Transport for NSW

Responses to post-hearing questions

Joint Standing Committee on Road Safety (Staysafe)

Religious exemptions for the wearing of helmets

Hearing date – 9 December 2024

QUESTIONS ON NOTICE

QUESTION 1. P36

BERNARD CARLON: Riders of bicycles, motorcycles and e-scooters are highly vulnerable to serious injury and death in a crash due to a lack of crash protection compared to occupants of motor vehicles. Helmets significantly reduce both the incidence and severity of head and brain injuries and the risk of death in the event of a crash or fall while riding, and since the mandatory introduction of helmet laws in New South Wales, at that time there was a 45 per cent reduction in fatalities on our roads for bicycle riders. The Centre for Road Safety has listened to the concerns of the Sikh community and taken steps to test, through the crash lab facility, the safety risks of riding a bicycle with a turban. This testing, which was undertaken with a Sikh adviser, determined the traditional Sikh turbans provided no significant head protection for bicycle riders in the event of a crash. I'm happy to provide that document to the Committee.

ANSWER:

In 2016, Transport undertook a research project to investigate the impact protection provided by a particular type of Sikh turban of a specific length tied around a head form with simulated scalp and hair when compared to that offered by a bicycle helmet.

The study found the Sikh turban offers no impact protection. The test concluded the turban wearer will suffer serious to severe head injury and/or skull fracture in the event of a crash if their head hits a solid object such as a road surface or the edge of a kerb.

The full project report is included at Attachment A – Turban impacts characteristic report (2016).

QUESTION 2. P39

Mr WARREN KIRBY: On an individual level, if that person understands those risks, they're prepared to take it but, from a road safety point of view, we are trying to determine if such an exemption would have a net negative impact on road safety throughout New South Wales. We're really struggling to find anybody who can identify — nobody disputes the fact that helmets protect the head; it's just a matter of what effect this would have. A lot of the medical experts in particular have said, "Yes, it would, but we don't have any data to support that it would happen in any meaningful sense." What we're trying to get to is what the impact of this specific exemption would be, and there's no international data to say it. There's no Australian data in other jurisdictions that highlights that direct line.

BERNARD CARLON: I make a couple of observations. It's not that trauma hasn't happened, and there are reports of people exercising their exemption in those other jurisdictions who have died and have suffered serious injury. From our point of view, we're willing to reach out to our colleagues in the UK, who we regularly are in contact with from a transport and safety perspective, to see whether non-published information might be available, that they have, to better inform the Committee as well.

ANSWER:

Transport has reached out to the UK government seeking any road safety casualty/trauma information or analysis undertaken in the UK regarding the non-wearing of motorcycle, bicycle and electric scooter helmets, in particular, related to religious observance by the Sikh community. Transport has not received a response at this stage.

QUESTION 3. P39

BERNARD CARLON: I make a couple of observations. It's not that trauma hasn't happened, and there are reports of people exercising their exemption in those other jurisdictions who have died and have suffered serious injury. From our point of view, we're willing to reach out to our colleagues in the UK, who we regularly are in contact with from a transport and safety perspective, to see whether non-published information might be available, that they have, to better inform the Committee as well. The other point I would note is that it's about whether the individual suffers a trauma. That clearly has costs associated with that in terms of trauma costs, but also we shouldn't, I think, underestimate the impact on those emergency service workers, the medical staff, the families that are affected when we see people who actually do suffer significant serious injuries and death, and the ripple effect that has in the community, and the impacts of that trauma in the community as well, in terms of just one individual case.

I'd also point out that we do know, for example, that in 2023 about 5 per cent of motorcyclists who were killed or seriously injured on New South Wales roads were not wearing a helmet—illegally not wearing a helmet, but 5 per cent, so a significant proportion there of people outside the law. In 2023, again, about 15 per cent of bicycle riders killed and seriously injured on our roads were not wearing a helmet. There is evidence of the outcomes of not wearing a helmet in actual numbers of trauma as well. Again, we're happy to provide more detail if the Committee would like it.

ANSWER:

Transport can advise that approximately 15 per cent (1 killed and 41 seriously injured) of bicyclists and 5 per cent (6 killed and 58 seriously injured) of motorcyclists killed or seriously injured on NSW roads were not wearing a helmet in 2023.

Overall, in 2023:

- Where a bicycle was involved, there were 776 casualty crashes (eight fatal crashes, 276 serious injury crashes, 298 moderate injury crashes and 194 minor/other injury crashes) reported on NSW roads resulting in eight fatalities and 814 injuries (serious, moderate and /other injury) from those crashes
- Where motorcycle was involved, there were 2,191 casualty crashes (53 fatal crashes, 1,141 serious injury crashes, 703 moderate injury crashes and 294 minor/other injury crashes) reported on NSW roads resulting in 53 fatalities and 2,357 injuries (serious, moderate and /other injury) from those crashes.

