Trends in Cycling, Walking & Injury Rates in New Zealand

Summary

Estimates of walking and cycling from 9 Household Travel surveys in New Zealand, conducted between 1989 and 2012, were combined with publicly-available injury statistics on discharges from public hospitals. The information was used to compare trends in the safety of cyclists and pedestrians since NZ's bicycle helmet law was introduced in January 1994. From 1989 to 2011, average time spent cycling (on roads and footpaths) fell by 79% for children aged 5-12 (from 28 to 6 minutes per person per week) and 81% for 13-17 year olds (52 to 10 mins/person/week). Adult cycling declined from 8 to 5 minutes/person/week then trended back up to 8 minutes. For cyclists of all ages, the overall reduction in time spent cycling was 47%.

Declines in pedestrian activity of 24% over the same period of time were more modest. Reductions for specific age groups were: 34% (children 5-14 years, from 92 to 61 mins/person/week), 23% (15-24 year olds, from 98 to 75 mins/person/week) and 11% (25-24 year olds, from 57 to 51 mins/person/week).

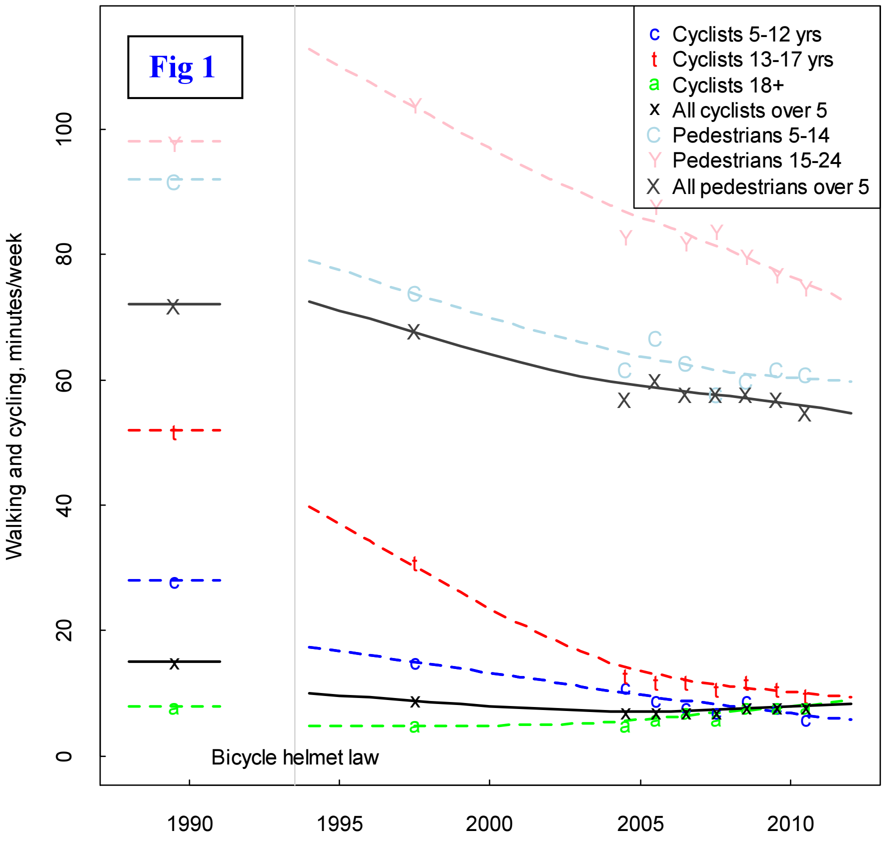
Injuries of cyclists and pedestrians discharged from public hospitals were subdivided into those due to motor vehicle traffic crashes and other causes. Injury rates per million hours of activity were calculated by dividing injuries per million people by estimated average hours cycled or walked per person per year.

Pedestrian injuries from motor vehicle crashes fell by 42% from 3.5 to 2.0 per million hours. This suggests the roads became safer, offset by a small increase in pedestrian injuries not involving motor vehicles (from 0.5 to 0.7 per million hours). The latter includes falls, trips and collisions with cyclists, but it was not possible to determine from publicly-available data whether there was any change in the proportion of pedestrian injuries involving cyclists.

Cyclist injuries from collisions with motor vehicles declined by 27% (from 8.2 to 6.0 per million hours), perhaps (as indicated by the 42% drop in the pedestrian injuries) a result of the safer road environment. In contrast, cycling injuries not involving motor vehicles increased dramatically, quadrupling in 15-19 year olds (from 11.6 to 45.9 injuries per million hours) and more than doubling for children (from 39.5 to 85.4 per million hours) and adults (from 15.9 to 32.3 per million hours).

In 1989, only 27% of cycling injuries were to adults, but in 2012, after the 79% and 81% reductions in child and teenage cycling, 67% of injuries were to adults, with only 11% of injuries to cyclists aged 15-19 and 22% to cyclists aged 5-14 years.

