Assessment of Child Helmet Efficacy for Motorcycle Use in Malaysia
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- Literature
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- Child Helmet – Availability and Design
- Child Helmet Testing
- Summary
  - Age
  - Helmet Design
- Challenge/Opportunity
<table>
<thead>
<tr>
<th>Country</th>
<th>No of Passenger</th>
<th>Passenger Age Limit</th>
<th>Helmet Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaysia</td>
<td>Only 1 passenger allowed</td>
<td>No requirement</td>
<td>Yes</td>
</tr>
<tr>
<td>Vietnam</td>
<td>No requirement</td>
<td>No requirement</td>
<td>Yes</td>
</tr>
<tr>
<td>US, 4 states</td>
<td>No requirement</td>
<td>Varies from &gt; 5 to &gt;8 years</td>
<td>Yes</td>
</tr>
<tr>
<td>Australia</td>
<td>No requirement</td>
<td>≥8 years, unless in a side car</td>
<td>Yes</td>
</tr>
</tbody>
</table>
## ACCIDENT DATA (2006-2008) - MALAYSIA

(Children age 1 to 18 years)

<table>
<thead>
<tr>
<th>Severity</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>Mean %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>485</td>
<td>469</td>
<td>578</td>
<td>511 (10.5)</td>
</tr>
<tr>
<td>Serious</td>
<td>1314</td>
<td>1223</td>
<td>1288</td>
<td>1275 (26.3)</td>
</tr>
<tr>
<td>Slight</td>
<td>2470</td>
<td>2330</td>
<td>2269</td>
<td>2356 (48.6)</td>
</tr>
<tr>
<td>Not Injured</td>
<td>707</td>
<td>628</td>
<td>785</td>
<td>707 (14.6)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4976</strong></td>
<td><strong>4650</strong></td>
<td><strong>4920</strong></td>
<td><strong>4849</strong></td>
</tr>
</tbody>
</table>

Average Annual Motorcycle fatality in Malaysia 3600, Child fatality in Motorcycle Accidents > 14 % annually
**CASUALTY BY CHILDREN AGE GROUP**

### Age Frequency by Casualty Type

<table>
<thead>
<tr>
<th>Age</th>
<th>Fatal</th>
<th>Serious</th>
<th>Slight</th>
<th>Not Injured</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-6</td>
<td>53</td>
<td>101</td>
<td>243</td>
<td>0</td>
</tr>
<tr>
<td>7-12</td>
<td>67</td>
<td>247</td>
<td>370</td>
<td>50</td>
</tr>
<tr>
<td>13-18</td>
<td>1412</td>
<td>3477</td>
<td>6456</td>
<td>2094</td>
</tr>
</tbody>
</table>

**Age 1-6 years fatality 3.5%, Age 7-12 years fatality 4.4%**

**For 1-12 age**
CASUALTY FOR AGE GROUP 13 TO 18 YEARS

Casualty for Age 13 to 18 years

<table>
<thead>
<tr>
<th>No. of Casualty</th>
<th>Fatal</th>
<th>Serious</th>
<th>Slight</th>
<th>Not Injured</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-15</td>
<td>365</td>
<td>996</td>
<td>1468</td>
<td>450</td>
</tr>
<tr>
<td>16-18</td>
<td>1047</td>
<td>2481</td>
<td>4070</td>
<td>1644</td>
</tr>
</tbody>
</table>

Licensing Age starts at age 16 years
LITERATURE REVIEW

2. Sub standard helmet provides inferior protection to user – Asa C.P., et al.
4. Applicable Legislation plus appropriate enforcement proven to increase use of helmet, absence or low enforcement resulted in low helmet use – Hung DV, et al.
5. RTA in schoolchildren due to lack in supervision and enforcement activities – Kanchan et al, Rohana et al.
6. Low child helmet use due to fear of neck injury – WHO report in Vietnam
8. Most studies were on adult subjects, limited evidence on children injury and motorcycle use
9. Children more susceptible to permanent brain damage than adult when subjected to similar impact forces – Anderson et al
ANTHROPOMETRIC AND BIO-MECHANICAL DIFFERENCES

