

# The possible effect on frequency of cycling if mandatory bicycle helmet legislation was repealed in Sydney, Australia: a cross sectional survey

Chris Rissel and Li Ming Wen

## Background

Cycling as a form of regular physical activity that is accessible to people of all ages confers substantial health benefits.<sup>1-4</sup> Increasingly in Australia, there are calls to increase levels of cycling because of the multiple co-benefits that come from a shift from private motor vehicles to bicycles, including reduced dependence on potentially dwindling oil supplies, less air and noise pollution, less greenhouse gas emissions, less congestion plus health benefits.<sup>5-8</sup>

The Australian National Cycling Strategy has a goal to double the number of people cycling by 2016.<sup>9</sup> New South Wales, the most populous Australian state, in its State Plan has set a target to increase the mode share of bicycle trips made in the Greater Sydney region, at a local and district level, to 5% by 2016,<sup>10</sup> and has published a BikePlan which outlines how this target can be achieved.<sup>11</sup> Individual local government areas have also set targets, such as the City of Sydney's Cycle Strategy and Action Plan 2007-2017, which has a target of 10% of trips to be made by bike by 2016.<sup>12</sup> In 2007, 1.2% of trips in the Sydney metropolitan area were made by bike.<sup>13</sup>

It is generally understood what needs to be done to increase cycling levels. Better urban design such as better cycling infrastructure, higher density development, mixing residential and commercial land

use, and shorter trip distances will facilitate more cycling.<sup>14</sup> Other strategies to encourage cycling include behaviour change programs such as TravelSmart, Ride to Work and Ride to School programs, public bicycle events to encourage infrequent and novice riders to cycle in a supportive social environment, and bicycle education programs for both children and adults.<sup>14</sup>

One issue that is not usually discussed when considering cycling promotion strategies in Australia is that of mandatory bicycle helmet legislation. This legislation remains controversial,<sup>15,16</sup> and represents differing public health perspectives (injury prevention versus physical activity promotion)<sup>17,18</sup> as well as disagreements about the evidence of the effectiveness of the legislation<sup>19-21</sup> and civil liberties.<sup>22</sup>

Advocates for helmet laws cite evidence from bio-mechanical tests and case-control studies, including Cochrane Reviews of the case control studies,<sup>23</sup> that repeatedly show that helmets protect against impact to the head<sup>15,18</sup> if worn correctly.<sup>24</sup> However, a recent review found that some of these studies were influenced by publication bias and time-trend bias that was not controlled for and, as a result, produced inflated estimates of the effectiveness of bicycle helmets.<sup>16</sup> Opponents of helmet laws claim that mandatory helmet legislation has reduced the number of people cycling and this is the main

## Abstract

**Issue addressed:** Australia has national, state and city targets to increase levels of cycling. The possible effect of repealing mandatory bicycle helmet legislation on the frequency of cycling in Sydney is examined.

**Methods:** A cross sectional survey by a market research company was conducted, using quota sampling, in Sydney, Australia. Participants were 600 residents aged 16 years and older. Data were collected in October 2010 using computer-assisted telephone interviews from randomly sampled households, with one respondent per household. The primary outcome measures were propensity to cycle more if a helmet was not required, how often a respondent who cycled would cycle without a helmet, and opinion on compulsory wearing of bicycle helmets. Frequency of cycling, and demographic questions were also assessed. Multiple logistic regression models were run for each of the three main outcomes.

**Results:** One in five (22.6%, 95% CI 18.8-26.4%) respondents said they would cycle more if they did not have to wear a helmet, particularly occasional cyclists (40.4% of those who had cycled in the past week and 33.1% of those who had cycled in the past month). Almost half (47.6%) of respondents said they would never ride without a helmet, 14.4% said 'all the time', 30.4% said 'some of the time' and the rest were not sure. One third (32.7%, 95% CI 28.5-37.0%) of respondents did not support mandatory helmet legislation.

**Conclusions:** While a hypothetical situation, if only half of the 22.6% of respondents who said they would cycle more if they did not have to wear a helmet did ride more, Sydney targets for increasing cycling would be achieved by repealing mandatory bicycle helmet legislation. A significant proportion of the population would continue to wear helmets even if they were not required to do so.

