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Article *in* Journal of Transport & Health · March 2017

DOI: 10.1016/j.jth.2017.02.008

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How dangerous is cycling in New Zealand?

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ARTICLE INFO

Article history:
Received 19 October 2016
Received in revised form
27 February 2017
Accepted 27 February 2017
Available online 7 March 2017

Keywords:
Cycling
Injury risks
Injury claims
Hospitalization
Emergency room visits
Fear of injury

ABSTRACT

We compared the injury risks of typical exposures to road cycling for transport with other common activities including do-it-yourself repairs (DIY) at home, horse riding, quad bike riding, rugby union and snow sports in New Zealand. Cycling on the road half an hour three times a week was similar to DIY twice a month and safer than horse riding 1.5 h twice a week (5-fold difference in injury claims), skiing half a day for 4–5 times per year (140-fold), and playing rugby once every 3 weeks (530-fold difference). In statistical terms, based on moderate injuries, cycling is less dangerous than many recreational and every day activities. We conclude that fear of cycling in car-dependent New Zealand arises mainly from other causes than risk of injury, associated with the marginal status of cyclists on the public road.

1. Introduction

The New Zealand transport system is dominated by the use of private motor vehicles, despite heavy costs including congestion, air pollution, greenhouse emissions and poor health outcomes (Howden-Chapman et al., 2010). Many trips by motor vehicle could be replaced by walking and cycling – almost 20% of household trips are less than 2 km, and almost half under 6 km (O'Fallon and Sullivan, 2009; Povey, 2010). However cycling in New Zealand accounts for less than 2% of total time spent in travelling on roads (Ministry of Transport, 2015a) and the reason most frequently given for not using bicycles is the fear of injury (Legge and Landtroop, 2013).This is broadly true in other countries also, especially for women (Broache,2012; Garrard et al., 2008) Indeed, in the authors' experience proposals to expand cycling sometimes elicit the response that modern roads are so dangerous it is simply irresponsible to encourage use of the bicycle.

How common is injury from road crashes among those travelling by bicycle in New Zealand? And how does the risk of such injuries compare with the risk of injury due to familiar recreational and day to day activities? Fear of a bad outcome, whatever the cause, has many explanations, amongst which the statistical likelihood of an event is just one contributor. But this does not mean, in our view, that comparisons of statistical risk are irrelevant to transport planning. We suggest that close examination of the statistics may assist policy-makers and the general public to interpret and respond to risk, especially when probability of harm can be related to typical or familiar exposures.

David Nutt attempted to illustrate the wide spread of risks associated with psychotropic drugs, both legal and illegal, by comparing the probability of serious ill-effects per standard dose with the risk of injury during a typical day of horse-riding

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http://dx.doi.org/10.1016/j.jth.2017.02.008
2214-1405/

(Nutt, 2009). We have taken this approach further, comparing the risk of injury of cycling on the road with that due to other common activities, based on what we characterise as familiar or typical exposures in New Zealand.

2. Methods

We calculated the risk of injury per typical exposure to an activity as the number of injuries per year divided by the number of people at risk and frequency of exposure. In this study we focused on moderately severe injuries sufficient to cause a visit to a hospital emergency room. We also calculated risk in terms of the number of claims in 2013 to the government-funded Accident Compensation Corporation (ACC), which covers injury-related treatment and rehabilitation costs for everyone (including visitors) in New Zealand.

In this study, we compared cycling with do-it-yourself (DIY) activities at home, horse riding, quad bike riding, rugby union and snow sports (skiing and snowboarding). These were chosen because they are common activities in New Zealand, for which data are available on both outcome (injuries and claims) and exposure (frequency and duration).

Exposure to risk of injury was estimated from a variety of data sets. The proportion of "regular" cyclists (those who ride a bike once a week or more often) was based on an Auckland survey (Legge and Landtroop, 2013) and the New Zealand Household Travel Survey (Ministry of Transport, 2015c). The nominated common or typical "dose" of cycling (30 m, three times a week) was based on the same sources, and a cohort study of New Zealand cyclists (Thornley et al., 2008). Exposure to risk of injury in the home drew on a PhD study of "do it yourself" home improvements in New Zealand (Mackay, 2011). Information on the frequency and duration of horse-riding came from a national study of equestrian injuries (Northey, 2003). We assumed that everyone working in a farm-related occupation in New Zealand was at risk of a quad bike injury – the annual frequency of injury was estimated from a study of loss of control events in a sample of agricultural workers (Milosavljevic et al., 2011). A longitudinal study of injury among New Zealand rugby union players provided data on injury rates and playing times (Chalmers et al., 2012), while the total number at risk was estimated from a national survey of participation in sports (Sport New Zealand, 2005). The same national survey provided information on numbers exposed to risk of snow sports injury, and the typical annual "dose" of snow sports, for those who participate in such activities, came from an American study of visits to ski fields (Vanat, 2014).

