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TRENDS IN DEATHS DUE TO MOTORCYCLE CRASHES AND RISK FACTORS IN INJURY COLLISIONS†

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Abstract—In the past 25 years, the numbers of registered motorcycles in the United States and California have increased about 1000 and 1100%, respectively. In the same period, the motorcycle collision death rate per million population more than doubled. The purposes of the study were to examine time trends in deaths due to motorcycle collisions, examine a methodologic problem in the study of motor vehicle collision death rates, and to determine driver and vehicle factors which may discriminate in the production of motorcycle crash related injurites.

With the exception of 1974, the increase in the ratio of registered motorcycles per 100,000 population in the United States corresponded to an increase in the crude death rate per million population. A similar pattern was also found in California.

Stepwise discriminant analysis was used to determine an optimum set of factors associated with motorcycle collision injuries. The analysis indicated that for male drivers age was the single factor most significantly related to motorcycle collision injuries. Other factors, in addition to age, which added to the power of the discrimination included number of prior motorcycle driving violations, frequency of motorcycle use, number of prior motorcycle crashes, motorcycle drivers' training, and height of the drivers.

INTRODUCTION

In the 25 year period from 1950 through 1974, motorcycle registrations in the United States increased about 1000%, from 453,874 to 4,969,000 [U.S. Department of Health, Education, and Welfare, 1967; National Safety Council, 1969–1973; U.S. Department of Transportation, 1950–1974]. This increase was most evident in California, where registrations increased 1111%, from 54,948 to 665,273. In 1974 more than 13% of all motorcycles in use in the United States were registered in California [California Department of Motor Vehicles, 1974]. The increasing use of motorcycles for transportation and recreational purposes has produced great concern over the number of deaths and injuries associated with their use. For example, in 1950 the death rate related to motorcycle crashes was 6.3 per million population in the United States and by 1974, the rate had more than doubled to 14.9 per million population. Moreover, such death rates in California have been consistently higher than for the remainder of the United States. For example, the death rate in California in 1950 was 13.7 per million population, while for 1974 the rate had almost doubled to 25.5 per million population.

There is a notable absence of reliable data on the incidence of motorcycle crash injuries. The National Safety Council [1973] estimated about 350,000 motorcycle crash injuries per year while the National Center for Health Statistics [1970] indicated 140,000 injuries per year. The difference in frequencies may be due to nonsimilarity in definitions of an injury and methods of injury ascertainment. Also, the National Center for Health Statistics estimate includes persons who were injured in bus and sports car crashes. The paucity of specific information on factors contributing toward the incidence of motorcycle crash injuries prompted us to initiate an intensive retrospective investigation of motorcycle-related injuries and deaths. Some findings on our studies in Sacramento County were reported earlier [Kraus, Riggins, Franti, 1975a, b]. The three areas studied included: patterns of injuries sustained in motorcycle crashes, factors associated with the incidence of these crashes, and factors contributing to the severity of injuries sustained.

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The present study was undertaken to examine time trends in motorcycle crash-related deaths in California and the United States, examine a methodologic problem associated with the study of motor vehicle collisions, and to determine using stepwise discriminant analyses, an optimum set of driver and vehicle factors associated with motorcycle crash injuries.

MATERIALS AND METHODS

Sources of data

Data on motorcycle crash-related deaths for the United States from 1950 through 1959 were obtained from a report by the U.S. Department of Health, Education and Welfare[1967]. Numbers of motorcycle deaths from 1960 through 1967 were obtained from unpublished figures from the U.S. National Center for Health Statistics. For the period from 1968 through 1974, numbers of motorcycle deaths were obtained from reports by the National Safety Council [1969–1973]. Figures on California motorcycle crash-related deaths from 1950 through 1972 were obtained from the State of California Department of Health, vital statistics reports. Estimates on numbers of motorcycle crash deaths in California for 1973 and 1974 were obtained from the California Highway Patrol.

The numbers of registered motorcycles for the United States were abstracted from reports published by the U.S. Department of Health, Education, and Welfare[1967], U.S. Department of Transportation [1950–1974] and the National Safety Council [1967–1974]. Numbers of motorcycles registered in California were obtained from the State Department of Motor Vehicles [1975]. Population data for California from 1950 through 1972 and the United States from 1950 through 1974 were abstracted from U.S. Bureau of the Census reports. California population data for 1973 and 1974 were obtained from the California Department of Finance.

