

Helmets and the Prevention of Traumatic Brain Injury

Cinnamon Dixon, DO

Assistant Professor of Pediatrics

Division of Emergency Medicine

and

Center for Global Health

Cincinnati Children's Hospital Medical Center

Outline

- Helmet Basics
- How Helmets Work
- Helmet Effectiveness
- Helmet Use
- Current Helmet Regulations/Recommendations
- Helmet Policies
- Room for Improvement

Helmet Evolution

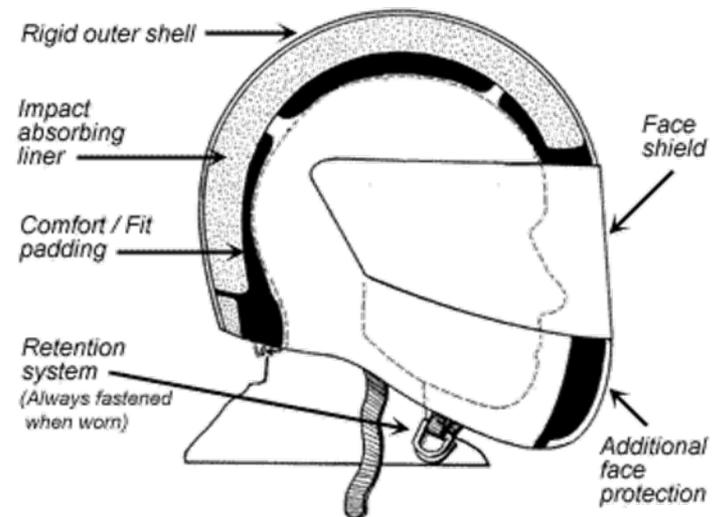


- Slow initially – without scientific evidence
 - Late 1800's – pith or soft leather
 - 1910-20's – suspension & hard leather
 - Late 1930's – plastic helmets
 - 1949 – NFL required
 - 1950's and beyond – continued development, standardization, regulations & policies
 - 1969 – NOCSEA founded
 - 1973 – safety standards for football helmets
 - Currently – U.S. CPSC

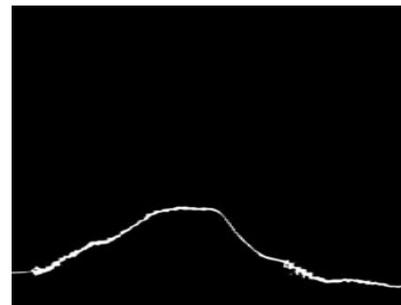
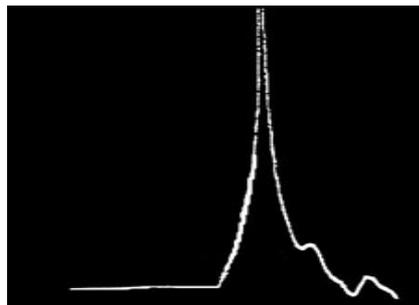
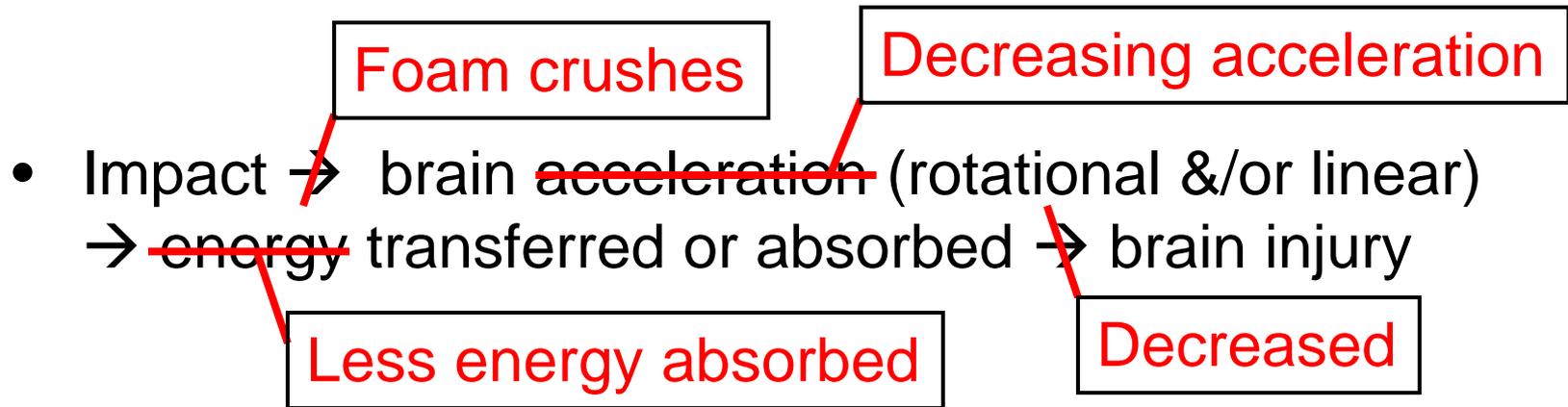


