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Wendy J. Pomerantz, Michael A. Gittelman and Gary A. Smith

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# No License Required: Severe Pediatric Motorbike-Related Injuries in Ohio

Wendy J. Pomerantz, MD, MS\*; Michael A. Gittelman, MD\*; and Gary A. Smith, MD, DrPH†

**ABSTRACT.** *Objective.* Motorbikes (MBs), including motorcycles and dirt bikes, are becoming increasingly popular among children and adolescents. MBs are intended for off-road use. Although children who are younger than 16 years cannot be licensed to drive cars, they can drive MBs off-road without licenses. The objective of this study was to determine the epidemiology of severe MB injuries to children who are younger than 16 years in Ohio.

*Methods.* Eight hospitals that admit the majority of pediatric trauma patients in Ohio were approached to participate. Cases were identified using hospital trauma registries and were defined as any hospitalized child who was younger than 16 years and sustained MB injuries between January 1, 1995, and December 31, 2001.

*Results.* Six hospitals participated. A total of 182 children were hospitalized with a mean age of 11.4 years (range: <1–15 years). A total of 89.6% were male, 89.0% were white, 68.7% had commercial medical insurance, and 71.4% were from urban areas. From 1995 to 1997, there were an average of 20 annual admissions; however, from 1998 to 2001, there were an average of 30 per year. Of the 85% of patients with injury events documented, 35.5% were riding in streets and 53.3% were unhelmeted. One patient died; 8 required rehabilitation. The mean injury severity score was 9.9 (median: 9), and mean length of hospitalization was 4.6 days (median: 3). Unhelmeted riders had significantly higher injury severity scores than helmeted ones (11.5 vs 8.4). The difference in mean length of hospitalization of unhelmeted compared with helmeted riders approached statistical significance (6.1 vs 3.7 days). Of the 163 patients with documented diagnoses, there were 510 injuries; 68.7% of patients sustained multiple injuries. Of all injuries, the most commonly injured body parts were lower extremity (23.4%), head (22.2%), abdomen/pelvis (13.4%), upper extremity (12.4%), and face (11.8%). The most common injuries were fractures (37.1%), abrasions/contusions (24.4%), lacerations (13.4%), intracranial injuries (7.5%), and solid abdominal organ injuries (7.5%). Central and Southwest Ohio had higher numbers of hospitalized injuries than other areas.

*Conclusion.* Urban, white boys with commercial medical insurance predominated among children with MB-

related injuries in Ohio. Most injured children did not wear a helmet and sustained multiple injuries. Not wearing a helmet resulted in significantly increased injury severity and a trend toward increased lengths of stay in the hospital. MB-related injuries increased by ~50% during the study period. Children should not operate MBs until they are old enough to obtain a motor vehicle driver's license, which occurs at a minimum of 16 years of age. High-risk populations need to be targeted to reduce these injuries, and requiring helmet use while operating MBs should be pursued. *Pediatrics* 2005;115:704–709; *motorcycle, motorbike, dirt bike, child, injury, epidemiology.*

ABBREVIATIONS. MB, motorbike; ISS, injury severity scores.

Motorized recreational vehicles consist of a wide array of machines that are used by individuals for recreation and transportation. The 2-wheeled vehicles currently being sold in the United States include minibikes, minicycles, trail bikes, mopeds, and motorcycles. Riding 2-wheeled motorized vehicles has been popular since the 1960s. Some vehicles are intended for on-road use by adults, whereas others are marketed for off-road use by children and adolescents. Off-road implies any road that is not a public road; it more commonly refers to any unpaved road or other surface. Some of these vehicles are manufactured for children as young as 4 years. There are currently no federal safety regulations governing the manufacture of these vehicles. In addition, a license may not be required for the vehicle or the rider.<sup>1</sup>