The use of motorcycles in California and the remainder of the United States was estimated by calculating the ratio of registered motorcycles per 100,000 population for each year from 1950 through 1974.

Data for motorcycle crash-related injuries in Sacramento County, California

Methods of investigation and findings related to the pattern of motorcycle crash-related injuries as well as driver, vehicular, and environmental factors associated with those crashes which occurred in 1970 in Sacramento County, California have been reported in detail eslewhere [Drysdale, Kraus, Franti *et al.*, 1975; Kraus *et al.*, 1975a, b]. However, for continuity and completeness, certain important methodologic points are summarized in this report.

In order to identify persons injured in motorcycle crashes which occurred in Sacramento County during 1970, injury reports were obtained from the Division of Accident Records of the California Highway Patrol, and from Sacramento City and County police agencies. In addition, the medical records of all persons seen in emergency rooms or admitted to Sacramento County hospitals in 1970 were searched for data on patients injured in motorcycle crashes which occurred in the county. Injured motorcyclists who were nonresidents of Sacramento County were not included in the analysis. No practical means were available to identify Sacramento County residents injured outside the county. Death certificates from the Sacramento county Health department and records of the Sacramento County Coroner were examined to identify those who died as a result of a motorcycle crash.

To ascertain differences between injured motorcyclists and an appropriate comparison group with respect to certain driver and vehicular characteristics, a random sample of 738 motorcyclists (about 3% of the 27,467 registered motorcycle owners) was drawn from the list of all registered motorcycle owners residing in Sacramento County in 1970. We reported previously [Kraus, Riggins and Franti, 1975a] that of the random sample of 738 registered motorcycle owners (operators), 19 of 677 drivers (61 owners/operators claimed they did not own or operate a motorcycle in 1970) sustained a medically treated motorcycle crash injury, a rate of 28.1 per 1,000 registered motorcycle drivers. The list provided by the California State Department of Motor Vehicles also included information on the number and makes of all registered motorcycles. Using the motorcycle identification number, the engine size for 81% of the registered motorcycles was obtained from their manufacturers.

Information on driving history for the injured motorcycle drivers and members of the comparison group (noninjured drivers) was obtained from the State of California Department of

Motor Vehicles. In California, drivers' records are purged every three years. Hence, it was possible to obtain precrash driver-record data for injured drivers only for a period of six months before the date of the crash. The 18 month period following the crash was specified as the post-crash period. For noninjured drivers, 1 January 1970 was selected as the target date, thus, the "precrash" period extended from 1 July 1969 to 31 December 1969. The "postcrash" period included 18 months after the target date (1 January 1970–30 June 1971).

Since police accident reports did not provide sufficiently detailed data on relevant driver characteristics, a self-administered questionnaire was mailed to all survivors of motorcycle crashes and all members of the comparison group. Two follow-up letters and two phone calls were made to maximize the level of response to the questionnaire. Since some motorcycles could have been registered to nonoperators, such as parents, a letter which accompanied the questionnaire requested that only operators of the motorcycle provide the information.

For purposes of this study, machine-related information requested in the questionnaire was limited to readily ascertainable factors, such as make, engine size, modifications, and age (model year) of the motorcycle.

Data analysis

To control the confounding factors of sex and driver/passenger status to the factors evaluated, the analyses were limited to comparisons of male drivers only. Further, 19 separate but not necessarily independent driver characteristics (age at time of crash, height, weight, training, and driving experience as well as numbers of previously reported motor vehicle crashes, injuries, traffic violations, and suspensions) and one vehicular factor (engine size) (Table 1) were evaluated using stepwise discriminant analyses [Dixon, 1971] to identify the best set of discriminator(s) between persons in the injured and comparison groups.