The above results for the risk of cycling injuries per million hours are approximations, because the published age categories in the NZ household travel survey (5-12, 13-17 and 18 or older) did not correspond exactly with the 5 year age categories (5-9, 10-14 etc) classifying the injury statistics. Rates per million hours were calculated from the nearest age category (injuries for age 5-14 *vs* cycling for age 5-12; injuries for age 15-19 *vs* cycling for age 13-17, injuries for age 20 & over *vs* cycling for age 18 & over). The declines in cycling were very similar for age 5-12 (79%) and 13-17 (81%), so this is not expected to have a major impact on the results.



Trends in walking and cycling (minutes per person per week) in New Zealand

Details

1) Trends in walking and cycling

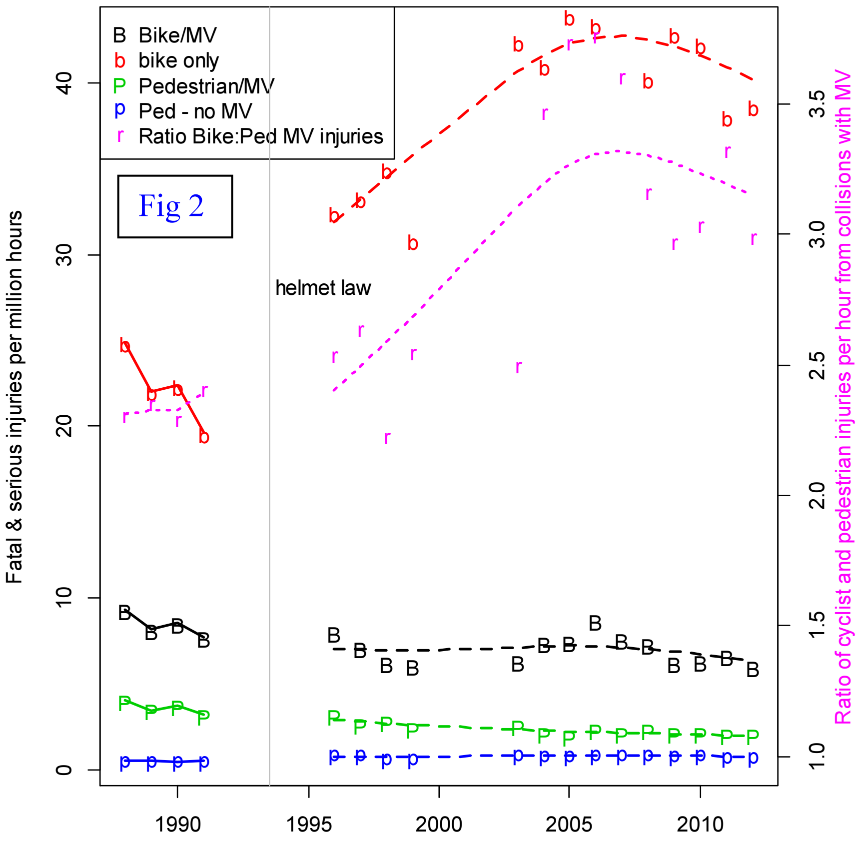
Fig 1 (left) show trends in walking and cycling (minutes/person/week) from the NZ household travel surveys.

From 1989 to 2011, average time spent cycling (on roads and footpaths) fell by 79% for children aged 5-12 (from 28 to 6 minutes/person/week) and 81% for 13-17 year olds (52 to 10 mins/person/week). Adult cycling declined from 8 to 5 mins per person/week then trended back up to 8 mins/person/week. The overall reduction for cyclists of all ages was 47%.

The decline in pedestrian activity of 24% over the same period was more modest. Reductions for specific age groups were: 34% (children aged 5-14, from 92 to 61 mins/person/week), 23% (15-24 year olds, from 98 to 75 mins/person/week) and 11% (25-24 year olds, from 57 to 51 mins/person/week).

In order to differentiate between trends and the effect of the helmet law, post-law estimates were projected backwards using spline curves. For all age groups (children, teenagers and adults), backward projections were substantially less than the amount of cycling observed in the 1989/90 survey, implying a substantial reduction in cycling coinciding with the helmet law. Average cycle use in the first survey after the helmet law (1997/98) was 40% less (9 mins/person/week) than the 15 mins/person/week in the pre-law survey. This contrasts with the almost identical estimates of pedestrian activity (68 mins/person/week in 1997/98 *vs* 72 in 1989/90), and suggests that the helmet law resulted in a substantial reduction in the amount of cycling on roads and pathways.

The NZ Household Travel surveys did not cover mountain biking. An estimate of the proportion of time spent mountain biking was provided by the Active NZ survey. In 2007/08, in an average month, 10.7% of New Zealanders participated in road cycling, compared to 2.9% in mountain biking.[2] This suggests that total cycling in 2007/08 was about 27% higher than the estimate in the household travel survey. Some care is therefore required in the interpretation of injury rates. Mountain bikers riding off-road trails are not at risk of colliding with motor vehicles, so estimate of injuries per million hours of cycling from collisions with motor vehicles should not include time spent mountain biking. However, the overall risk for injuries from non-motor-vehicle crashes might be inflated by the exclusion of the 21% of cycling described in 2007/08 as mountain biking; comparisons between years or time periods might be affected by any changes in the percentage of time spent mountain-biking.



