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Does an on-road motorcycle coaching program reduce crashes in novice riders? A randomised control trial

Rebecca Q. Ivers[a,*], Chika Sakashita[a], Teresa Senserrick[b], Jane Elkington[a,c], Serigne Lo[a], Soufiane Boufous[b], Liz de Rome[a,d]

[a] The George Institute for Global Health, University of Sydney, Sydney, Australia
[b] Transport and Road Safety Research, The University of NSW, Sydney, Australia
[c] New York University, Sydney, Sydney, Australia
[d] Neuroscience Research Australia, Sydney, Australia

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ABSTRACT

Objectives: Motorcycle riding is increasing globally and confers a high risk of crash-related injury and death. There is community demand for investment in rider training programs but no high-quality evidence about its effectiveness in preventing crashes. This randomised trial of an on-road rider coaching program aimed to determine its effectiveness in reducing crashes in novice motorcycle riders.
Methods: Between May 2010 and October 2012, 2399 newly-licensed provisional riders were recruited in Victoria, Australia and completed a telephone interview before randomisation to intervention or control groups. Riders in the intervention group were offered an on-road motorcycle rider coaching program which involved pre-program activities, 4 h riding and facilitated discussion in small groups with a riding coach. Outcome measures were collected for all participants via telephone interviews at 3 and 12 months after program delivery (or equivalent for controls), and via linkage to police-recorded crash and offence data. The primary outcome was a composite measure of police-recorded and self-reported crashes; secondary outcomes included traffic offences, near crashes, riding exposure, and riding behaviours and motivations.
Results: Follow-up was 89% at 3 months and 88% at 12 months; 60% of the intervention group completed the program. Intention-to-treat analyses conducted in 2014 indicated no effect on crash risk at 3 months (adjusted OR 0.90, 95% CI: 0.65–1.27) or 12 months (adjusted OR 1.00, 95% CI: 0.78–1.29). Riders in the intervention group reported increased riding exposure, speeding behaviours and rider confidence.
Conclusions: There was no evidence that this on-road motorcycle rider coaching program reduced the risk of crash, and we found an increase in crash-related risk factors.

1. Introduction

Motorcycles are widely used globally, with 314 million powered two- and three-wheelers (PTW) registered in 154 countries in 2010, representing a quarter of all registered vehicles. PTWs accounted for nearly one half of total registered vehicles in low- and middle-income countries (49.6% and 45.8%) and 6.8% in high-income countries in 2010 (World Health Organisation, 2013).

Motorcycle riders have a high risk of crash related injury compared to car occupants: in high income country settings the rate of death and serious injury for motorcyclists is 30–40 times that of car occupants (Johnston et al., 2008). In low income settings road injury is a significant contributor to catastrophic household costs (Nguyen et al., 2013) and motorcycle related trauma is a rapidly growing public health issue.

Novice riders have a greater risk of crashing than experienced riders (Mullin et al., 2000; Haworth et al., 2000). Although skill development for novice riders is important for safe riding, there is little evidence on whether rider training programs decrease risk of crash in novice riders. Multiple studies have examined the effectiveness of various rider training programs, but a Cochrane review found research on effectiveness of rider training programs to be inconclusive (Kardamanidis et al., 2010). The review also recommended that due to significant attrition in previous studies of learner riders, any future trials should focus on recruiting committed riders who had passed their provisional licence test (Kardamanidis et al., 2010).

* Corresponding author at: The George Institute for Global Health, University of Sydney, PO Box M201, Missenden Road, 2050 NSW, Australia.
E-mail address: rivers@george.org.au (R.Q. Ivers).

