

Factors Influencing Helmet Use, Head Injury, and Hospitalization Among Children Involved in Skateboarding and Snowboarding Accidents

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ABSTRACT

Context: Up to 75% of skateboarders and snowboarders admitted to the hospital sustain head injuries. It is unclear why not all children and teenagers wear helmets while snowboarding and skateboarding given the protection they afford.

Objectives: To report on the prevalence of, and factors associated with, skateboarding and snowboarding in injured children and to explore factors that influence helmet use, head injury, and hospitalization in this sample.

Design: A cross-sectional study of skateboard- and snowboard-associated injuries from 2003 to 2012 among individuals younger than age 18 years using National Electronic Injury Surveillance System (NEISS) data from approximately 100 hospitals.

Main Outcome Measures: Helmet use, head injury, and hospitalization.

Results: Of 1742 patients in the study, 852 (48.9%) and 890 (51.1%) were skateboarders and snowboarders, respectively. Overall, 907 (52.1%) did not use helmets, and 704 (40.4%) sustained head injuries. Multiple logistic regression analysis showed that age, race/ethnicity, location of boarding, and engaging in skateboarding influenced helmet use. Sex, race/ethnicity, helmet use, and skateboarding predicted head injury. Age, sex, skateboarding, and head injury predicted hospital admission.

Conclusion: Statistically significant differences exist in helmet use, head injury, and hospitalization rates between skateboarders and snowboarders. Our findings suggest that injury prevention and outreach programs are needed to increase helmet use and reduce the risk of head injury and hospitalization in skateboarders and other at-risk groups. Further studies are needed to clarify the association between race/ethnicity and helmet use among skateboarders and snowboarders.

INTRODUCTION

Skateboarding and snowboarding have become more popular since the 1990s.¹⁻⁴ According to 1998 data from the Consumer Product Safety Commission's National Electronic Injury

Surveillance System (NEISS) and the National Sporting Goods Association (NSGA) annual survey of nationally representative households, the rate of skateboard-associated injuries seen in Emergency Departments that required hospitalization was 2.9% per 1000 for patients aged 7 years or older.⁴ The data also reveal that the rate of skateboard-associated injuries declined from 1987 to 1993, but nearly doubled in 1998 to 8.9%. The most frequent injuries among adolescent and young adult skateboarders include ankle strain/sprain and wrist fracture.⁴ One study reports that the "lower leg," ankle, and foot are the regions most severely affected in skateboarding injuries.⁵ However, in other research, the proportion of head injuries is reported as high as 75% among hospitalized snow- and skateboarder patients,⁶ and the incidence is increasing.^{3,7}

Although helmet use is known to provide protection against head injury in snowboarding and skateboarding,^{7,8} not all "boarders" use them. One study, for instance, reports that only 13% of skateboarders used helmets, jockstraps, and other protective equipment.⁵ Other studies report that a considerable percentage of children and teenagers (17% to 87%) do not use helmets when boarding.^{5,9} Researchers have tried to identify factors that promote helmet use in child and teenaged boarders, including helmet use by parents^{9,10} and peers,⁷ and personal experience of a previous head trauma injury.⁷ However, very little is known regarding factors that influence helmet use in skateboarders.

In this study, we aim to 1) report the prevalence of, and factors associated with, skateboarding and snowboarding in injured children and 2) explore factors influencing helmet use, head injury, and hospitalization in this sample. Although both activities are similar, the use of helmets in skateboarding has not been as aggressively promoted as in snowboarding. We therefore hypothesized that there are statistical differences in helmet use, head injury, and hospitalization rates between skateboarders and snowboarders. Our findings will help in designing and implementing specific public education and awareness efforts, and in determining strategies to promote helmet use. This, in turn, will likely reduce injury in these sports.

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METHODS

This cross-sectional study used data extracted from the NEISS. The NEISS injury data are gathered from the Emergency Departments of approximately 100 geographically dispersed hospitals throughout the US and its territories. They are selected as a stratified probability sample of all 5000-plus US hospitals with Emergency Departments. These hospitals have a minimum of 6 beds and provide 24-hour emergency services. Patient information is collected from each NEISS hospital for every emergency visit involving an injury associated with consumer products.

