

CONCUSSIONS

How Sports-Related Injuries Are Impacting
Our Youth in Los Angeles County



Director's Message



Injuries to professional athletes caused by concussions have put a spotlight on the potential long-term effects of sports-related injuries. Every day in Los Angeles County, more than 26 residents are treated in emergency departments and hospitals for concussions, and the number of people being treated for concussions is increasing. Since 2005, the rate of people treated in emergency departments for concussions has increased by 58%, although the rate of people hospitalized for concussions has remained stable. This is a trend seen nationally and is thought to be due largely to increased public awareness around concussion injuries.¹

This report provides information on Los Angeles County residents who were treated for a concussion either as a patient in the hospital or in an emergency department. For teens and young adults, who have the highest risk of concussion injury, we examine additional details about these injuries, including the type of activity involved in the injury. Many of these concussion injuries are sports-related. An annual count conducted by the California Interscholastic Federation (CIF) showed that over 168,000 high-school students in Los Angeles County participated in CIF-endorsed sports for their schools during the 2011-2012 school year. Many more teens and young adults participate in sports programs sponsored by non-school organizations. These young athletes are at risk for sports-related concussions and both short- and long-term health effects. We hope the information and recommendations provided in this report will be useful for targeting prevention efforts and reducing the impact of concussion injuries, particularly among our youth and young adults.

A handwritten signature in black ink that reads "Jonathan E. Fielding". The signature is written in a cursive, flowing style.

Jonathan E. Fielding, MD, MPH
Director of Public Health and Health Officer

Introduction

In this report, we present information about overall patterns of injuries resulting in concussions in Los Angeles County. We pay particular attention to teens and young adults, who have higher rates of emergency department visits for concussions, and we explore the activities that are commonly related to concussions among this population. Concussions are brain injuries that occur when a blow to the head results in temporary or permanent changes to the way the brain functions. They are a subset of traumatic brain injuries (TBIs) which can have a significant impact on functioning, particularly when a person has repeated concussions. Many concussions, particularly among children and young adults, occur as a result of playing sports, and recent research highlights the cumulative effect of repeated concussions.²⁻⁴ In addition, since athletes who have already had one concussion are at increased risk of sustaining additional concussions,⁵ it is important to both prevent the initial concussion and, once a concussion has occurred, to take extra precautions to reduce the risk of future concussions.

There has been increasing public awareness of concussions, particularly those related to sports, although concussions and other types of TBIs can also result from falls, motor vehicle crashes, being struck by an object, or assaults. Young children, older adolescents, and the elderly are at increased risk for brain injury, both because they are more likely to suffer from a blow to the head, and because when they do so, they are more likely to sustain a concussion. Injuries among the elderly are more likely to be severe enough to require hospitalization, while the majority of injuries among youth are treated in emergency departments.¹

Since 2010, improvements to injury reporting from hospitals and emergency departments have resulted in more information about the type of activity a patient was participating in when an injury occurred. This report concludes with prevention recommendations tailored to the high-risk populations and activities identified in this report. We hope this information will be useful for designing and implementing interventions that minimize the likelihood of concussion among teens and young adults who participate in sports and



recreation activities.

Methods

California hospitals must report certain information about every patient admitted to the hospital or treated in the emergency department to the Office of Statewide Health Planning and Development (OSHPD). Using these data, we examined Los Angeles County residents treated in California emergency departments (ED) or hospitals between 2005 and 2011, and who were diagnosed with a concussion. The ED data used in this report includes only those patients who were treated and released from the ED, while the hospital data includes patients who were admitted to the hospital and whose injuries were not fatal. This analysis did not include visits to outpatient facilities, office-based physicians, or any fatal injuries.