Minibikes are small 2-wheeled motorized bicycles that weigh <45 kg. They have bicycle-style frames and are powered by engines that are <4 horsepower.<sup>2</sup> Some are constructed small enough for a 4-year-old to ride, and they are generally intended for use by school-aged children.<sup>2</sup> Minicycles resemble miniature motorcycles; they have suspension systems and transmissions and run on more horsepower. Trail bikes are designed for rough terrain. They are larger than minicycles, with more horsepower, and are usually approved only for off-road use.<sup>3</sup> All of these vehicles have short wheel bases, small tires, slow acceleration, and brakes that are not ideal for all conditions. In addition, they are usually poorly visible and relatively unstable.<sup>3</sup> Despite that these are off-road vehicles, they are often used illegally on roadways.<sup>4,5</sup>

Mopeds and motorcycles are motorized 2-wheeled vehicles that are intended for use on streets. Mopeds are similar to bicycles but with built-in unenclosed motors; they are intended for use by only 1 person

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and can reach speeds up to 30 mph. Although they are intended to be used on streets, in many states, neither the driver nor the vehicle requires a license, and helmet use is generally not required.<sup>3</sup> Motorcycles are the largest 2-wheeled motorized vehicles. They can attain high speeds but lack stability and crash protection. However, a license is required to operate them in all states.<sup>3</sup>

From 1994 through 1996, ~40 000 injuries were treated annually in emergency departments nationwide related to off-road motorized 2-wheeled vehicles.<sup>6</sup> Twenty-six percent of the injuries occurred among children who were younger than 15 years. Between 1990 and 1995, at least 50 deaths caused by trail bikes and minibikes were reported to the US Consumer Product Safety Commission, 26% of which were among children who were younger than 15 years.<sup>7</sup> Many injuries occur as a result of illegal use on roadways. Other injuries result from striking fixed objects, rocks, holes, or bumps and losing control of the vehicle. In addition, moped-related injuries occur because of collisions with other vehicles, because they are mainly for on-road use and are usually ridden in urban settings.<sup>8</sup> More than half of the victims of moped crashes are younger than 20 years; 1 study reported the average age as <13 years.<sup>9</sup>

Ohio currently has no state laws governing the use of minibikes, minicycles, and trailbikes. For mopeds, 14- to 15-year-olds must pass a vision and road test. If passed, then probationary licenses are given until 16 years of age.<sup>10</sup> These probationary permits may be revoked at any time if any law is disregarded. Other regulations that pertain to mopeds include (1) a rear license plate is mandatory, (2) a driver must never carry another person, (3) a helmet with chin strap is recommended if younger than 18 years, and (4) the driver must ride 3 ft from the edge of the right curb.<sup>10</sup> There is no law requiring use of a helmet while operating these vehicles.<sup>11</sup> For motorcycles, helmets are required for novice riders and those who are younger than 18 years.

It is important to note that children and adolescents often lack the necessary judgment and skills to safely operate these motorized vehicles. In addition, although children < 16 years cannot be licensed to drive cars, they can drive motorized 2-wheeled vehicles without licenses. The purpose of this study is to determine the epidemiology of severe motorcycle/dirt bike (motorbike [MB]) injuries to children <16 years of age presenting to pediatric, urban, trauma hospitals in Ohio to develop targeted prevention strategies for these injuries. Severe injuries were defined as those resulting in hospitalization. We hypothesized that children who are admitted to pediatric hospitals after sustaining injuries while riding motorized, 2-wheeled recreational vehicles will have lower injury severity scores (ISSs) if protective helmets were worn compared with children who were not wearing helmets.

## METHODS

This is a retrospective, epidemiologic study that examined injuries to children who were younger than 16 years of age sustained

while riding 2-wheeled motorized recreational vehicles in Ohio. Eight hospitals in Ohio that admit the majority of pediatric trauma patients in the state were approached to participate in the study. Data for 1995 through 2001 were collected from the trauma registries from the following hospitals: Cincinnati Children's Hospital Medical Center, Cincinnati; Children's Hospital, Columbus; The Children's Medical Center, Dayton; Medical College of Ohio, Toledo; Rainbow Babies & Children's Hospital, Cleveland; and Tod Children's Hospital, Youngstown. Institutional review board approval was obtained at all of the participating hospitals.