Helmet Design

- Hard exterior shell
- Middle stiff foam – expanded polystyrene, polypropylene, polyurethane
- Spongy internal foam and padding
- At least one strap
- Good ventilation holes



How Helmets Work



- Hard shell protects external surface

Activity Requirements & Recommendations

Football

- American Youth Football League
- National Federation of State High School Associations (NFSHSA)

Baseball

- CPSC Consumer Product Review – batting helmets

Hockey

- USA Hockey-sanctioned events or leagues
- NFSHSA

Equestrian

- US Equestrian Federation
- US Pony Club

Helmet Effectiveness in Bicycling

- Reduce risk of head & brain injury by **63-88%**
- Reduce risk upper/mid face injury by **65%**
- Equal protection with crashes involving cars (69%) v. other causes (68%)



Helmet Effectiveness in Motorcycling

- Reduced risk of death by 42%
- Reduced risk of head injury by 69%
- Insufficient evidence comparing type of helmet
- Some studies suggest protective effect for facial injury and/or no effect on neck injury



Helmet Effectiveness in ATV use

- Reduce risk of death by **42%**
- Reduce risk of nonfatal injury by **64%**
- Social direct and indirect costs of fatal and nonfatal head injuries -- savings of US\$364,306 per injury over a 50-year period



Helmet Effectiveness in Skiing/Snowboarding

- Reduce risk of head injury by **29-60%**
- No evidence that helmet use is associated with riskier activities leading to other injuries



Helmet Effectiveness in Horse-back Riding

- Helmets decrease

– Frequency

	Helmet	No Helmet
Significant Injury		
CNS	5/20	5/10
Fracture	5/20	4/10
Internal	2/20	4/10
Soft Tissue Injury		
With significant injury	5/11	2/10
Without significant injury	9/9	0

– Severity

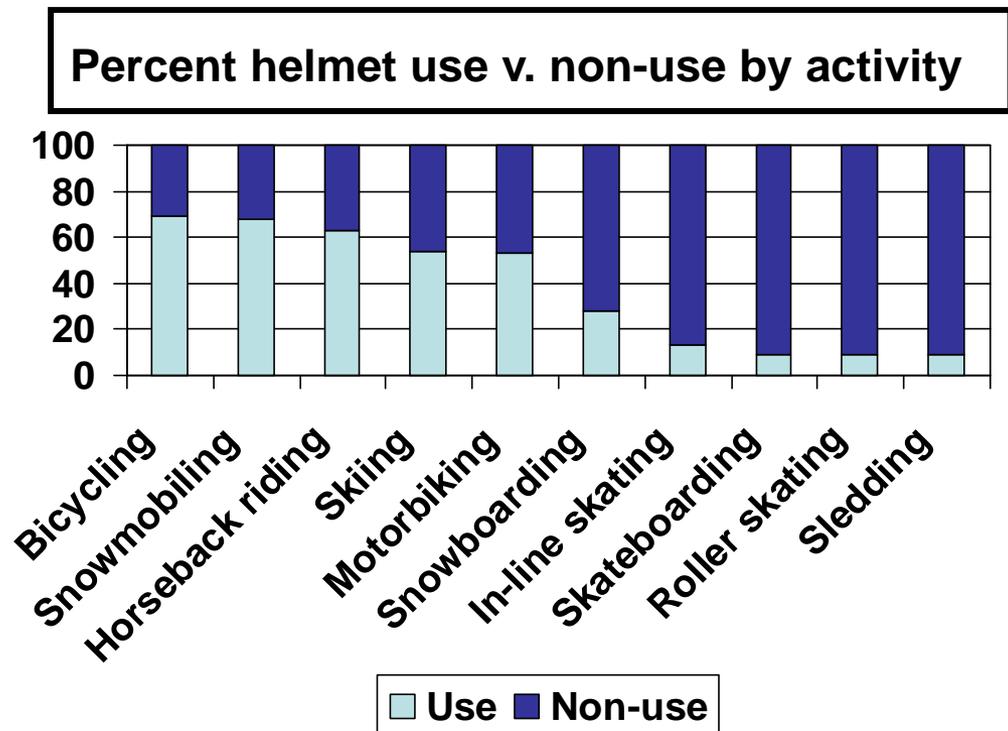
	Helmet	No Helmet	
Mean MISS score (\pm SD)	2.8 \pm 2.6	12.9 \pm 14.2	P = .002
GCS <15	0/20	3/10	P = .03
Hospitalized	2/20	6/10	P = .007
Ward	2/2	2/6	
ICU	0/2	3/6	
Died in OR	0/2	1/6	