University of Michigan Transportation Research Institute (UMTRI) data - Dr. Kathleen Klinich

- Head size growth development (head breadth, depth, circumference)
  - 0-4 years old → growth rapidly
  - 4 years old → 90% of adult size
  - 12 years old → 95% of adult size
  - 20 years old → the bone plates of the skull fully close

- Neck Development
  - 4 years old → 75% of adult size
  - 12 years → 85% of adult size

Mr Edward Becker (Snell Memorial Foundation)
+ Facial structure of children is vastly different from the adults
+ Children heads are smaller in vertical height

Dr. Susan Margulies (University of Pennsylvania)
+ The greater water content in a child’s brain makes it stiffer than an adult
+ The skull stiffness increase by age

ANTHROPOMETRIC AND BIO-MECHANICAL DIFFERENCES

- Dr. Kristy Arbogast (The children’s Hospital of Philadelphia)
  + Neck muscles of children are weaker than adult-neck ligaments, it can stretch more
  + Children bend their neck at higher vertebral level
  + Their vertebral joint are flatten so they don’t restrict much vertebral motion

Scaling helmet weight by using animal study by Randall Ching (University of Washington Applied Mechanic Laboratory)

Assumption

- Accept maximum helmet weight for adults is 2 kg (Prange, 2003)
- Scaling based on functional metric (stiffness, modulus, range of motion)

## Child Helmet Mass Scale

<table>
<thead>
<tr>
<th>Age Group (Years)</th>
<th>UW (Baboon)</th>
<th>MCW (Goat)</th>
<th>Mean (± IS.D.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tension</td>
<td>Compression</td>
<td>Tension</td>
</tr>
<tr>
<td>1</td>
<td>0.42</td>
<td>0.29</td>
<td>0.19</td>
</tr>
<tr>
<td>3</td>
<td>0.47</td>
<td>0.38</td>
<td>0.28</td>
</tr>
<tr>
<td>6</td>
<td>0.56</td>
<td>0.51</td>
<td>0.41</td>
</tr>
<tr>
<td>12</td>
<td>0.71</td>
<td>0.72</td>
<td>0.64</td>
</tr>
<tr>
<td>Adult</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age Group (years)</th>
<th>Lower Limit (kg)</th>
<th>Higher Limit (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.23</td>
<td>0.72</td>
</tr>
<tr>
<td>3</td>
<td>0.35</td>
<td>0.86</td>
</tr>
<tr>
<td>6</td>
<td>0.91</td>
<td>1.17</td>
</tr>
<tr>
<td>12</td>
<td>1.24</td>
<td>1.6</td>
</tr>
<tr>
<td>Adult</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

ANTHROPOMETRIC AND BIO-MECHANICAL DIFFERENCES - SUMMARY

Summary of findings

- The Anthropometric and Bio-mechanical of child and adults are different
- Adults helmet may not be suitable for child of early age (<12 years old)
- There is a need to develop helmet to cater children of various age
- Minimum age limit of the motorcycle passenger (pillion) need to be established
TYPICAL CHILD HELMET DESIGN REQUIREMENTS

- Size(cm) - 50 – 57
- Outer Shell Thickness(mm) – 5
- Inner Shell Thickness(mm) -25
- Mass(g) – 500 – 1000
- Impact test performance – less than 200 g

CHILD HELMET CAMPAIGN
MALAYSIAN EFFORT

Direct
• Paper media
• Soft media, i.e. www.panducermat.gov.my
• Advertisement and TV commercials

Indirect
• Addressing children to wear helmets
• Instill safety habit from young age, carry over to adulthood
CHILD HELMET CAMPAIGN
MALAYSIAN EFFORT

Advertisement and TV commercials

Protect Your Child
With SIRIM Approved Child Helmets
CHILD HELMET CAMPAIGN
MALAYSIAN EFFORT

Advertisement and TV commercials
CHILD HELMET CAMPAIGN
MALAYSIAN EFFORT

Advertisement and TV commercials

Tak ada topi keledar, tak boleh ikut.