The stepwise discriminatory procedure first identified the best single discriminator of

Table 1. Descriptive factors available for discriminant analyses, Sacramento County, 1970

Factor	Measure
1. Age	Years
2. Weight	Pounds
3. Height	Inches
4. Motorcycle (m/c) driver's training	Yes = 1, No = 2
5. How often rode m/c in 1970	1 = Freq., 2 = Occas., 3=Rarely, 4=Almost never
6. Helmet use	1 = Always, 2 = Sometimes 3=Rarely, 4=Never
7. Eye protection	1 = Always, 2 = Sometimes 3=Rarely, 4=Never
8. How long drove car before 1970	In weeks/months
9. Serious m/c injury before 1970	Yes = 1, No = 2
10. A helmet law in California	Yes = 1, No = 2
11. m/c violations 6 mos. before crash or target date*	Number reported
12. m/c violations 18 mos. after crash or target date*	Number reported
13. Auto violations 6 mos. before crash or target date*	Number reported
14. Auto violations 18 mos. after crash or target date*	Number reported
15. m/c reported accidents 6 mos. before crash or target date*	Number reported
16. m/c reported accidents 18 mos. after crash or target date*	Number reported
17. Auto reported accidents 6 mos. before crash or target date*	Number reported
18. Auto reported accidents 18 mos. after crash or target date*	Number reported
19. Suspensions, probations, revocations 18 mos. after crash or target date*	Number reported
20. Capacity of motorcycle	Cubic Centimeters (cc's)

*Target date includes the driver record during the period July 1, 1969 to December 31, 1969 for members of the non-injured driver group. Post-crash target date includes the driver record from January 1, 1970 to June 30, 1971

motorcycle injury among the 20 factors. Other factors were added sequentially to the set of discriminating factors, these sets having the property that given the best previous set of discriminators, the augmented set was better. The stepwise procedure was halted when the addition of another factor did not significantly ($p = 0.01$) improve the ability to discriminate between members of the injured and non-injured groups or when the discriminating set of factors exhausted the entire set of candidate factors.

The first discriminant analysis involved a random sample of 150 injured and 150 noninjured motorcyclists. Subsequent analyses were performed on age-limited groups, those less than 25 years of age and those 25 years of age and older. One hundred injured and 100 noninjured drivers were evaluated in each of the two age groups. The validity of discriminant function was determined on the remaining injured and noninjured drivers in the corresponding age groups.

Prior to discriminant analysis the data file for each injured driver and noninjured driver was examined for missing data. Thirty-seven of 407 noninjured drivers and fifty-five of the 557 records for injured drivers were found to have incomplete information on the questionnaire or driver record and were excluded from analyses.

RESULTS

Magnitude and trends in motorcycle deaths

Total United States. The motorcycle crash unadjusted (crude) death rate per million population in the United States declined slightly in the early 1950's as illustrated in Fig. 1. Since about 1963, however, there has been an upsurge in unadjusted death rates due to motorcycle crashes. (Figure 2 shows the decrease in the ratio of registered motorcycles per 100,000 population which corresponded to the slight decrease in the United States unadjusted death rate in the early 1950's.) A sharp increase in the ratio of registered motorcycles per 100,000 population (Fig. 2) of about 28% per year from 1963 through 1966 corresponded to an upsurge in the population death rate during that the same period. From 1967 through 1969, the average increase in the ratio of registered motorcycles per 100,000 population was about 10% per year. During this same period, population death rates for motorcycle crashes (Fig. 1) declined. After this period of decline, and beginning in 1969, the United States population death rate continued to increase until 1973 at which time it leveled off and remained unchanged in 1974. There was, during this period, a continuing increase in the ratio of registered motorcycles per 100,000 population for the United States (Fig. 2). Of interest was the fact that in the United States the death rate reached a peak in 1973 and 1974 (Fig. 1), yet the ratio of registered motorcycles (Fig. 2) continued to climb at about the same rate per year as during the previous decade.

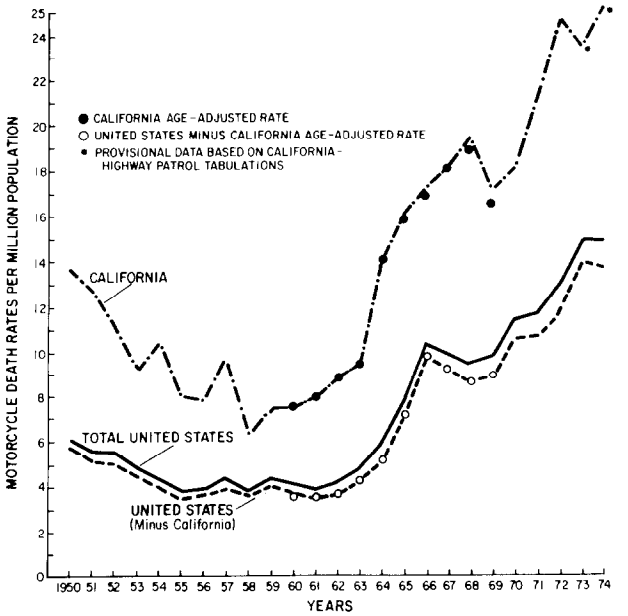

Fig. 1. Crude and age-adjusted population death rates for motorcycle crashes—United States, California, and U.S. minus California, 1950–1974. (Reprinted with permission—*Am. J. Epidemiology* **102**, 77, 1975).