**Key words:** bicycle, cycling, helmet, legislation, physical activity

*Health Promotion Journal of Australia* 2011; 22: 178-83

## So what?

To the extent that Sydney is representative of the rest of Australia, the repeal of mandatory helmet legislation would be likely to substantially increase cycling in Australia.

cause of any reductions in cycling-related injuries attributed to the legislation. The reduction in numbers of people cycling may have actually increased the risk to the remaining cyclists because of Smeed's Law and reduced safety in numbers, and also because of risk compensation.<sup>25,26</sup> One UK study found that motor vehicle drivers leave significantly less room when overtaking a helmeted cyclist.<sup>27</sup> Another found that cyclists accustomed to wearing helmets ride significantly faster (and presumably take more risks) when wearing helmets than without.<sup>28</sup> Further, they argue that the debate over what impact protection helmets may provide is a distraction from the main bicycle-related health issue: the safety of the bicycling environment, and that cost-benefit analyses do not support mandatory helmet use.<sup>29,30</sup>

The introduction of mandatory bicycle helmet legislation in Australia in 1991 was reported to have led to a 25-38% reduction in people cycling in Western Australia,<sup>31</sup> a reduction of 47% of NSW students riding to school (much higher for females),<sup>32</sup> and 29% fewer adult and 42% fewer child cyclists (36% overall) in Melbourne.<sup>33</sup> This negative effect on cycling levels was also observed in New Zealand when bicycle helmet legislation was introduced in 1994, with a 51% drop in the number of trips by bicycle between 1989-1990 and 2003-2006.<sup>34</sup> However, a Canadian study found no change in self-reported bicycle use in two provinces that introduced helmet laws, but failed to report the effect of legislation on helmet use in those provinces.<sup>35</sup>

There are no Australian data on stated preference for bicycle helmet wearing. This study seeks to examine if, 20 years after the introduction of helmet legislation in Australia, people in Sydney say they would cycle more if helmets were not required, how often they would wear helmets, and to describe the characteristics of these people.

## Methods

A computer-assisted telephone interviewing (CATI) survey of 600 people aged 16 years and over living in Sydney was conducted over the week from 18 to 24 October, 2010. Data were collected as part of a routinely conducted omnibus survey run by a market research company primarily to monitor media use patterns, and allowed for a limited number of additional questions to be asked about bicycle helmets. This sample size provides reasonably precise estimates of prevalence for both small and moderate proportions and took into account scarce available resources.

There was a two-stage sampling strategy. Telephone numbers were randomly selected from an electronic copy of the Sydney telephone directory. Each phone number was tried up to five times at different times and on different days in order to maximise the response rate. Only one person aged 16 years and over was selected and interviewed per household using quota sampling, with quotas for age, sex and region of Sydney. All interviewers were briefed about the cycling and helmet use questions before commencement. Interviewing was conducted between 4:30 pm and 8:30 pm weeknights, and 9:00 am and 5:00 pm Saturdays and Sundays by trained and accredited interviewers under constant supervision from the McNair Ingenuity Research call centre in Crows Nest NSW.

## Outcomes measured

As the data collection was primarily for another purpose, only

four questions were able to be asked, in addition to the standard demographic items. These questions were generated following discussion and feedback from members of local Sydney Bicycle User Groups. They are:

*When was the last time you rode a bicycle? Was it: Today, within the last week, within the last month, within the last year, longer than a year, or never.*

*Would you cycle more often if you didn't have to wear a helmet? Yes or No.*

*How often would you cycle without a helmet if you were legally allowed to? Would that be: All the time, some of the time, never, or not sure.*

*Which of the following three statements best describes your view on the compulsory wearing of bicycle helmets? Agree, it should be compulsory; Disagree, it should not be compulsory; or People should wear helmets, but it should not be compulsory.*

All respondents were asked the first, second and fourth question. Those people who had never ridden a bicycle were not asked the third question. For some analyses, frequency of riding was dichotomised into regular rider (within the last month) and others. The frequency of likelihood of cycling without a helmet if legally allowed to was dichotomised into those who would always or sometimes ride without a helmet and the rest. Demographic questions included sex, age (in five-year categories), education and work status. Age was grouped into four categories: 16-24, 25-39, 40-54 and 55 years or over. Response options for work status were collapsed into those who worked full or part time and the rest (including home duties, retired/pensioner, unemployed or student). Response options for education included primary school, secondary or high school, some tertiary or TAFE, university (Bachelor) degree, or higher degree. For analysis purposes, those with a degree or higher were allocated to one group and the rest to another group.