Fatal & serous injuries per million hours, all cyclists & pedestrians over 5

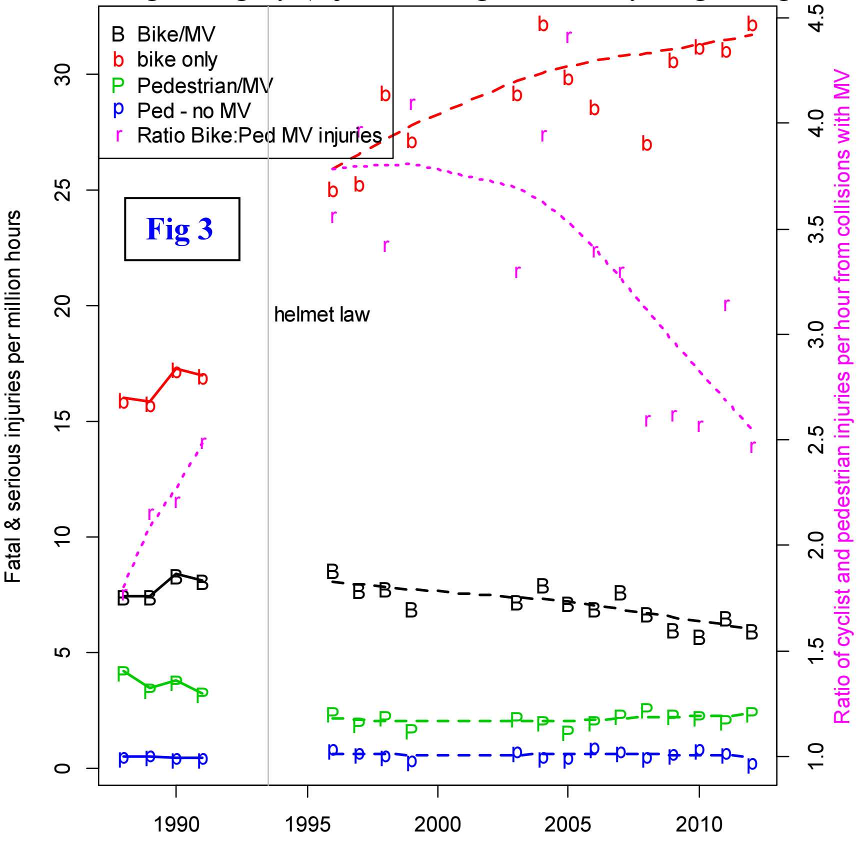
2) Trends in injury rates

Fatalities and injuries to cyclists, (classified by age group and whether or not the injury was from a motor vehicle traffic crash), were downloaded from the NZ National Injury Query System (**NZNIQS**).[3] Injuries to cyclists and pedestrians (aged 5 years and over) were combined with data from the NZ Household Travel Surveys (see Appendix) on total time cycled and walked by New Zealanders aged at least 5 years to calculate injuries per million hours of cycling, for years covered by (or within a year of) the travel surveys.

As shown in Fig 2, from 1989/90 to 2010/12, fatal and serious injuries from collisions with motor vehicles per million hours trended down by 42% for pedestrians. The decline for cyclists (27%) was more modest. The ratio of cyclist to pedestrian injuries from collisions involving motor vehicles is shown by the purple line, drawn using the right hand scale of Fig 2. Before the helmet law, for motor vehicle traffic crash injuries, cyclists had about 2.3 times the risk of pedestrians. However, by 2005 the risk had increased to about 3.2 times that of pedestrians, suggesting that cyclist safety post-helmet law had deteriorated compared to pedestrians.

However, the most dramatic change over time was the substantial increase in the risk of injuries from non motor vehicle crashes, as shown in Fig 2. Details up are provided in Figs 3 and 4, which show a quadrupling of the risk of injury from non-motor vehicle collisions for 15-19 year olds (from 11.6 to 45.9 injuries per million hours), more than doubling for children (from 39.5 to 85.4 per million hours) and doubling for adults (from 15.9 to 32.3 per million hours).