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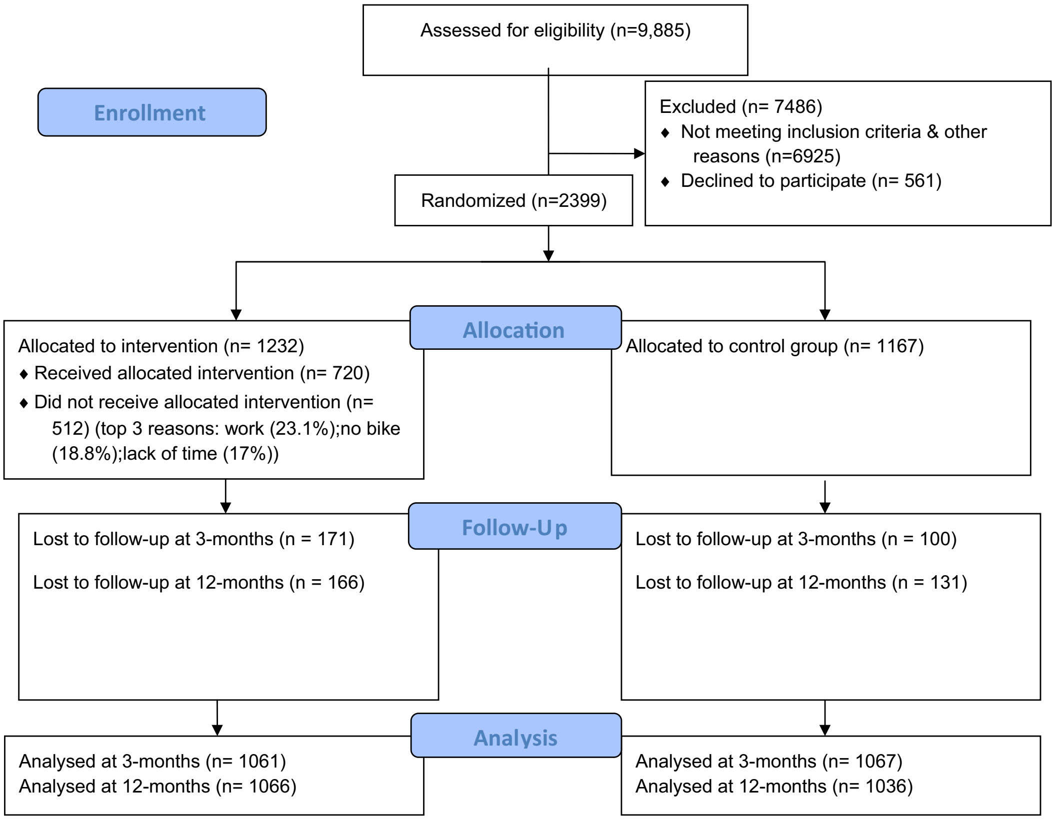

Fig. 1. Trial design and procedure.

In 2010, VicRoads, the road authority for the State of Victoria, Australia, commissioned the development of an on-road coaching program for novice riders in Victoria. The aim of the program was to assist recently licensed riders who to become safer riders and to reduce their involvement in risk-taking behaviour and crashes. Learner-centred approaches and principles of insight training (Gregersen, 1996) were central to the philosophy of the program design. This study aimed to determine the effectiveness of the resulting program "VicRide" in reducing crash involvement for novice motorcycle riders in Victoria.

2. Methods

2.1. Study design and participants

This was a randomised control trial with blinded outcome assessment conducted in the state of Victoria, Australia. The target population were novice motorcycle riders who had passed the motorcycle operators' test (MOST) within the previous 12 months and held a probationary or restricted licence. In Victoria there is no mandatory pre-licence training. Participants were required to be the registered owner of a motorcycle (not a scooter) that complied with the VicRoads Learner Approved Motorcycle Scheme (power-to-weight ratio of the motorcycle less than 150 kW per tonne and engine capacity no greater than 660 cc), and to have ridden at least 500 km over at least 12 trips on public roads since obtaining their learner permit to ensure a minimum level of experience riding on-road.

The trial was registered on 10th May 2010 with the Australian and New Zealand Clinical Trial Registry: ACTRN12610000372088 and ethics approval was obtained from the Monash University and the University of Sydney Human Ethics committees.

The study design and procedures are summarised in a flow diagram in Fig. 1.

2.2. Recruitment and randomisation

Baseline interviews were conducted between 19 May 2010 and 30 October 2012 and the final follow-up interview was on January 8 2014. Data were analysed in 2014. Recruitment was initially by mailed invitation through the State licence database but proved slow so a second recruitment approach was introduced from 25th October 2010, whereby participants were approached directly by trained telephone interviewers after receiving the initial mailed invitation. Consenting participants completed a baseline telephone interview, and were randomised to intervention or control groups using an automatic simple randomisation process built into the CATI software. Initially a 50:50 allocation was used but was changed to a 60:40 allocation in April 2012 due to low intervention completion rates.