QUESTION 4. P40

Mr WARREN KIRBY: As a bit of an aside to that, I've noticed over the last few years, certainly in my area, a significant increase in the amount of people who are riding

bicycles, in particular, without helmets. Have we seen an uptick recently? I assume that's through lack of enforcement; I know the laws haven't changed. Has there been a change in the stats with the amount of enforcement versus the amount of trauma?

BERNARD CARLON: We could provide you additional information on that and more detail. The 15 per cent of bicycle riders killed or seriously injured last year is a significant proportion. My recollection is that may be an increase in the trend in terms of non-helmet use. We do empathise with police who are in a situation currently, in terms of enforcement, of having to prioritise their resources into areas of significant concern in the community. We're always working with our colleagues in police to come up with strategies for improving that situation, particularly through our enhanced enforcement program, but they're focused very much on those circumstances where, for example, 43 per cent of fatalities over the last 12 months have been speed related. They're focusing their efforts, I think, on those higher priorities.

Mr WARREN KIRBY: I'm not suggesting a change in the way the police do their job. I fully respect they need to prioritise. I'm just curious as to whether that's been reflected in the data: As there's been less compliance with the wearing of helmets, has that been an increase in the rates of fatalities in particular?

BERNARD CARLON: As I said, we'll be able to give you more detail on that, in terms of the change over time. We would think that 15 per cent is significant in terms of the non-wearing of helmets in the trauma data last year. Louise might have additional information, particularly about the enforcement component of that.

LOUISE HIGGINS: We do have some bicycle penalty figures. We have seen a change in enforcement. Looking at the figures over the last three financial years, the latest is not finalised. But we are looking at numbers of around 3,000 to up to 3,500 bicycle helmet offences statewide at that time. If we look back to the 2018-19 year, we were up around the 6,000 mark. There has certainly been a shift in enforcements. But whether there's a direct correlation back to the trauma is probably another question. But we can certainly provide that information, as Bernard has intimated, about what we're seeing in terms of the trauma data.

Mr ROY BUTLER: To make that data useful, you'd also have to consider the number of the uptake of e-bikes. A lot more people are riding e-bikes. There are delivery riders on e-bikes. You've got moving datasets in terms of the number of people, plus then the enforcement, then the injury. There are several different bits of data that you'd need to weigh up.

Mr WARREN KIRBY: I understand. But if the injury rate is more or less the same when there was a much higher enforcement rate and fewer people on the road, then that in itself tells you.

Mr ROY BUTLER: Anecdotally, as I said earlier — and I agree with you. I'm seeing more and more people riding pushbikes or e-scooters not even in an active transport trial area, just using those devices without helmets. I've seen a lot more of it.

BERNARD CARLON: The reality is that trauma potential — that risk — increases the more that that level of exposure without helmet use — from participants who are using those devices. Certainly, we've seen an increase in the growth of active transport over recent years and not really a significant increase in the trauma levels. But this percentage of non-helmet use — we can actually interrogate that relative to those issues. Certainly this

year — and Australia is quite fortunate. We have a relatively low number of cycling fatalities. This year so far we've only had four bicycle rider fatalities. We normally average around 11 to 14. That's a good sign as well. Serious injuries is really where we see the bulk of the trauma, where up to 1,700 people are being admitted to hospital. We can provide additional information to the Committee on that.

ANSWER:

Bicyclists

- In 2023, bicyclists were the third-largest road user group for hospitalisations, representing 18 per cent of all hospitalisations, with 1,895 bicyclists seriously injured. Of the 1,895 seriously injured, 273 hospitalisations are matched (matched) with NSW Police data, and 1,622 hospitalisations have not been matched (unmatched) with NSW Police data.
- 348 or 18 per cent (both matched and unmatched) bicyclists who were seriously injured sustained head injuries.
- 41 of the 273 matched bicyclists who were seriously injured were not wearing a helmet, and 17 of them sustained a head injury.
- Transport does not collect enforcement data relating to not wearing helmets for bicycle riders, therefore cannot advise on whether there has with respect to enforcement compared with levels of trauma.

Motorcyclists

- In 2023, motorcyclists were the second-largest road user group for hospitalisations, representing about 26 per cent of all hospitalisations, with 2,864 (1,147 matched and 1,717 unmatched) motorcyclists seriously injured.
- 243 or 8 per cent (both matched and unmatched) motorcyclists who were seriously injured sustained head injuries.
- 58 of the 1,147 matched motorcyclists who were seriously injured were not wearing a helmet, and 19 of them sustained a head injury.

