

Clinical Article



The Importance of Headgear During Scooter Riding in the Pediatric Population, and Suggesting Recommendations

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Conflict of Interest

The authors have no financial conflicts of interest.

ABSTRACT

Objective: The authors analyzed the characteristics of pediatric patients who visited trauma center due to injuries sustained while riding scooters and suggested recommendations on our concerns about pediatric scooter use.

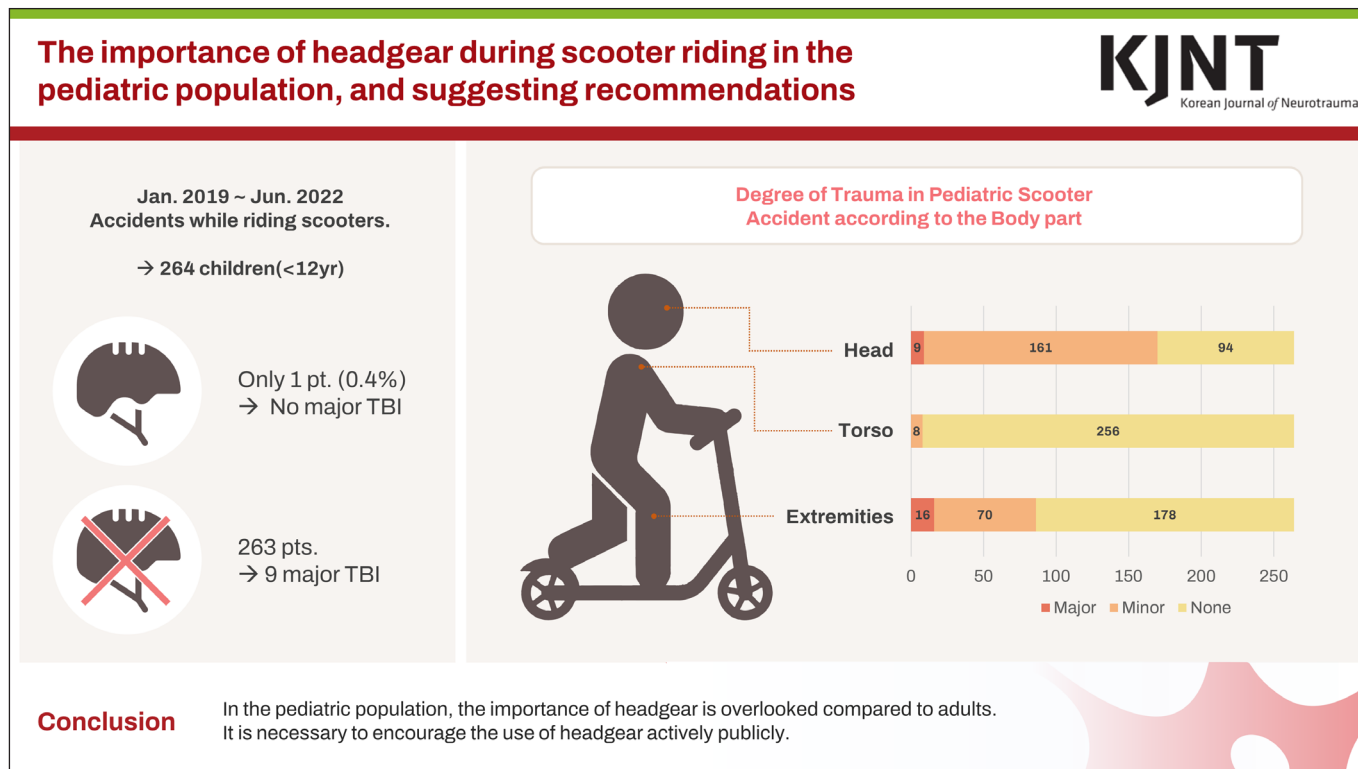
Methods: From January 2019 to June 2022, we collected data for those who visited due to accidents while riding scooters. And, the analysis was conducted by dividing it into pediatric (younger than 12 years) and adult (older than 20 years) patients.

Results: There were 264 children (<12 years), and 217 adults (>19 years). We observed 170 head injuries (64.4%), in the pediatric population and 130 head injuries (60.0%) in the adult population. There were no significant differences between pediatric and adult patients for all three injured regions. Among pediatric patients, only 1 reported the use of protective headgear (0.4%). The patient suffered a cerebral concussion. However, 9 of the pediatric patients who did not wear protective headgear suffered major trauma. Among 217 adult patients, 8 (3.7%) had used headgear. 6 suffered major trauma and 2 suffered minor trauma. Of the patients who did not wear protective headgear, 41 suffered major trauma and 81 suffered minor trauma. Since there was only one patient in the pediatric group who wore headgear, no statistical inferences could be calculated.