On completion of the baseline interview, participants were advised of their intervention group status. The intervention group were asked to complete the program within six weeks; the control group were advised their program participation would be delayed for 12 months. All participants consented to data linkage to their police-recorded crash and offence data and to telephone interviews at baseline, and at three and 12 months following program delivery. Participants received $90 and a high visibility vest on completion of the program. Those who undertook the program within six weeks received an additional $50.

2.3. Procedures

Prior to the coached ride, participants were sent a booklet in preparation for the ride. This included becoming familiar with the

Table 1
Reliability of the self-reported attitude, behaviour, and motivation scales.

	Baseline	Interview-2	Interview-3
Confidence for riding skills	.78	.80	.81
Crash attribution scale – Driver attribution	.56	.57	.56
Crash attribution scale – Rider attribution	.35	.37	.43
Safety beliefs scale – deviant beliefs	.73	.77	.76
Safety beliefs scale – safety beliefs	.59	.60	.61
MRBQ – errors	.79	.81	.82
MRBQ – speeding behaviours	.80	.81	.82
MRBQ – stunts	.64	.65	.68
MRBQ – protective gear use	.48	.51	.50
MRMQ – pleasure	.75	.76	.77
MRMQ – speeding motivations	.75	.78	.79
MRMQ – convenience	.68	.70	.69

hand signals to be used by their coach, and completing a short survey designed to stimulate reflection on their riding experiences to date and to provide an indicator of their crash risk profile. Before departing on the ride, participants were required to demonstrate to the coach they had basic competence in braking, cornering and obstacle avoidance.

The program consisted of one four-hour session comprising a series of short rides (15–20 min) on a planned route and pre- and post-ride discussions in a group of up to three novice riders accompanied by a trained coach. The route included both rural and urban riding environments selected to expose riders to everyday situations identified as potentially hazardous for motorcyclists. The focus of the program was on higher order riding skills including cognitive strategies for safe riding, especially in relation to road craft, hazard perception, motivations and experience.

Coaches were experienced riding instructors who were trained in coaching methods. Their training emphasised their role to facilitate discussions and safe riding, intervening only as necessary, and to use questions to the group to re-focus discussion rather than providing answers.

2.4. Outcomes

The primary outcome was a composite measure of police-recorded and self-reported crashes at three and 12 months after program delivery. Secondary outcomes included time to first police-recorded crash, self-reported near crashes, safety attitudes, riding behaviours, riding motivations and riding exposure, and police-recorded traffic offences at 12 months.

Police-recorded outcomes were collected via deterministic (based on licence number) and probabilistic (based on first and last names, date of birth, and gender) data linkage.

Self-reported outcomes were collected at baseline, three and 12 months via computer-assisted telephone interviews by trained interviewers blinded to participants' intervention status. Established instruments administered: the Motorcycle Rider Behaviour Questionnaire (MRBQ) (Elliott et al., 2007); the Motorcycle Rider Motivation Questionnaire (MRMQ) (Sexton et al., 2004); the Crash Attribution Scale (Haworth and Mulvihill, 2005); optimism bias (the perception that the rider is at less risk of crashing) and rider confidence (Sexton et al., 2004), the Safety Belief Scales (Burgess et al., 2010); number of near crashes and riding exposure (Haworth and Mulvihill, 2005; de Rome et al., 2010).

The MRBQ consists of 33 items with four behaviour scales of errors, speeding violations, stunts, and protective gear use (Sakashita et al., 2014a), with higher scores indicating more frequent engagement in the behaviours. The MRMQ consists of 20 items with three motivation scales of speed, pleasure and convenience (Sakashita, 2013); higher scores indicating stronger motivation. Riders' assessment of their own level of riding skills compared to other riders of their age, gender, and riding experience was measured by a four-item scale of confidence in riding skills. Riders' assessment of their own likelihood of being involved in a crash compared to other riders of their age, gender, and riding experience was measured by a one-item scale of optimism bias for crashes. Lower scores indicate more confidence in riding skills, and optimism bias for crashes (perceived reduced risk of crashing). Riding exposure was measured via a single item reporting hours of riding in an average week (Sakashita et al., 2014b).