Most of the injury data refer to the period between 2004 and 2013, including cycling (2013), DIY at home (2009), quad bike (2011), rugby union (2004) and snow sports (2009). Recent data for horse riding were not available. We assumed the rate of these injuries was unchanged from an earlier period (1993–2001). Data on the number of people at risk were adjusted for population change using the national census (Statistics New Zealand, 2016). We took injury hospitalization data for a particular cause (such as cycling) and estimated visits to emergency departments (ED) on a pro rata basis, according to the ratio of all ED visits due to all categories of injury to total injury hospitalizations (Ministry of Health, 2015, 2016). We contacted two ACC analysts separately in extracting the number of injury-related new claims as a quality check. The data sources and definitions of injury and exposure are shown in Table 1.

We presented the risks of injuries and ACC claims per million exposures using a log-scale diagram and calculated the 95% approximate Poisson confidence intervals (Dobson, 1991).

3. Results

The overall patterns of risks of injuries and ACC claims were more or less similar in magnitude (Table 2).

A typical exposure to cycling (which we defined as a half hour trip 3 times a week) was 1.2 to 2.2 times safer than DIY, 1.3 to 5.3 times safer than horse riding (1.5 h twice a week), 60 to 140 times safer than skiing (half a day, 4–5 times per year), and 460 to 530 times safer than rugby (one game every three weeks) (Fig. 1).

4. Discussion

The figures we report here are not precise measures. They include many approximations and assumptions, and for this reason should be treated as no more than a guide to risk relativities. It is often difficult to quantify exposure to risk of injury since frequency and duration of activities are usually not well documented and are highly variable. For example, in many sports the player's competitive level influences both the amount played and rates of injury (Parkkari et al., 2004). Our comparisons are limited to injuries in the broad categories of "sufficient to cause a vist to an ED" and "sufficient to give rise to a claim to ACC". We do not consider fatal injury, which may have an effect out of proportion to numbers, on perceptions of risk. Also, we have not accounted for other impacts on health than injury, although these mostly weigh heavily in favour of the bicycle. (Numerous studies report that health gains from increased physical activity exceed by a wide margin detrimental effects of injury and air pollution (Mueller et al., 2015)) We have not allowed, in comparisons between activities, for the effects of variables such as age and gender, which correlate with risk-taking in snow sports and road use, for instance. Better estimates of risk comparisons will come from large cohorts that include detailed assessments of cycling and other activities, coupled with standardized outcome measures.

Table 1
Sources of injury data and exposure.

Activity	Injuries (2001–2013)		ACC claims (2013)		Standard exposure
	No. of injuries per year	No. of people at risk	No. of ACC claims	No. of people at risk	
Cycling for transport	Based on 2277 injury hospitalizations (V10-V19) for pedal cyclists aged 15+ (MoH 2015) multiplied by 580,927 emergency department non-admitted attendance (MoH 2016) over 198,065 of all injury hospitalizations (MoH 2015)	Based on the proportion (12%) of regular cyclists in a random population sample (Legge and Landtroop, 2013) and 3,579,900 population age 15+ in 2013 (Statistics NZ 2016)	Excluded mountain biking and cycling for sport only	Based on 12% of regular cyclists in a random population sample (Legge and Landtroop, 2013) and 3,579,900 population age 15+ in 2013 (Statistics NZ 2016)	Assumed 0.5 h trip 3 times per week (Thornley et al., 2008; Legge and Landtroop 2013; Ministry of Transport, 2015a) for 52 weeks a year
DIY at home	Based on the cutting and piercing injury hospitalization rate of 30.7 per 100,000 (Sharpe et al., 2012) multiplied by the annual average of 1645 DIY injury visits at the emergency department over the annual average of 164 cutting and piercing injury hospitalizations (Ashby, 1999)		Only included accident scene is "home"	Based on 61% (Mackay, 2011) of 2,272,000 female population and 80% (Williams, 2004; Mackay, 2011) of 2,174,700 male population in 2013 (Statistics NZ 2016)	Assumed once every fortnight
Horse riding	Based on annual average of 624 hospitalizations for horse-riding injuries (Northey, 2003)) multiplied by 580,927 emergency department non-admitted attendance (MoH2016) over 198,065 of all injury hospitalizations (MoH, 2015)	Based on 133,400 adults in 2001 (Northey, 2003)		Based on 133,400 adults in 2001 (Northey, 2003) adjusted for population changes from 2001 to 2013 (Statistics NZ 2016)	Assumed 1.5 h ride twice a week (Dekka et al., 2004) for 52 weeks a year
Quad bike	Based on 10% of farm workers per year losing control of the quad bikes and 11.5% of these events resulted in injury (Milosavljevic et al., 2011)	Based on 103,671 population in farm-related occupations in 2013 (Statistics NZ, 2016) and assumed 100% of farm workers exposed to using quad bikes (Milosavljevic et al., 2011)		Based on 103,671 population in farm-related occupations in 2013 (Statistics NZ 2016) and assumed 100% of farm workers exposed to using quad bikes (Milosavljevic et al., 2011)	Assumed 229 working days per year
Rugby	Based on 615 injuries in a study of Rugby Union in 2004 (Chalmers et al., 2012)	Based on 704 players in a study of Rugby Union in 2004 (Chalmers et al., 2012)	Included both Rugby league and Rugby Union	Based on 109,000 participants in rugby in 2013 (Sport New Zealand, 2015)	Based on 0.32 games per player per week (Chalmers et al., 2012) for 52 weeks a year
Snow sports	Based on 5,455 injury incidents in 2009 (NZ Mountain Safety Council, 2009)	Based on 205,000 participants in skiing and snowboarding in 2013 (Sport New Zealand, 2015) adjusted for population changes from 2013 back to 2009 (Statistics NZ 2016)	Included both skiing and snowboarding	Based on 205,000 participants in skiing and snowboarding in 2013 (Sport New Zealand, 2015)	Based on 1,413,552 skiers visits divided by 305,558 national skiers in 2013 (Vanat, 2014)