All children who were admitted to the participating hospitals and sustained an injury involving a 2-wheeled motorized recreational vehicle were studied. Cases were identified through hospital-based trauma registries using *International Classification of Diseases, Ninth Revision* discharge codes and E-codes, when available. They were defined as hospitalized children who were younger than 16 years and sustained injuries while riding on 2-wheeled motorized recreational vehicles between January 1, 1995, and December 31, 2001. Two-wheeled motorized recreational vehicles included minibikes, minicycles, trailbikes, mopeds, and motorcycles. Data abstracted from trauma registries included race; gender; age; date of birth; date of hospital admission; patients' city, state, county, and zip code of residence; insurance type; date of injury; time of injury; mechanism of injury; E-code; site of occurrence of injury; whether there was loss of consciousness at the scene; safety devices used; Glasgow Coma Scale score; ISS; toxicology report; body part injured; injuries sustained; *International Classification of Diseases, Ninth Revision* discharge code; outcome (whether the patient lived or died); discharge disposition; and length of hospital stay. Glasgow Coma Scale is a score used to assess a patient's verbal, motor, and eye responses to a defined stimulus (range: 3, no response, to 15, normal response); it allows for a neurologic assessment of a patient. ISS is one of the most commonly used assessment scores for patients with traumatic injuries; it is a description of the anatomy and the severity of injury and correlates directly with mortality (range: 0, not injured, to 75, extremely severely injured). Body part injured was placed into 1 of 8 categories: head, neck, face, chest, abdomen, extremity, external, or unspecified.

Patients were excluded from the study when the majority of data concerning the injury event were missing. Data were mapped by zip code of residence using ArcView mapping software to determine whether clusters of injured children from rural or urban settings or from specific areas of Ohio could be identified. When examining and reporting types of the injuries seen and body parts injured, all injuries sustained by all children were included. Data were compiled and analyzed using the Statistical Package for Social Sciences (Release 11.5.0; SPSS, Inc, Chicago, IL).

## RESULTS

Six hospitals participated in the study; 1 hospital declined to participate, and 1 was unable to identify any children from the trauma registry who sustained MB-related injuries. From January 1, 1995, through December 31, 2001, 182 children who were younger than 16 years were hospitalized for injuries sustained while riding 2-wheeled, motorized recreational vehicles. Table 1 lists the demographics of injured children. A total of 89.6% were male, 89.0% were white, 68.7% had commercial medical insurance, and 71.4% were from urban areas. The mean age of the patients was 11.4 years (median: 12 years; range: <1–15 years). The number of injured children from each of the participating hospitals was as follows: 77 from Columbus Children's Hospital, 46 from Cincinnati Children's Hospital, 29 from The Children's Medical Center in Dayton, 12 from Mercy Hospital in Toledo, 9 from Rainbow Babies and Children's Hospital in Cleveland, and 9 from Tod Children's Hospital in Youngstown. Figure 1 shows the zip codes of residence of patients who sustained injuries. It can be seen from the figure that the central and southwest

**TABLE 1.** Demographics of Children Who Were Hospitalized for MB-Related Injuries in Ohio, 1995–2001

Characteristic	No. (%) of injured patients (N = 182)
Gender	
Male	163 (89.6)
Female	19 (10.4)
Race	
White	162 (89.0)
Black	9 (4.9)
Other	4 (2.2)
Unknown	7 (3.8)
Age	
0–4 years	6 (3.3)
5–8 years	29 (15.9)
9–12 years	62 (34.1)
13–15 years	85 (46.7)
Type of insurance	
Commercial	125 (68.7)
Medicaid	14 (7.7)
Self-pay	11 (6.0)
Other	4 (2.2)
Unknown	28 (15.4)
Location of residence	
Urban	130 (71.4)
Rural	44 (24.2)
Unknown	8 (4.4)

areas of Ohio had higher numbers of injured children who were hospitalized in participating hospitals than other areas. Sixty percent of injuries occurred in the summer months, May through June; nearly 70% of the injuries occurred between noon and 8:00 PM, with an additional 21% between 8:00 PM and midnight. The number of injuries by year can be seen in Fig 2. From 1995 to 1997, there were an average of 20 annual admissions; from 1998 to 2001, there were an average of 30 admissions per year.