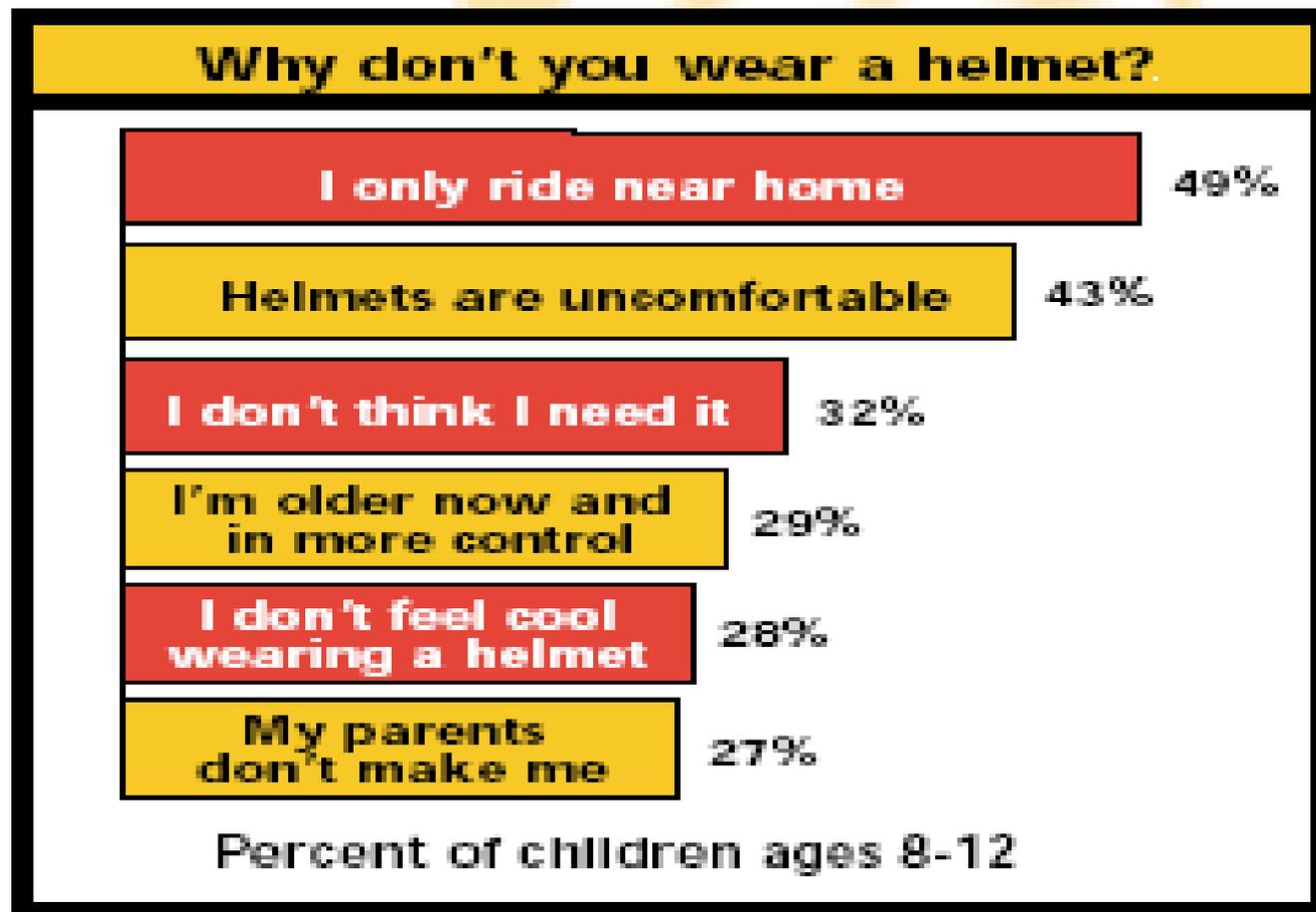
CDC Statement on preventing TBI

- Wearing a helmet and making sure your children wear helmets when:
 - Riding a bike, motorcycle, snowmobile, scooter, or all-terrain vehicle;
 - Playing a contact sport, such as football, ice hockey, or boxing;
 - Using in-line skates or riding a skateboard;
 - Batting and running bases in baseball or softball;
 - Riding a horse; or
 - Skiing or snowboarding.

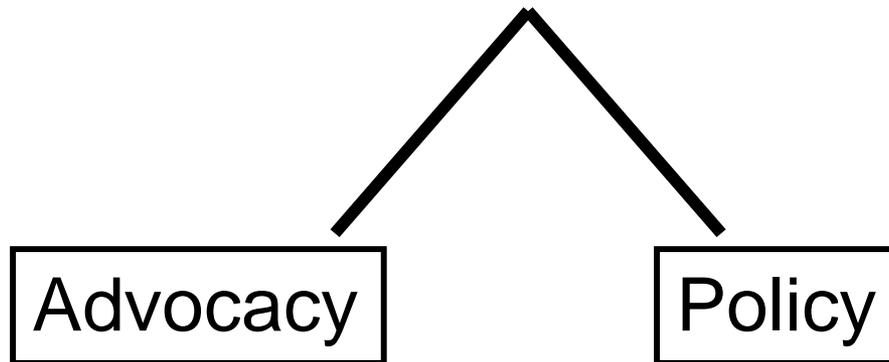
Helmet Use - Children