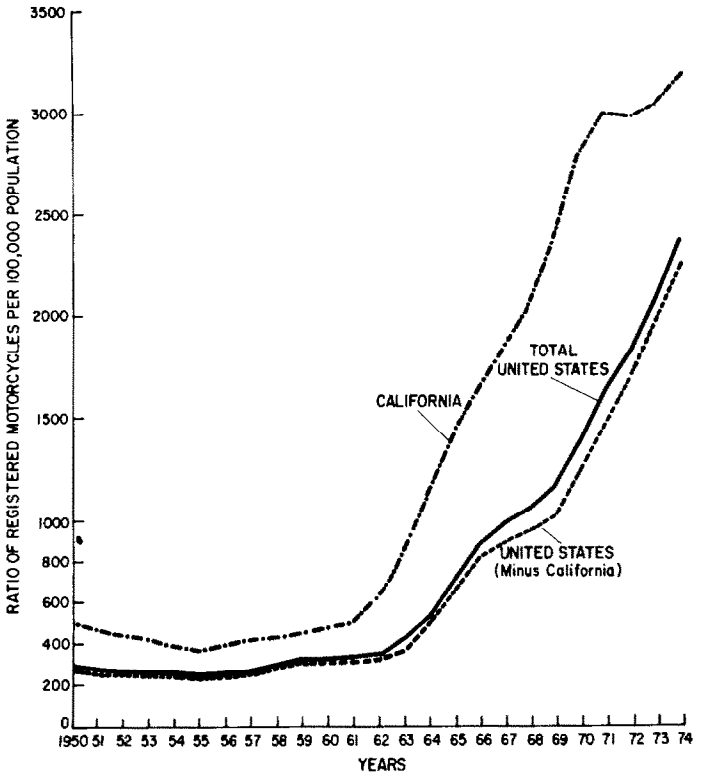

Fig. 2. Registered motorcycles per 100,000 population—United States, California, and U.S. minus California, 1950–1974. (Reprinted with permission—*Am. J. Epidemiology* **102**, 78, 1975).

A comparison of the motorcycle crash-related death rates and ratios of registered motorcycles per 100,000 population for the 25 year period of 1950 through 1974 in the United States (Figs. 1 and 2) indicates that, with the exception of the early 1950s and 1970 through 1974, the trend in the increase in motorcycle death rates was similar to the trend in the increase in the ratio of registered motorcycles per 100,000 population.

California. Although the overall trend of unadjusted motorcycle crash death rates per million population for California for 1950 through 1974 was similar to that of the United States (Fig. 1), chi square tests showed California rates were consistently and significantly higher ($p < 0.0001$). A

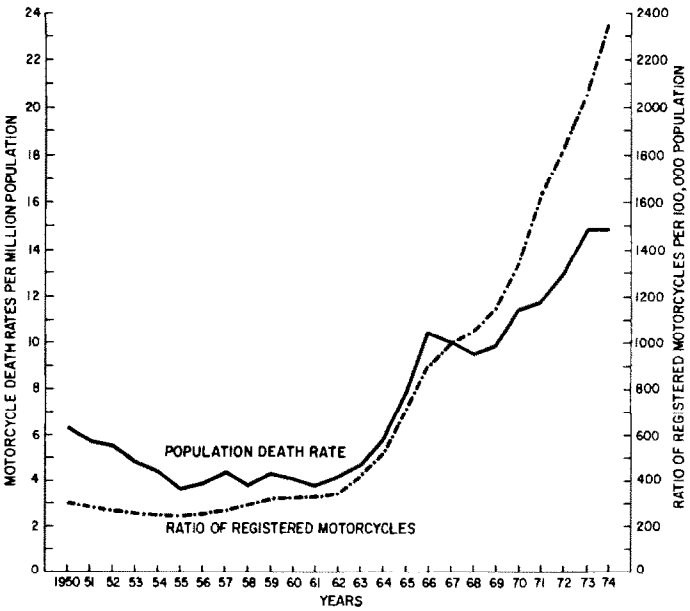

Fig. 3. Motorcycle crash death rates and ratio of registered motorcycles, United States, 1950–1974.