Effectiveness of a Sikh turban as a bicycle helmet

Contents

1. Introduction

1.1 Scope

This research project is to investigate the impact protection provided by a particular type of Sikh turban of a specific length tied around a headform with simulated scalp and hair when compared to that offered by a bicycle helmet.

1.2 Objective

The objective of the research project is to investigate the effectiveness of a Sikh turban as a bicycle helmet.

1.3 Limitation

The results presented in this report are from tests of the most common type of Sikh turban worn in Australia of a certain length and type of wrapping as carried out by a practising Sikh.

2. Background

Research has confirmed that cyclists who wear helmets were estimated to experience an eight-fold reduction in risk of head injury compared to unhelmeted cyclists (McDermott and Klug, 1985). Because of this, in 1991 the NSW Government introduced a law mandating cyclists to wear an approved bicycle helmet when riding on NSW roads, and there have been no exemptions issued from this requirement. Under this law, an approved bicycle helmet is defined as the one that complies with Australian Standard AS/NZS 2063: *Bicycle helmets*.

The Sikh community has made a number of representations to Transport for NSW and the Minister's office seeking an exemption from this mandatory helmet law in recent years. The Centre for Road Safety (CRS) previously met with two community groups that approached Transport for NSW to discuss the bicycle helmet laws. Issues raised by the Sikh community included:

- The turban is an article of faith worn by all Sikh men and some Sikh women.
- It is not practicable to wear a helmet over a turban.
- Mandatory helmet law discriminate against Sikhs who wear a turban as they either cannot ride a bike or must remove their turban to comply with the law.
- There are some reported instances where magistrates have not applied penalties to Sikh cyclists who ride without wearing a helmet.
- Western Australia, Victoria, South Australia and Queensland currently have a religious exemption for mandatory helmet laws available to Sikhs. Tasmania also has exemptions available by application based on 'exceptional circumstances'.
- Representatives from the Sikh community have alleged that a turban can provide sufficient head protection in a crash.

In response, the Minister's office directed the Centre for Road Safety's Safer Vehicles team to establish a research project to investigate the head protection offered by a Sikh turban.

3. Equipment and Method

3.1 General

One of the main requirements in AS/NZS 2063 is that a bicycle helmet must be able to attenuate the impact energy received by its wearer in the event a crash. This is done by dropping the helmet with a headform - simulating a human head - fitted with the helmet from a height of 1.5 metres onto a flat anvil. The helmet must be able to reduce the impact energy to minimise head and brain injuries.

A series of energy attenuation tests as stipulated in AS/NZS 2063 were conducted on a Sikh turban. The turban was formed and adjusted properly for each test to ensure it was in the same condition for all tests. The testing was conducted at the Road and Maritime Services' - Crashlab road safety research laboratory.

3.2 Turbans – material and arrangement

A turban is a type of headwear that is made by winding a fabric material around the wearer's head. It is traditionally worn by men and followers of the Sikh religion. Practising male Sikhs do not cut their hair. They comb their hair and draw it forward to the front of the head. The turban is then wrapped around the head as shown in Figure 1.

Turban material is usually a light cotton gauze, although other materials are permitted if they are in a fabric form. A standard turban for men is normally 5 metres long and 1 metre wide. The length can vary however, from 5 to 8 metres, depending upon the kind of turban worn. There are some exceptions where people like the Nihang Singh may wear a turban that is 10 metres or more in length. High school children normally wear a turban that is 4 to 5 metres in length.

The most common type of turban style worn by Sikhs in Australia is the Punjabi style (Figure 1). This type has a bunching of material at the back and the front of the head, as do the other styles, but the bunching at the back is sited low on the nape of the neck, and below the rim of a bicycle helmet.

For the tests, a member of the Sikh community provided advice on the choice of turban materials. The advisor, with the help from Crashlab's technical staff, wrapped the turbans on a headform in accordance with standard Sikh practice.

Figure 1. The most common type of turban

3.3 The type of turban used in this study

The materials used in the test were obtained from a supplier in Sydney. In this study one turban length of approximately 5 metres was tested.

3.4 The headform

A size J headform as specified in the AS/NZS 2512.1 was used in this study. A size J headform represents an average adult male head.