Sayang, pakai yang ini baru betul.

Anda Mampu Mengubahnya.
CHILD HELMET CAMPAIGN
MALAYSIAN EFFORT

TV News
CHILD HELMET CAMPAIGN
MALAYSIAN EFFORT

Poster

Topi keledar kanak-kanak bukan aksesori. lanya satu keperluan.

Tiada gunanya kalau tidak diikat ketat.

Lindungi diri anda dengan topi keledar yang disahkan oleh SIRIM. Bagaimana?
## TYPICAL CHILDREN HELMET WEARING IN MALAYSIAN SCHOOLS -KLANG VALLEY

<table>
<thead>
<tr>
<th>Use of Helmet</th>
<th>Yes</th>
<th>Percentage, %</th>
<th>No</th>
<th>Percentage, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban (N=309)</td>
<td>79</td>
<td>28.6</td>
<td>230</td>
<td>74.4</td>
</tr>
<tr>
<td>Suburban (N=493)</td>
<td>197</td>
<td>40.0</td>
<td>296</td>
<td>60.0</td>
</tr>
</tbody>
</table>
## SUBURB SCHOOLS

<table>
<thead>
<tr>
<th>School</th>
<th>Use Standard</th>
<th>Use Non Standard</th>
<th>Not Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sek. Keb. Jln Semenyih Dua Kajang</td>
<td>39.7</td>
<td>25.0</td>
<td>35.3</td>
</tr>
<tr>
<td>Sek. Keb. Taman Jasmin Dua Kajang</td>
<td>25.5</td>
<td>12.7</td>
<td>61.8</td>
</tr>
<tr>
<td>Sek. Keb. Seksyen 7 Bangi</td>
<td>16.4</td>
<td>20.0</td>
<td>63.6</td>
</tr>
<tr>
<td>Sek. Keb. Bandar Tun Hussein Onn (2)</td>
<td>34.9</td>
<td>8.4</td>
<td>56.6</td>
</tr>
<tr>
<td>Sek. Keb. Dato Abu Bakar Baginda</td>
<td>14.3</td>
<td>5.4</td>
<td>80.4</td>
</tr>
<tr>
<td>Sek. Keb. Puchong Batu 14</td>
<td>4.6</td>
<td>4.6</td>
<td>90.8</td>
</tr>
<tr>
<td>Sek Keb Taman Cuepacs Bt 9 Cheras</td>
<td>28.4</td>
<td>23.9</td>
<td>47.7</td>
</tr>
<tr>
<td>Sek Keb Taming Jaya, S.Kembangan</td>
<td>34.8</td>
<td>21.7</td>
<td>43.5</td>
</tr>
<tr>
<td><strong>Percentage, %</strong></td>
<td><strong>25.0</strong></td>
<td><strong>15.0</strong></td>
<td><strong>60.0</strong></td>
</tr>
</tbody>
</table>
## URBAN SCHOOLS