- Bicycles: 69%
- Snowmobile: 68%
- Horseback riding: 63%
- Skiing: 54%
- Motorbiking: 53%
- Snowboarding: 28%
- In-line skating: 27%
- ATV: 25%
- Skateboarding: 9%
- Roller skating: 9%
- Sledding: 9%



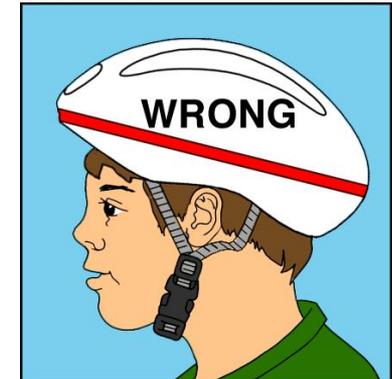
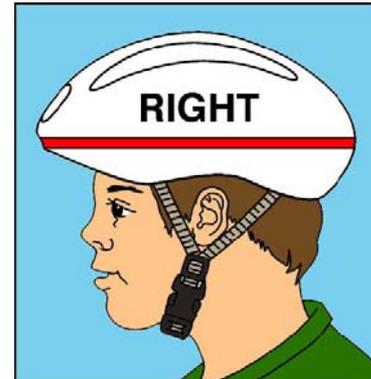


How do we get kids to wear helmets?



Advocacy

- Educate
 - Self
 - Family
 - Neighborhood
 - Communities
 - Patients
- Know recommendations and standards for each helmet we own and wear