Cronbach's alphas for the multiple item scales in the present sample are summarised in Table 1. Most of the self-reported scales were reliable with alpha scores greater than 0.7, except for the crash attributions, safety belief, MRBQ stunts and protective gear use, and MRMQ convenience scales (Sakashita, 2013).

2.5. Statistical analysis

Sample size calculations assumed a composite crash outcome (at least one police-recorded crash or self-reported crash) of 22% after 12 months, based on previous studies reporting crash rates in novice motorcyclists or drivers (Haworth et al., 1997; Boufous et al., 2010). Assuming a 15% drop-out rate, 2400 riders were required for statistical power of 88% ($\alpha = 0.05$) to detect an absolute reduction in crash outcome of 5.5% (a relative reduction of 25%).

Primary analyses were conducted by intention-to-treat. Differences in primary outcomes were compared between the two groups by using standard logistic regression. Count outcomes of police-recorded offences were modelled with a zero-inflated Poisson regression. Count outcomes of self-reported near crashes were modelled with a generalised Poisson regression. All other continuous variables were modelled with simple linear regression. All models were adjusted for age, gender, and riding exposure reported at baseline. Time to follow-up was included as an offset variable in all regression models.

Time to first police-recorded crash was measured from program completion for the intervention group and for controls from baseline interview date plus the average days to program completion (47 days). This outcome was treated by means of the Kaplan–Meier survival curves and tested using the log-rank test or the Cox model (when adjusted). Analyses were led by S. Lo.

2.6. Sensitivity analysis

A supplementary sensitivity analysis based on a 1:1 propensity score matching was conducted to estimate the effect of the VicRide program for only those intervention group riders who actually completed the program. Sixty percent (720/1232) of the participants randomised to the intervention group completed the program. A logistic regression using automatic forward-selection for all participants randomised to the intervention was conducted to predict program completion. Due to missing values, 1136 (92%) of 1232 riders in the intervention group contributed to the final model, with

Table 2
Participant characteristics at baseline interview.

Characteristics	Control (N = 1167)	Training Group (N = 1232)	Total (N = 2399)
Male	937 (80.3%)	1000 (81.2%)	1937 (80.7%)
Mean age (SD)	35.4 (11.09)	35.3 (11.27)	35.3 (11.18)
Total months on learner permit			
Mean (SD)	7.5 (4.29)	7.5 (4.47)	7.5 (4.38)
Motorcycle type			
Sports (including Super sports/super motard)	449 (38.7%)	478 (39.0%)	927 (38.8%)
Cruiser	235 (20.2%)	272 (22.2%)	507 (21.2%)
Standard (including Naked)	301 (25.9%)	298 (24.3%)	599 (25.1%)
Touring (including Sports tourer)	95 (8.2%)	97 (7.9%)	192 (8.0%)
Adventure/adventure tourer/dual sport	34 (2.9%)	25 (2.0%)	59 (2.5%)
Off road – Trail/enduro/mx	38 (3.3%)	47 (3.8%)	85 (3.6%)
Scooter	0 (0.0%)	0 (0.0%)	0 (0.0%)
Average weekly hours of on-road riding			
Mean (SD)	4.1 (3.95)	4.0 (3.41)	4.1 (3.68)
On-road riding experience before learner permit			
No	930 (79.7%)	999 (81.1%)	1929 (80.4%)
Yes	237 (20.3%)	233 (18.9%)	470 (19.6%)
Number of times riding on-road before learner permit			
1–3 times	36 (15.2%)	39 (16.7%)	75 (16.0%)
4–10 times	26 (11.0%)	31 (13.3%)	57 (12.1%)
>10 times	175 (73.8%)	163 (70.0%)	338 (71.9%)
Previously attended any formal rider training			
No	419 (35.9%)	399 (32.4%)	818 (34.1%)
Yes	748 (64.1%)	833 (67.6%)	1581 (65.9%)
Years held a driver licence			
Mean (SD)	16.7 (11.50)	16.5 (11.39)	16.6 (11.44)
Employment status			
Working full time – more than 20 h per week	928 (79.5%)	972 (78.9%)	1900 (79.2%)
Working (part time – less than 20 h per week	92 (7.9%)	116 (9.4%)	208 (8.7%)
School student	4 (0.3%)	6 (0.5%)	10 (0.4%)
Tertiary or other student	96 (8.2%)	93 (7.5%)	189 (7.9%)
Full time home duties or not seeking work	9 (0.8%)	6 (0.5%)	15 (0.6%)
Retired/Pensioner	16 (1.4%)	17 (1.4%)	33 (1.4%)
Unemployed	22 (1.9%)	22 (1.8%)	44 (1.8%)
Level of income			
Less than $30,000	87 (7.8%)	95 (8.1%)	182 (8.0%)
$30,001–$50,000	170 (15.3%)	181 (15.5%)	351 (15.4%)
$50,001–$100,000	423 (38.0%)	425 (36.4%)	848 (37.2%)
$100,001–$150,000	253 (22.7%)	261 (22.3%)	514 (22.5%)
More than $150,000	180 (16.2%)	206 (17.6%)	386 (16.9%)
Missing/Do not know/Refused	0/19/35	0/30/34	0/49/69
Highest level of education			
Still attending school	1 (0.1%)	1 (0.1%)	2 (0.1%)
Year 11 or less (did not complete VCE or equivalent)	160 (13.7%)	149 (12.1%)	309 (12.9%)
Completed VCE (Year 12 or equivalent)	195 (16.7%)	203 (16.5%)	398 (16.6%)
Trade or other Certificate – or working towards this	200 (17.1%)	205 (16.6%)	405 (16.9%)
Tertiary Degree or Diploma or working towards this	608 (52.1%)	666 (54.1%)	1274 (53.1%)
Post-graduate degree (Masters, PhD)	3 (0.3%)	8 (0.6%)	11 (0.5%)