<table>
<thead>
<tr>
<th>School</th>
<th>Use Standard</th>
<th>Use Non Standard</th>
<th>Not Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sek. Keb. Padang Jawa Petaling, Shah Alam</td>
<td>3.2</td>
<td>1.1</td>
<td>95.7</td>
</tr>
<tr>
<td>Sek. Keb. Taman Sri Muda (2) Jln Cermat 25/36 S.Alam</td>
<td>26.8</td>
<td>14.3</td>
<td>58.9</td>
</tr>
<tr>
<td>Sek. Keb. Bukit Kuda Jln Landasan Klang</td>
<td>21.0</td>
<td>5.3</td>
<td>73.7</td>
</tr>
<tr>
<td>Sek. Keb. Seafield 3 Pesiaran Kewajipan 47610 USJ Subang Jaya</td>
<td>12.4</td>
<td>18.8</td>
<td>68.8</td>
</tr>
<tr>
<td>Sek. Keb. Seafield Jln USJ 6/3 Subang Jaya</td>
<td>0</td>
<td>23.1</td>
<td>76.9</td>
</tr>
<tr>
<td>Sek. Keb. Kg Lindungan Jln PJS 10/11 Petaling Jaya</td>
<td>16.0</td>
<td>12.0</td>
<td>72.0</td>
</tr>
<tr>
<td>Sek. Keb. Bandar sunway Jln PJS 7/15 Petaling Jaya</td>
<td>20.7</td>
<td>5.8</td>
<td>73.5</td>
</tr>
<tr>
<td>Sek. Keb Klang Jln Dato' Hamzah Klang</td>
<td>27.8</td>
<td>22.2</td>
<td>50.0</td>
</tr>
<tr>
<td><strong>Percentage, %</strong></td>
<td><strong>15.2</strong></td>
<td><strong>10.4</strong></td>
<td><strong>74.4</strong></td>
</tr>
</tbody>
</table>
CHILDREN AT RISK
CHILDREN AT RISK
CHILDREN AT RISK

The legs are dangling on the air

Cannot hold parents tightly
CHILDREN AT RISK

Children sitting in front of rider
Helmets are not designed for children's size.

Helmet size on the vertical are big until it's rest on the shoulder.
SUMMARY-HELMET USE STUDY

- Focusing on school areas where motorcycles are one of the popular mode of transport
- The findings
  - Majority of the children are not wearing helmets
  - There are cases more than 1 pillion passenger carried on the motorcycles
  - There are cases where the physical size of the children may not be suitable to become pillion passengers (refer to photo)
  - Some helmet size may not be suitable to the children head size especially on the vertical side
SUMMARY-HELMET USE STUDY

- The findings (continue)
  - Majority of the younger age children (maybe less than 7 years) are carried in front of the rider – safer? Or otherwise?
CHILD HELMET AVAILABILITY AND DESIGN

- Standard child helmet (Compliance with MS 1),
  - Current available CH are mainly fitted for 6 years and above (based on child helmet dimension and head circumference)
  - The helmet designed with thicker foam in order to fit with child head size. The outer shell is using the same size with adult

- Non-standard – non compliant to any standards
  - Available in various size for children
  - Available in different design(e.g toy, game and others)
  - The performance is questionable?
STANDARD CHILD HELMET

Approval sticker Approval sticker, behind comfort liner

Size 54cm
TOY/GAME HELMET (NON-STANDARD)
HELMET SPECIFICATION

- MS1: 1996 Addresses general helmet construction and minimum performance criteria, similar to ECE R22 but without HIC
- Size available: min 50 ~ max 62 cm of head circumference, size not suitable for age <6 years
- Current Child helmet test with the same standards with Adult
# HELMET STANDARDS COMPARISON

