

Fatalities Involving Bicycles: A Non-random Population

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ABSTRACT: Bicycle riders constitute a small subgroup of all roadway deaths. Bicycle/motor vehicle collision fatalities are less frequent than pedestrian/motor vehicle fatalities. Studies have shown that non-fatal injuries of bicyclists are not randomly distributed, but follow age and sex trends that differ in the U.S. and Scandinavia. Although the bicycle-related fatalities reviewed herein do not constitute a complete profile of all such cases within our geographic area, review of these cases does provide insight into the non-random population of fatally injured cyclists in urban and rural America. A retrospective demographic and forensic medical review of 36 bicycle-related fatalities was done to clarify features of this non-random population. Consistent features including age and sex, patterned injuries and risk-taking behavior are discussed. Three of 24 (12%) adult cyclists died of homicidal gunshot wounds.

KEYWORDS: pathology and biology, motor vehicle accidents, motor vehicle accident reconstruction, pattern recognition, postmortem examinations, patterned injuries, autopsy

In the ten-year period 1984 through 1993, bicycles were involved in 36 of 6552 consecutive cases examined by autopsy in the Forensic Pathology section of the Department of Pathology and Laboratory Medicine at Indiana University School of Medicine in Indianapolis. Cases were referred from elected county coroners throughout central Indiana. Indiana coroners are not required by law to obtain autopsies in all bicycle/motor vehicle collisions. These 36 cases are a non-random sample of all such incidents—those deemed by the local coroner to require autopsy. While the geographic distribution for cases included virtually the entire state of Indiana, only two of the cases were actually referred from rural areas outside the city of Indianapolis. Reported data for these 36 cases show a definite trend: in Indiana, adults killed on bicycles are typically male. This finding is similar to data reported from Rhode Island and Seattle, but unlike data reported in Finland, where a much larger percentage of the adult population ride bicycles, and fatal accidents are almost equally distributed between men and women [1-3].

Circumstantial Data

Twenty-six of our 36 cases involved bicyclists who were riding their bicycle when struck by a motor vehicle. The other ten cases

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included one person struck by a vehicle while walking a bike, one motorized (moped) bicyclist struck by a vehicle, three fatal accidental falls from the bike, three deaths by natural disease while riding, and two intentional murders of cyclists by gunshot wounding (Fig. 1). Twelve of the 26 deaths-while-riding involved children below the age of legal operation for motor vehicles, and this group included 7 boys and 5 girls (Fig. 2). Fourteen of the 26 deaths-while-riding involved adults older than the minimum legal driving age, and all 14 were male.

Four of the 26 riders struck by vehicles were hit-and-run incidents, and all of these cases involved adult male bike riders. One of these incidents was alleged to have occurred as an intentional murder. With this case reported as "homicide," intentional murder accounted for 8% (3 of 36) of all cases, or 12% (3 of 24) of the adult deaths.

36 Bicycle-related Fatalities

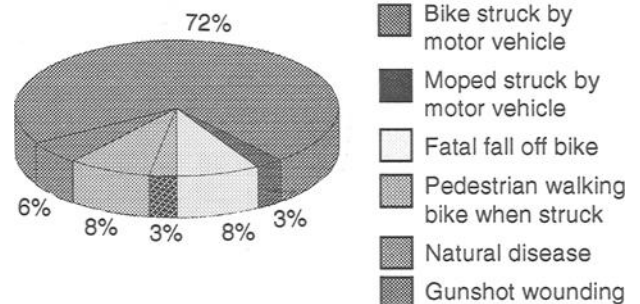


FIG. 1—Mode of fatal injury for 36 "bicycle-related" deaths.

26 Bicyclists Struck by Motor Vehicles While Riding

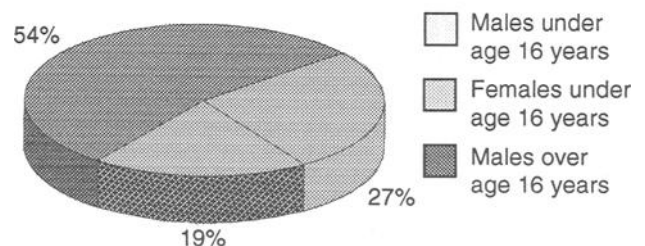


FIG. 2—Age and sex distribution for fatal bicycle/motor vehicle collisions.