Information reported to OSHPD includes patient demographics such as age, race/ethnicity, and gender. It also includes medical information about the injury or disease that led to the ED visit or hospitalization. The medical information is coded using the International Classification of Diseases, ninth revision (ICD-9). For each patient, up to 25 ICD-9 codes can be reported to describe the nature of the injury or disease; for injuries, an additional 5 codes can be used to describe how the injury occurred. ICD-9 codes 850.0-850.9 were used to select patients with concussions. For patients with concussions, we analyzed the additional ICD-9 codes that described the type of incident that resulted in the injury, such as a motor vehicle crash, an unintentional fall, or an assault.*

We could not identify unique individuals. As such, patients who were treated more than once for a concussion during the 7-year study period were included in the dataset multiple times. We calculated annual rates per 100,000 population for the 7-year period to describe trends in concussion reporting. Where appropriate, we age-adjusted the rates to the 2000 U.S. population.

Starting in October 2009, hospitals and EDs began reporting additional ICD-9 codes that identified the type of activity a patient was involved in when injured. The codes include a wide variety of activities, including household tasks, indoor and outdoor recreation, and organized sports. There are also non-specific codes that indicate other or unspecified activities. We grouped activity codes into categories based on the type of activity: team sports/athletics (soccer, football, etc.), individual sports/athletics (biking, skateboarding, etc.), winter sports, walking/jogging, other sports/athletics, other non-sports activities, other/non-specified activities. While these codes are not reported consistently, we report the available data on these codes for 2010 and 2011 to provide a general, although incomplete, picture of the types of activities that were most often involved in concussion injuries.

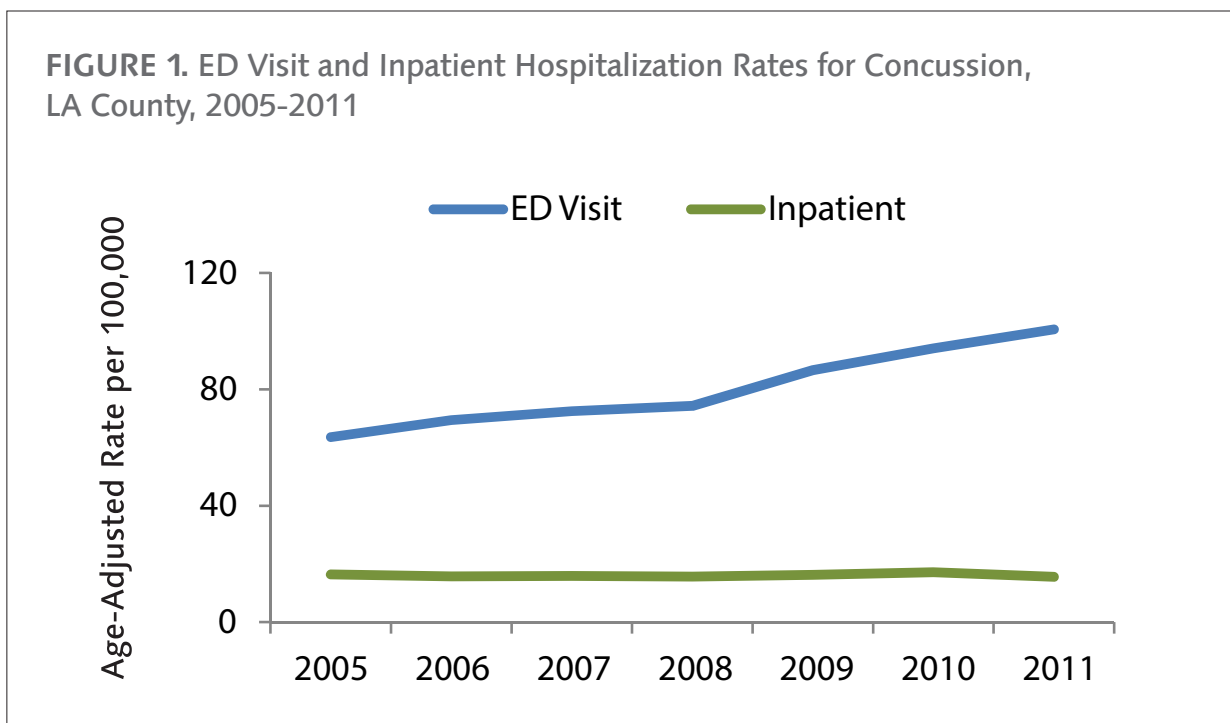


* We examined two types of ICD codes in this study: diagnosis codes and external cause of injury codes. All patients treated in hospitals and emergency departments are assigned a diagnosis code (or multiple codes) that describes the problem for which they are seeking medical attention. While the diagnosis codes would describe the actual physical injury, the external cause codes provide details about how the injury occurred (motor vehicle crash, firearm, fall, etc.).