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Scope</td>
<td>Children motorsports use</td>
<td>Motor vehicle free environment, &lt;7 yrs old</td>
<td>Vehicle user</td>
<td>Children</td>
<td>Moped and Motorcycle use</td>
<td>Road users and moped</td>
</tr>
<tr>
<td>Size, cm</td>
<td>&lt;49 – 59</td>
<td>50-62 Head form</td>
<td>50 – 62 Headform</td>
<td>45 – 60</td>
<td>50 – 62 Headform</td>
<td>&lt;50, 50-52, &gt;52</td>
</tr>
<tr>
<td>Mass, g</td>
<td>1000 – 1300</td>
<td>No requirement</td>
<td>No requirement</td>
<td>500-1000</td>
<td>No requirement</td>
<td>Full face *,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L &lt;1500  M&amp;S &lt;1200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Open and ½ shell</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L &lt;1000  M&amp;S &lt;800</td>
</tr>
<tr>
<td>Performance</td>
<td>Impact test, m/3.8– 7.75</td>
<td>4.57-5.42</td>
<td>5.94-6.42 (1.8 – 2.1m)</td>
<td>5.94-6.42 (MS1:1996)</td>
<td>5.5 – 7.5 (8.5 for oblique test)</td>
<td>4.8 – 6</td>
</tr>
<tr>
<td></td>
<td>Max. head deceleration, g</td>
<td>&lt; 290g</td>
<td>&lt;250g</td>
<td>&lt; 300g</td>
<td>&lt;200g</td>
<td>&lt;275</td>
</tr>
<tr>
<td></td>
<td>HIC value</td>
<td>No requirement</td>
<td>No requirement</td>
<td>No requirement</td>
<td>No requirement</td>
<td>&lt;2400</td>
</tr>
<tr>
<td></td>
<td>i.Penetration drop height, mm</td>
<td>3000</td>
<td>No requirement</td>
<td>2000</td>
<td>No requirement</td>
<td>No requirement</td>
</tr>
<tr>
<td></td>
<td>mass of striker, kg</td>
<td>3.0</td>
<td>No requirement</td>
<td>4.5</td>
<td>No requirement</td>
<td>No requirement</td>
</tr>
</tbody>
</table>
Snell covers wider range of sizes
MS1, Malaysian Patent and Vietnam specs are lighter in mass, most likely because of Open Face pattern, not Full Face
Snell test more severe, probably to cater the rigorous motorsport safety
MS1727 and Vietnam standard addresses <50cm size but headform for testing such size is unclear
Half shell is accepted in Vietnam standard only

So, further studies may be necessary to correlate children physiology to helmet usage
In Malaysia,

- Child helmet – tested to Normal Standard (MS1)
- Using standard head form prescribed for adult size
- Specific performance standard for child helmet unavailable
- Common test parameters, i.e. velocity, peak acceleration for child helmet maybe need further research
Main Test: Impact Energy Attenuation
Equipment Name: Impact Tester

(Courtesy of SIRIM QAS International)
Main Test: Resistance to Penetration
Equipment Name: Penetration Tester

(Courtesy of SIRIM QAS International)
TEST PROCESS

Main Test: Strength of Retention System Equipment: Retention System Test Machine

(Courtesy of SIRIM QAS International)
MALAYSIAN STANDARD CONFORMITY

QUALITY SYSTEM
SIRIM

MS
SIRIM

OH&S SYSTEM
SIRIM

ENVIRONMENTAL SYSTEM
SIRIM

MALAYSIA
SIRIM

ISO 14001
Certificate Number: 000000000

ISOMEC GUIDE 62: 1996
# CHILD HELMET: IMPACT TEST RESULT

<table>
<thead>
<tr>
<th>‘g’ acceleration range</th>
<th>Ambient</th>
<th>Hot</th>
<th>Wet</th>
<th>Ageing</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100 g</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2.3</td>
</tr>
<tr>
<td>101-150</td>
<td>9</td>
<td>6</td>
<td>12</td>
<td>9</td>
<td>40.9</td>
</tr>
<tr>
<td>151-200</td>
<td>11</td>
<td>4</td>
<td>7</td>
<td>9</td>
<td>35.2</td>
</tr>
<tr>
<td>201-250</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>6</td>
<td>21.6</td>
</tr>
<tr>
<td>&gt;250</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
# ADULT HELMET: IMPACT TEST RESULT

<table>
<thead>
<tr>
<th>‘g’ acceleration range</th>
<th>Ambient</th>
<th>Hot</th>
<th>Wet</th>
<th>Ageing</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100 g</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>101-150</td>
<td>18</td>
<td>15</td>
<td>16</td>
<td>16</td>
<td>40.6</td>
</tr>
<tr>
<td>151-200</td>
<td>16</td>
<td>12</td>
<td>7</td>
<td>16</td>
<td>31.9</td>
</tr>
<tr>
<td>201-250</td>
<td>6</td>
<td>13</td>
<td>17</td>
<td>8</td>
<td>27.5</td>
</tr>
<tr>
<td>&gt;250</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