Distribution of Fatal Injuries in Bicycle/Motor Vehicle Impacts

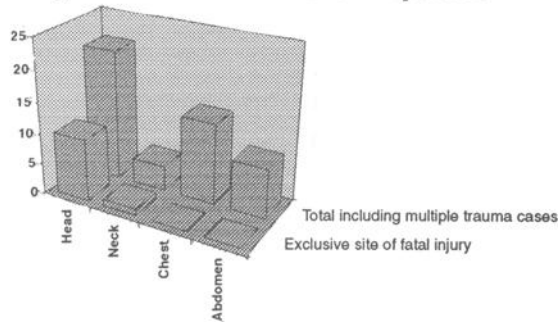


FIG. 3—Distribution of fatal injuries by body area for bicycle/motor vehicle collisions.

Coroners did not report whether any of the bicyclists had current driver's licenses, so it was not possible to determine how many of the adult cyclists had suspended licenses. The usefulness of investigative reports in these mishaps was limited, and varied among different law enforcement agencies. The murder cases were well documented by detectives at the scene; otherwise, police reports were not even submitted, unless the dead body was present at the scene of the accident and had to be removed from the street by the coroner. This phenomenon of inadequate investigative reports for bicycle-related mishaps was previously well-documented in Los Angeles and Helsinki [3,4].

All cases were tested for alcohol and drugs of abuse, and no cases were positive. Absence of alcohol in bicycle-related fatalities was previously reported in Finland [5].

Injuries

For bicyclists struck by motor vehicles, the distribution of fatal injuries by body region is shown in Fig. 3. Head injury accounted

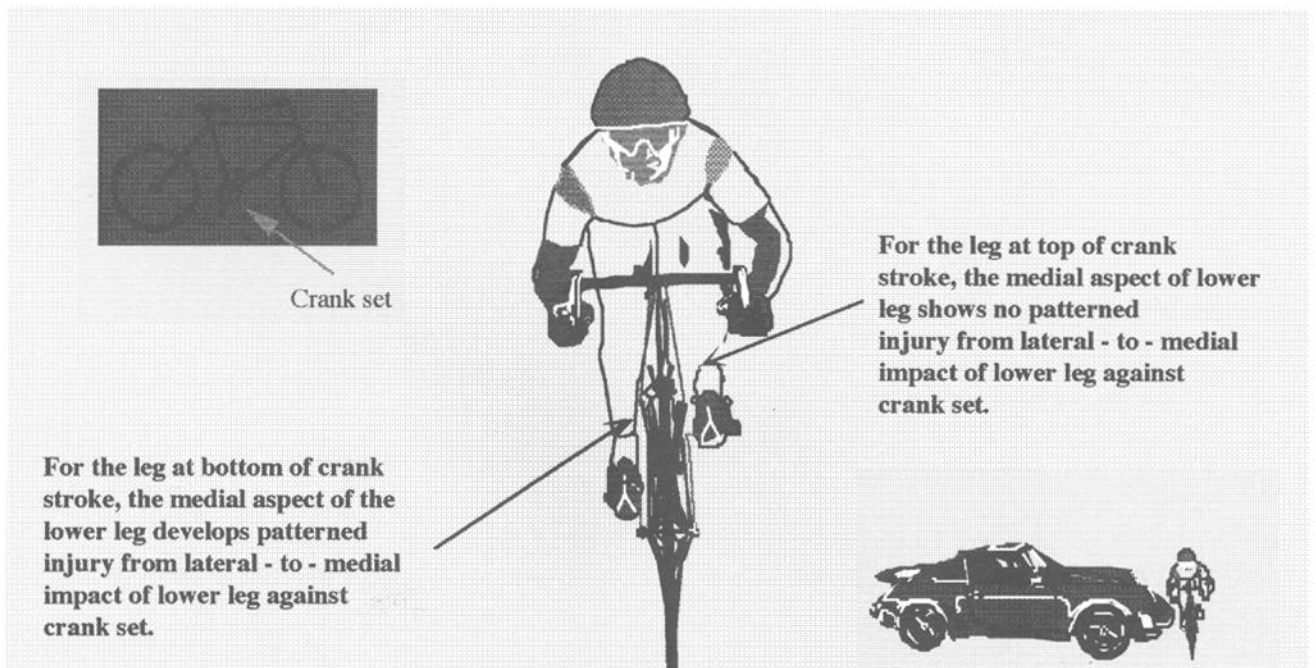
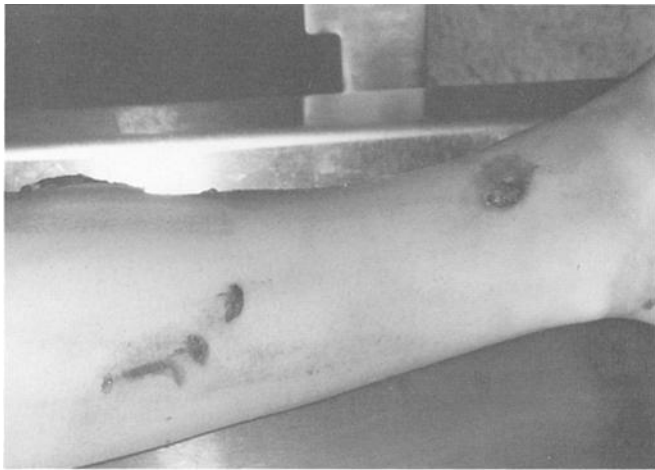