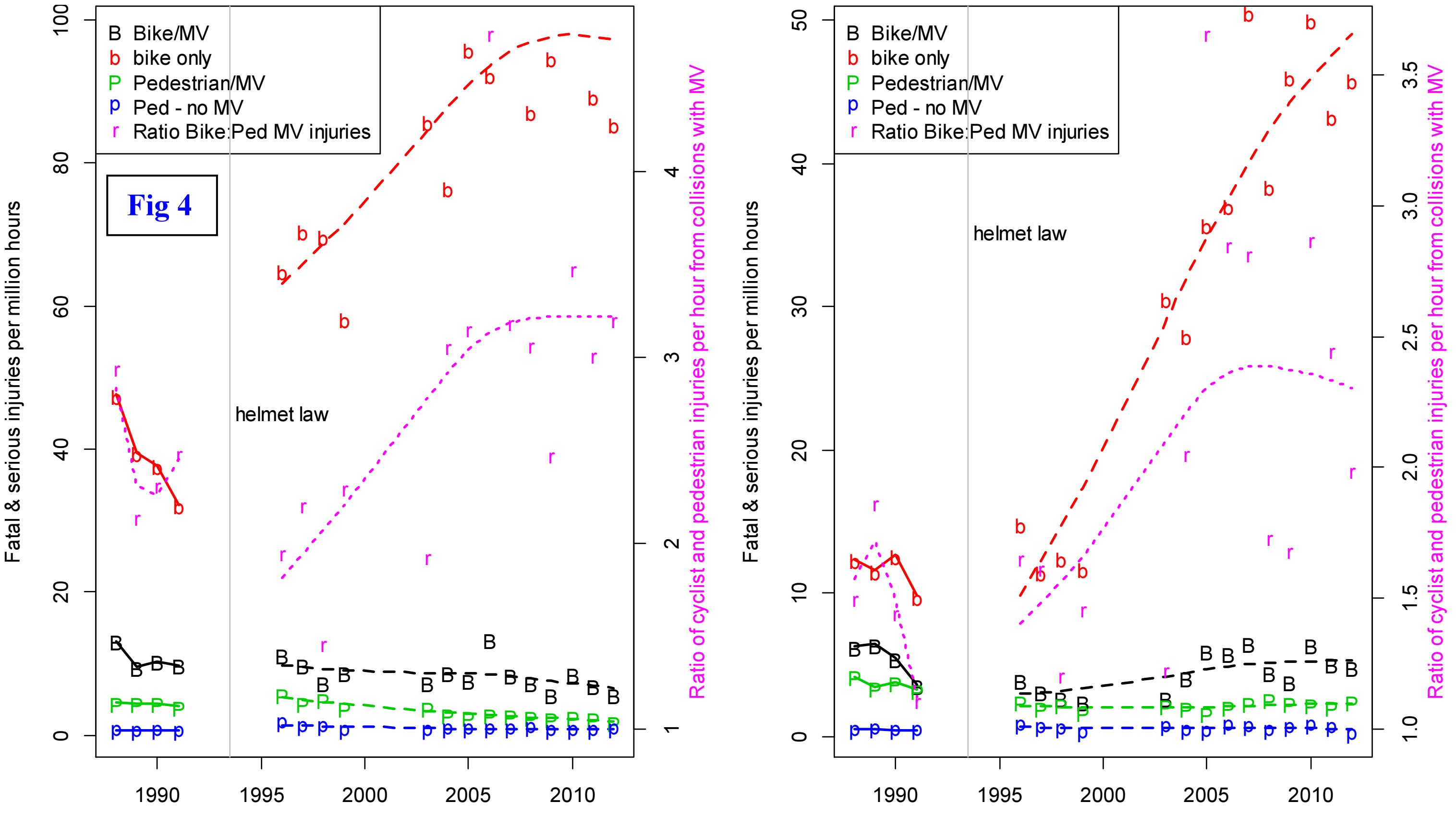
Note that the results for different age groups are approximations because the age categories in the NZ household travel survey (5-12, 13-17 and 18 or older) do not correspond exactly with the 5 year intervals (5-9, 10-14 etc) used to classify the injury statistics. Rates per million hours were therefore calculated from the nearest age category (injuries for age 5-14 *vs* cycling for age 5-12; injuries for age 15-19 *vs* cycling for age 13-17, injuries for age 20 & over *vs* cycling for age 18 & over). This is not expected to have a major impact on the results, because the reductions in cycling were very similar for age 5-12 (79%) and 13-17 (81%).



Fatal & serous injuries per million hours, cyclists 20+ & peds 15-24 years

One possible explanation for the large increase in the risk of injury from non-motor vehicle crashes was provided by Dr Glen Koorey, who investigated all cycling fatalities on NZ roads from January 2006 to December 2012. His submission to a coronial inquiry into cycling safety noted: "*Only nine victims were noted as not wearing a helmet, similar to current national helmet‐wearing rates (92%). This highlights the fact that helmets are generally no protection to the serious forces involved in a major motor vehicle crash; they are only designed for falls … There is a suspicion that some people (children in particular) have been "oversold" on the safety benefits of their helmet and have been less cautious in their riding style as a result.*"[4]

The estimates presented here for injuries per million hours of cycling strongly suggest that the helmet law has not generated benefits, but instead resulted in large reductions in children's cycling and large increases in the risk for injury in non-motor vehicle crashes. Although fatal and serious injuries from crashes involving motor vehicles have declined, cyclists have not enjoyed the same reductions in injury rates as pedestrians.