3.5 The hair knot

In this research the hair was simulated by using a black nylon wig. Before putting the wig onto the headform, the headform was covered with a swimming cap to simulate the human scalp. The wig was then secured onto the swimming cap using adhesive tape. The Sikh advisor then drew the hair forward to the front of the head, twisted tightly along its length and wound it into a knot on top of the headform. The hair was then tied up in a bun or a knot at the top of the head near the front, right above the forehead. The hair was then fastened with a rubber hair tie – see Figure 2.

Figure 2. Tying the hair

3.6 Tying of the turban

Before the turban was fitted to the headform, the Sikh advisor folded the fabric over four times length-wise. The fabric was then wrapped around diagonally starting with the fabric being lower on one side and higher on the other side, and was wrapped around about six times. This process is shown in a series of images in Figure 3. The completed tying process is shown in Figure 4.

Figure 3. Tying the turban

Figure 4. The completed turban

3.7 Test method

The prepared headform was tested using the impact energy attenuation test specified in AS/NZS 2063 and test standards referenced therein.

The prepared headform was set up in accordance with AS/NZS 2512.3.1: *Methods of testing protective helmets*. The prepared headform was dropped from a drop height of 1.5 metres onto a flat anvil impacting at the hair knot (see Figure 5), the crown (Figure 6), the left side (Figure 7), the rear (Figure 8) and right side (Figure 9).

Figure 5. Testing at hair knot

Figure 6. Testing at crown

Figure 7. Testing on the left side

Figure 8. Testing on the rear

Figure 9. Testing on the right side

Pass/fail criteria:

AS/NZS 2063 requires that the headform deceleration does not exceed 250 times the earth's gravity (*g*) and the cumulative duration of deceleration does not exceed:

- 3.0 milliseconds (ms) for deceleration greater than 200*g*; and
- 6.0 milliseconds for deceleration greater than 150*g*.

4. Results

4.1 Energy attenuation tests

The results of the energy attenuation tests are presented in Table 1.

Table 1. Results from energy attenuation tests

Test location	Result (*g*) Pass= 250	Cumulative duration (ms)	
		150*g*	200*g*
Hair knot (Figure 5)	356.5	1.9	1.5
Crown (Figure 6)	423.7	1.9	1.6
Left side (Figure 7)	404.2	1.9	1.5
Rear (Figure 8)	447.1	1.8	1.5
Right side (Figure 9)	680.8	1.4	1.2

In all cases the measured peak head accelerations exceeded the maximum specified limit of 250*g* and ranged from 356.5*g* to 680.1*g* depending on the testing location. The highest peak head acceleration was recorded when the head and turban assembly was dropped on the right side. At the location where the fabric is heavily bunched the head accelerations are less compared to the other locations but they are still above the maximum limit of 250*g*.

The results for cumulative head acceleration in 3 ms and 6 ms duration were under the maximum permitted limits.

4.2 Risks to Injury

Injury risks developed by McIntosh (1993) and Prasad & Mertz (1985) were used to analyse the risk of head injuries using the results obtained from the attenuation tests. Figure 10 presents the predicted likelihood of Abbreviated Injury Scales (AIS) 3&4 (Serious to Severe) head injury as developed by McIntosh and the predicted likelihood of skull fractures as developed by Prasad & Mertz.

Refer to Table 2 for more details on the relation between the AIS and the injury severity.

Table 2 – Abbreviated Injury Scales

Abbreviated Injury Scale	Severity
0	None
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Maximum Injury (Unsurvivable)