One patient died; 8 required rehabilitation. The mean ISS was 10 (median: 9; range: 1–45), and mean length of hospitalization was 4.6 days (median: 3; range: <1–100). Of the 155 (85.1%) patients with location of injury documented, 35.5% were riding on streets; of the 152 (83.5%) patients with the presence or absence of protective devices documented, 53.3% were unhelmeted. Unhelmeted riders had significantly higher ISSs than helmeted riders (11.5 vs 8.4;  $P = .02$ ). Children were significantly more likely to have ISSs  $\geq 16$  when they were not wearing helmets (odds ratio: 3.96; 95% confidence interval: 1.29–12.20). The difference in mean length of hospitalization of unhelmeted compared with helmeted riders approached statistical significance (6.1 vs 3.7 days;  $P = .056$ ).

Of the 163 patients with documented diagnoses, there were 510 injuries; 68.7% of patients sustained multiple injuries. As seen in Fig 3, the most commonly injured body parts were lower extremity (23%), head (22%), abdomen/pelvis (13%), face (12%), and upper extremity (12%). Figure 4 depicts the injury types among children. The most common injuries were fractures (38%), abrasions/contusions (25%), and lacerations (13%).

## DISCUSSION

Injuries to children who ride all terrain vehicles or “all motorized recreational vehicles” are com-

monly described in the literature. However, little has been reported specifically about children who ride 2-wheeled motorized vehicles. Riding these vehicles is dangerous; the rider’s body is fully exposed, and there is very little protection during a crash. Although helmets protect the head, and protective clothing, boots, and gloves help to minimize road rash, safety restraints are not possible for these vehicles. Fast vehicles, combined with the immature skeletal systems, strength, coordination, and judgment of many young riders, result in increased potential for injuries.

Urban, white boys predominated among injured children in our study. Most of these children were not wearing a helmet and sustained multiple injuries. These results are similar to other studies that have examined motorcycle-related injuries.<sup>12,13</sup> In addition, ISS, length of hospital stay, and injured body parts were similar to those of other studies.<sup>13–15</sup>

The mean age of the children was 11.4 years. In the United States, it is not legal to drive an automobile without a proper license; and in all states but 1, a license cannot be obtained until a person is at least 16 years of age. Therefore it follows that children who can not be licensed to drive a car should not be allowed to operate 2-wheeled off-road vehicles. The authors support the position of the American Academy of Pediatrics that children who are younger than 16 years generally do not possess the judgment and motor skills to operate a MB safely and that passage of legislation to prohibit the use of 2-wheeled off-road vehicles by children who are younger than 16 years should occur in all states.<sup>1</sup>

It is interesting that more than two thirds of patients in this study had commercial medical insurance. The percentage of patients in this study who were uninsured was less than that in other studies, which have reported between 29% and 75% uninsured.<sup>13,14,16–18</sup>

Ohio does not have a mandatory helmet law for riders of 2-wheeled motorized recreational vehicles. Comprehensive helmet laws are effective in increasing helmet use. Without mandatory helmet laws, helmets are worn less frequently.<sup>14,19</sup> There has been a clear reduction in mortality rates after the enactment of mandatory helmet laws; similarly, with repeal of helmet laws, increased injuries and deaths have occurred.<sup>20–23</sup> Helmets are 67% effective in preventing brain injuries and 29% effective in preventing deaths in motorcycle crashes.<sup>21</sup>

In this study, when a helmet was worn during a crash, the ISS was significantly lower than when a helmet was not worn. In addition, lengths of stay were shorter among crash victims who wore helmets. Although no studies have specifically addressed children, studies of primarily adult patients who ride motorcycles have shown that helmet use is associated with fewer head injuries, decreased length of hospital stay, ISS, and cost of hospitalization.<sup>13,15,20,24,25</sup> Increased cost of hospitalization not only affects the patient but also affects the health care system and society.