Fatal/serous injuries per million hrs, cyclists & peds 5-15 years

Fatal/serous injuries per million hrs, cyclists 15-20 & peds 15-24 years

For adults, the first post-law survey found a 38% reduction in cycling, which slowly trended back to pre-law levels. If the slow upward trend had happened without the immediate post-law decline, adult cycling would now be 60% above pre-law levels. As with children and teenagers, the risk of injury to adult cyclists from non-motor vehicle crashes appears to have increased substantially and, although there was some reduction in injuries from motor vehicle crashes, it was not as favourable as for adult pedestrians.

Thus for all age groups, injury rates are substantially higher than what would have been expected without the helmet law, and the amount of cycling is lower than would have been expected without the law. This suggests that the NZ helmet law has been detrimental to health.

The large increases in crashes not involving motor vehicles suggest a possible move away from general on-road cycling to potentially more dangerous off-road activities. Although mountain biking was noted to represent only 21% of cycling, it may account for a disproportionate number of hospital admissions. Results from Australia suggest that enforced helmet laws discourage cycling[5], but this may be particularly true for transport cycling, where, unlike sports cycling and mountain biking, many participants did not wear helmets before legislation. Research into risk compensation in Norway suggested that at least part of the reason why helmet laws do not appear to be beneficial is that they disproportionately discourage the safest cyclists.[6] Such results, and in particular the large increase in injuries to cyclists in NZ from crashes not involving motor vehicles, suggests that NZ's helmet law has not reduced the risk of injury to cyclists, and may even have increased it.

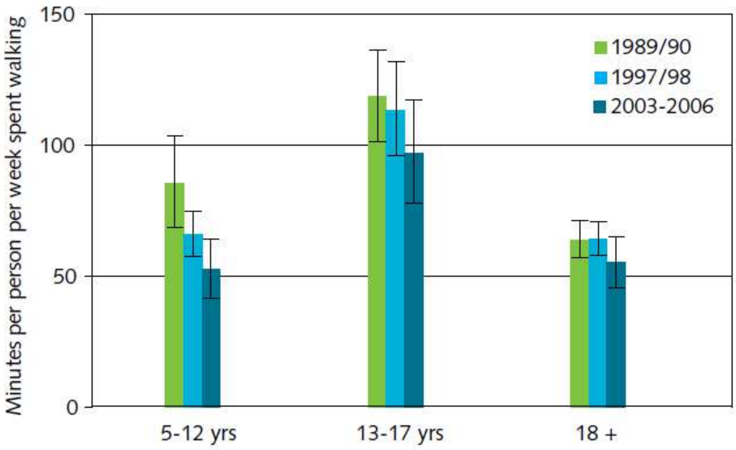
3) Comparison with other studies

This study was based on publicly-available data on patients admitted to public hospitals because of injuries as pedestrians or cyclists. Day patients (who were discharged before midnight on the day of admission) and re-admissions for the same injury were excluded.

An interesting comparison is with results from 'Raising the Profile of Walking and Cycling in New Zealand' (RPWCNZ).[1] Figure 9 of RPWCNZ shows a gradual decline in numbers of pedestrians killed or hospitalised

Figures 6, 8, 9 and 10 from 'Raising the Profile of Walking and Cycling in New Zealand' [1]

Figure 6: Time spent walking per person



8: Kilometres cycled per person per week by age group

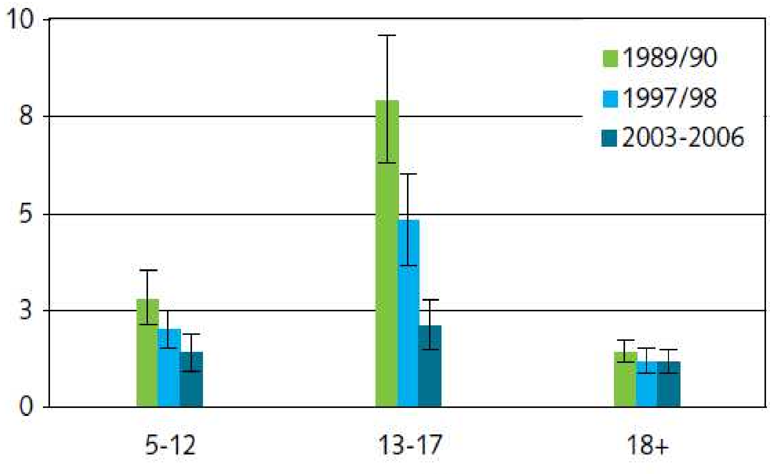


Figure 9: Pedestrians hospitalised or killed from crashes involving motor vehicles on public roads (1995-2007)