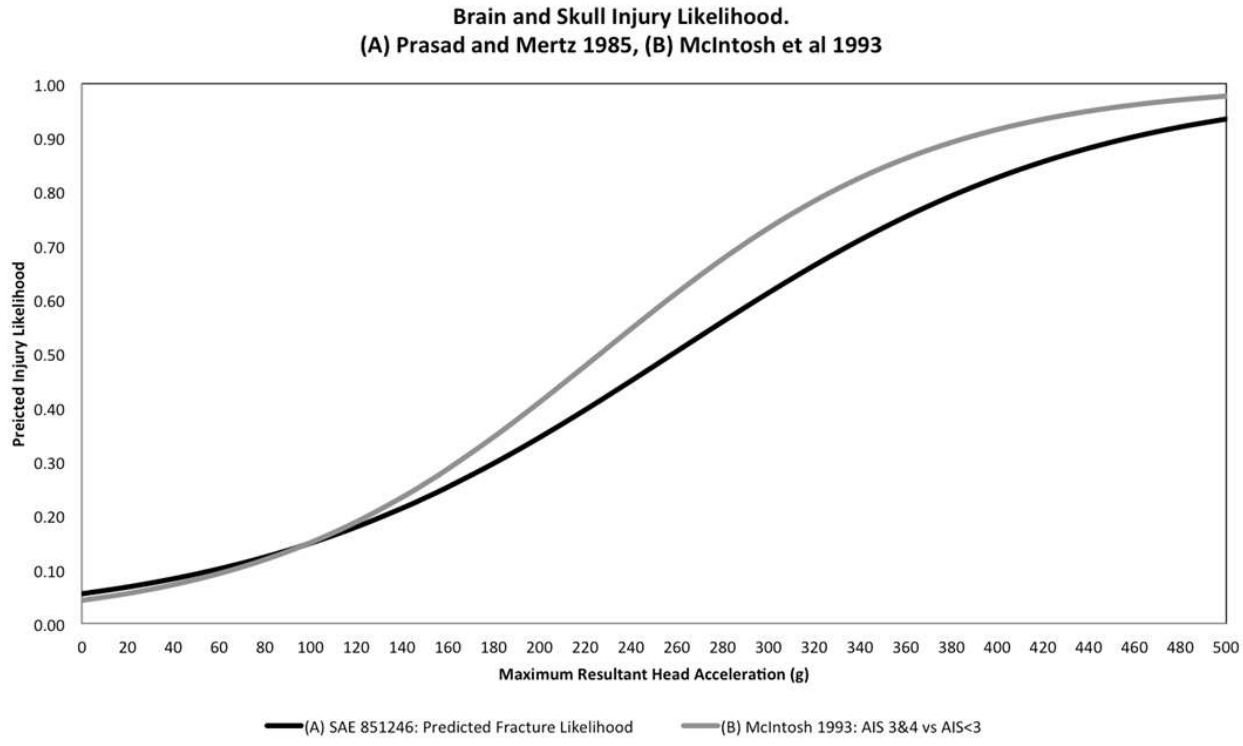

Figure 10. Predicted likelihood of AIS severity 3&4 head injury developed by McIntosh (1993) and skull fracture developed by Prasad & Mertz.

The results of the risk to injury assessment are presented in Table 3. The results show that for all tests, the predicted likelihoods of AIS 3&4 head injury and skull fracture are extremely high. Depending upon the location of the impact, the likelihood of AIS 3&4 head injury is between 85% and 100%, while the likelihood of skull fracture is between 75% and 95%. This indicates that:

1. A Sikh turban does not have the same impact protection characteristics as those of an approved bicycle helmet, hence, does not comply with AS/NZS 2063; and
2. the turban wearer will most likely suffer serious to severe head injury and/or skull fracture in the event of a head impact to a solid object.

Table 3. Predicted likelihood of AIS 3&4 and Skull fracture for this study

Test location	Max head acceleration (g)	Predicted likelihood of AIS 3&4 head injury	Predicted likelihood of skull fracture
Hair knot	356.5	85%	75%
Crown	423.7	97%	86%
Left side	404.2	93%	83%
Rear	447.1	98%	87%
Right side	680.8	~100%	~95%

5. Conclusions and Discussion

5.1 Conclusions

The conclusions of this study indicate that:

- The Sikh turban does not conform to the impact protection requirements of AS/NZS 2063.
- In the head areas with minimum fabric coverage the likelihood of AIS 3&4 head injury is approximately 100% and the likelihood of skull fractures is above 80%. Even with the maximum fabric coverage, the likelihood of AIS 3&4 head injury is still 85%.This indicates that the turban wearer will suffer serious to severe head injury and/or skull fracture in the event of a crash if their head hits a solid object such as road surface or the edge of a kerb.

5.2 Discussion

The results show that the turban's impact protection property is not uniform over the entire protective zone. Specifically, the turban offers little protection for the crown, side and rear regions. In the hair knot region - where the fabric is heavily bunched - the turban offers its maximum protection, but still cannot provide anywhere near the levels of protection offered by a bicycle helmet. This indicates that even if all of the head regions are covered with a longer turban with a uniform thickness similar to one in the heavily bunched region, the turban would still not be adequate to provide reasonable protection.

6. Acknowledgements

The author wishes to thank the Sikh advisor - who does not want to be named - for his advice and for tying the turbans.

7. References

Attawell, R. G., K. Glase, M. McFadden, *Bicycle helmet efficacy: a meta-analysis*, Accident Analysis & Prevention 33, 2001 .

McIntosh, A., D. Kallieris, R. Mattern, and E. Miltner, *Head and Neck Injury Resulting from Low Velocity Direct Impact*, 37th Stapp Car Crash conference proceeding, 1993.

Prasad, P. and Mertz, H, *The position of the United States Delegation to the ISO Working Group 6 on the use of HIC in the automotive environment*, SAE Technical Paper, 1985.