**Table 1. Demographic characteristics of the sample compared with the Sydney Statistical Division.**

	Number of respondents (%)	Weighted Study sample (%)	Sydney Statistical Division (%)
<b>Sex</b>			
Male	284 (47.3)	49.0	49.3
Female	316 (52.7)	51.0	50.7
<b>Age (years)<sup>a</sup></b>			
16-24	77 (12.8)	17.5	17.2
25-39	144 (24.0)	29.2	28.6
40-54	132 (22.0)	25.4	26.2
55+	247 (41.2)	27.9	28.0
<b>Education<sup>a</sup></b>			
Degree or higher	199 (33.2)	33.5	36.5
Others	401 (66.8)	66.5	63.5
<b>Work Status<sup>a</sup></b>			
Full or part-time	321 (53.5)	57.3	63.1
Others	279 (46.5)	42.7	36.9

*a Denominator for SSD is those persons 16 years and older*

## Analysis

Data were weighted to the total population based on 2006 Australian Bureau of Statistics population census data for the Sydney Statistical Area.<sup>36</sup> Summary characteristics of the study sample and the Sydney Statistical Area population are presented in Table 1. Data were analysed using STATA (version 10.1) software. Basic descriptive frequencies and cross-tabulations with the three main outcome variables (would ride without a helmet if allowed, how often would ride without a helmet, and support of mandatory legislation) were run initially. Simple logistic regression models computed a crude odds ratio. A multiple logistic regression model was then run for each of these outcomes, with the variables sex, age group, work status, employment and riding frequency and an adjusted odds ratio (AOR) and 95% confidence interval (95% CI) calculated. All variables were included in the multiple logistic regression model because all are known to be associated with frequency of cycling and are potential confounders.

As this research was considered negligible risk research and used non-identifiable data, ethics committee approval was not sought. However, the market research company that conducted the omnibus survey fully complies with industry quality assurance accreditation and professional practice under Australian Standards ISO 20252.

## Results

After weighting, 49% of the sample was male, and the age distribution included 27.9% of respondents aged 16-24 years, while 17.5% were 25-39 years, 29.2% were 40-54 years and 25.4% were 55 years or over. About a third (33.5%) of respondents had a degree or higher, and 52.5% were working either full or part-time. This sample was not

statistically different to that of residents 16 years and older in the Sydney Statistical Division.<sup>36</sup>

Two participants (1.8%) had ridden a bicycle the day they were interviewed, 9.2% in the past week, 6.8% in the past month (totalling 17.8% who had cycled at all in the past month), and 16.3% in the past year. For three out of five respondents (60.6%) it had been longer than a year since they had ridden a bicycle, and a further 5.4% had never ridden one.

Regarding the propensity to cycle more without a helmet if allowed, 22.6% (95% confidence interval (CI) 18.8-26.4%) of all respondents reported that they would cycle more if they did not have to wear a helmet. Those who were aged 16-24 years (AOR = 3.07, 95% CI 1.60-5.90) and 25-39 years (AOR = 2.52, 95% CI 1.39-4.58), and those regular riders that had ridden in the past week or month or had ridden the day of the survey (AOR = 1.93, 95% CI 1.16-3.21) were significantly more likely to ride more if they did not have to wear a helmet (see Table 2).

When asked how often participants would ride without a helmet if allowed, 14.4% said 'all the time', 30.4% said 'some of the time' (with the sum of 'all or some' being 44.8%, 95% CI 40.3-49.3%) and 47.6% said 'never' and 7.6% were 'not sure'. Compared with those aged 55 years and older, all other age groups were significantly more likely to ride always or sometimes without a helmet (see Table 3). Regular riders that had ridden in the past week or month or had ridden on the day of the survey (AOR = 2.05, 95% CI 1.26-3.34), were also significantly more likely to ride all or some of the time without a helmet (see Table 3).

In addition, two-thirds of respondents (67.3%, 95% CI 63.0-71.5%) supported mandatory helmet legislation, with the youngest age group (16-24 years, AOR = 0.24, 95% CI 0.13-0.42) and regular riders (AOR = 0.53, 95% CI 0.33-0.86) significantly less likely to support

**Table 2: Weighted proportion, crude and adjusted odds ratio (AOR) of respondents (n=600) who would ride more if they did not have to wear a bicycle helmet by characteristics of respondents.**

