COMMENTARY

Alberta's helmet law – children's cycling halved, injuries increased per cyclist

Includes a commentary on:
Bicycle helmet use and bicyclists head injuries before and after helmet legislation in Alberta Canada
Karkhaneh M, University of Alberta, 2011. (Karkhaneh, 2011)

Evidence on changes in cycle use and risk

A helmet law for Alberta

A helmet law for cyclists under 18 was introduced in Alberta, Canada, on 1 May 2002.

Edmonton – 59% reduction in children's cycling by 2004

Cyclists were counted in Edmonton (a city in Alberta), in 2000 (pre-law) and 2004 (post-law). The percentage of cyclists under 18 fell from 26% in the pre-law survey, to 15% post-law (Hagel et al, 2006), suggesting that the law discouraged substantial numbers of youngsters from cycling. Compared to adults who were not required to wear helmets, children's cycling (<13 years) fell by 59%, with a 41% reduction for teenagers aged 13-17 (Hagel et al, 2006).

At the time, great concerns were also expressed that injuries per cyclist had increased after the introduction of Alberta's helmet law (BHRF, 1055).

Wider surveys – 56% reduction in children cycling and 27% reduction in teenagers, by 2006

Comprehensive survey results were published in 2011 in a PhD thesis (Karkhaneh, 2011). The data were collated from observational studies of Albertan cyclists in several cities, involving 330 hours of pre-law observations in 2000, and 313 hours of observation post-law in 2006.

The survey showed a large and significant 56% decrease in children's cycling, confirming the large decrease in children's cycling noted in the Edmonton survey, 2 years earlier. The greatest decreases were at schools (68% decrease), on commuter routes (41% decrease) and in residential areas (37% decrease).

There was also a significant 27% decrease in teenage (13-17 years) cycling. In contrast, there was a 21% increase for adults, who were not required to wear helmets. (Karkhaneh, 2011)

Increased risk for child and teenage cyclists after the helmet law

With such large decreases in children's cycling, commensurate decreases would be expected in the numbers of children with cycling injuries. Table 1 shows changes in cycle use and in average annual numbers of cyclists requiring emergency room treatment for non-head injuries over the 3 years pre-law (1999-2002) and post-law (2003-2006).

**Table 1. Number of cyclists per hour from the observational surveys in Alberta (pre-law in 2000, post-law in 2006),
compared to numbers treated in emergency rooms (ER) for non-head injuries. From Karkhaneh, 2011**

	Cyclists per hour	Non-head injuries (ER) [1]	Change in injuries

							relative
	Pre	**Post**	**CRatio** [2]	**Pre**	**Post**	**IRatio** [2]	**to change in cycling** [3]
Children	3.56	1.58	0.44	1676.3	1762.0	1.05	2.37
Teenagers	1.92	1.41	0.73	870.3	1101.0	1.27	1.72
Adults 18+	6.29	7.58	1.21	1846.7	2062.5	1.12	0.93

[1] Average annual number of non-head injuries; [2] Post-law divided by pre-law; [3] IRatio divided by CRatio

The table paints a shocking picture. With only 44% as many children cycling, there should have been only 44% as many injuries – i.e. 44% of 1676 = 744. The observed post-law number of injuries – 1676 per year – is 2.37 times higher than would have been expected for the amount of cycling. In contrast, the safety of adult cyclists (who were not affected by the law) improved.

Thus, far from improving safety for children and teenagers, the risk of injury seems to have increased after Alberta introduced its helmet law. Similar calculations (Tables 2 & 3), show increases in the risk of head and non-head injuries requiring ER treatment for both children and teenagers, as well as increased risk of head injuries for children, and non-head injuries for children and teenagers admitted to hospital. In contrast, risks for adults generally decreased.

Unlike cyclists, there were substantial reductions in the risks of injury for pedestrians (Table 3).