It can be argued that insurance premiums should be higher for riders who do not wear helmets. Higher



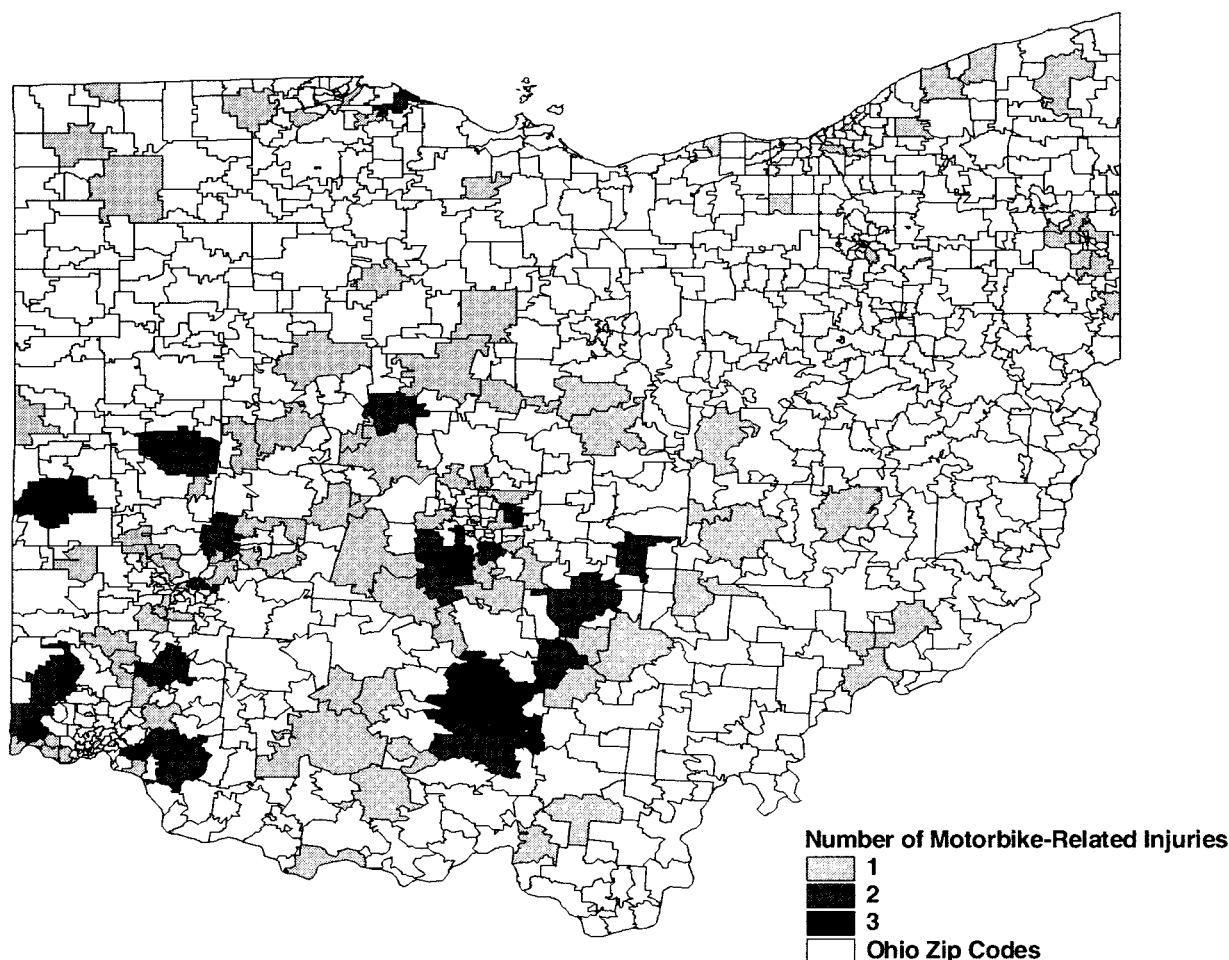


Fig 1. Zip codes of residence of children who were younger than 16 years and hospitalized for MB-related injuries in Ohio, 1995–2001.