	%	% would ride more	OR	AOR <sup>a</sup>	AOR 95% confidence interval
<b>Total</b>		22.6			
<b>Sex</b>			<i>p</i> =0.17		<i>p</i> =0.32
Male	49.0	24.7	1.32	1.24	0.81 – 1.93
Female	51.0	20.5	1	1	
<b>Age (years)</b>			<i>p</i> <0.01		<i>p</i> =0.09
16-24	17.5	34.1	3.76	3.07	1.60 – 5.90
25-39	29.2	28.8	3.01	2.52	1.39 – 4.58
40-54	25.4	20.1	1.92	1.51	0.79 – 2.88
55+	27.9	11.1	1	1	
<b>Education</b>			<i>p</i> =0.58		<i>p</i> =0.84
Degree or higher	33.5	23.6	1.13	1.05	0.66 – 1.66
Others	66.5	22.1	1	1	
<b>Work Status</b>			<i>p</i> =0.52		<i>p</i> =0.28
Full or Part-time	57.3	24.0	1.50	1.32	0.80 – 2.18
Others	42.7	20.7	1	1	
<b>Frequency of riding</b>			<i>p</i> <0.01		<i>p</i> =0.01
Today	1.8	34.3			
Last week	9.2	40.4			
Last month	6.8	33.1	2.59*	1.93*	1.16 – 3.21
Last year	16.3	24.4	2.43**		
Longer than a year	60.6	18.9	1	1	
Never	5.4	11.5			

*a* adjusted for all other variables in the table

\* compares those who have ridden in the past month (plus past week and today) with those who have not ridden in the past year and those who have never ridden

\*\* compares those who have ridden in the past year (plus month, week and day) with those who have not ridden in the past year and those who have never ridden

mandatory helmet legislation (see Table 4). Support for helmet laws increases as cycling frequency decreases – 44% of people who cycled in the past week, 48% of those who cycled in the past month but not the past week, 64% of those who cycled in the past year but not the past month, 72% of those who cycled less frequently and 88% of people who have not cycled supported helmet laws. Further, 40% of the respondents who said they would ride more if they did not have to wear a helmet supported helmet legislation, and 77% of people who said they would not ride more if they did not have to wear a helmet supported helmet legislation.

## Discussion

Younger people and those who ride occasionally reported the highest likelihood to ride more if they did not have to wear a helmet. With one in five (22.6%) of all respondents saying that they would ride more if they did not have to wear a helmet, when translated to the Sydney population of 4.5 million, this could represent a substantial increase in cycling levels. While the relationship between intent to perform a behaviour and actual behaviour (for example, helmet wearing) is not known, if only a half or even quarter of these people who say they would ride more actually did so, our data suggest that the Sydney cycling participation targets would be easily reached by repealing the mandatory helmet legislation. To the extent that Sydney is representative of the rest of Australia, other state or national targets might also be reached.

The figures indicate that the greatest increases would be among occasional cyclists. Clearly, people already cycling every day have less capacity to increase their cycling than those cycling, say, once a week or once a month. While a lower proportion (19%) of infrequent riders said they would ride more if they did not have wear a helmet, these

people also represent almost two-thirds of the adult population and therefore would make a very significant contribution to the increase in cycling levels if they did ride more because helmet wearing was not compulsory.

These findings are consistent with other commentators that have noted that legislation requiring bicycle helmets discourages cycling.<sup>17,29,37,38</sup> As noted, the introduction of legislation in Australia in 1991 led to reductions in levels of cycling of about 30-40% with much greater drops in some sub-groups.<sup>32</sup> Similar reductions were reported in New Zealand in 1994 when helmet legislation was introduced there.<sup>34</sup> In further support of the robustness of these data, a recent Cycling Promotion Fund report of a national survey of cycling reported that 16.5% of recent transport riders cited helmets as one of the barriers to them cycling more.<sup>39</sup> While the question was asked differently (helmets were one option of a long list of possible barriers which were ticked) in this study 1 in 6 cyclists nationally thought helmets were a barrier to riding more for transport.<sup>39</sup>

Further research is needed to understand how helmet legislation deters people from cycling. There are anecdotal reports that some people do not ride at all because of helmets, or cannot be bothered with some trips. Even more important is the negative image of cycling as a dangerous activity that helmet legislation engenders.<sup>40</sup> Safety concerns are the main barrier to cycling cited by most people. To justify mandatory helmet legislation, cycling must be seen as a dangerous activity, requiring protection, regardless of actual risk. Mountain biking or competitive cycling is far more dangerous than recreational or utility cycling, although cycling as a sport is far less risky than many other organised sports per time spent participating.<sup>14</sup> Almost half of our sample reported that they would wear a helmet regardless of whether it is legally required or not. With Australia and