Table 2. Ratio of pre-law (1999-2001) and post-law (2003-2006) numbers of cyclists given emergency room (ER) treatment or admitted to hospital per year – head and all cycling injuries – compared to ratio of post vs pre-law cycle use. From Karkhaneh, 2011

	Cyclist head injuries			**All cyclist injuries**			**Injury vs cycle use changes** [1]	
	Pre	**Post**	**Ratio**	**Pre**	**Post**	**Ratio**	**Head**	**All**
Cyclists – ER Treatment								
Children	739.0	577.3	0.78	2415.3	2339.3	0.97	1.76	2.18
Teenagers	230.0	253.0	1.10	1100.3	1354.0	1.23	1.50	1.68
Adults 18+	476.3	504.0	1.06	2323.0	2566.5	1.10	0.88	0.92
Cyclists – hospital admissions								
Children	36.3	19.0	0.52	107.7	93.3	0.87	1.18	1.95
Teenagers	24.3	16.8	0.69	60.0	72.3	1.20	0.94	1.64
Adults 18+	56.7	51.8	0.91	206.7	258.3	1.25	0.76	1.04

[1] Injury vs cycle use changes: calculated as the ratio of injury rates (post-law to pre-law injuries) divided by the change in cycle use
(ratio of cyclists per hour post-law cyclists to pre-law – 0.44 for children, 0.73 for teenagers and 1.21 for adults, see Table 1).
Values less than 1 imply improved safety per cyclist, those greater than 1 imply greater danger.

Table 3. Ratio of pre-law (1999-2001) and post-law (2003-2006) numbers of pedestrians given emergency room (ER) treatment or admitted to hospital per year – head and all injuries – compared to ratio of post vs pre-law population counts by age group. From Karkhaneh, 2011

	Pedestrian head injuries			**All pedestrian injuries**			**Injury vs population changes** [1]	
	Pre	**Post**	**Ratio**	**Pre**	**Post**	**Ratio**	**Head**	**All**

Pedestrians – ER Treatment								
Children	87.7	47.3	0.54	267.3	162.0	0.61	0.54	0.60
Teenagers	39.3	37.0	0.94	220.0	206.3	0.94	0.88	0.88
Adults 18+	188.0	187.3	1.00	867.3	929.0	1.07	0.88	0.95
Pedestrians – hospital admissions								
Children	20.3	13.0	0.64	48.0	31.3	0.65	0.63	0.64
Teenagers	16.7	11.25	0.68	32.0	24.8	0.77	0.63	0.72
Adults 18+	99.3	85.75	0.86	251.7	224.3	0.89	0.77	0.79

[1] Injury vs population changes: calculated as the ratio of injury rates (post-law to pre-law injuries) divided by the change in population
(1.003 for children, 1.064 for teenagers and 1.128). Values less than 1 imply improved safety per capita.

Conclusion

When changes in cycle use are taken into account, Alberta's helmet law seems to have increased the risk of both head and non-head injuries.

Evidence of increased risk per cyclist seems paradoxical. However, there is strong evidence that helmet laws lead to increased risk taking. For example, many males (Messiah et al, 2012) and cyclists accustomed to wearing helmets (Phillips, Fyhri and Sagberg, 2011) have been shown to cycle faster when wearing a helmet. In addition, drivers were found to leave less room when overtaking helmeted cyclists (Walker, 2007). UK researcher, Dr Ian Walker, was hit twice by vehicles when carrying out his research, both times when wearing a helmet (Eureka, 2006). With only 44% as many children cycling as before the law, it is also possible that relatively safe cycling activities were discouraged more than riskier types of cycling.

Published analysis ignores changes in cycle use

Karkhaneh, 2011 ignores the large and obvious reduction in cycle use when discussing the effect of the law on injuries. The thesis also makes light of the 56% overall reduction in children's cycling. As shown in Table 4, the greatest decreases were at schools (68% decrease), on commuter routes (41% decrease) and in residential areas (37% decrease). These were the only locations with statistically significant increases in percent helmet wearing of children (see Table 3.1 of Karkhaneh, 2011), suggesting that the increases in helmet wearing were achieved mainly by discouraging cycling by children who dislike helmets, rather than persuading them to don helmets and continue cycling. Convincing parents that cycling is so dangerous that every child must wear a helmet at all times may also may also lead to the conclusion that it is safer still not to allow children to cycle at any time.