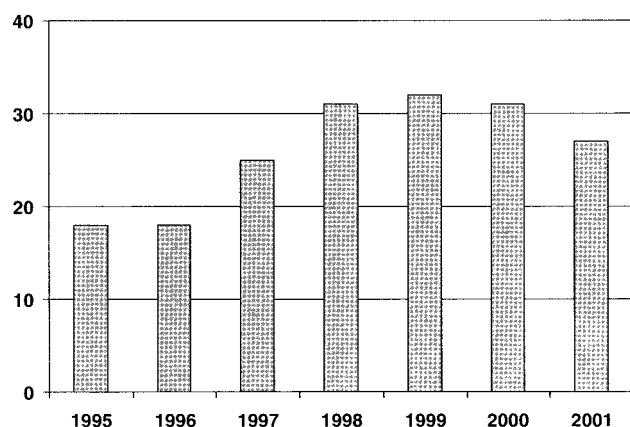


Fig 2. Number of children who were younger than 16 years and hospitalized for MB-related injuries in Ohio by year.

premiums are standard for smokers and those who engage in other high-risk behaviors for which there is a potential for higher health care costs. There also are insurance premium discounts for those who have safety devices in place, such as airbags and automatic seat belts. Insurance discounts should be applied to helmet wearers as well.

The numbers of severe and fatal injuries to children who ride 2-wheeled motorized vehicles have been increasing over the past few years, after drop-

ping during the late 1980s and early 1990s.<sup>6</sup> The annual number of injuries in this study increased throughout the study period. Increased numbers of injured patients could be attributable to an increase in the number of young riders, faster and more powerful vehicles, increased availability of vehicles, more reckless riding, and/or changes in who seeks care in the study's participating hospitals.

It is difficult to know the exact age, physical development, strength, coordination, emotional maturity, and judgment at which children can or should be able to ride these motorized vehicles. The level of tolerable risk likely varies from person to person. Additional data on characteristics of riders, parents, riding conditions and surfaces, protective devices, and effects of legislation would have to be obtained to address these issues better. In the meantime, we support the current American Academy of Pediatrics recommendation that children who are younger than 16 years not operate these vehicles.

There are some limitations of this study. First, this study underestimates the actual burden of the problem in Ohio, because 1 hospital chose not to participate, 1 hospital had no data, and although every attempt to identify all eligible patients was made by participating hospitals, some patients might have been missed. In addition, data were not obtained

Fig 3. Body parts injured among children who were hospitalized for MB-related injuries in Ohio, 1995–2001.