Snowboard- and skateboard-related injuries were identified by the correlating NEISS product code for snowboards and skateboards, respectively. Data were collected during a 10-year period, from January 1, 2003, to December 31, 2012. We included all children (aged < 18 years), both boys and girls, who had helmet status recorded in the comments section of the database. We separated these children into 2 groups: age 12 years or younger, and older than age 12 years, mainly to distinguish teenagers from younger children, and because there were very few snow- and skateboarders 4 years of age or younger. All medical records of patients who sustained a skateboarding or snowboarding injury during the study period were retrospectively reviewed. Date collected included age, sex, race, location of boarding activity, body

part injured, presence or absence of head injury, need for hospitalization, and mortality.

To analyze the data, we used descriptive and χ^2 tests to first describe the overall characteristics of skate- and snowboarders in the sample, and then to identify factors associated with helmet use, head injury, and hospital admission. Next, we used adjusted logistic regression to assess the independent role of skateboarding or snowboarding in predicting helmet use, head injury, and hospital admission, controlling for sex, age, race/ethnicity, and activity location.

Using NEISS weighted data, all analyses were performed using the Predictive Analytics Software (PASW) statistics Version 18.0 package (SPSS Inc, Chicago, IL). Ninety-five percent confidence intervals were calculated, and p values below 0.05 were considered statistically significant. This study was approved by our institutional review board and was conducted in accordance with regulations established through the Declaration of Helsinki.

RESULTS

Between January 2003 and December 2012, a total of 1742 patients were found who met study inclusion criteria. These consisted of 1415 boys and 327 girls (M:F ratio = 4.3:1). Of the overall sample of boarders, 852 (48.9%) and 890 (51.1%) were

Table 1. Association of study variables, with helmet use and head injury^a

Variable	Boarding			Helmet use			Head injury		
	Skateboarding (n = 852)	Snowboarding (n = 890)	p value	Yes	No	p value	Yes	No	p value
Sex									
Boys	775 (54.8)	640 (45.2)	< 0.001 ^b	646 (45.7)	769 (54.3)	< 0.001 ^b	609 (43.1)	802 (56.9)	< 0.001 ^b
Girls	77 (23.5)	250 (76.5)		189 (57.8)	138 (42.2)		95 (29.1)	232 (70.9)	
Age, years									
≤ 12	227 (53.7)	196 (46.3)	0.03 ^b	251 (59.3)	172 (40.7)	< 0.001 ^b	160 (37.9)	262 (62.1)	0.46
> 12	625 (47.4)	694 (52.6)		584 (44.3)	735 (55.7)		544 (41.3)	772 (58.7)	
Race/ethnicity									
Minorities	126 (77.3)	37 (22.7)	< 0.001 ^b	45 (27.6)	118 (72.4)	< 0.001 ^b	65 (40.2)	97 (59.8)	< 0.001 ^b
Whites	483 (38.4)	774 (61.6)		681 (54.2)	576 (45.8)		454 (36.2)	801 (63.8)	
Hospital admission									
Yes	129 (74.6)	44 (25.4)	< 0.001 ^b	50 (28.9)	123 (71.1)	< 0.001 ^b	112 (65.0)	60 (35.0)	< 0.001 ^b
No	723 (46.1)	846 (53.9)		785 (50.0)	784 (50.0)		592 (37.8)	974 (62.2)	
Location									
Sports/rec parks	165 (16.3)	850 (83.7)	< 0.001 ^b	645 (63.5)	370 (36.5)	< 0.001 ^b	345 (34.0)	669 (66.0)	< 0.001 ^b
Other	323 (94.4)	19 (5.6)		85 (24.9)	257 (75.1)		164 (48.4)	175 (51.6)	
Boarding									
Skateboarding				230 (27.0)	622 (73.0)	< 0.001 ^b	428 (50.4)	421 (49.6)	< 0.001 ^b
Snowboarding				605 (68.0)	285 (32.0)		276 (31.0)	613 (69.0)	
Injury									
Head	428 (60.8)	276 (39.2)	< 0.001 ^b	257 (36.5)	447 (63.5)	< 0.001 ^b			
Other	421 (40.7)	613 (59.3)		578 (55.9)	456 (44.1)				
Helmet use									
Yes	230 (27.5)	605 (72.5)	< 0.001 ^b				257 (30.8)	578 (69.2)	< 0.001 ^b
No	622 (68.6)	285 (31.4)					447 (49.5)	456 (50.5)	

^a Data are number (percentage) except for p values.