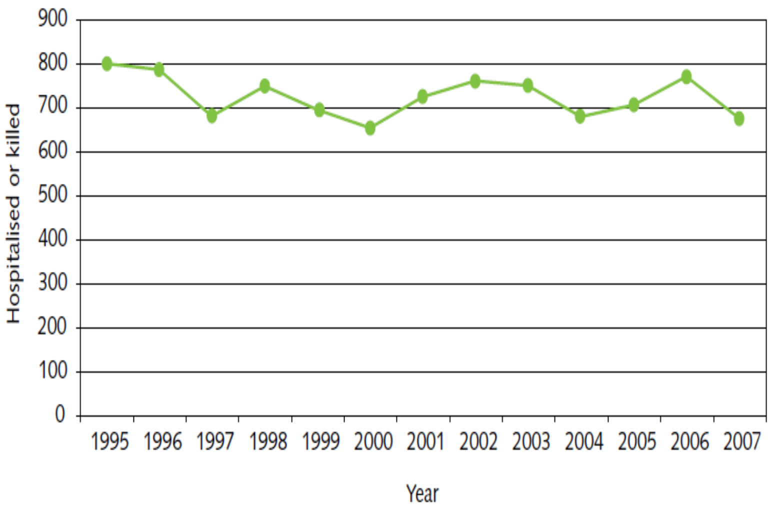
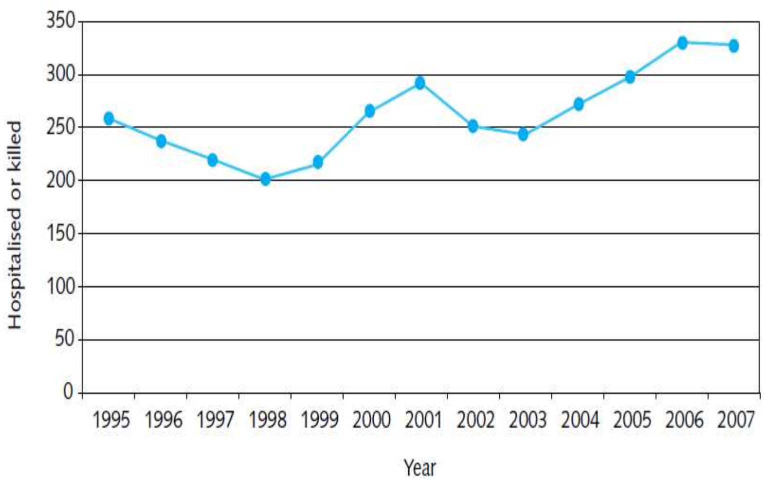
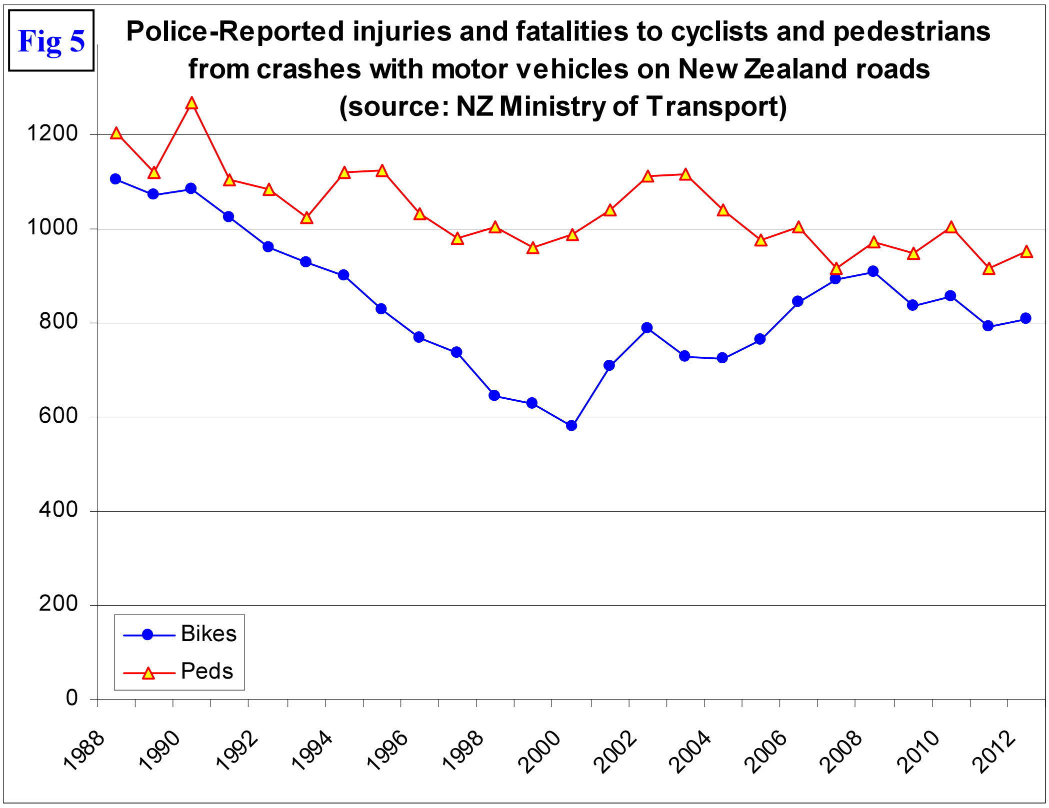


Figure 10: Cyclists hospitalised or killed from crashes involving motor vehicles on public roads



from crashes involving motor vehicles on public roads – from about 800 to just under 700 per year. The overall reduction (about 15%) is consistent with the 15% reduction in time spent walking, shown in Figure 6 of RPWCNZ. In contrast, injuries to cyclists trended upwards from about 255 to 330, despite the large reduction in cycling, especially the 13-17 age group (Figs 8 and 10 of RCWCNZ, reproduced above).