Conclusion: In the pediatric population, the head injury rate is as high as in adults. We were unable to statistically support the significance of headgear in the current study. However, in our general experience, the importance of headgear is overlooked in the pediatric population compared to adults. It is necessary to encourage the use of headgear actively publicly.

Keywords: Scooter; Head injuries; Pediatrics; Brain concussion

GRAPHICAL ABSTRACT



INTRODUCTION

The development of personal mobility devices and associated safety issues recently led to changes in Korean law that require associated use of protective headgear. However, such use in children often is overlooked because the devices children use are not electric and their speeds are relatively low. Despite these limitations, unfortunate consequences continue to occur. Our institution is a regional trauma center in northern Gyeonggi Province and is the only educational university hospital in the vicinity, managing primary emergency care for both local and transferred patients.

In this study, we identify the characteristics of pediatric patients who visited our regional trauma center due to injuries sustained while riding scooters and suggest recommendation on our concerns about pediatric scooter use.

MATERIALS AND METHODS

Among patients who visited the emergency department of our regional trauma center from January 2019 to June 2022, we collected and analyzed data for those who visited due to accidents while riding scooters. In this study, since scooter use in the pediatric population is the main point of interest, the analysis was conducted by dividing it into pediatric (younger than 12 years) and adult (older than 20 years) patients, excluding those between the ages of 12 and 20 years, which are not clearly characterized.

We collected all cases with a record of scooter-related injury. We recorded the affected region of the body, with intracranial and facial injuries included in the head category; limb injuries in the extremities category; and chest, abdomen, and pelvic injuries in the torso category. In each category, cases of simple abrasion, contusion, or minor laceration were classified as minor trauma, while cases requiring intervention such as surgery were classified as major trauma.

Since they were often not clearly distinguished in medical records, non-electric and electric scooters were not analyzed separately. However, electronic scooters are legally permitted to be operated only by adults with a driver's license in Korea. Therefore, all scooters ridden by children under the age of 12 were considered non-electric.

Statistical analysis

Patient demographic and clinical data were summarized using standard descriptive statistics and frequency tabulations. Fisher's exact test was used to evaluate differences in categorical variables, and the Kruskal-Wallis test was used to evaluate differences in continuous variables among groups. The value of $p < 0.05$ were considered statistically significant. All analyses were performed in R version 4.2 (<https://cran.r-project.org/>).

RESULTS

Among patients who visited our regional trauma center emergency room from January 2019 to June 2022, 804 visited due to accidents while riding a scooter, of which 532 were male (66.2%) and 272 were female (33.8%). Among these patients, there were 264 children under the age of 12 years, comprising 172 males (65.2%) and 92 females (34.8%). There were 217 adults over the age of 19 years, with 148 males (68.2%) and 69 females (31.8%).

We observed 170 head injuries (64.4%) and 86 extremity injuries (32.6%) in the pediatric population (patients under 12 years of age). We observed torso injuries in only 8 patients (3.0%) in the pediatric population. We observed 130 head injuries (60.0%), 78 extremity injuries (34.0%), and 9 torso injuries (4.1%) in adults (over 20 years of age). There were no significant differences between pediatric and adult patients for all three injury types (**FIGURE 1**).

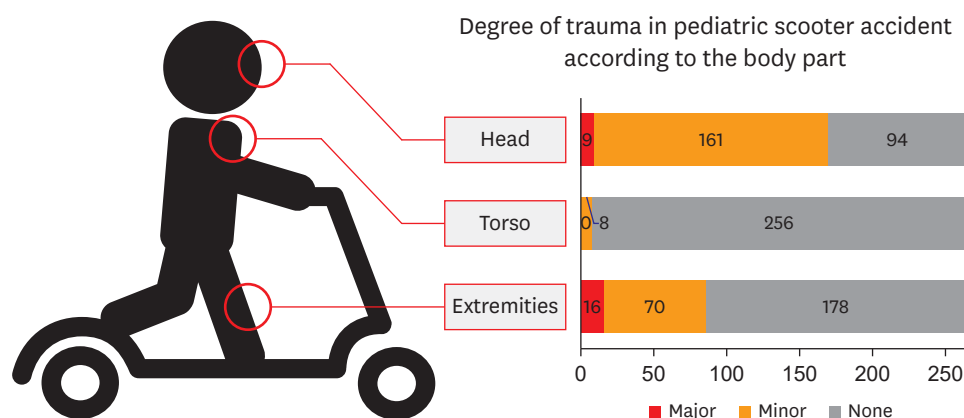


FIGURE 1. Diagram of injury sites in pediatric and adult patients. Head injury was the most common, and torso injury was the least.