① Activity	② Helmet Type	③ Applicable Standard(s)
Individual Activities – Wheeled		
Bicycling (including low speed, motor assisted) Roller & In-line Skating – Recreational Scooter Riding (including low speed, motor assisted)	Bicycle	CPSC, ASTM F1447, Snell B-90/95, Snell N-94†
BMX Cycling	BMX	CPSC, ASTM F2032
Downhill Mountain Bike Racing	Downhill	CPSC, ASTM F1952
Roller & In-line Skating – Aggressive/Trick Skateboarding	Skateboard	ASTM F1492†, Snell N-94†
Individual Activities – Wheeled Large Motor		
ATV Riding Dirt- & Mini-Bike Riding Motocrossing	Motocross or Motorcycle	DOT FMVSS 218, Snell M-2005
Karting/Go-Karting	Karting or Motorcycle	DOT FMVSS 218, Snell K-98, Snell M-2005
Moped Riding Powered Scooter Riding	Moped or Motorcycle	DOT FMVSS 218, Snell L-98, Snell M-2005
Individual Activities – Non-Wheeled		
Horseback Riding	Equestrian	ASTM F1163, Snell E-2001
Rock- & Wall-Climbing	Mountaineering	EN 12492†, Snell N-94†
Team Sport Activities †		
Baseball, Softball & T-Ball	Baseball Batter's	NOCSAE ND022
	Baseball Catcher's	NOCSAE ND024
Football	Football	NOCSAE ND002, ASTM F717
Ice Hockey	Hockey	NOCSAE ND030, ASTM F1045
Lacrosse	Lacrosse	NOCSAE ND041
Winter Activities		
Skiing Snowboarding	Ski	ASTM F2040, CEN 1077, Snell RS-98 or S-98
Snowmobiling	Snowmobile	DOT FMVSS 218, Snell M-2000
Although a helmet has not yet been designed for the following two activities, until such helmets exist, wearing one of the three listed types of helmets may be preferable to wearing no helmet at all.		
Ice Skating Sledding	Bicycle	CPSC, ASTM F1447, Snell B-90/95 or N-94†
	Skateboard	ASTM F1492†, Snell N-94†
	Ski	ASTM F2040, CEN 1077, Snell RS-98 or S-98

Advocacy

- Role models:
 - Family
 - Neighborhood
 - Communities
 - Patients



Advocacy

Educational/Promotional campaigns

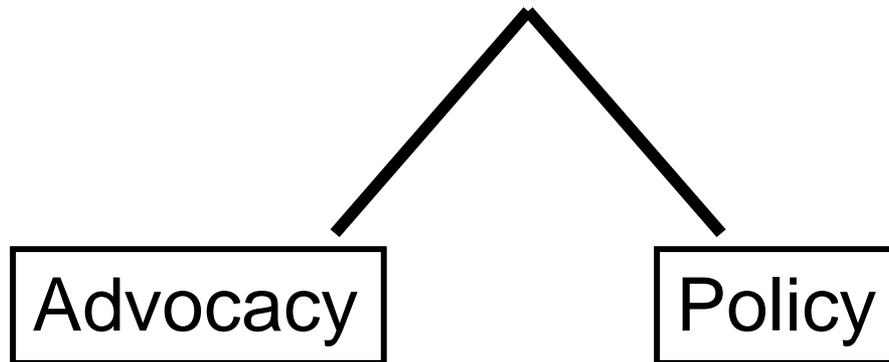
- “After a campaign, children were more likely to wear helmets than other children.”
- Best campaigns:
 - Community-based with education and free or subsidized helmet provision
 - Promotion of helmets in schools

Advocacy

Media

- Public service announcements
- Movie Industry
 - 50 top grossing movies 2000-2004
 - 7% motorcycle & 4% bicycle/skateboard scenes
 - Overall helmet use 33.3%
 - Verbal indications for helmet use in 1.0%
 - Injury rate for noncompliant was 10.7%

How do we get kids to wear helmets?



Policy and Legislation

- Policies at local sporting sites and events
 - Ski resorts
 - Skate parks
 - Skating rinks
- Regulations in neighborhoods

Policy and Legislation

Bikes:

- Helmet legislation is “effective in **increasing helmet use and decreasing rates of head injury rates** in the populations for which it is implemented.”