(Extracted from SIRIM QAS International Test Result)
<table>
<thead>
<tr>
<th>Variable</th>
<th>Child</th>
<th>Adult</th>
<th>Mean Difference</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headform Deceleration, g</td>
<td>8 165.03 (39.985)</td>
<td>160 167.57 (40.791)</td>
<td>2.54</td>
<td>0.63</td>
</tr>
</tbody>
</table>

No significant relationship
COMMENT ON TEST RESULT

- All child helmets passed the impact, penetration and retention system tests, except games helmet which failed the penetration test (may be due to lower shell thickness, not designed for such impact, thus not suitable for motorcycle use)
- Majority (>70%) of impact values were between 100 - 200 g, none exceeded 250 g (MS1 limit 300 g)
- Mass of sample child helmet range from 780 – 950 grams
- Use of common headform for all helmet sizes in impact attenuation test, may possibly provide inaccurate measurement due to fitness issue (over or under, tight/loose)
Requirement of 2 successive impacts at the same spot – 2\textsuperscript{nd} impact point was manually determined and may possibly pose some challenge in locating the exact impact point.

Test sequence – Impact test interchangeably done with penetration test may possibly exhibit a variation in ‘g’ value.
There are no age limits on the children riding as passenger in Asian countries.

There are mixed of age limit between US and Australia (range between 5 to 8 years old).

Any scientific evidence to support “a” threshold limit for various type of motorcycle (super bike to scooter).

There are needs to establish the minimum age limit for children as motorcycle passenger, but at what age?

Children anthropometrical constraints must be considered in setting the minimum age requirement – sit properly (Health) and safely (Safety) as rear pillion passenger.
FINDINGS - AGE

Can he sit properly as a rear *pillion* passenger?

As compared to his elder brother?

What Do You Think?
Children are different in terms of anthropometric and bio-mechanical limit compared to adults.

A range of helmet to serve different age of children (Children head are growing function of age) is required.

The weight and size range versus age need to be established and considered in developing children helmet specifications and performance requirements.
Age Limit is required, in view of child safety and health. Thus, a comprehensive scientific study to establish the influence of anthropometric factors and child injury tolerances on injury outcomes of a motorcycle crash is scarce and badly needed.

With defined age limit, then only we can determine the more appropriate specification(s) and requirement(s) of a child helmet, with high benefit to cost ratio.
Existing **Adult** helmet standard needs to be enhanced further in addressing child physiological needs

- Separate **Child** helmet standard with more representative performance criteria or indicator may be required

- Is there any need to ensure general safety of the helmet as for toy safety, such as CE 88/378/EEC at present, not a concern at all.
ALTERNATIVE FOR UNDER AGE PASSENGER?

Child riding belt (Canada)

**Specifications**
Belt Weight ........ 1.5 kgs., (3 lbs)
Shipping Size ...... 25cm X 25cm X 48cm, (10” X 10” X 19”)
Belt Type .......... Heavy Nylon
Pad Type .......... High Density Foam
Handle Grips ...... B.M.X. Style
Solid Nylon Buckles
Pad Cover .......... Waterproof Nylon
Child Size .......... Maximum 45.5 kgs, (100) pounds

Really Safer than not buckling up ???
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Thank you
THE IMPACT TEST

- Video
- High Speed Video

(With Permission from SIRIM QAS International)
THE PENETRATION TEST

- Child Helmet with SIRIM Approval
  + Video
  + High Speed video

- Toys Helmet
  + Video
  + Photo

(With Permission from SIRIM QAS International)
RETENTION SYSTEM TEST

- Child Helmet with SIRIM Approval
  - Video

- Toys Helmet
  - Video

(With Permission from SIRIM QAS International)