slight decrease in the ratio of registered motorcycles per 100,000 population of about 2.5% per year in the early 1950's (Fig. 2) was accompanied by a decline in the crude death rates per million population (Fig. 1). However, the sharp increase in the ratio of registered motorcycles per 100,000 population (Fig. 2) of about 25% from 1963 through 1970 corresponded to an upsurge in the motorcycle crash death rate, except for the noticeable interruption of 1969 (Fig. 1). It should be pointed out that in 1969 the increase in the ratio of registered motorcycles per 100,000 population was somewhat less than the average of 25% per year for the six preceeding years. Another interruption in the increase in death rate was noted in California in 1973. This interruption was associated with a marked decline in the annual rate of increase in the ratio of registered motorcycles per 100,000 population (Fig. 2).

Many factors could account for the differences in population death rates between California and the remainder of the United States from 1950 through 1974. These factors might include: (1) a larger proportion of California population using motorcycles; (2) a larger percentage of younger persons residing in California, thereby inflating the crude death rate proportionately; (3) greater nonuse of head protection by California drivers or passengers; (4) more numerous driving hazards in California; and (5) longer duration or different patterns of motorcycle use in California due to more favorable weather conditions as opposed to some other areas in the United States.

As shown in Fig. 1, the unadjusted population death rate from motorcycle crashes for the United States minus California was slightly lower but similar in pattern to the rate for the United States as a whole. After age-adjustment there was no appreciable change in the rates from 1960 through 1969 (the only years for which the distribution of United States motorcycle deaths by age were available). Thus, the death rates in California remain significantly higher than those of the rest of the nation. No data were available to evaluate the effect of helmet use on the death rate in California or the effects of duration or differences in motorcycle use, road, or driving hazards. It should be noted, however, that recent reports suggests that mandatory helmet legislation has significantly reduced the mortality rate associated with motorcycle collisions [Bauchanan, Beschoff, Richardson, 1973; Robertson, 1975].

Methodologic problem

An extremely important methodologic point must be considered when evaluating and comparing trends in motorcycle crash death rates in California and the United States, viz. the basis on which the comparisons are made. In the previous discussion, death rates were presented per million population and motorcycle usage was depicted as a ratio of registered motorcycles per 100,000 population. In some earlier reports [Metropolitan Life Insurance Co., 1973], mortality occurrence has been depicted as "*rates*" *per number of registered motorcycles.* Although this expression does not give a true rate of occurrence for purposes of statistical comparison, it does characterize a relationship by expressing the ratio of the number of motorcycle deaths to the numbers of registered motorcycles. Motor vehicle death rates have been reported per number of vehicle miles. A review of the literature failed to yield any information on motorcycle mileage for the United States or California on which a ratio can be calculated for purposes of time-trend analysis. Although death rates are reported per 100,000 population, it is, of course, understood that not all of the population is at *risk* of being killed in a motorcycle crash. That is, not all members of the general population drive or ride motorcycles, and if they did, they all would not have equal exposure to the possibility of a crash.

Risk of death

The rates and ratios which have been used in the past to describe mortality experience from motorcycle crashes are summarized in Table 2. The data relate to California and for 1973 and 1974 only. The motorcycle related death rate per million general *population* is considerably less than that for other motor vehicles. It must be noted, however, that the denominator is identical for both rates.

In California in 1970, legislation was enacted making it mandatory to obtain a special class IV license or an endorsement to an existing license to operate a motorcycle. Hence, an estimate of the number of licensed motorcycle drivers in the State of California was available for the first time. The death rate per million *motorcycle drivers* in California provides a more realistic estimate of the risk of death associated with the operation of motorcycles than the rate derived using the general population as the basis for calculation of the rate (Table 2).