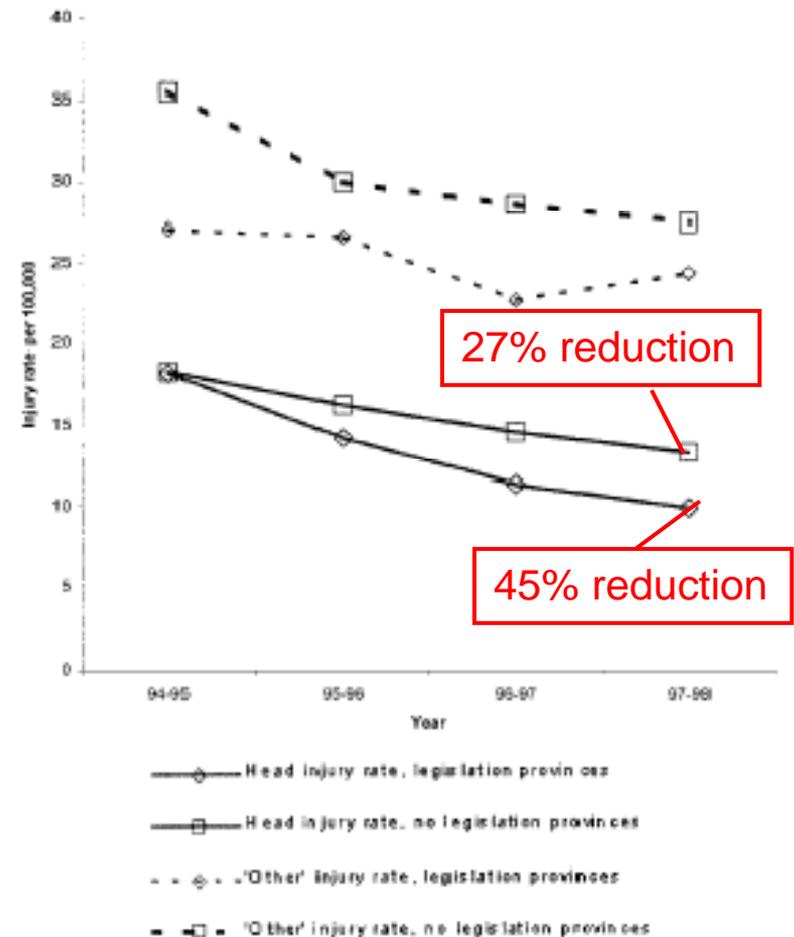
Ohio Bicycle Helmet Laws

Akron	Under 16 2001	Glendale	Under 19 *2000
Beachwood	Under 16 1990	Kettering	Under 16 *2004
Blue Ash	Under 16 2003	Lakewood	Under 18 1997
Brecksville	Under 18 *1998	Madeira	Under 17 *2002
Brooklyn	Under 14 2001	Marietta	Under 16 *2004
Centerville	Under 16 1999	Orange Village	Ages 6 to 15 1992
Cincinnati	Under 16 *2004	Pepper Pike	Under 18 2000
Columbus	Under 18 effective 2009	Shaker Heights	All ages over 5 inc. Passengers 1997
Dayton	Under 13 2004	South Euclid	Under 14 2000
E. Cleveland	Under 18 *2004	Strongsville	Under 12 1993
Enon	Under 16 *2004	Waynesville	Under 17 *2000
Euclid	Under 14 2001		

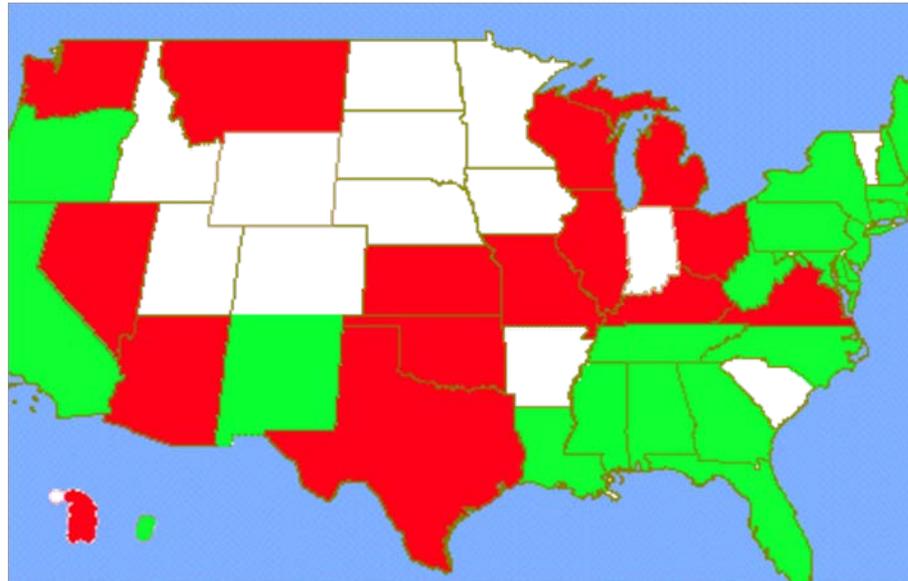
Policy and Legislation

Bikes Canada:

- Country-wide study of head injury in regions with and without mandatory helmet legislation.
- Youth and adults are significantly more likely to wear helmets as the comprehensiveness of helmet legislation increases.



