$	$\$78 \times 10^6$
<u>Total (helmeted and unhelmeted):</u>	$\$104 \times 10^6$ (A)	

If all riders were helmeted,
the costs would be estimated as: $N=6979 @ \$7470 = \52×10^6 (B)

Therefore, a potential savings in medical expenses of about \$52 million could result if all motorcyclists in Illinois wore helmets (A - B). Immediate savings to taxpayers would be of the order of 25% of the above amount in reduced public aid payments, or \$13 million.

These data clearly indicate that the prevention of head injury would have beneficial effects in reducing the treatment and rehabilitation costs of crash-involved motorcyclists. Furthermore, since a substantial proportion of those expenses are paid by public funds, it is in the public interest to insure that head injuries among motorcyclists, as well as all other types of injuries are reduced as much as possible. Because Illinois is a state which does not presently have a law that requires motorcyclists and their passengers to wear helmets, the state is incurring unnecessary costs for lost productivity, disability payments and direct state aid for treatment costs for *preventable* trauma.

Extensive research has indicated that helmets are the single most effective device in the prevention of head injuries to motorcyclists in collisions (4). Several studies have also shown that most motorcyclists in Illinois already own a helmet (12, 15). Therefore, requiring their use would not place any significant financial burden upon motorcyclists. Furthermore, such laws are enforceable due to the visibility of the helmet.

RECOMMENDATIONS

- . Information on motorcycle related fatalities is readily available in the US. Nonfatal injury information is sorely lacking. Well defined research studies are needed to document the incidence and especially the severity of nonfatal casualties, particularly those resulting in permanent disability.
- . While the Abbreviated Injury Scale is the system of choice worldwide for assessing road related trauma, it was not used in this study which focused principally on estimating cost of motorcycle related casualties. Assigning dollar values to the AIS in order to compare disparate types of injuries is not a valid use of the AIS. A disability scale to complement the AIS should be developed in order to assess long term consequences and corresponding societal costs.
- . Linkage between police and hospital records is necessary to define the injury picture. Helmet use or nonuse should be routinely recorded in the injury record, and the injuries should be coded according to the AIS.
- . This study did not include the relationship of alcohol as a causative factor in motorcycle collisions. However, the data collectors noted a substantial incidence of alcohol impairment as reported in hospital records. This area needs further study.
- . Helmet use in the US decreased by 40-50% following repeal of laws since 1976 requiring their use, resulting in a significant increase in serious and fatal head injuries. Laws requiring helmet use by all age groups of motorcyclists are an effective public health measure and should be re-enacted immediately.
- . While this study did not concentrate in detail on specific injuries in all body regions, the vast majority of injuries were to the lower extremities. If motorcycles continue to be an accepted mode of transport, they must be designed to offer more protection to lower limbs.

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