Table 4. Comparison of pre and post-law surveys, cyclists aged < 13. From Karkhaneh, 2011, Table 5-1

	Pre-law survey (2000)			**Post-law survey (2006)**			**Cyclists per hour Ratio of post-law to pre-law counts[1]**
	No of Cyclists	**Total Hours**	**Cyclists per hour**	**No of Cyclists**	**Total Hours**	**Cyclists per hour**	
All cyclists	1175	330.3	3.56	494	313.2	1.58	0.44* (0.36 to 0.55)
Urban	1039	300.0	3.46	409	284.7	1.44	0.41* (0.33 to 0.52)
Non-urban	136	30.3	4.49	85	28.5	2.99	0.66 (0.38 to 1.18)
Site type: School	854	71.0	12.0	246	63.3	3.89	0.32* (0.24 to 0.44)
Campus/colleges	2	12.0	0.17	8	10.0	0.80	4.80* (1.10 to 20.9)
Park	69	40.0	1.72	75	36.0	2.09	1.21 (0.62 to 2.37)
Cycling path	54	43.6	1.24	48	44.7	1.07	0.87 (0.54 to 1.38)

Commuter route	88	61.7	1.43	53	63.4	0.84	0.59* (0.37 to 0.92)
Residential	108	102.0	1.06	64	95.8	0.67	0.63* (0.41 to 0.98)
Weather: Wet	147	68.1	2.16	57	60.8	0.94	0.43* (0.26 to 0.73)
Dry	1028	262.2	3.92	437	252.3	1.73	0.44* (0.35 to 0.56)
Temperature: Low	188	20.7	9.09	23	19.3	1.19	0.13* (0.08 to 0.22)
Moderate	608	162.6	3.74	246	151.8	1.62	0.43* (0.31 to 0.60)
High	379	147.0	2.58	225	142.1	1.58	0.61* (0.45 to 0.83)

[1] Ratio of post-law to pre-law counts (95% confidence intervals in brackets)

Surprisingly the published analysis states (page 80) “Since bicycling rates decreased in only two of the five groups of observation sites (schools and commuter routes) among the legislated target age group (<18) post-legislation and simultaneous increases in cycling were observed in other locations, the results of our study refute claims that helmet legislation has a negative effect on cycling exposure.” (Karkhaneh, 2011)

This is an extraordinary assertion that ignores the many surveys where adult and child cyclists categorically stated that helmet legislation was a deterrent to cycling, or that they would cycle more if they did not have to wear a helmet (Robinson, 1996; Robinson, 2006b; Rissel and Wen, 2011). The Mexico City and Israeli governments repealed helmet laws in order to increase the likelihood of successful public bike hire schemes (BHRF, 1214). The much lower usage of city cycle schemes in Brisbane and Melbourne also seem likely to be a consequence of helmet laws.

In Alberta, there were large overall decreases in children’s cycling, in all weathers and all temperatures (Table 4). In a few situations, numbers counted were too small to distinguish between random variation and a reduction in cycle use. However, a lack of a statistically significant difference does not imply there was no effect, simply that the small numbers involved make it impossible to be certain one way or the other. The only recorded increase in children’s cycling was from 2 to 8 cyclists under the age of 13 on campus/colleges. This hardly offsets the 56% overall decrease in children’s cycling!

A few additional youngsters at colleges/campus might reflect a co-operative arrangement allowing children to access college libraries, sporting or computer facilities. To see a claim in a PhD thesis that this refutes evidence that helmet laws have a negative effect on cycling is extraordinary.

Helmet laws are likely to affect some cyclists more than others. Cyclists who routinely use helmets, e.g. sporting or racing cyclists, are unlikely to be affected by helmet laws. No significant reduction would therefore be expected in areas such as parks that were predominantly used by such cyclists. This would in no way imply that helmet laws do not discourage other forms of cycling.

The significant increase in post-law cycling of adults (Table 6) should also be noted. Without the helmet law, there might have been a similar increase in children’s cycling. Consequently, helmet laws could still be discouraging cycling (and have a significant effect on public health) even if cycling did not decrease, but would have been expected to increase in the absence of helmet legislation.

More importantly, comparisons of post and pre-law injury rates should take account of the reduction in cycling, irrespective of whether such reductions can be attributed to helmet laws. Helmet laws would be counter-productive if injury rates increased because of risk compensation. Overall risks must therefore be assessed by comparing number of injuries with the amount of cycling.