Table 2. Rates and ratios describing motorcycle and other motor vehicle mortality experience in California, 1973–74

Measure	Motorcycle		Other Motor Vehicles	
Deaths per:	1973	1974	1973	1974
Million Population	24	25	211	176
Million Licensed Drivers	4111	4006	344	286
Million Vehicles	778	800	292	242
Billion Vehicle Miles	173*	178*	33	29

*Estimate based on 4500 annual miles per registered motorcycle

When the number of licensed drivers is the unit of comparison, the motorcycle driver specific risk of death is 7 to 12 times higher than the risk associated with drivers for all other motor vehicles. The risk is even greater when one considers that upwards of four to six passengers *may* be killed along with the licensed automobile driver whereas for motorcycles seldom does this number exceed one driver and never more than two passengers.

In 1973–74 in California there were from 778 to 800 deaths per million registered motorcycles compared with 242 to 292 deaths per million for all other motor vehicles. Motorcycle mileage for the United States is based on an average estimate of 4,500 miles per registered motorcycle per year [United States Department of Transportation, 1975]. The ratio of deaths per billion vehicle miles is about 5 to 6 times higher for motorcycles compared to all other motor vehicles.

All of these expressions of the "risk" of death associated with motorcycles or other motor vehicles have limitations. As pointed out earlier, not all persons in the general population are at risk of a motorcycle crash, and hence, of a resulting fatality. While the number of licensed drivers is a fairly accurate representation of the number of persons at risk, it does not include passengers, nonlicensed drivers, or pedestrians who may be struck by a motorcycle. In addition, the risk of injury or death associated with operating a motorcycle is not uniform for all drivers because of differences in frequency and type of use. Although the ratio of deaths per number of registered motorcycles is a useful expression of the notion of risk, it is not an acceptable probability statement for purposes of statistical evaluation. Assuming that actual motorcycle mileage data were known, their accuracy as a measure to exposure to hazard would be open to question because all miles driven are not equally hazardous nor are all conditions for the same miles. The purpose of this discussion has been to point out that consideration must be given to the basis on which estimates of risk of death are derived while describing rates of death associated with motorcycle usage.

Risk factors in motorcycle collision injuries

In almost all previously reported studies of factors associated with injuries from motorcycle crashes, driver/passenger, vehicle, and environmental characteristics have been examined individually or in groups of two or three without regard to their possible interactions with other factors also related to the crash.

In the earlier reports of Kraus *et al.*[1975a, b] and Drysdale *et al.*[1975], the individual relationships between a large number of factors and the occurrence of motorcycle collision injuries were reported. Factors associated with the occurrence of motorcycle collision injuries are summarized in Table 3.

The interrelationship between small groups of factors was assessed by considering these factors simultaneously [Kraus *et al.*, 1975]. For example, when age, height, and weight were considered together the relationship between excess injuries and short stature and light weight persisted for drivers 20 to 24 years of age. In addition, for each age group the proportion of

Table 3. Factors associated with incidence of motorcycle collisions injuries—Sacramento County, 1970*

FACTOR	HIGH RISK GROUP DESCRIPTION
AGE	HIGHEST RATES 15-24, PEAK RISK 17-19
SEX	MALE RATE 10-15 TIMES FEMALE RATE
HEIGHT	SHORTER DRIVERS
WEIGHT	LIGHTER WEIGHT DRIVERS
MOTORCYCLE DRIVING EXPERIENCE	1-12 MONTHS DRIVING EXPERIENCE
MOTORCYCLE TRAINING	THOSE REPORTING HAVING HAD TRAINING
MOTORCYCLE USE	MORE FREQUENT USE
TYPE OF MOTORCYCLE USE	FREEWAYS AND DIVIDED ROADS
MAKE	HARLEY-DAVIDSON, TRIUMPH, BULTACO
ENGINE SIZE	251-500, 501-750 cc
DRIVER'S RECORD	POOREST RECORD OF VIOLATIONS, SUSPENSIONS, REVOCATIONS BEFORE AND AFTER CRASH

KRAUS, ET AL., 1975A, 1975B.

injured drivers reporting motorcycle drivers' training was uniformly higher than that for the comparison group. Stepwise discriminant analysis was employed to study factors relative to their effects on the risk of motorcycle crash injury.