Results

Emergency Department Visits and Inpatient Hospitalizations Involving a Concussion

From 2005 through 2011, there were more than 69,000 patient visits to hospitals for concussions in Los Angeles County: 57,949 (84%) were ED visits and 11,222 (16%) were inpatient hospitalizations, an average of nearly 10,000 incidents per year. During this 7-year time period, the rate of ED visits for concussions increased 58% from 64 to 101 per 100,000, while the rate of inpatient hospitalizations for concussions remained relatively flat (Figure 1).



Overall, the rates of hospital visits (both ED and inpatient) for concussion were highest for males, whites and blacks, and among 15- to 24-year-olds (Table 1). Although 15- to 24-year-olds represented only 15% of the County's population,⁶ this group made up 29% of ED visits and 21% of inpatient hospitalizations. On average, patients treated in the ED were younger than those who were hospitalized. Among all age groups, falls (n=25,392) were the most common cause of concussions, with similar proportions receiving ED and inpatient treatment. Among those treated for concussion, motor vehicle crashes (n=14,206) caused the injury for 17% of ED patients and 39% of hospitalized patients. Being struck by or against an object or person[†] (n=12,532) caused the injury for 21% of ED patients and 4% of patients admitted to the hospital. While most concussions were the result of unintentional injuries, 13% overall were the result of an assault.

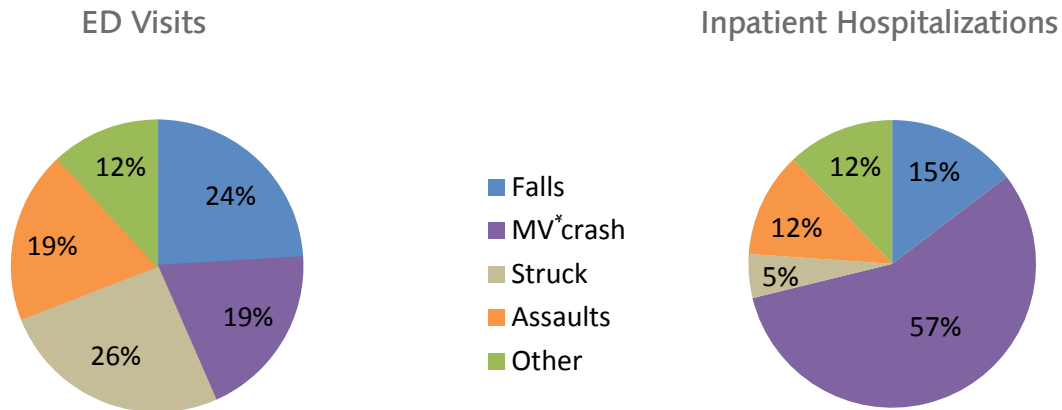
[†] The struck by or against category includes being struck by an object in motion (like a baseball bat) or striking against a stationary object (like running into the barriers at the edge of a hockey rink), and it also includes collisions between two people (such as tackles in football).