**Table 3: Weighted proportion, crude and adjusted odds ratio (AOR) of how often respondents (n=567 – excludes 'never ridden') would ride always or sometimes without a helmet if legally allowed by characteristics of respondents.**

	%	% would ride without helmet	OR	AOR <sup>a</sup>	AOR 95% confidence interval
<b>Total</b>		44.8			
<b>Sex</b>			<i>P</i> =0.09		<i>P</i> =0.30
Male	49.7	47.2	1.34	1.22	0.84 – 1.76
Female	50.3	42.6	1	1	
<b>Age (years)</b>			<i>P</i> <0.01		<i>P</i> <0.01
16-24	18.5	66.9	6.79	5.45	3.03 – 9.83
25-39	29.6	47.6	2.66	2.59	1.56 – 4.31
40-54	25.5	47.3	2.79	2.56	1.52 – 4.31
55+	26.5	24.1	1	1	
<b>Education</b>			<i>P</i> =0.20		<i>P</i> =0.16
Degree or higher	33.6	39.5	0.79	0.75	0.51 – 1.11
Others	66.4	47.6	1	1	
<b>Work status</b>			<i>P</i> =0.16		<i>P</i> =0.57
Full or part-time	57.6	45.9	1.27	1.13	0.74 – 1.73
Others	42.4	43.4	1	1	
<b>Frequency of riding</b>			<i>P</i> <0.01		<i>P</i> <0.01
Today	1.9	64.5			
Last week	9.7	70.1			
Last month	7.2	63.3	3.06*	2.05*	1.26 – 3.34
Last year	17.2	50.6	2.47**		
Longer than a year	64.0	36.6	1	1	

*a* adjusted for all other variables in the table

\* compares those who have ridden in the past month (plus week and day) with those who have not ridden in the past year and excluding those who have never ridden

\*\* compares those who have ridden in the past year (plus month, week and day) with those who have not ridden in the past year and excluding those who have never ridden

New Zealand the only countries in the world that have national mandatory helmet legislation, it is evident from many countries that about 30% of the cycling population will voluntarily wear a helmet. In the US, 35% of bicyclists reported that they wore a helmet all the time or for most trips.<sup>41</sup> Removing compulsion to wear a helmet simply means that people would have a choice, with the decision to wear a helmet or not based on the context, risk-taking propensity of the rider and the type of ride being taken (for example, short local trip, commuting, racing, recreation).

Those riders who rarely rode (had not ridden a bicycle in the last year) were the least likely (36.6%) to ride without a helmet, and support for helmet legislation increased as cycling participation decreased. One possible explanation for this is the common public perception image of cycling as a dangerous activity. Those with less cycling experience typically over-estimate the dangers of cycling,<sup>42</sup> a perception reinforced by the requirement to wear a helmet.

Two-thirds of respondents supported mandatory helmet legislation. This is not surprising in the context of Sydney, which has a very low level of cycling,<sup>43</sup> is generally not a cycling friendly environment compared to other Australian capital cities,<sup>44</sup> and where the local media is actively hostile to cycling.<sup>45</sup> After 20 years of authorities enforcing helmet legislation with the road safety message that 'helmets save lives', it is noteworthy that as many as a third of Sydney respondents do not support the legislation. Those who never rode were the strongest supporters of the legislation, with those infrequent riders also supporters.

A major limitation of this study is that it used quota sampling which may have introduced potential for bias towards those people more likely to be at home and agree to participate in market research surveys. This was primarily done for cost reasons, and to broadly

gauge the community attitude towards helmet legislation. However, weighting of the data should address this limitation to some extent. The demographic characteristics of the study sample showed a similar distribution to that of the Sydney Statistical Division.<sup>36</sup> Those people with unlisted phone numbers, and on the Australian 'Do Not Call' register (numbers that market research companies have agreed to exclude from surveys) were excluded. The limited number of questions restricted our ability to explore this issue further, and the relationship between what people say they might do and what they actually do (regarding helmet wearing) in this situation is unclear.