Numbers of ACC claims in 2013 were derived by the ACC Customer Analytics in 2016.

Table 2
Estimated risks of injuries or accident claims per million exposures.

Activity	Injuries (2001–2013)		ACC claims (2013)		Exposure frequency per year	Risk of injuries per million exposure (95%CI)		Risk of ACC claims per million exposure (95%CI)	
	No. of injuries per year	No. of people at risk	No. of ACC claims	No. of people at risk					
Cycling for transport	6678	429,588	6,301	429,588	156	100	(97.3, 102.1)	94	(91.7, 96.4)
DIY at home	*309*	*100,000*	16,769	3,130,110	26	119	(105.8, 132.7)	206	(202.9, 209.2)
Horse riding	1829	133,400	7942	152,462	104	132	(125.9, 138.0)	501	(489.9, 512.0)
Quad bike	*1192*	*103,671*	2562	103,671	229	50	(47.4, 53.1)	108	(103.8, 112.2)
Rugby	*615*	*704*	77,981	109,000	16.5	52,875	(48778, 57224)	43,302	(42999, 43607)
Snow sports	5455	198,418	12,761	205,000	4.6	5,943	(5786, 6103)	13,456	(13223, 13691)

Numbers in *italic* denote relative quantity derived from the reported rates of injury in the literature. Exposure frequency per year is drawn from Table 1.

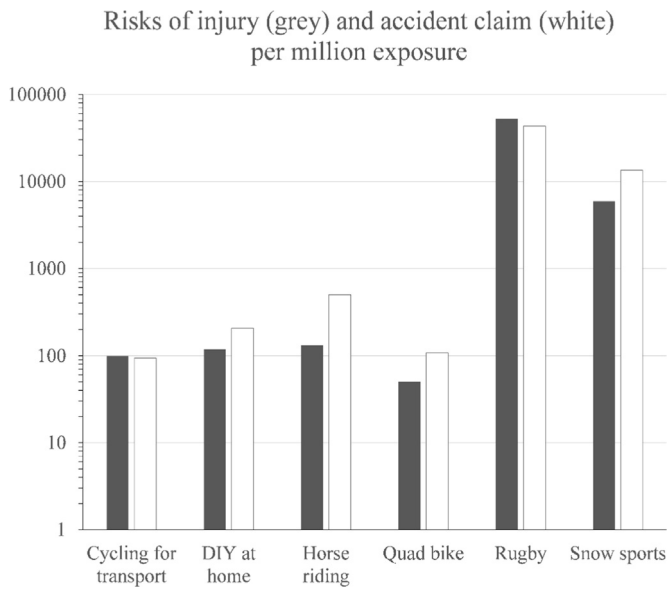

Fig. 1. Comparison of injury risks and ACC claims, cycling for transport and other common activities in New Zealand (2001–2013).