TABLE 1. Patients Treated in the Emergency Department or Admitted to the Hospital for Concussion, LA County, 2005-2011

	Emergency (n=57,949)			Inpatient (n=11,222)			Total (n=69,171)		
	No.	%	Rate ^a	No.	%	Rate ^a	No.	%	Rate ^a
Gender^b									
Male	34,969	60%	96	7,149	64%	21	42,118	61%	117
Female	22,923	40%	63	4,069	36%	11	26,992	39%	75
Race/ethnicity^c									
White	20,887	36%	111	4,379	39%	19	25,266	37%	130
Black	6,017	10%	92	1,212	11%	19	7,229	10%	111
Hispanic	22,325	39%	62	4,291	38%	14	26,616	38%	76
Asian/PI ^d	2,916	5%	31	741	7%	8	3,657	5%	38
Age group^e									
0-14	13,010	22%	86	1,194	11%	8	14,204	21%	94
15-24	17,045	29%	161	2,335	21%	22	19,380	28%	183
25-44	15,292	26%	72	2,754	25%	13	18,046	26%	85
45-64	8,767	15%	53	2,368	21%	14	11,135	16%	67
65+	3,824	7%	50	2,571	23%	34	6,395	9%	84
Cause of injury: All concussions									
Fall	21,424	37%	n/a	3,968	35%	n/a	25,392	37%	n/a
MV ^f crash	9,786	17%	n/a	4,420	39%	n/a	14,206	21%	n/a
Struck ^g	12,083	21%	n/a	449	4%	n/a	12,532	18%	n/a
Assault	7,877	14%	n/a	893	8%	n/a	8,770	13%	n/a
Other	6,779	12%	n/a	1,492	13%	n/a	8,271	12%	n/a
Cause of injury: 15- to 24-year-olds									
Fall	4,099	24%	n/a	342	15%	n/a	4,441	23%	n/a
MV ^f crash	3,306	19%	n/a	1,320	57%	n/a	4,626	24%	n/a
Struck ^g	4,376	26%	n/a	115	5%	n/a	4,491	23%	n/a
Assault	3,241	19%	n/a	276	12%	n/a	3,517	18%	n/a
Other	2,023	12%	n/a	282	12%	n/a	2,305	12%	n/a

- a. Rate per 100,000; rates for gender and race/ethnicity are age-adjusted
- b. Total includes 61 persons of unknown gender
- c. Total includes 6,403 persons of other or unknown race
- d. PI = Pacific Islander
- e. Total includes 8 persons of unknown age
- f. MV = Motor vehicle
- g. Struck = Struck by an object

FIGURE 2. Circumstances of Injuries Resulting in ED Visits and Inpatient Hospitalizations for Concussions, 15- to 24-Year-Olds, LA County, 2005-2011



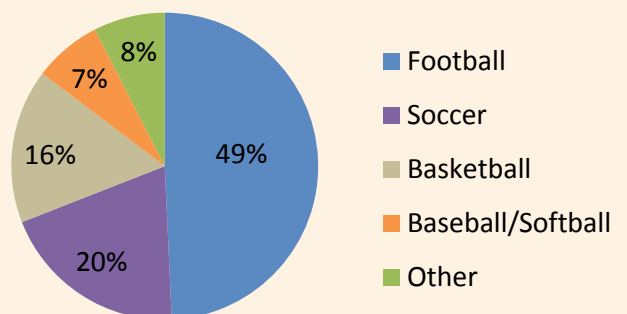
* MV = Motor vehicle

Because of the high rate of ED visits and inpatient admissions among teens and young adults aged 15-24 (n=19,380), the remainder of this report focuses on this high-risk age group. Similar to concussion demographics for the entire County, among 15- to 24-year-olds, males (247 per 100,000), whites (264 per 100,000) and blacks (206 per 100,000) had the highest rates of concussions. Among those treated in the ED, injuries caused by an assault (n=3,241) or being struck by or against an object or person (n=4,376) were more common in this group than for the County overall. Among those who were hospitalized, motor vehicle crashes (n=1,320) caused more than half of the injuries (Figure 2).

Reported Activities at Time of Injury

In 2010 and 2011, 2,544 ED visits among 15- to 24-year-olds had a reported activity code (45%). Nearly half of these codes (45%) indicated involvement in a team sport, while 11% reported participation in an individual sport, such as bike riding or skateboarding (Table 2). American football was the most commonly reported activity, and accounted for nearly half of all team sports activities, followed by soccer and basketball (Figure 3). Bike riding (n=133) and roller skating/skateboarding (n=106) accounted for 83% of the reported individual sports activities. Other infrequently reported activities included wrestling (n=37), cheerleading (n=34), rough play (n=22), and bathing or showering (n=19).