Concern that a repeal of mandatory helmet legislation would lead to a significant increase in head injuries is not founded for two reasons. The first is because of the well documented safety in numbers phenomenon.<sup>25,26</sup> As more people cycle, the safer it becomes for everyone cycling as drivers adjust to bicycles in the road environment and improvements are made to the cycling environment. While there may be an increase in the number of cycling injury events the rate of injuries per exposure decreases. The second reason is that there is already a case study of one Australian Territory (the Northern Territory) where it is legal to ride on a footpath or bicycle path without a helmet. Traffic conditions and availability of bicycle infrastructure in the Northern Territory main urban areas are not substantially different from country towns in other states or territories. Injury figures show that there is a significantly higher level of motor vehicle related injuries in the Northern Territory, but pedal cycle injury rates are similar to other Australian states.<sup>46</sup> If allowed, it is plausible that adults could make decisions on the degree of risk involved in their cycling, and choose to wear a helmet or not.

Three cost-benefit analyses that have compared the risks with the benefits of cycling have concluded that the benefits outweigh the

**Table 4: Weighted proportion, crude and adjusted odds ratio (AOR) of respondents (n=600) who support mandatory helmet legislation by characteristics of respondents.**

	%	% support helmet legislation	OR	AOR <sup>a</sup>	AOR 95% confidence interval
<b>Total</b>		67.3			
<b>Sex</b>			<i>p</i> =0.06		<i>p</i> =0.09
Male	49.0	63.1	0.60	0.72	0.49 – 1.05
Female	51.0	71.2	1	1	
<b>Age (years)</b>			<i>p</i> <0.01		<i>p</i> =0.09
16-24	17.5	44.0	0.20	0.24	0.13 – 0.42
25-39	29.2	71.2	0.68	0.85	0.49 – 1.45
40-54	25.4	64.8	0.47	0.62	0.36 – 1.06
55+	27.9	80.0	1	1	
<b>Education</b>			<i>p</i> =0.57		<i>p</i> =0.35
Degree or higher	33.5	66.8	0.90	0.82	0.55 – 1.24
Others	66.5	67.5	1	1	
<b>Work status</b>			<i>p</i> =0.13		<i>p</i> =0.15
Full or Part-time	57.3	65.5	0.76	0.72	0.46 – 1.13
Others	42.7	69.6	1	1	
<b>Frequency of riding</b>			<i>p</i> <0.01		<i>p</i> =0.01
Today	1.8	82.8			
Last week	9.2	36.8			
Last month	6.8	53.8	0.37*	0.53*	0.33 – 0.86
Last year	16.3	63.6	0.41**		
Longer than a year	60.6	72.0	1	1	
Never	5.4	88.5			

*a* adjusted for all other variables in the table

\* compares those who have ridden in the past month (plus week and day) with those who have not ridden in the past year and excluding those who have never ridden

\*\* compares those who have ridden in the past year (plus month, week and day) with those who have not ridden in the past year and excluding those who have never ridden

risks,<sup>47,48</sup> including a recent Australian cost-benefit analysis finding that mandatory helmet use was not cost-effective when the many health benefits of more people cycling are considered.<sup>30</sup> Increases in cycling would lead to important improvements in public health in Australia.

## Acknowledgements

McNair Ingenuity for the data collection. The study was funded by the Health Promotion Service of the (former) Sydney South West Area Health Service.

