Helmets and the Prevention of Traumatic Brain Injury

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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

http://www.popularmechanics.com/outdoors/sports/football/4281378?click=main_sr
http://www.bhsi.org/history.htm
Helmet Design

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

http://www.chandigarhtrafficpolice.org/helmet.htm
How Helmets Work

• Impact → brain acceleration (rotational &/or linear) → energy transferred or absorbed → brain injury
  Foam crushes  Decreasing acceleration
  Less energy absorbed  Decreased

• Hard shell protects external surface

http://www.bhsi.org/general.htm
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

http://www.fotosearch.com/UNC152/u15405782/ Royalty free
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

http://www.fotosearch.com/photos-images/atv.html Royalty free
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
  - Severity

<table>
<thead>
<tr>
<th></th>
<th>Helmet</th>
<th>No Helmet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant Injury</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CNS</td>
<td>5/20</td>
<td>5/10</td>
</tr>
<tr>
<td>Fracture</td>
<td>5/20</td>
<td>4/10</td>
</tr>
<tr>
<td>Internal</td>
<td>2/20</td>
<td>4/10</td>
</tr>
<tr>
<td>Soft Tissue Injury</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With significant injury</td>
<td>5/11</td>
<td>2/10</td>
</tr>
<tr>
<td>Without significant injury</td>
<td>9/9</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Helmet</th>
<th>No Helmet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean MISS score (± SD)</td>
<td>2.8 ± 2.6</td>
<td>12.9 ± 14.2</td>
</tr>
<tr>
<td>GCS &lt;15</td>
<td>0/20</td>
<td>3/10</td>
</tr>
<tr>
<td>Hospitalized</td>
<td>2/20</td>
<td>6/10</td>
</tr>
<tr>
<td>Ward</td>
<td>2/2</td>
<td>2/6</td>
</tr>
<tr>
<td>ICU</td>
<td>0/2</td>
<td>3/6</td>
</tr>
<tr>
<td>Died in OR</td>
<td>0/2</td>
<td>1/6</td>
</tr>
</tbody>
</table>

Bond GR, Christoph RA, and Rodgers BM. Pediatrics 1995.
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%

Why don’t you wear a helmet?

- I only ride near home: 49%
- Helmets are uncomfortable: 43%
- I don’t think I need it: 32%
- I’m older now and in more control: 29%
- I don’t feel cool wearing a helmet: 28%
- My parents don’t make me: 27%

Percent of children ages 8-12

How do we get kids to wear helmets?

- Advocacy
- Policy
Advocacy

- Educate
  - Self
  - Family
  - Neighborhood
  - Communities
  - Patients

- Know recommendations and standards for each helmet we own and wear
<table>
<thead>
<tr>
<th>Activity</th>
<th>Helmet Type</th>
<th>Applicable Standard(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individual Activities — Wheeled</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycling (including low speed, motor assisted)</td>
<td>Bicycle</td>
<td><strong>CPSC, ASTM F1447, Snell B-90/95, Snell N-94†</strong></td>
</tr>
<tr>
<td>Roller &amp; In-line Skating — Recreational</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scooter Riding (including low speed, motor assisted)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMX Cycling</td>
<td>BMX</td>
<td><strong>CPSC, ASTM F2032</strong></td>
</tr>
<tr>
<td>Downhill Mountain Bike Racing</td>
<td>Downhill</td>
<td><strong>CPSC, ASTM F1952</strong></td>
</tr>
<tr>
<td>Roller &amp; In-line Skating — Aggressive/Trick</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skateboarding</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Individual Activities — Wheeled Large Motor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATV Riding</td>
<td>Motocross or Motorcycle</td>
<td><strong>DOT FMVSS 218, Snell M-2005</strong></td>
</tr>
<tr>
<td>Dirt- &amp; Mini-Bike Riding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motocrossing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Karting/Go-Karting</td>
<td>Karting or Motorcycle</td>
<td><strong>DOT FMVSS 218, Snell K-98, Snell M-2005</strong></td>
</tr>
<tr>
<td>Moped Riding</td>
<td>Moped or Motorcycle</td>
<td><strong>DOT FMVSS 218, Snell L-98, Snell M-2005</strong></td>
</tr>
<tr>
<td>Powered Scooter Riding</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Individual Activities — Non-Wheeled</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horseback Riding</td>
<td>Equestrian</td>
<td><strong>ASTM F1163, Snell E-2001</strong></td>
</tr>
<tr>
<td>Rock- &amp; Wall-Climbing</td>
<td>Mountaineering</td>
<td><strong>EN 12492†, Snell N-94†</strong></td>
</tr>
<tr>
<td><strong>Team Sport Activities ‡</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseball, Softball &amp; T-Ball</td>
<td>Baseball Batter’s</td>
<td><strong>NOCSAE ND022</strong></td>
</tr>
<tr>
<td></td>
<td>Baseball Catcher’s</td>
<td><strong>NOCSAE ND024</strong></td>
</tr>
<tr>
<td>Football</td>
<td>Football</td>
<td><strong>NOCSAE ND002, ASTM F717</strong></td>
</tr>
<tr>
<td>Ice Hockey</td>
<td>Hockey</td>
<td><strong>NOCSAE ND030, ASTM F1045</strong></td>
</tr>
<tr>
<td>Lacrosse</td>
<td>Lacrosse</td>
<td><strong>NOCSAE ND041</strong></td>
</tr>
<tr>
<td><strong>Winter Activities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skiing</td>
<td>Ski</td>
<td><strong>ASTM F2040, CEN 1077, Snell RS-98 or S-98</strong></td>
</tr>
<tr>
<td>Snowboarding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snowmobiling</td>
<td>Snowmobile</td>
<td><strong>DOT FMVSS 218, Snell M-2000</strong></td>
</tr>
<tr>
<td><strong>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.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ice Skating</td>
<td>Bicycle</td>
<td><strong>CPSC, ASTM F1447, Snell B-90/95 or N-94†</strong></td>
</tr>
<tr>
<td>Sledding</td>
<td>Skateboard</td>
<td><strong>ASTM F1492†, Snell N-94†</strong></td>
</tr>
<tr>
<td></td>
<td>Ski</td>
<td><strong>ASTM F2040, CEN 1077, Snell RS-98 or S-98</strong></td>
</tr>
</tbody>
</table>
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%

http://www.youtube.com/watch?v=HNoo9ZekHbs
How do we get kids to wear helmets?

Advocacy

Policy
Policy and Legislation

• Policies at local sporting sites and events
  – Ski resorts
  – Skate parks
  – Skating rinks

• Regulations in neighborhoods

Helmets and TBI
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

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

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.

Bicycle Helmet Safety Institute, June, 2010,
US Low-Power Cycle Helmet Laws

Insurance for Highway Safety, July 2010.
US Motorcycle Helmet Laws

Insurance for Highway Safety, July 2010.
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

- http://www.chandigarhtrafficpolice.org/helmet.htm
- Prevention Info from the Centers for Disease Control (CDC), National Center for Injury PreventionControl (NCIPC). www.cdc.org