If helmets encourage cyclists to ride faster, or drivers to overtake with less care, so that the risk of crashes increased, helmet laws would be counter-productive if this was enough to outweigh any benefits of helmets. Surprisingly, this was not even considered in the published thesis.

Table 5. Comparison of pre and post-law surveys, cyclists aged 13-17. From Karkhaneh, 2011, Table 5-2

	Pre-law survey (2000)			Post-law survey (2006)			Cyclists per hour Ratio of post-law to pre-law counts
	No of Cyclists	Total Hours	Cyclists per hour	No of Cyclists	Total Hours	Cyclists per hour	
All cyclists	635	330.3	1.92	440	313.2	1.41	0.73* (0.57 to 0.94)
Urban	560	300.0	1.87	410	284.7	1.44	0.77* (0.60 to 0.99)
Non-urban	75	30.3	2.48	30	28.5	1.05	0.43 (0.18 to 1.01)
Site type: School	306	71.0	4.31	151	63.3	2.38	0.55 (0.31 to 1.00)
Campus/colleges	9	12.0	0.75	8	10.0	0.80	1.10 (0.59 to 1.93)
Park	46	40.0	1.15	38	36.0	1.06	0.92 (0.54 to 1.56)
Cycling path	83	43.6	1.90	73	44.7	1.63	0.86 (0.59 to 1.25)
Commuter route	101	61.7	1.64	69	63.4	1.09	0.67 (0.43 to 1.04)
Residential	90	102.0	0.88	101	95.8	1.05	1.19 (0.79 to 1.80)
Weather: Wet	142	68.1	2.08	111	60.8	1.82	0.88 (0.46 to 1.68)
Dry	493	262.2	1.88	329	252.3	1.30	0.69* (0.54 to 0.89)
Temperature: Low	57	20.7	2.76	5	19.3	0.26	0.09* (0.02 to 0.38)
Moderate	286	162.6	1.76	207	151.8	1.36	0.78 (0.51 to 1.18)
High	292	147.0	1.99	228	142.1	1.60	0.81 (0.61 to 1.08)

In conclusion, when the data are correctly analysed, accounting for the reduction in children's cycling, the results strongly suggest that child and teenage cyclists in Alberta are more likely to suffer both head and non-head injuries than before helmet laws were introduced. This is consistent with the latest review of Canadian data showing "*In general the rate of head injuries is declining, but this is not consistent across the country, nor is it attributable to legislation as some provinces with legislation experienced a decline while others did not*." (Middaugh-Bonney et al, 2010)

Table 6. Comparison of pre and post-law surveys, adult cyclists. From Karkhaneh, 2011, Table 5-3

	Pre-law survey (2000)			Post-law survey (2006)			Cyclists per hour Ratio of post-law to pre-law counts
	No of Cyclists	Total Hours	Cyclists per hour	No of Cyclists	Total Hours	Cyclists per hour	
All cyclists	2077	330.3	6.29	2375	313.2	7.58	1.21* (1.03 to 1.41)
Urban	2004	300.0	6.68	2335	284.7	8.20	1.23* (1.05 to 1.44)
Non-urban	73	30.3	2.41	40	28.5	1.41	0.58* (0.35 to 0.97)
Site type: School	124	71.0	1.75	207	63.3	3.27	1.87* (1.17 to 2.99)
Campus/colleges	201	12.0	16.8	248	10.0	24.8	1.48 (0.90 to 2.45)
Park	577	40.0	14.4	524	36.0	14.6	1.01 (0.63 to 1.63)
Cycling path	396	43.6	9.08	425	44.7	9.50	1.05 (0.77 to 1.41)
Commuter route	417	61.7	6.76	505	63.4	7.97	1.18 (0.88 to 1.58)
Residential	362	102.0	3.55	466	95.8	4.86	1.37* (1.06 to 1.78)
Weather: Wet	327	68.1	4.8	300	60.8	4.93	1.03 (0.63 to 1.68)
Dry	1750	262.2	6.67	2075	252.3	8.22	1.23* (1.04 to 1.46)
Temperature: Low	35	20.7	1.69	40	19.3	2.07	1.22 (0.64 to 2.34)
Moderate	801	162.6	4.93	790	151.8	5.21	1.06 (0.82 to 1.36)
High	1241	147.0	8.44	1545	142.1	10.9	1.29* (1.05 to 1.58)

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