TABLE 1. Demographics of patients and injured regions of the body

Variables	Pediatric, <12 years (n=264)	Adult, >19 years (n=217)	p-value
Age, median (range)	6 (2-11)	31 (20-89)	<0.001*
Sex (male: female)	172:92	148:69	0.498†
Injured region (No., %)			
Head	170 (64.4)	130 (60.0)	0.345†
Torso	8 (3.0)	9 (4.1)	0.622†
Extremity	86 (32.6)	78 (34.0)	0.441†
Headgear, (+) : (-)			N/A
Total of head injury	1:263	8:209	
Major head injury	0:9	6:41	
Minor head injury	1:160	2:81	
None	0:94	0:87	

N/A: not available.

*Kruskal-Wallis test; †Fisher's exact test.

Among 264 pediatric patients, only 1 reported use of protective headgear (0.4%). The one patient who wore headgear suffered a minor head injury and experienced a temporary loss of consciousness due to cerebral concussion, but there was no hemorrhaging and no neurological problems. However, 9 of the pediatric patients who did not wear protective headgear suffered major head trauma, such as facial bone fractures and deep lacerations, with 160 suffering minor head trauma such as concussions or abrasions. Among 217 adult patients, 8 (3.7%) had used headgear. Of the patients who wore protective headgear, six suffered major head trauma and two suffered minor head trauma. Of the patients who did not wear protective headgear, 41 suffered major head trauma and 81 suffered minor head trauma. Since there was only one patient in the pediatric group who wore headgear, no statistical inferences could be calculated (**TABLE 1**).

Illustrative case

An 8-year-old girl collided with a motorcycle while riding a scooter and visited the emergency room of the regional trauma center of our hospital after referral from another hospital. A witness stated that neither the speed of the motorcycle nor that of the scooter were fast, but the patient was not wearing headgear while riding the scooter.

At the time of the hospital visit, the patient showed alert mentality and a minimal epidural hematoma with a linear fracture of the left temporal bone (**FIGURE 2A**). However, 4 hours after visiting the hospital, her headache worsened, and a CT scan showed enlarged epidural hematoma (**FIGURE 2B**). Emergency surgery was performed, with endoscopic hematoma evacuation performed via a single burr hole considering the patient's age. After surgery, the hematoma was successfully evacuated, and the patient's headache improved (**FIGURE 2C**). The patient was discharged on the 11th day after surgery without any specific neurological abnormalities.

DISCUSSION

In this study, we were unable to find evidence regarding the effects of protective headgear in the pediatric population due to the small sample size. However, we confirmed that the rate of headgear use was lower in children than in adults. Though only 3.7% of adults wore helmets while operating scooters, the use rate in children was much lower, at 0.4%. This discrepancy is likely because adults are required by law to wear protective headgear. However, it is possible that children wearing headgear did not suffer significant injuries and did not visit the emergency room, resulting in selection bias. The use of protective headgear in the injured