^b Statistically significant.

rec = recreational.

skateboarders and snowboarders, respectively; 907 (52.1%) of the overall sample ($n = 1742$) did not use helmets, and 704 (40.4%) suffered head injuries. Two deaths occurred, both in skateboarders who did not use helmets.

As illustrated in Table 1, the skateboarder group contained a higher percentage of boys (54.8%), children 12 years or younger (53.7%), minorities (77.3%), those admitted to the hospital (76.6%), those who used “other” sites (other than sports/recreational parks) for boarding (94.4%), those who presented with head injury (60.8%), and those who did not use helmets (68.6%). Girls were mostly snowboarders, and snowboarders were mostly teenager, white, less frequently admitted to the hospital, presented with fewer “other” injuries, and used helmets ($p > 0.05$, Table 1).

Table 1, column 2, shows that helmet use was significantly ($p > 0.05$) lower in skateboarders vs snowboarders, in boys vs girls, in children older than age 12 years vs children age 12 years or younger, and in racial and ethnic minorities (ie, African Americans, Native Americans, Latinos, and Asians) vs whites. Helmet use also was significantly lower in patients admitted to the hospital vs those who were not, in those who boarded in “other” settings vs sports/recreational parks, and in patients who sustained head injury vs those who did not. Table 1 also shows that those with head injury were significantly ($p > 0.05$) more likely to be skateboarders, boys, ethnic minorities, admitted to the hospital, and to have boarded in “other” locations.

Results of the adjusted logistic regression show that the likelihood of helmet use was significantly higher in children age

12 years or younger (odds ratio [OR] = 2.48), and in those who boarded in sports/recreational parks (OR = 1.18). Racial/ethnic minorities (OR = 0.84), skateboarders (OR = 0.28), and those who sustained head injury (OR = 0.58) had lower odds of using helmets (Table 2). Table 2 also reveals that male sex (OR = 1.44), minority race/ethnicity (OR = 1.19), not wearing a helmet (OR = 1.7), and engaging in skateboarding as opposed to snowboarding (OR = 1.96) resulted in greater odds of head injury, compared with female sex, white race, use of helmets, and engaging in snowboarding. With respect to hospital admission, our findings showed that boys (OR = 3.08), skateboarders (OR = 2.54), and children who sustained head injuries (OR = 2.33) were more likely to be hospitalized, whereas the likelihood of hospital admission was lower in younger children (OR = 0.42) compared with their older counterparts.

DISCUSSION

Skateboarding and snowboarding have become more popular since the 1990s.¹⁻⁴ In this study, we report on the prevalence and characteristics of injured skateboarders and snowboarders, and identify factors associated with helmet use, head injury, and hospital admission in the sample. We found that nearly half of the sample engaged in skateboarding. More than half did not use helmets, and almost one in three experienced head injuries. In the sample, skateboarders were mainly boys, older teenagers and minorities, used “other” sites rather than sports/recreational parks, sustained head injury, and did not use helmets.

Table 2. Independent predictors of helmet use, injury, and hospital admission, using multiple logistic regression

Variable	Helmet use		Head injury		Hospital admission	
	Odds ratio (95% CI)	p value	Odds ratio (95% CI)	p value	Odds ratio (95% CI)	p value
Sex						
Boys	1.13 (0.86-1.50)	0.38	1.44 (1.11-1.92)	0.007 ^a	3.08 (1.53-6.20)	0.002 ^a
Girls	Referent		Referent		Referent	
Age, years						
≤ 12 years (children)	2.48 (1.92-3.21)	< 0.001 ^a	1.1 (0.86-1.38)	0.49	0.42 (0.26-0.68)	< 0.001 ^a
> 12 years (teens)	Referent		Referent		Referent	
Race/ethnicity						
Minorities	0.84 (0.62-1.12)	0.002 ^a	1.19 (0.84-1.69)	< 0.001 ^a	1.10 (0.75-1.64)	0.49
Whites	Referent		Referent		Referent	
Location						
Sports/rec parks	1.18 (0.83-1.67)	0.002 ^a	0.99 (0.73-1.34)	0.83	1.18 (0.77-1.83)	0.71
Other	Referent		Referent		Referent	
Helmet use						
Yes			Referent	< 0.001 ^a	Referent	0.09
No			1.72 (1.38-2.15)		1.39 (0.94-2.04)	
Boarding						
Skateboarding	0.28 (0.20-0.38)	< 0.001 ^a	1.96 (1.44-2.69)	0.002 ^a	2.54 (1.51-4.28)	< 0.001 ^a
Snowboarding	Referent		Referent		Referent	
Injury						
Head	0.58 (0.46-0.72)	< 0.001 ^a			2.33 (1.66-3.28)	< 0.001 ^a
Other	Referent		Referent		Referent	