675 completers, and 461 non-completers. Of the 675 completers, 671 (99%) were matched to an appropriate control. All baseline characteristics were well-matched and had few standardised differences.

3. Results

3.1. Participant characteristics

A total of 2399 participants completed the baseline interview; of these, 1232 were randomised to the VicRide program and 1167 to the control group. The majority (80.7%) were males and the average age was 35.3 years. Participant characteristics across the intervention and control groups, including age, motorcycle type and riding exposure, were not significantly different (Table 2). Almost two-thirds (n = 720, 62%) of those allocated to the intervention group completed the program, although 29% (n = 205) of these participants did not complete the pre-program preparation activity. Most (94.3%) of the riders who completed the ride did so in metropolitan locations: Somerton (40.6%), Kilsyth (33.1%), and Cranbourne (20.6%). A small proportion (5.8%) participated in rural locations; Bendigo (5.1%) and Warragul (0.7%). Of all participants, 2128 completed the three month (88.7%) and 2102 (87.6%) the 12-month interview. The three month interviews occurred on average at 144 days since the baseline interview for the intervention group, and 145 days for controls. Twelve month interviews were on average 410 days since the baseline interview for the intervention group and 411 days for controls.

3.2. Primary outcome

The composite crash rates were 6.4% for control and 5.8% for intervention groups at three months and 11.7% for control and

Table 3
Effect of the Vicride program.