US Bicycle Helmet Laws

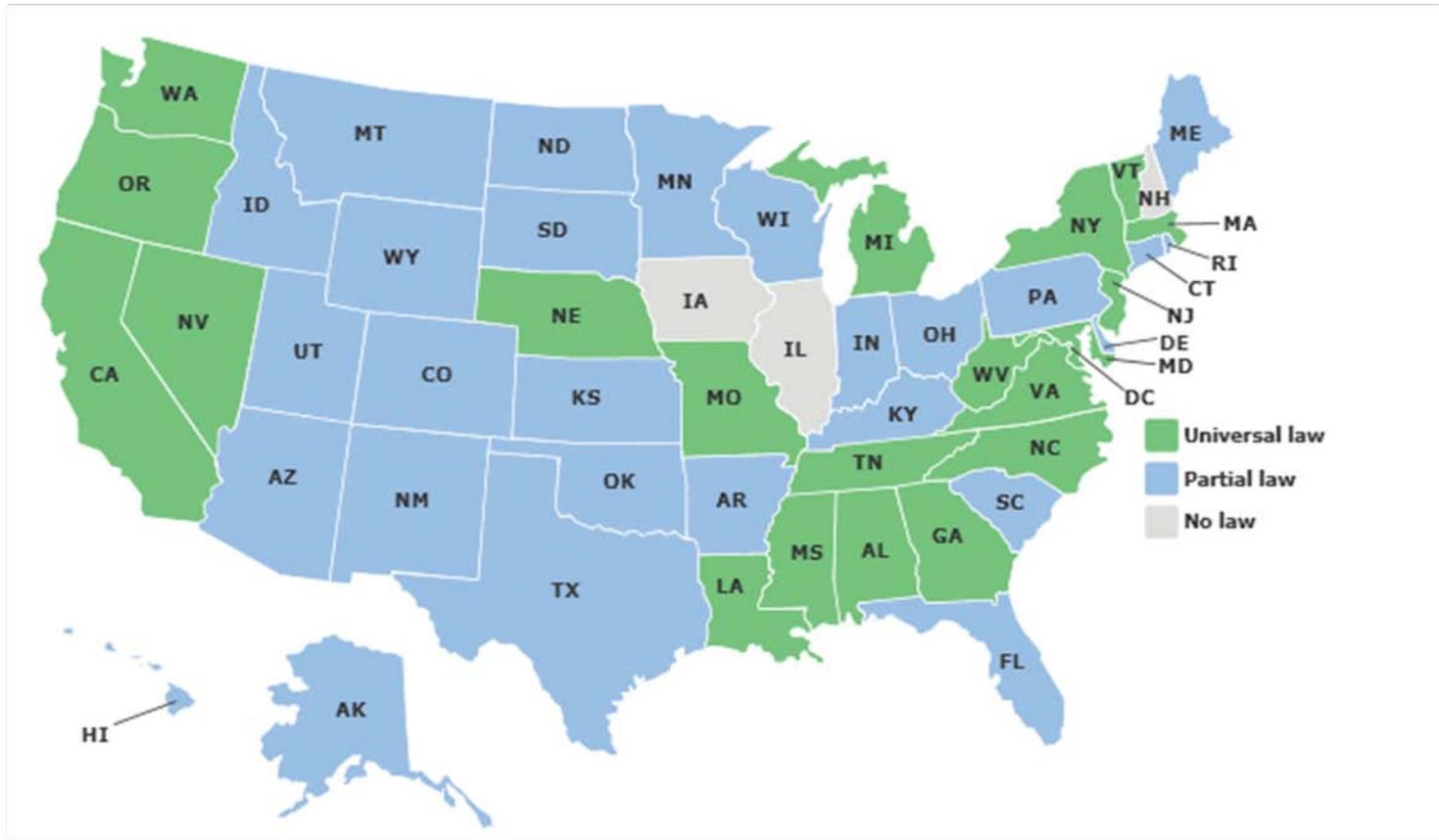


Green = States with **state-wide bike helmet laws**

Red = States with **some local helmet laws**

White = States with no known local or state-wide helmet laws, including Arkansas, Colorado, Idaho, Indiana, Iowa, Minnesota, Nebraska, North Dakota, South Dakota, South Carolina, Utah, Vermont and Wyoming--13 in all.