Total police-reported injuries[7,8] (which include less serious injuries as well as hospital admissions) present a somewhat different picture (Fig 5, left). Injuries to cyclists followed a steeper downward trend than pedestrians until 1999, then increased until about 2007, resulting in a similar overall decline as pedestrians from 1988-2012.



Only a small proportion of injuries are reported to police, and the proportion may change over time, so the interpretation of police-reported injuries requires considerable care. A comparison of cyclist hospital admissions with police-reported injuries in Western Australia (WA), found that only 21% of cyclist hospital admissions were from crashes reported to the police. There was also a notable change in reporting rates after the helmet law. Pre-law, from 1988-91, the average reporting rate was 25.4%. From 1993-98 (post-law), the average reporting rate was 17.5%.[9] A possible explanation is that non-helmeted cyclists (who might be concerned about being fined) are more reluctant to report bike/motor vehicle crashes to the police.

It is also interesting to compare the results of the current study with an earlier study of injuries on public roads in NZ.[10] The results for motor vehicle crash injuries were very similar to the NZNIQS data reported here.[3] However, there were considerable differences between non-motor vehicle injuries in the earlier study (annual averages of 592 for 1988-91, 327 for 1996-99 and 427 for 2003-07) and NZNQIS non-road-traffic injuries (annual averages of 911 for 1988-91, 898 for 1996-99 and 1022 for 2003-07). In NZNIQS data, non-motor-vehicle injuries represented 72% all cyclist hospital admissions pre-law in 1988-91, compared to 83% and 85% in 1996-99 and 2003-07 (the two post-law time periods considered in the earlier study).

In New Zealand, helmet legislation applies only to on-road cycling. The increasing discrepancy for non-motor-vehicle injuries between the previous study and NZNIQS hospital admissions data could suggest a move away from relatively safe activities such as cycling for transport on quiet roads or pathways towards sports cycling and mountainbiking (which represented 21% of cycling in 2007/08[2]). The fact that the helmet law does not apply to off-road cycling may also have encouraged cyclists to ride off-road. Cyclists injured while not wearing a helmet might also claim to have been riding off-road to avoid risking a penalty.

4) Discussion and Conclusions

For injuries from collisions with motor vehicles, the overall conclusion is that, as shown by the purple line representing the ratio of the risk per million hours for cyclists compared to pedestrians in Figs 2 to 4, the overall safety of cyclists compared to pedestrians seems to have deteriorated, especially for children and teenagers. Part of the problem may relate to reduced cycling and reduced safety in numbers[11]. As well as direct discouragement, helmet laws may also contribute to the failure of public bike schemes that might otherwise have led to a resurgence in the popularity of cycling[12].

The largest change over time was for non-motor-vehicle crashes, where injuries quadrupled for 15-19 year olds (from an estimated 11.6 to 45.9 injuries per million hours), more than doubled for children (from 39.5 to 85.4 per million hours) and doubled for adults (from 15.9 to 32.3 per million hours). Risk compensation could have contributed to this increase in cycling injuries after helmet laws. One study found that when children ran an obstacle course wearing a helmet and wrist guards, tripping, falling and bumping into things increased by 51% compared to without[13]. A Norwegian study also suggested that at least part of the reason why helmet laws do not appear to be beneficial is that they disproportionately discourage the safest cyclists[6].

In 2002, a cost-benefit analysis suggested that New Zealand's helmet was cost-saving in the youngest age group, but that large costs from the law were imposed on adult cyclists[14]. However, the estimated cost-saving for younger cyclists was based on the premises of: P1 – zero health and environmental benefits from cycling, and P2 – no increase in injury rates per million hours of cyclist. The evidence presented here suggests that the P2 is unrealistic. A NZ Government publication questioned P1 noting that "increased numbers of walkers and cyclists can stimulate economic activity, promote accessibility and community cohesion, reduce congestion, improve safety, reduce transport emissions and improve public health"[1]. An Australian government report noted that the economic benefits per kilometre walked or cycled are: decongestion (20.7 cents per kilometre walked or cycled), health (up to 168.0 cents per kilometre), vehicle operating costs (35.0 cents per kilometre), infrastructure savings (6.8 cents per kilometre) and environment (5.9 cents per kilometre)[15].