## References

- Andersen LB, Schnohr P, Schroll M, Hein HO. All-cause mortality associated with physical activity during leisure time, work, sports and cycling to work. *Arch Intern Med*. 2000;160:1621-8.
- Hu G, Qiao Q, Silventoinen K, Eriksson JG, Jousilahti P, Lindstrom J, et al. Occupational, commuting, and leisure-time physical activity in relation to risk for type 2 diabetes in middle-aged Finnish men and women. *Diabetologia*. 2003;46:322-329.
- Matthews CE, Jurj AL, Shu X, Li HL, Yang G, Li Q, et al. Influence of exercise, walking, cycling, and overall nonexercise physical activity on mortality in Chinese women. *Am J Epidemiol*. 2007;165:1343-50.
- Bassett DR Jr, Pucher J, Buehler R, Thompson DL, Crouter SE. Walking, cycling, and obesity rates in Europe, North America, and Australia. *J Phys Act Health*. 2008;5:795-814.
- Rissel C. What price petrol? *Health Promot J Austr*. 2006;17(1):3-4.
- Woodcock J, Edwards P, Tonne C, Armstrong BG, Ashiru O, Banister D, et al. Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. *Lancet*. 2009;374:1930-43.
- Capon AG, Rissel C. Chronic disease and climate change: understanding co-benefits and their policy implications. *NSW Public Health Bull*. 2010;21(5-6):109-113.
- Rissel CE. Active travel: a climate change mitigation strategy with co-benefits for health. *NSW Pub Health Bull*. 2009;20:10-3.
- Australian Bicycle Council. *The Australian National Cycling Strategy 2011-2016*. Sydney (AUST): Austroads; 2010 [cited 2011 Nov 10]. Available from: [http://www.austroads.com.au/documents/Australian\\_National\\_Cycling\\_Strategy\\_2011-16\(4\).pdf](http://www.austroads.com.au/documents/Australian_National_Cycling_Strategy_2011-16(4).pdf)
- Department of Premier and Cabinet. *NSW State Plan: Investing in a Better Future*. Sydney (AUST): State Government of New South Wales; 2010 [cited 2011 Nov 10]. Available from: [www.stateplan.nsw.gov.au](http://www.stateplan.nsw.gov.au)
- Premier's Council of Active Living. *New South Wales BikePlan*. Sydney (AUST): State Government of New South Wales; 2010 [cited 2011 Nov 10]. Available from: [www.shapeyourstate.nsw.gov.au](http://www.shapeyourstate.nsw.gov.au)
- City of Sydney. *Cycle Strategy and Action Plan 2007-2017*. Sydney (AUST): The City; 2007 [cited 2011 Nov 10]. Available from: <http://www.cityofsydney.nsw.gov.au/2030/documents/CycleStrategyAndActionPlan.pdf>
- Merom D, Van Der Ploeg HP, Corpuz G, Bauman AE. Public health perspectives on household travel surveys active travel between 1997 and 2007. *Am J Prev Med*. 2010;39(2):113-21.
- Bauman A, Rissel C, Garrard J, Kerr I, Speidel R, Fishman E. *Cycling: Getting Australia Moving – Barriers, Facilitators and Interventions to get more Australians Physically Active Through Cycling*. Melbourne (AUST): Cycling Promotion Fund; 2008.
- Attewell RG, Glase K, McFadden M. Bicycle helmet efficacy: a meta-analysis. *Accid Anal Prev*. 2001;33(3):345-52.
- Elvik R. Publication bias and time-trend bias in meta-analysis of bicycle helmet efficacy: A re-analysis of Attewell, Glase and McFadden, 2001. *Accid Anal Prev*. 2011;43:1245-51.
- Robinson DL. No clear evidence from countries that have enforced the wearing of helmets. *BMJ*. 2006;332:722-5.
- Hagel B, Macpherson A, Rivara FP, Pless B. Arguments against helmet legislation are flawed. *BMJ*. 2006;332:725-6.
- Thompson D, Rivara F, Thompsons R. Helmets for preventing head and facial injuries in cyclists (Cochrane Review). In: *The Cochrane Database of Systematic Reviews*; Issue 2, 2004. Chichester (UK): John Wiley & Sons; 2004.
- Curnow WJ. The Cochrane Collaboration and bicycle helmets. *Accid Anal Prev*. 2005;37(3):569-73.
- Curnow WJ. Bicycle helmets: lack of efficacy against brain injury. *Accid Anal Prev*. 2006;38(5):833-4.
- Piper T, Willcox S, Bonfiglioli C, Emilsen A, Martin P. Science, media and the public – the framing of the bicycle helmet legislation debate. Unpublished Observations.
- Macpherson A, Spinks A. Bicycle helmet legislation for the uptake of helmet use and prevention of head injuries (Cochrane Review). In: *The Cochrane Database of Systematic Reviews*; Issue 3, 2008. Chichester (UK): John Wiley & Sons; 2008.
- Rivara FP, Astley SJ, ClarrenSK, ThompsonDC, ThompsonRS. Fit of bicycle safety helmets and risk of head injuries in children. *Inj Prev*. 1999;5(3):194-7.