FIGURE 3. Types of Team Sports Reported Among 15- to 24-Year-Olds with ED Visits Involving a Concussion, LA County, 2010-2011



Limitations of the Data

Examining activity codes reported for concussions can provide information about what activities commonly result in ED visits and hospitalizations for concussions; however, there are limitations to the data. The data only includes those patients who seek treatment and who subsequently are diagnosed with a concussion. Since we do not have accurate information on how many people across the County participate in each of the different activities examined, we are not able to calculate concussion rates for specific activities and cannot determine which activities are more likely to cause a concussion event. Additionally, the use of activity codes is not yet widespread; among all ages, only about one-third of ED visits and one-quarter of inpatient hospitalizations for concussions had an activity code reported; teens and young adults were somewhat more likely to have activity codes reported. Also, the accuracy of the coding has not been fully evaluated and it is not known if codes are more likely to be reported for particular types of activities.

TABLE 2. Reported Activity at the Time of Injury among 15- to 24-Year-Olds Treated in the ED for Concussion, LA County, 2010-2011

	No.	%
Team sport	1,157	45%
Football	570	49%
Soccer	229	20%
Basketball	188	16%
Baseball	83	7%
Other	87	8%
Individual sport	288	11%
Bicycle	133	46%
Roller skates/skateboard	106	37%
Other	49	17%
Snow^a	151	6%
Walking/running	78	3%
Other specified	174	7%
Unspecified/unknown	696	27%
Total	2,544	

a. Includes downhill skiing, snowboarding, sledding, tobogganing, and snow tubing

Discussion

Our findings show that ED visits for concussion injuries in Los Angeles County have been increasing, and that the highest rates of ED visits were among teenagers and young adults. Among this age group, team sports and, in particular, football, are responsible for many of these ED visits. Potential reasons contributing to this rise in ED visits include increased awareness concerning concussions or increased participation in sports and leisure activities with high rates of concussion injuries. However, since we did not see a similar increase in inpatient hospitalizations for concussion injuries, this suggests that increased awareness of concussions and the need for clinical evaluation may be the primary contributor to the increase. Similar patterns have been reported in a national study examining non-fatal TBIs caused by sports and recreation activities among children.⁷ Even with this increased recognition, concussions and other TBIs are thought to be significantly underreported. Many athletes may fail to report concussion symptoms due to fear of being prohibited from playing and, in general, people often do not seek medical advice following mild to moderate head injuries since they may underestimate the potential health impact of such injuries.

POSSIBLE SIGNS AND SYMPTOMS OF CONCUSSIONS

Thinking & Remembering	Physical	Emotional/Mood	Sleep
<ul style="list-style-type: none"> • Difficulty thinking clearly • Feeling slowed down • Difficulty concentrating • Difficulty remembering new information 	<ul style="list-style-type: none"> • Headaches • Fuzzy/blurred vision • Nausea or vomiting (Early on) • Dizziness • Sensitivity to light or sounds • Balance problems • Tired/no energy 	<ul style="list-style-type: none"> • Irritability • Sadness • More emotional • Nervousness/anxiety 	<ul style="list-style-type: none"> • Sleeping more than usual • Sleeping less than usual • Trouble falling asleep

Source: U.S. Centers for Disease Control and Prevention: What Are the Signs and Symptoms of Concussions?

Concussions are generally less severe than other types of TBIs, with no loss of consciousness reported in over 90% of concussions. Concussion-related symptoms may become obvious immediately following the injury or may not become apparent until several days or weeks after the injury. Concussions can affect many aspects of health, including memory and the ability to think, emotional health, physical health, and sleep patterns (see box for more details). Over the long term, there is increasing evidence to suggest that TBIs, including concussions, can also cause epilepsy and increase the risk for Alzheimer’s and Parkinson’s diseases.⁸