Discriminant analysis for 150 injured and 150 noninjured male drivers of all ages indicated that age of the driver was the single most significant factor related to motorcycle crash injuries. Other factors which were important in discriminating between injured and noninjured male drivers included number of prior motorcycle driving violations, and how frequently the motorcycle was driven during 1970. Over 67% (202 of 300 male drivers) were correctly classified on the basis of these three factors. It should be noted that 196 (65.3%) of 300 drivers were correctly classified on the basis of age alone. Although not adding significantly to our ability to discriminate between injured and noninjured drivers, the number of prior motorcycle crashes, whether the person reported having had motorcycle driver's training, and height of the driver were variables next selected as having potential discriminatory value.

Because of the overwhelming influence of the driver's age, additional age-limited discriminant analyses were performed. In the first such analysis random samples of 100 each of injured and noninjured male drivers less than 25 years of age were studied. For these drivers no variable

Table 4. Factors which discriminate injured from non-injured male motorcycle drivers by two age groups, Sacramento, California 1970

AGE GROUP	FACTORS (IN ORDER OF IMPORTANCE)	CUMULATIVE % CORRECT CLASSIFICATION NUMBER IN CASE/COMPARISON GROUPS	CROSS VALIDATION % AND NUMBER IN CASE/ COMPARISON GROUPS
ALL AGES	AGE (YOUNG) NO. PRIOR M/C* VIOLATIONS FREQUENCY OF M/C USE (LESS) IN 1970 NO. PRIOR M/C CRASHES REPORTED M/C DRIVER'S TRAINING HEIGHT (TALLER)	67.3 (150,150)	59.9 (162/278; 131/211)
<25	NO. PRIOR M/C VIOLATIONS AGE (YOUNGER) HEIGHT (TALLER)	62.0 (100,100)	55.5 (88/166; 23/34)
≥25	AGE (YOUNGER) SELDOM USE OF M/C IN 1970 NO. PRIOR M/C CRASHES PRIOR AUTO EXPERIENCE BEFORE 1970 LESS USE OF EYE PROTECTION LARGER SIZE OF M/C REPORTED M/C DRIVER'S TRAINING	72.0 (100,100)	65.1 (43/62; 80/127)

*M/C = MOTORCYCLE

alone was able to discriminate between injured and noninjured drivers but jointly the variables correctly classified 124 of 200 drivers (62.0%). Motorcycle collision injuries for drivers less than 25 years of age were associated with increased number of motorcycle violations prior to the collision or target date, younger age, and increased height.

Among the older group of motorcyclists (25 years or older), the injured drivers tended to be younger, had less frequently ridden their motorcycles previously in 1970, had greater numbers of prior motorcycle crashes, reported wearing eye protection more frequently, had slightly more experience driving an automobile, drove larger motorcycles (large engine size), and were more likely to have reported receiving motorcycle drivers' training. These seven variables correctly classified 144 (72%) of 200 drivers. Interestingly, age alone correctly placed 126 (63%) of these 200 older drivers.

Among the young (<25 years of age) drivers, cross validation correctly placed 88 of 166 injured drivers and 23 of 34 noninjured drivers. ($\chi^2_{(1)} = 4.82$, $p < 0.05$). Among the older (25 years of age and older) drivers, 43 of 62 injured drivers and 80 of 127 noninjured drivers were correctly classified by cross validation ($\chi^2_{(1)} = 17.48$, $p < 0.001$).

DISCUSSION AND SUMMARY

The data substantiate the high risk associated with youthful operators of motorcycles. Older drivers represent survivors from the younger ages who were at high risk, so that experience with motor driven vehicles may be another reflection on the age of the driver.

Age-limited discriminant analysis identified prior motorcycle violations, prior motorcycle crashes, and automobile driving experience as risk factors in motorcycle crash injuries. These factors may indicate "collision-susceptibility" of certain motorcycle drivers, that certain drivers are less discerning of hazards or are willing to take more chances, or have differences in quality and quantity of exposure while operating a motorcycle. The identification of motor vehicle violations and prior collisions as factors suggests some drivers are less mindful of the customary courtesies and precautions in motor vehicle operation, irrespective of whether they are driving automobiles or motorcycles.

With extant data, the researcher is dependent upon the ability of the driver to recall certain events and the traffic officer to record certain relevant data on the accident report form. With retrospective studies it is difficult to obtain data on all factors of interest as was the case in this study. Hence, it is clear that additional prospective studies are needed to elucidate more clearly the influence of the various human, vehicular and environmental factors that produce motorcycle crash injuries.

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