- Jacobsen PL. Safety in numbers: more walkers and bicyclists, safer walking and bicycling. *Inj Prev*. 2003;9:205-9.
- Robinson DL. Safety in numbers in Australia: more walkers and bicyclists, safer walking and bicycling. *Health Promot J Austr*. 2005;16(1):47-51.
- Walker I. Drivers overtaking bicyclists: Objective data on the effects of riding position, helmet use, vehicle type and apparent gender. *Accid Anal Prev*. 2007;39(2):417-25.
- Phillips RO, Fyhri A, Sagberg F. Risk compensation and bicycle helmets. *Risk Anal*. 2011;31(8):1187-95.
- Robinson DL. Bicycle helmet legislation: can we reach a consensus? *Accid Anal Prev*. 2007;39(1):86-93.
- De Jong P. The Health Impact of Mandatory Bicycle Helmet Laws. *SSRN eLibrary Working Papers*. 2010 [cited 2010 Apr 12] February 24. SSRN-id1799302.
- Gillham C. *Bike Numbers in Western Australia: Government Surveys* [Internet]. Perth (Aust): Cycle-helmets.com; 2010 [cited 2010 Jan 26]. Available from: [http://www.cycle-helmets.com/bicycle\\_numbers.html](http://www.cycle-helmets.com/bicycle_numbers.html)
- Smith NC, Milthorpe FW. *An Observational Survey of Law Compliance and Helmet Wearing by Bicyclists in New South Wales – 1993*. Sydney (AUST): NSW Roads and Traffic Authority; 1993.
- Finch CF, Heiman L, Neiger D. *Bicycle Use and Helmet Wearing Rates in Melbourne, 1987 to 1992: The Influence of the Helmet Wearing Law*. Melbourne (AUST): Monash University Accident Research Centre; 1993.
- Land Transport New Zealand. *Sustainable and Safe Land Transport – Trends and Indicators*. Wellington (NZ): NZ Transport Agency; 2006 [cited 2010 May 20]. Available from: <http://www.cycle-helmets.com/nz-itsa-2006.pdf>
- Dennis J, Potter B, Ramsay T, Zarychanski R. The effects of provincial bicycle helmet legislation on helmet use and bicycle ridership in Canada. *Inj Prev*. 2010;16:219-224. doi:10.1136/ip.2009.025353. PubMed PMID: 20587815.
- Australian Bureau of Statistics. *Sydney Statistical Division*. Canberra (AUST): ABS; 2011 [cited 2011 Apr 6]. Available from: <http://www.censusdata.abs.gov.au>
- Curnow WJ. Bicycle helmets and public health in Australia. *Health Promot J Austr*. 2008;19(1):10-15.
- Finch C, Heiman L, Neiger D. *Bicycle Use and Helmet Wearing Rates in Melbourne, 1987 to 1992: The Influence of the Helmet Wearing Law*. Report 45. Melbourne (AUST): Accident Research Centre, Monash University; 1993.
- Cycling Promotion Fund. *Riding a Bike for Transport – 2011 Survey Findings*. Canberra (AUST): CPF; 2011.
- Horton D. Fear of cycling. In: Horton D, Rosen P, Cox P, editors. *Cycling and Society*. Aldershot (UK): Ashgate; 2007. p. 133-52.
- Bicycle Helmet Safety Institute. *Helmet Related Statistics from Many Sources*. Arlington (VA): BHSI; 2011 [cited 2011 Jul 22]. Available from: <http://www.bhsi.org/stats.htm>
- Rissel C, Campbell F, Ashley B, Jackson L. Driver knowledge of road rules and attitudes towards cyclists. *Aust J Prim Health*. 2002;8(2):66-9.
- Roads and Traffic Authority. *Cycling in Sydney—Bicycle Ownership and Use*. Sydney (AUST): RTA; 2008.
- Pucher J, Garrard J, Greaves S. Cycling down under: a comparative analysis of bicycling trends and policies in Sydney and Melbourne. *Journal of Transport Geography*. 2010;18(2):332-45.
- Rissel C, Bonfiglioli C, Emilsen A, Smith BJ. Representations of cycling in metropolitan newspapers – changes over time and differences between Sydney and Melbourne, Australia. *BMC Public Health*. 2010;10:371. doi:10.1186/1471-2458-10-371
- Henley G, Harrison JE. *Serious Injury Due to Land Transport Accidents, Australia 2006-07*. Canberra (AUST): Australian Institute of Health and Welfare; 2009.
- Hillman M. Cycling and the promotion of health. *Policy Studies*. 1993;14:49-58.
- Wardlaw MJ. Three lessons for a better cycling future. *BMJ*. 2000;321:1582-5.

## Authors

Chris Rissel, School of Public Health, University of Sydney, New South Wales

Li Ming Wen, Health Promotion Service, Clinical Support Cluster (Western), New South Wales

## Correspondence

Chris Rissel, School of Public Health, University of Sydney K25, Level 2, Medical Foundation Building, Parramatta Road, Camperdown, NSW 2050; e-mail: [chris.rissel@sydney.edu.au](mailto:chris.rissel@sydney.edu.au)