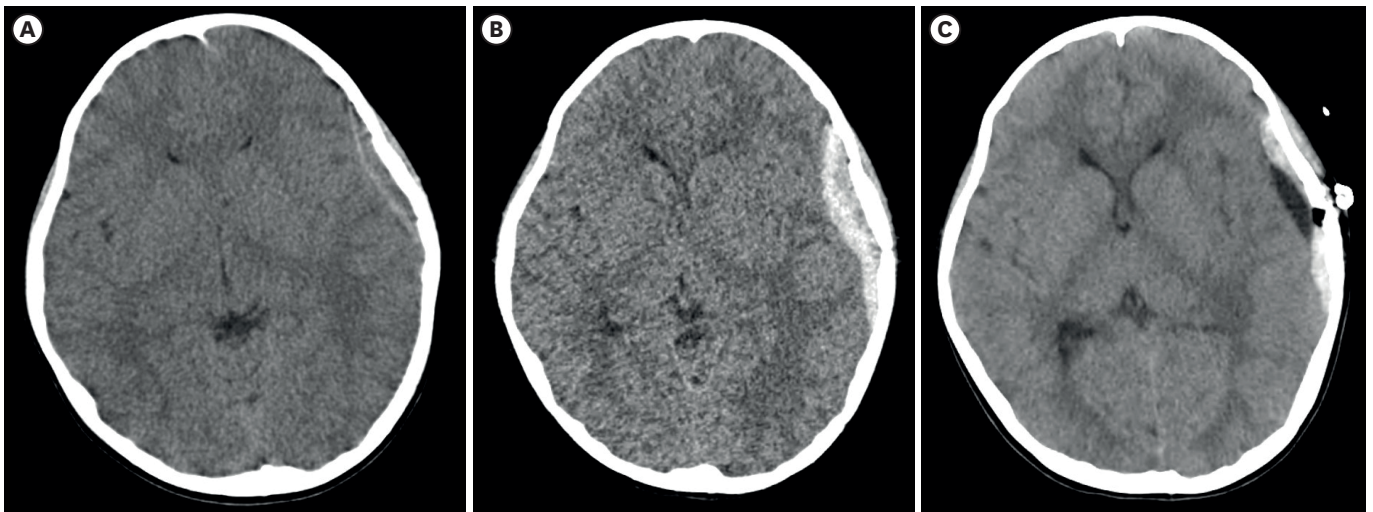


FIGURE 2. Illustrative case. An 8-year-old girl who experienced a scooter accident while not using headgear. (A) At the hospital visit, a minimal epidural hematoma with a linear fracture was observed. (B) However, at 4 hours after visiting the hospital, a computed tomography scan showed enlarged epidural hematoma. (C) Endoscopic hematoma evacuation via a single burr hole was performed, the hematoma was evacuated, and the headache improved.

children in our study suggests the importance of headgear while scootering. A nationwide study using data from the National Electronic Injury Surveillance System (NEISS) comparing motorized and non-motorized scooter injuries in pediatric patients found that extremity injuries were most common at 65.8% of the sample, with head injuries comprising 27.1%.¹¹ However, use of headgear was not included as a variable in that study. In addition, other studies evaluating pediatric injuries associated with non-motorized scooters have reported injuries to the head and upper extremities as the most common.⁸ Several studies have addressed electric scooters. Between 2014 and 2018, accidents involving electric scooters soared in the United States. Among them, 32% of patients had head injuries,¹⁴ while only 4% reported wearing headgear.^{9,10} Concussion and traumatic brain injury remain critical foci in the pediatric population, as the sequelae of these events include increased risk of future epilepsy, alcoholism, and depression.^{2,6,7,13} Previous studies have also shown that headgear use significantly decreases the risk of brain injury when using other transport devices, such as motorbikes, bicycles, and skateboards.^{8,10,15,16} In order to choose the appropriate headgear for children, find headgear with an appropriate size and design to protect a child's head. And, since children may be reluctant to wear headgear, it's best to choose headgear in colors or designs that children like.¹⁷

Based on our and previous findings, we make the following recommendations for children riding scooters (**TABLE 2**). This recommendation is a compilation of several guidelines that have been published so far.^{1,3,4,5,12,17}

- 1) Safety gear: When riding a scooter, children should always wear properly fitting helmets to protect their head from injury in the event of a fall or collision. Additionally, elbow and knee pads can provide extra protection for these vulnerable joints.
- 2) Age and weight restrictions: Scooters have specific age and weight recommendations, and manufacturer guidelines should be consulted before use. Some scooters are not suitable for very young children or those over a certain weight, and it is important to ensure that a scooter is appropriate for the child.

TABLE 2. Scooter safety recommendations for pediatric patients

Recommendation	Description
Safety gear	Children should always wear headgear and should be encouraged to use elbow and knee pads.
Age and weight restrictions	Check and adhere to the manufacturer's guidelines before use.
Proper posture	Children should stand upright, keep hands on handlebars, and maintain a safe distance from other people/objects.
Supervision	Children should be supervised by an adult.
Location	Use scooters in safe and appropriate locations only, such as parks, bike paths, or sidewalks. Avoid busy roads, steep hills, or uneven surfaces.
Regular maintenance	Regularly check for loose or damaged parts and repair or replace as necessary.
Rules of the road	Children should follow traffic laws and be mindful of other riders and pedestrians.

3) Proper posture: Children should be taught to stand upright when riding a scooter, with their feet on the deck and their hands on the handlebars. They should also be taught to maintain a safe distance from other riders and pedestrians, both in front of and behind them.

4) Supervision: Children should always be supervised by an adult when riding a scooter, especially younger children who may not have the experience and judgement to ride safely. This can help to prevent accidents and ensure that the child is riding in a safe and responsible manner.

5) Location: Scooters should only be ridden in safe and appropriate locations, such as parks, bike paths, or sidewalks. Avoid riding on busy roads, steep hills, or uneven surfaces.

6) Regular maintenance: Regular maintenance of the scooter is important to ensure it is in good working order. This can include assessment for loose or damaged parts and repair or replacement as necessary.

7) Rules of the road: Children should be taught to follow traffic laws when riding a scooter, such as observing traffic signals, yielding to pedestrians and other riders, and riding on the right-hand side of the road. They should also be mindful of other riders and pedestrians and use appropriate hand signals when turning.

Such recommendations would reduce injuries to children when riding scooters and should be disseminated to the public and potentially legislated.

CONCLUSION

In the pediatric population, the rate of head injury is as high as in adults. We were unable to statistically support the significance of headgear in the current study. However, in our general experience, the importance of headgear is overlooked in the pediatric population compared to adults. Therefore, it is necessary to actively publicly encourage the use of headgear. It is our hope that this study will contribute to the development of a prevention strategy as well as establishment of a legal basis for use of headgear while riding scooters among children in Korea.

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