	3 Months		12 Months	
	Univariate	Multivariate[a]	Univariate	Multivariate[a]
Combined police/self-reported crashes				
OR (95% CI)	0.90 (0.65–1.26)	0.90 (0.65–1.27)	0.99 (0.77–1.27)	1.00 (0.78–1.29)
Police-recorded offence (all)				
RR (95% CI)	–	–	0.93 (0.80–1.07)	0.91 (0.78–1.06)
Police-recorded car offence				
RR (95% CI)	–	–	0.88 (0.74–1.05)	0.87 (0.73–1.04)
Police-recorded motorcycle offence				
RR (95% CI)	–	–	1.09 (0.80–1.48)	1.15 (0.87–1.53)
Near crashes				
RR (95% CI)	0.88[+] (0.82–0.96)	0.91[^] (0.83–0.98)	1.00 (0.92–1.09)	1.01 (0.93–1.11)
Riding exposure				
Beta (95% CI)	0.17 (−0.16–0.51)	0.27 (−0.33–0.58)	0.25 (−0.79–0.58)	0.32[^] (0.02–0.62)
Optimism bias				
Beta (95% CI)	−0.05 (−0.12–0.02)	−0.05 (−0.12–0.02)	−0.02 (−0.09–0.05)	−0.03 (−0.10–0.04)
Rider confidence				
Beta (95% CI)	−0.06[^] (−0.10, −0.01)	−0.07[+] (−0.12, −0.03)	−0.07[^] (−0.11,−0.02)	−0.07[+] (−0.11, −0.03)
Driver attribution				
Beta (95% CI)	−0.02 (−0.06–0.02)	−0.01 (−0.05–0.02)	−0.01 (−0.05–0.03)	0.001 (−0.04–0.04)
Rider attribution				
Beta (95% CI)	−0.09[+] (−0.14, −0.03)	−0.06[^] (−0.10, −0.01)	−0.07[+] (−0.13, −0.02)	−0.05[^] (−0.10, −0.001)
Safety beliefs				
Beta (95% CI)	0.03 (−0.03–0.09)	0.04 (−0.10–0.09)	−0.02 (−0.08–0.04)	<0.001 (−0.05–0.05)
Deviant beliefs				
Beta (95% CI)	−0.03 (−0.06–0.05)	0.001 (−0.04–0.04)	−0.03 (−0.08–0.03)	−0.02 (−0.06–0.03)
MRMQ convenience				
Beta (95% CI)	−0.02 (−0.08–0.05)	−0.03 (−0.07–0.02)	0.03 (−0.04–0.09)	0.03 (−0.02–0.07)
MRMQ pleasure				
Beta (95% CI)	−0.02 (−0.05–0.02)	−0.03 (−0.05–0.001)	−0.02 (−0.06–0.02)	−0.03 (−0.06–0.001)
MRMQ speeding				
Beta (95% CI)	0.003 (−0.05–0.05)	0.01 (−0.03–0.04)	−0.02 (−0.07–0.03)	−0.02 (−0.05–0.02)
MRBQ errors				
Beta (95% CI)	0.01 (−0.02–0.04)	0.02 (−0.03–0.04)	<0.001 (−0.03–0.03)	0.01 (−0.02–0.03)
MRBQ speeding				
Beta (95% CI)	0.04 (−0.02–0.10)	0.05[^] (0.01–0.10)	0.06 (−0.01–0.12)	0.06[^] (0.01–0.10)
MRBQ stunts				
Beta (95% CI)	0.01 (−0.04–0.03)	0.01 (−0.03–0.03)	−0.01 (−0.03–0.14)	−0.003 (−0.03–0.03)
MRBQ protective gear use				
Beta (95% CI)	0.06 (−0.03–0.14)	0.04 (−0.03–0.10)	0.004 (−0.08–0.09)	−0.001 (−0.07–0.07)

[a] Adjusted for age, gender and riding exposure (hours/week).
[^] $p < .05$.
[+] $p < .01$.

11.5% for intervention groups at 12-months. The odds of crashing (composite) did not differ significantly between groups at three months (unadjusted OR = 0.90, 95% CI: 0.65–1.26; adjusted OR = 0.90, 95% CI: 0.65–1.27) or 12 months (unadjusted OR = 0.99; 95% CI: 0.77–1.27; adjusted OR = 1.00, 95% CI: 0.78–1.29).

3.3. Secondary outcomes

The relative risks did not differ significantly between intervention and controls in relation to the number of days to first police-recorded crash (unadjusted RR = 1.07; 95% CI: 0.65–1.76; adjusted RR = 0.95, 95% CI: 0.53–1.71) or for overall offences (adjusted RR = 0.91, 95% CI: 0.78–1.06), car offences (adjusted RR = 0.87, 95% CI: 0.73–1.04) or motorcycle offences (adjusted RR = 1.15, 95% CI: 0.87–1.53). Intervention participants were less likely than controls to report near crashes at three months (adjusted RR = 0.91; 95% CI: 0.83–0.98), although this effect was not sustained at 12 months (adjusted RR = 1.01, 95% CI: 0.93–1.11).

There were no significant differences in reported riding hours in an average week at three months but at 12 months the intervention group reported riding significantly more hours than controls (mean 5.6 versus 3.7 h per week; adjusted beta coefficient = 0.319; $p = .0385$).