While most athletes (80%-90%) report that all symptoms disappeared within 7 days of the concussion,⁵ this varies by individual. Athletes are sometimes reluctant to report symptoms, and it is critical to prevent further injury to the brain by removing athletes from play and not allowing athletes to return to play too soon. The impact of concussions varies from person to person, so rather than setting a particular time frame, existing guidelines focus on the use of standardized assessment tools and the importance of an individualized plan for returning to play based on the recommendations of medical professionals trained in the treatment of concussions.⁵ However, this can be difficult, as a recent study found that pediatricians and ED providers may not have adequate training or support tools to systematically diagnose and manage patients with concussions.⁹ The Centers for Disease Control and Prevention has partnered with multiple agencies in the Heads Up Initiative, which is designed to educate specific audiences, including health care providers, coaches, trainers, school nurses, parents, and athletes, about concussions.



Preventing Concussion Injuries

Youth and younger adults are at higher risk for severe outcomes from concussion injuries and for more prolonged recovery following brain injuries.⁵ Other research has indicated that concussion risk is likely elevated for football players, and that while the overall number of concussions is higher among males, in sports in which males and females play under similar rules (basketball, soccer), concussion risk is actually higher for females.¹⁰ It is important to both focus on preventing an initial concussion (primary prevention), and once a concussion has occurred, to provide proper treatment and to prevent any future concussions (secondary prevention).



Primary Preventive Measures

- **Protective equipment** – Protective equipment, including helmets, are important components of injury prevention. However, while helmets are effective in preventing skull fractures, lacerations, and fatalities, it is important to know that there are no helmets that prevent concussion injuries. Mouth guards, while not necessarily protective against concussions, are important for the prevention of dental injuries during sports and recreational activities with some degree of injury risk, and they should be worn at all levels of competition. The use of protective equipment is not a guarantee against concussions and should not substitute for good judgment. Following game rules, limiting risky behavior, and using equipment such as helmets, faceguards, and mouth protectors is key for injury prevention and is always encouraged.¹¹
- **Teaching skills, safe practices, and proper playing techniques** – Teaching good sportsmanship, following the rules, and use of proper techniques, e.g., tackling techniques in football that minimize the risk of a blow to the head, play an important role in injury prevention.
- **Strength and conditioning** – Proper preparation for sports activities through muscle strengthening and conditioning exercises are an important part of an injury prevention program.
- **Rule changes and strict officiating** – One of the most effective approaches to reducing concussion injuries is to institute rule changes that are enforced by strict officiating. This may be particularly effective because higher concussion rates are generally reported during competition rather than practice.¹²

Secondary Preventive Measures

- **Increase educational efforts** – Parents, coaches, and school staff (including physical education teachers) need to be trained to recognize the signs and symptoms of concussions. Athletes should be encouraged to talk about their symptoms to trained staff, a coach, or parent. Once an injury occurs, it is important to have trained staff perform an initial assessment as well as monitor the athlete to check for signs or symptoms of a possible concussion. Coaches, staff,

and parents should be aware of the signs and symptoms of concussions and feel confident about when to remove an athlete from play. It is very important to prevent return to play too early, which can result in further and more severe injury. The American Academy of Neurology and the American Medical Society for Sports Medicine recently released updated guidelines on management of sports-related concussions, which provides further information on this subject.^{5,10}

Public Policy Efforts

- Laws governing concussion in youth sports have been passed by 48 states and Washington D.C.¹³ These laws are in various stages of implementation and require concussion education for coaches, athletes, and parents; they also mandate removal of athletes from activity if there is any suspicion of concussion and require clearance from a medical professional before they return to play.
- In October 2011, California passed legislation requiring school districts to have a protocol to deal with concussions and other head injuries while providing concussion prevention information to student athletes and their parents. All athletes removed from play for a suspected concussion must be evaluated by a health care provider trained in the management of concussions before returning to play (AB 25).
- In January 2013, another California law requires high school coaches renewing their CPR/First Aid certification to complete a free online training that focuses on recognizing the signs and symptoms of concussions (AB 1451).