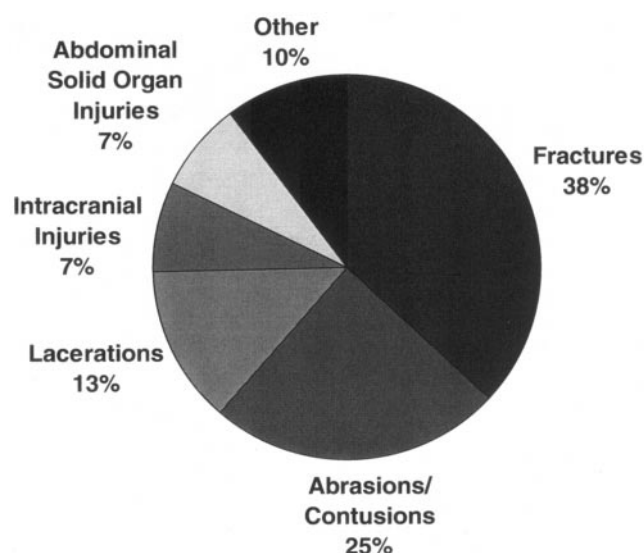
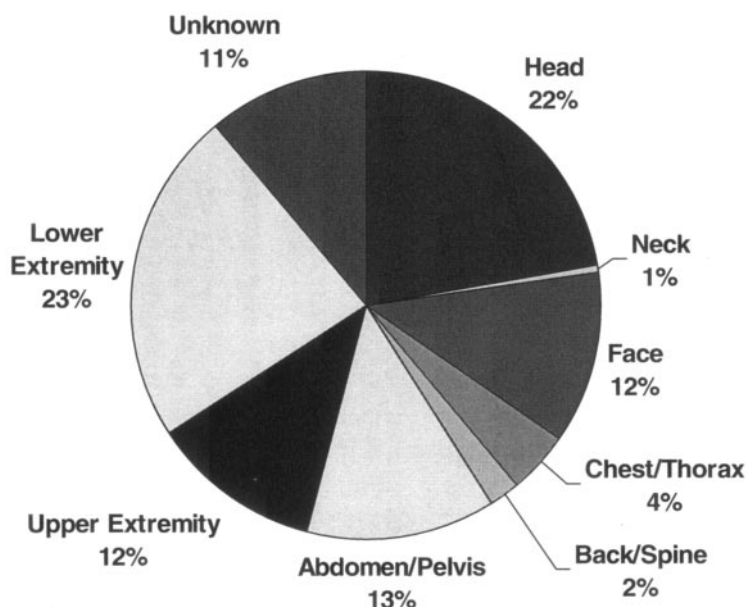


Fig 4. Types of injuries among children who were hospitalized for MB-related injuries in Ohio, 1995–2001.

from all Ohio hospitals or from coroners in the state. Data from coroners is not computerized in many counties and is not collected on a statewide level. Most of the study patients were from Southwest and Central Ohio. This is most likely seen as a result of the hospitals that participated in the study, which may have skewed the results, or because of the higher number of residents in those areas of the state. Patients who were seen in only emergency departments, urgent care centers, or doctors offices and those who were not admitted to a study hospital were also not included. Another limitation is that hospital admission criteria may have varied among the hospitals that participated in this study; some of the patients who were admitted may not have had “severe” injuries. Finally, injury rates could not be calculated because of incomplete numerator data and lack of exposure data for denominators.

## CONCLUSIONS

Urban, white boys with commercial medical insurance predominated among children with MB-related injuries in Ohio. Most children in this study did not wear a helmet and sustained multiple injuries. Not wearing a helmet resulted in significantly increased injury severity and a trend toward increased lengths of stay in the hospital. MB-related injuries increased by ~50% during the study period. The severity and increased frequency of these injuries underscore the need to increase efforts to prevent these injuries. Children should not operate MBs until they are old enough to obtain a motor vehicle driver’s license, which, in nearly all states, is a minimum of 16 years of age. High-risk populations need to be targeted to reduce these injuries. Legislation has been shown to increase helmet use and should be pursued to decrease injuries to riders on 2-wheeled, motorized recreational vehicles.

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## THE MEDICALIZING OF DISCONTENT

“Viagra is an example of the growing phenomenon that [Meika] Loe (author of *The Rise of Viagra: How the Little Blue Pill Changed Sex in America*) calls the medicalizing of discontent. Ritalin (methylphenidate) and Prozac (fluoxetine), she suggests, are others. It involves reinventing complex sociopsychological problems as simple medical conditions. To create the market for Viagra, impotence is reinvented as erectile dysfunction and frigidity as female sexual dysfunction. In each case, the identified problem is shorn of its social, cultural, emotional, and psychological elements, leaving a core physiological dysfunction that is intrinsic to the individual and independent of society. This can be ‘cured’ with a specific medical treatment. In short, the problem is designed to fit the treatment, not the reverse. In the case of Viagra, this ‘cure’ actually exacerbates the wider problem, cynically ensuring the continuing growth of the condition, the treatment, and the profits from drug sales. Loe shows how in America, this medicalizing of discontent has been facilitated by the passage of legislation permitting direct-to-consumer drug advertising, online drug sales, and the entanglement (even merger) of health professionals and drug marketers.”

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