The only significant differences evident for self-reported rider attitudes (Table 3) were crash attribution to riders and confidence in riding skills. The scores on the crash attribution scale were significantly lower for the intervention group compared to the control group at both three months (adjusted beta coefficient = −0.057; $p = .0139$) and 12 months (adjusted beta coefficient = −0.049; $p = .0450$). That is, the intervention group attributed the cause of crashes to riders (as opposed to drivers) significantly more than the controls. The intervention group reported more confidence in their riding ability than controls at both three months (adjusted beta coefficient = −0.073; $p = .0013$) and 12 months (adjusted beta coefficient = −0.070; $p = .0020$).

No significant differences were evident for any of the self-reported MRMQ motivations for riding scales, or MRBQ riding behaviours except speeding. The intervention group reported more speeding behaviours than controls at both three months (adjusted beta coefficient = 0.054; $p = .0103$) and 12 months (adjusted beta coefficient = 0.056; $p = .0157$).

3.4. Sensitivity analyses

Sensitivity analyses results were broadly consistent with the main results based on intention-to-treat analyses with a few exceptions. The significant program effect on reduced near crashes found at three months was no longer significant. The significant program effect on riding exposure found at 12 months was instead found at three and not at 12 months. The significant program effect on crash attribution to riders only remained in the univariate model and was no longer significant in the multivariate model. However, in all three cases, both the unadjusted and adjusted relative ratios were in the same direction for both three- and 12-month results for both intention-to-treat and sensitivity analyses. Finally, the non-significant result for self-reported protective gear use became significant in the multivariate model at three months only.

4. Discussion

We found no effect of the on-road coaching program on novice riders crashes. Riders in the intervention group reported fewer near crashes at three months, but the effect was not sustained at 12 months; nor was it replicated in sensitivity analyses including only riders who completed the program. The intervention group reported more confidence in riding skills, more attribution of crash responsibilities to riders, more speeding behaviours and more riding hours in an average week than control riders, after accounting for the effects of age, gender, and riding exposure. There were no differences in police-recorded traffic offences, or in other self-report measures.

Our findings on a lack of effect on crashes are consistent with previous rider training literature, although this is at least in part due to the absence of a strong body of evidence (Kardamanidis et al., 2010). It is also consistent with the driver training literature which shows no evidence for effectiveness of post-licence training in reducing road traffic injuries or crashes (Lund and Williams, 1985; Ker et al., 2005). This is despite best efforts to develop the program in keeping with best practice principles.

The fewer near crashes reported by riders in the intervention group than controls at 3 months in the intention-to-treat analysis could be attributed to improved skills to avoid crashes, given one of the aims of the program was to improve hazard perception skills. It is possible that the intervention group developed better skills to anticipate the road and traffic ahead, detect, recognise and react to traffic hazards. Other rider and driver training programs employing such training approaches have been successful in improving hazard perception skills (Crick and McKenna, 1991; Vidotto et al., 2011; Boele-Vos and de Craen, 2015), including transfer to on-road driving (Pradhan et al., 2006). However, if the significantly fewer near crashes in the intervention group was an indication of improved hazard perception skills it did not lead to significant crash reductions. Even though hazard perception skills may be learnt via training, a weak link between hazard perception skills and crash risks has been suggested (Sagberg and Bjornskau, 2006; Cheng et al., 2011; Beanland et al., 2013); the previous small randomised trial conducted in the Netherlands which found trained motorcycle riders exhibited better hazard perception did not assess crash outcomes (Boele-Vos and de Craen, 2015). Near crashes are complex events and perception of them may depend on rider's stage of riding development. Nevertheless this effect on near crashes was no longer evident at 12 months.

Riders in the intervention group reported significantly greater confidence in their riding skills than those in the control group. A careful balance must be achieved in training to ensure riders do not develop unrealistic confidence in their ability, as this may lead to greater risk taking behaviour and therefore higher crash risk; the insight approach is designed to address this (Gregersen, 1996). Although it is difficult to determine whether riders had unrealistic confidence in their riding ability, our result may suggest that the insight training used to address the overestimation of personal ability (Gregersen, 1996) was not successful. Nonetheless, the program aimed to improve hazard perceptions skills and the present measure of confidence in skills addressed mostly hazard perception skills (three out of the four items were in relation to hazard perception skills and one item on vehicle control skills), which may mean that the increased confidence reported might not be unrealistic. However, if the intervention group in our study really improved their hazard perception skills (making their confidence realistic), this did not lead to any detectable reductions in crash risks or other indicators of road safety benefits such as reduced risk taking including speeding.