US Motorcycle Helmet Laws



In Conclusion

- Helmets have a long history
- Designed and standardized to decrease TBI
- Effective in nearly all sporting activities
- **American youth still lack the frequent use**
- Education/Promotion campaigns and legislation are effective at increasing use
- Micro and macro advocacy and policy initiatives and support are necessary

Thank you!



References

- Gaffney, Andrew. *Popular Mechanics*. 10 Steps in the High-Tech Evolution of Pro Football Helmets. Dec, 2009. http://www.popularmechanics.com/outdoors/sports/football/4281378?click=main_sr
- Bicycle Helmet Safety Institute. <http://www.bhsi.org>
- Insurance Institute for Highway Safety. <http://www.iihs.org/laws/HelmetUseOverview.aspx>
- Liu BC, Ivers R, Norton R, Boufous S, Blows S, Lo SK. Helmets for preventing injury in motorcycle riders. *Cochrane Database of Systematic Reviews* 2008, Issue 1. Art. No.: CD004333. DOI: 10.1002/14651858.CD004333.pub3.
- Thompson DC, Rivara F, Thompson R. Helmets for preventing head and facial injuries in bicyclists. *Cochrane Database of Systematic Reviews* 1999, Issue 4. Art. No.: CD001855. DOI: 10.1002/14651858.CD001855.
- Hagel BE, Pless IB, Goulet C, et al. Effectiveness of helmets in skiers and snowboarders: case-control and case crossover study. *BMJ* 2005; 330:281.
- Sulheim S, Holme I, Ekeland A, Bahr R. Helmet use and risk of head injuries in alpine skiers and snowboarders. *JAMA* 2006; 295:919–924.
- Hagel B, Pless IB, Goulet C, et al. The effect of helmet use on injury severity and crash circumstances in skiers and snowboarders. *Accid Anal Prev* 2005; 37:103–108.
- Bond GR, Christoph RA, and Rodgers BM. Pediatric Equestrian Injuries: Assessing The Impact of Helmet Use. *Pediatrics* 1995;95:487-489
- U. S.Consumer Product Safety Commission; National Bike Helmet Use Survey. April 1999. Available at: <http://www.cpsc.gov/library/helmet.html>
- Dixon C, Gittelman MA. Pediatric helmet use: teaching patients to use their heads. *Pediatr Ann.* 2008 Sep;37(9):606-12.
- <http://www.chandigarhtrafficpolice.org/helmet.htm>
- National Safe Kids Campaign Youth Survey, 2002.
- Royal S, Kendrick D, Coleman T. Non-legislative interventions for the promotion of cycle helmet wearing by children. *Cochrane Database of Systematic Reviews* 2005, Issue 2. Art. No.: CD003985.
- Macpherson A, Spinks A. Bicycle helmet legislation for the uptake of helmet use and prevention of head injuries. *Cochrane Database of Systematic Reviews* 2008, Issue 3. Art. No.: CD005401.
- Cowan JA Jr, Dubosh N, Hadley C. Seatbelt and helmet depiction on the big screen blockbuster injury prevention messages? *J Trauma.* 2009 Mar;66(3):912-7.
- Alison K. Macpherson, Teresa M. To, Colin Macarthur, Mary L. Chipman, James G. Wright and Patricia C. Parkin. Impact of Mandatory Helmet Legislation on Bicycle-Related Head Injuries in Children: A Population-Based Study. *Pediatrics* 2002;110:e60
- Jessica Dennis, Beth Potter, Tim Ramsay, et al. The effects of provincial bicycle helmet legislation on helmet use and bicycle ridership in Canada. *Inj Prev* published online June 29, 2010. doi: 10.1136/ip.2009.025353
- Prevention Info from the Centers for Disease Control (CDC), National Center for Injury PreventionControl (NCIPC). www.cdc.org
- U.S. Consumer Product Safety Commision “Which Helmet for Which Activity”. <http://www.cpsc.gov/cpscpub/pubs/349.pdf>
- Insurance for Highway Safety, July 2010. <http://www.iihs.org/laws/mapmotorcyclehelmets.aspx>