In 1987/88, before the introduction of helmet laws, 4.4% of New Zealanders cycled to work, 11.6% cycled to primary school and 18.6% to secondary school[16]. By 2004/08, only 2.2% and cycled to work, 4.3% to primary school and 4.9% to secondary school[16]. Given the large reductions in cycling, and the substantial increase in injuries to cyclists, a comprehensive review is required of the costs and benefits of New Zealand's bicycle helmet laws, taking account of the health and environmental costs of reduced cycling, barriers to successful public bike hire schemes, risk compensation and reduced safety in numbers.

4) Appendix

NZ Household travel survey results – minutes of cycling and walking per week by age group.

	Minutes cycling per week								
Age group	**1989/ 90**	**1997/ 98**	**2003–06**	**2004–07**	**2005–08**	**2006–09**	**2007–10**	**2008–11**	**2009–12**
5 - 12	28	15	11	9	8	7	9	8	6
13 -17	52	31	13	12	12	11	12	11	10
18+	8	5	5	6	7	6	8	8	8
Total 5 or over	15	9	7	7	7	7	8	8	8

	Estimated minutes walking per week								
Age group	**1989/ 90**	**1997/ 98**	**2003–06**	**2004–07**	**2005–08**	**2006–09**	**2007–10**	**2008–11**	**2009–12**
0–4#	#	41	32	43	42	48	42	42	38
5–14	92	74	62	67	63	58	60	62	61
15–24	98	104	83	88	82	84	80	77	75
25–34	57	75	51	56	60	58	54	51	51
35–44	52	50	48	50	49	51	50	48	45
45–54	55	53	50	49	47	47	50	53	53
55–64	70	54	50	53	48	52	58	60	53
65–74	62	59	51	60	63	63	55	52	51
75+	78	51	49	46	50	45	50	43	45
Total	#	66	55	59	57	58	57	56	54
Total age 5 or over	72	68	57	60	58	58	58	57	55

Table 3: Cycling trips by age group and sex

Sex	Age group	*Trip legs in sample*	Trip legs per year (million)	Time spent cycling per year (million hours)	Distance cycled per year (million km)	km cycled per person[3] per week	km per trip leg
Female	Child, 5-17	*269*	6.4	1.6	12.2	0.6	1.9
	Adult, 18 and over	*664*	16.8	5.8	63.0	0.7	3.8
Male	Child, 5-17	*659*	18.0	3.8	27.5	1.3	1.5
	Adult, 18 and over	*1,460*	42.6	16.3	225.3	2.8	5.3
All	5-12 years	*536*	13.5	2.7	19.6	0.8	1.4
	13-17 years	*392*	10.8	2.7	27.9	1.7	2.6
	18 years and over	*2,124*	59.4	22.2	288.4	1.7	4.9

Table 3, above, is for the 2009-2013 survey.

Table 7: Trends in km cycled each week per person by age group

	Km cycled per week								
Age group	**1989/ 90**	**1997/ 98**	**2003–06**	**2004–07**	**2005–08**	**2006–09**	**2007–10**	**2008–11**	**2009–12**
5 - 12	2.8	2.0	1.2	0.9	0.9	0.9	1.2	0.9	0.8
13 -17	7.9	4.8	2.2	2.1	1.8	1.9	2.0	1.8	1.7
18+	1.4	1.2	1.3	1.3	1.5	1.4	1.7	1.5	1.7
Total 5 or over	2.2	2.0	1.3	1.3	1.5	1.4	1.7	1.5	1.6

Numbers of cyclists & pedestrians killed or injured in motor vehicles crashes and cyclist injuries from non-motor vehicle crashes (NZNIQS data).

	Crashes involving motor vehicles (MV)				Non-MV crashes	
Year	**Ped Inj**	**Ped Inj**	**Bike Inj**	**Bike Fatal**	**Bike Inj**	**Bike Fatal**
1988	700	83	358	18	1000	4
1989	598	81	311	22	898	1
1990	642	97	327	26	921	2
1991	555	85	298	23	819	0
1992	579	77	253	17	802	2
1993	547	67	291	18	964	4
1994	607	48	272	16	840	4
1995	592	66	217	14	867	1
1996	576	61	201	13	868	3
1997	505	45	180	12	904	1
1998	520	64	156	16	960	1
1999	444	57	162	7	851	4
2000	402	34	162	16	905	2
2001	408	38	169	10	862	2
2002	450	38	136	14	878	4
2003	415	54	139	5	962	0
2004	363	36	164	6	943	4
2005	370	29	162	12	1026	1
2006	408	46	197	9	1024	2
2007	375	43	168	14	1146	4
2008	426	35	191	10	1104	4
2009	381	34	164	9	1189	3
2010	369	34	169	9	1180	8
2011	358	31	179	9	1078	
2012	362	31	163	8	1104	
2012, %89/90	58%	35%	51%	33%	121%	

Ped = pedestrian; inj=(non-fatal) injury crash. Changes in numbers of injuries should be compared with the 24% reduction in pedestrian and 47% reduction in cycling activity.

5) References

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