The intervention group also reported statistically significantly more speeding behaviours compared to the control group. A combination of greater confidence in their riding skills and a possible lower perception of risks as indicated by fewer reporting of near crashes may lead to greater risk taking behaviour such as speeding. Links between low risk perception and greater risk taking behaviour (Brown and Groeger, 1988) as well as between confidence and greater risk taking behaviour (Fuller, 2005) have been observed among drivers.

No significant differences in riding exposure between the two groups were apparent at three months, however, riding exposure was significantly higher for the intervention group than the control group at 12 months. While increased riding per se is not a negative outcome, its combination with greater risk taking behaviours such as speeding may put riders at a greater risk of being involved in a motorcycle crash.

The Crash Attribution scale measured the extent to which motorcyclists attribute causes of crashes to driver errors (driver attribution) versus motorcyclist errors (motorcyclist attribution). The reported increased confidence in riding skills in the intervention group may suggest those who have been trained believe they are better riders than other riders and they may be making the attribution of the cause of crashes to 'other' riders who they believe are worse riders than themselves. Other studies show similar observations where people may be aware that their peer group is at higher risk for crashes compared with others in general but still rate themselves as if they are not part of that group (Finn and Bragg, 1986; Horswill et al., 2004). However our results may also suggest that intervention riders were more aware or accepting of the risks of riders as opposed to drivers. In any case, the very low reliability of this scale (Cronbach's alpha ranging from 0.35 to 0.43 for the three survey time-points) must be noted, and caution must be made in interpreting this significant result.

This was a randomised trial with high follow-up rates. Selection bias previously noted in a previous systematic review (Kardamanidis et al., 2010) due to failure to progress to the next level of licensing was minimised by recruiting newly-licensed provisional riders. The composite crash rate was found lower than anticipated at 11.6% on average and with the low program completion rates, decreased the statistical power to detect a program effect. However, as the effect size evident was very small, and because participation in the program led to statistically significant increases in behaviours that are associated with increased crash risk, it is unlikely that even with a much larger sample size that any crash reduction would have been detected.

The mean age of study participants was 35.3 years; 80.7% were male. The novice rider population in Victoria in March 2012 had a mean age of 33.6 years, and 84.4% were males. The trial population was therefore in line with Victoria-wide age and gender novice rider demographics, although it is likely that more riders living in metropolitan areas were recruited, given the delivery locations for the VicRide program.

Given the substantial and growing contribution of motorcycle related crashes to the burden of global trauma, there is an important need to find effective ways to improve motorcycle safety. This trial of a best practice on-road motorcycle rider coaching program found no effect of the program on risk of crash or on riding offences, but found an increase in riding exposure, speeding behaviours and rider confidence, although the belief that riders were more likely than car drivers to be responsible for their crashes also increased. While the latter finding could indicate that some aspects of the training were effective, this did not translate into improved safety. Systems approaches to road safety shift the focus away from a singular focus on road user behaviour to modification of the system from multiple perspectives, including roads and roadsides, vehicles, speed and road users. There are multiple other known effective interventions for improving motorcycle safety (Keall et al., 2013) including police enforcement (Christie et al., 2003; Rizzi et al., 2011), safer vehicles – including daytime running lights (Quddus et al., 2002; Wells et al., 2004; Yuan, 2000), anti-lock brakes (Rizzi et al., 2011, 2009, 2013; Teoh, 2011), stability control systems (Rizzi et al., 2011; Seiniger et al., 2008), alcohol interlocks (Rizzi et al., 2011), helmets (Liu et al., 2008) and protective gear use (Rizzi et al., 2011; deRome et al., 2011, 2012), and black spot treatments (Scully et al., 2008). Given the absence of road safety benefits of rider training, and the substantial challenges in successfully implementing state wide programs, rider training should be considered a less promising strategy than other aspects of a safe system approach.

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