We report here snapshots of injury risk at particular points in time, and acknowledge that perceptions may not track changes over time in the actual frequency of injury. Despite recent growth in cycling in New Zealand cities, the annual number of fatalities declined in the last decade, reaching a 25 year low (5 deaths) in 2016 (Ministry of Transport 2017). The reported numbers of cycling crashes on the road and injuries have altered little in the same period. In the future, if cycling becomes more popular, how will injury risks, and risk comparisons of the kind presented here, change? This is uncertain, depending on the future mix of cyclists (age, gender, experience), the road environment, and perhaps other effects of the safety in numbers phenomenon.

We know of few studies that have calculated injury rates for a raft of everyday activities in a strictly comparable fashion. One exception is a study in Finland, which followed 3,657 participants aged 15–74 for a year. The injury risk for cycling was about 1 per 1000 h (Parkkari et al., 2004). Sports, such as judo, basketball, soccer and volleyball carried a much higher injury risk, ranging from 6.6 to 18.3 per 1000 h of participation (Parkkari et al., 2004).

Despite all the difficulties with comparisons of this kind, and the caveats that apply to any numbers that are derived, we suggest this is a robust conclusion: in terms of moderate injury, cycling is no more dangerous in a statistical sense than many recreational and every day activities, and in some instances is a good deal safer. We note that sports cyclists may experience a higher rate of injury. In our study of people who took part in the 2006 Taupo Challenge, including a mix of social riders and competitive cyclists, we found there were 3 falls causing injury sufficient to disrupt daily activities for every 1000 typical rides (Thornley et al., 2008). But even in this population serious injuries were uncommon – an individual would

be riding for 50 years on average before suffering an injury sufficiently severe to be admitted to hospital. A similar longitudinal study of Australian cyclists observed no cases of injury requiring overnight hospital stay in 25,971 days of cycling (Poulos et al., 2015).

If the statistical risk of injury on a bicycle is unremarkable, why is fear of injury such a barrier to people taking up cycling? One might argue that the comparisons should be transport-specific: the injury risk per million hours travelled is 75% less for motor vehicles compared with bicycles (Ministry of Transport, 2015b). However the figures are very small in absolute terms, and cannot explain why bicycles are singled out as "unsafe". In the UK, the injury rate due to vehicle crashes is higher among young men than the rate per km travelled by bicycle (Mindell et al., 2012), yet this has not led to the promotion of bicycles for the young. In New Zealand, the risk of injury while travelling by light 4-wheeled vehicles is an order of magnitude higher than that for bus travel (Ministry of Transport, 2015b), yet few choose public transport on the basis of safety. It is true that cyclist injury rates in New Zealand are high by international standards, and many New Zealand roads are poorly designed for cyclists. But the major reason, we suggest, why road traffic crashes involving bicycles loom large in the popular imagination in New Zealand (and other car-dominated countries) is cultural.

In the age of automobility cycling is a marginalized activity, and many authors have pointed to the ways that this marginalisation is maintained through the notion that cycling is inherently dangerous and irresponsible (Fincham, 2007). Road safety programmes commonly emphasise the dangers of cycling, often using graphic images designed apparently to frighten young cyclists into keeping themselves safe, rather than exhorting car users to reduce the disproportionate risk they pose to other road users (Horton, 2007). Supporters of the status quo in transport have recognized that concerns over the safety of cycling provide a means to oppose new uses of the public road (Lubitow et al., 2016). Improving public understanding of the relative risk of cycling will require closer attention to the ways 'risk' is represented in public discourse. We know comparisons that focus just on probabilities are weak motivators (Lee,1981). Probabilities are not irrelevant, but decision taking under risk is influenced powerfully by characteristics of threat and opportunity such as familiarity and social framing (Kahneman and Tversky,1984).

This is where, we conclude, interventions to promote cycling will have the greatest effect. Historically the hostile environment of New Zealand roads has led to a vicious spiral of fewer bikes, greater fearfulness and increased resistance to road changes in favour of bikes. Reversing this spiral is fundamental to managing the real and perceived danger of cycling. (Fishman et al.,2012) Recently New Zealand has taken big steps to bring bikes back from the margin – for example, $100 million from the Urban Cycleways Fund will be spent between 2016 and 2018 to improve cycling routes. Promotion campaigns have moved away from safety to an emphasis on the positive aspects of cycling and the diversity of people who enjoy this mode of transport. If the grants from the Urban Cycleways Fund and the new-style campaigns succeed in attracting more cyclists onto the road, and help to normalise this mode of transport, then they will succeed also in making cycling in New Zealand less dangerous.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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