^a Statistically significant.

CI = confidence interval; rec = recreational.

Our analysis reveals that, in those injured, the likelihood of helmet use was lower among skateboarders, racial/ethnic minorities, and patients who sustained head injury, and higher in younger children, and among those who used sports/recreational parks. We also found that the probability of head injury was higher in boys, skateboarders, racial/ethnic minorities, and patients who did not use helmets, compared with girls, white, snowboarders who used helmets. In terms of being hospitalized, boys were three times more likely, skateboarders two and one-half times more likely, and patients with head injury more than two times more likely than their reference groups.

Some of these findings are in agreement with other studies that have showed increased rates of injury among adolescent and young adult skateboarders.^{2,4,6,10,11} As these activities continue to gain popularity and the number of boarders increase, the incidence of head injuries will also rise if further protective and educational steps are not taken. Our findings suggest that greater efforts should be directed toward identifying incentives that increase helmet use in at-risk groups. Also, interventions that reinforce using helmets and perhaps other personal protective equipment must be a priority.

Once informed about the benefits of helmet use and when family and peers reinforce the routine use of protective gear, teenagers are more likely to use them.^{7,9} Popular media has a huge potential in promoting and disseminating safety messages and changing safety perceptions in these groups, which can be reinforced by primary care physicians.¹² These issues and concerns are of paramount importance, as we found no change in helmet use from 2003 to 2012 ($p = 0.20$) in our sample (data not shown).

The higher incidence of helmet use at sports/recreation parks is reported in previous studies⁶ and is probably because of an emphasis on safety at these locations. Children who use sports and recreational parks are usually required to use helmets as a condition of their use. Usually this is a liability/insurance requirement. Nevertheless, children and their parents should be educated about the substantial risks and burden of injury associated with these activities, and with not wearing a helmet. In our study, skateboarders were more likely to be injured in other settings, including home or streets, where helmet use warnings are not in place or are hard to enforce, which warrants special precautions by their parents or guardians.

Racial/ethnic minorities had a lower likelihood of helmet use and a higher probability of head injury and hospitalization. This may stem from different shared attitudes and behaviors in safety practices, precautions, and routines, which needs to be further explored. Larger studies are also needed to substantiate our findings in separate racial/ethnic groups. The nature of our data limits our ability to perform such analyses.

Our research has several other limitations. Our data are only from January 1, 2003, to December 31, 2012. Moreover, we can account only for helmet use in pediatric boarders who were injured and whose helmet status have been recorded. Our sample may therefore not be representative of the population we intend to analyze because of selection bias. However, our findings are purported to be generalizable, because NEISS estimates of consumer product-related injuries for more than three decades attest to the stability and rigor of their reporting over time in contrast to a voluntary reporting system.¹³

CONCLUSION

A high proportion of skateboarders and snowboarders in our study did not use helmets and sustained head injury. We also found that skateboarders, teenagers, minorities, and those who used places other than sports/recreational parks were significantly less likely to use helmets. In addition, boys, racial/ethnic minorities, those who did not use helmets, and skateboarders were more likely to sustain a head injury. Engaging in skateboarding, not wearing a helmet, and presenting with a head injury significantly increased the odds of hospitalization. Publicity campaigns and educational efforts may have led to a higher rate of helmet use in snowboarders. This suggests that similar injury prevention and outreach programs are needed for skateboarders to reduce head injuries and hospitalization. ❖

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

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