FIG. 4—Patterned injuries of medial lower leg produced by bicycle crank set.

for the fatal wound in nearly all of the riders struck by vehicles (25 of 26 cases). This experience is uniformly reported in other large population studies concerning bicycle helmet use [2,6]. Isolated fatal neck injury was uncommon (1 of 26 cases). Isolated fatal chest or abdomen injury did not occur.

Patterned injuries specific for bicycle riders were reviewed in each of the 36 cases. A patterned stamp abrasion and puncture wound of the medial lower leg, probably produced by the bicycle crank set, was observed in two of the riders struck by motor vehicles (Fig. 4 *a* and *b*). This injury could occur from lateral-to-medial impact of the vehicle into the lower leg, carrying the medial aspect of the lower leg into the crankset. The patterned injury would only be present if the impacted leg were struck while the foot was at the bottom of the crank stroke (Fig. 4*c*). If the foot were at the top of the crank stroke at the instant of impact, the medial aspect of the lower leg would not stamp into the crank set.

A patterned stamp abrasion of the anterior abdomen was observed in one child who fell from a bicycle and probably landed on the handlebar end, producing laceration of the liver (Fig. 5). Otherwise, the injuries observed in our cyclists were essentially identical with the injuries sustained by pedestrians in motor vehicle impacts.

Protective Gear

We were unable to document helmet use in any of these cases. The coroner's investigative reports did not specify helmet use in any case. Several of the victims in our cases were dead at the scene, so all clothing and property was available at the autopsy. The case photographs of clothed bodies, and clothing lists from the cases, do not include a single case where a helmet, protective or reflective clothing, cycling shoes or lights were recovered. For two of the adult males struck by vehicles, the coroner's reports did specify that the collision occurred in pre-dawn darkness and that the bicycles had no lights. These same two cases included clothing lists that specifically mentioned dark-colored clothing.

Anecdotal Experiences

In one of the deaths by natural disease, an adult male rider was witnessed to fall off his bike onto the roadside. His bicycle, lying at the side of the roadway, was then overrun by a hit-and-run vehicle. The body, not struck by the vehicle, showed no injuries. Death was due to arteriosclerotic occlusion of coronary arteries. Investigators first arriving at the scene worked under the impression that the rider had been struck by a motor vehicle.

One of the shootings was investigated as a hit-and-run case. Seven gunshot wounds were identified at autopsy.

One of the adult male cases involved a person described by investigators as "mentally retarded," and this mishap occurred during predawn darkness as the darkly clothed rider was pedaling to work on city streets. One of the adult males murdered by gunshot wounding was also described as "mentally retarded," and frequently rode a bicycle through an urban neighborhood at night.

In summary, the population of fatally injured bicyclists is not random. Andrews noted that an estimate of injuries-per-mile-of-biking is not possible, because careful recreational bicyclists log thousands of injury-free miles while other risk-taking individuals may show significant injuries as often as every 3.3 miles [7].



FIG. 5—Patterned stamp abrasion of abdomen produced by fall against end of handlebar.

Our population of fatally injured cyclists appears to be skewed significantly toward individuals at high risk of injury whether cycling, walking or driving. We believe but are unable to document that most of our fatally injured adult cyclists were biking instead of driving due to suspension of their driver's license for habitual DUI offense. Data to support this conjecture could not be obtained by us.

Acknowledgments

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