The **HEADS UP** Initiative

This program was developed by the Centers for Disease Control and Prevention as a way to educate coaches, school officials, parents, and students on sports-related concussions. The materials provide information on preventing, recognizing, and responding to a concussion.

- **Heads Up: Concussion in High School Sports** provides training for high school coaches | www.cdc.gov/concussion/HeadsUp/high_school.html
- **Heads Up: Concussion in Youth Sports** provides training for all who coach youth sports | www.cdc.gov/concussion/HeadsUp/youth.html
- **Heads Up to Schools: Know Your Concussion ABCs** provides education and resources for school nurses, teachers, and school administrators www.cdc.gov/concussion/HeadsUp/schools.html
- **Heads Up to Clinicians: Addressing Concussions in Sports among Kids and Teens** provides online training on diagnosing, managing, and preventing concussion injuries | www.cdc.gov/concussion/HeadsUp/clinicians.html
- **Heads Up: Brain Injury in Your Practice** is a tool kit of resources for clinicians to use in assessing, diagnosing, and managing patients with mild traumatic brain injury | www.cdc.gov/concussion/HeadsUp/physicians_tool_kit.html

Conclusion

Between 2005 and 2011, the rate of Los Angeles County residents treated for concussions in emergency departments increased by 58%. Youth and young adults ages 15-24 years have the highest rates of ED visits for concussions, particularly males, whites, and blacks. Among injuries that had an associated activity reported, team sports accounted for nearly half of all concussions.

The increase in reported concussions was likely largely driven by expanding awareness of the potential severity of concussions and the importance of seeking appropriate medical care. It may also be due to increased participation in high-risk sports and physical activities. However, while the increased awareness has led to increased efforts around concussion prevention strategies, there is concern that many concussions are still not being regularly and consistently diagnosed and treated, particularly among athletes who may worry about being restricted from playing. It is important for the public to be aware of the signs and symptoms as well as the long-term impacts concussions can have on an individual's health. New tools and guidelines, such as the Heads Up Initiative, can help ensure that clinicians have adequate training and tools to diagnose and treat concussions. The data and recommendations included in this report should stimulate local efforts to prevent concussions, particularly among teens and young adults who are disproportionately affected by these injuries.

69,171

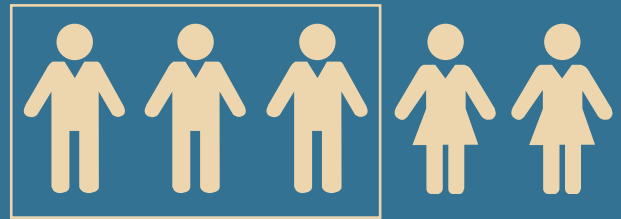
Patients Treated in the Emergency Department or Admitted to the Hospital for Concussion

Los Angeles County, 2005-2011



Over **22** ED visits
with concussions **each day**

Males account for 3 out of every 5
ED visits for concussions



Over **4** inpatient hospitalizations
with concussions **each day**

15- to 24-year-olds accounted for

15% of the County's
2010 population

29% of ED visits with
concussions

Over the past 7 years, the
Rate of ED visits with concussions
increased by >50%



↑ 50%

Rate of inpatient hospitalization
with concussions was constant

Rates of ED visits
for concussions among

15- to 24-year-olds

were almost

Twice as High

as for any other
age group

HELPFUL ONLINE RESOURCES

Los Angeles County Department of Public Health

Injury and Violence Prevention Program

www.publichealth.lacounty.gov/ivpp

Centers for Disease Control and Prevention

Traumatic Brain Injury Resources

www.cdc.gov/TraumaticBrainInjury

Facts about Concussion and Brain Injury

www.cdc.gov/concussion

Concussions in Sports Information

www.cdc.gov/concussion/sports

Concussion Diagnosis and Management Resources for Clinicians

www.cdc.gov/concussion/clinician.html

Safe Kids USA

Sports Safety Guide for Schools, Coaches, and Parents

www.SafeKids.org/sports

4th International Conference on Concussion in Sport

Consensus Statement

<http://bjsm.bmj.com/content/47/5/250.full.pdf+html>

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