

Sport Cycling Crashes on Public Roads, the Influence of Bunch Riding and Experience.

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ABSTRACT

Cycling is a popular but unsafe mode of transport in the Netherlands and the number of seriously injured bicyclists has increased significantly since 2006. A special subgroup is the population of sport cyclists who perform their sport on public roads. The number of road crashes with sport cyclists shows an increasing trend. We propose two factors which might contribute to this trend. First, bunch riding among sport cyclists, and second the inflow of cyclists with low experience. No evidence is available related to sports cycling in particular.

A questionnaire was developed in cooperation with the Dutch Tour Cycling Union (NTFU). The questionnaire aimed to observe involvement in crashes and possible contributing factors (e.g.: bunch riding, experience, distance travelled). The questionnaire was sent to 2625 members, with a response rate of 28% (N=744, male respondents). Two groups were researched: a group (N=313) with cyclists known to have experienced at least one public road crash in the recent past, and a reference group with no such crash involvement (N=431).

Binary logistic regression analysis shows that bunch riding and experience contribute significantly to sport cyclist crash involvement. Experience had an effect regardless of age. This is in line with previous research among cyclists in general. Annual distance travelled had no effect on crash involvement. This means that cyclists who travel a longer annual distance have a lower risk (crashes per km). Further analysis indicated an effect of experience, where more experienced cyclists also travelled further on an annual basis.

Bunch riding and relatively few years of sport cycling experience independently contribute to an increase in crash involvement. We recommend that the efficacy of bunch riding training interventions is evaluated, with the goal of promoting safety among inexperienced bunch riding sport cyclists.

Keywords: sport cycling, road crashes, bunch riding, riding experience, crash prevention.

1 INTRODUCTION

In general, traffic safety has improved in the Netherlands by a factor of 5 over the past 40 years. This is most pronounced with respect to victims from crashes involving motorized vehicles (fatalities, seriously injured) [1], [2]. However, over the past 8 years the situation did not improve much for injuries sustained by cyclists from crashes not involving motorised vehicles. Although the number of traffic fatalities among bicyclists reduced slightly, the number of seriously injured bicyclists has increased significantly since 2006 [2].

Cycling is a popular mode of transport in the Netherlands, especially for short distance trips and for everyday purposes like traveling to school, shopping or commuting to work [3]. A special group among the cyclists are the about 600.000 sport cyclists (18 years and older), who perform their cycling sport on public road infrastructure. They are mainly men (83%), their mean age is 42 and their mean yearly cycling distance is about 3000 km. About 10% perform their sport as a member of a sport cycling club, others sport individually with an average of 8 years of experience [4]. Statistics from the emergency department of Dutch hospitals indicate that the number of injured sport cyclists treated at the emergency ward increased from about 2000 (average 2007-2010) to 4200 in 2012 [5].

One factor that might be involved in the increase of injuries is the increasing popularity of sport cycling in The Netherlands as reflected in the about 35% increase of members of the Dutch Tour Cycling Union (NTFU) in the past five years, currently counting about 60.000 members. This trend implies an increased influx of inexperienced sport cyclists. Different studies in traffic safety indicate that inexperienced road users have a relatively high risk of crash involvement [6], [7]. However, the authors know of no evidence for the association between sport cycling experience and crash involvement. The possible impact of experience on crash involvement may be due to a combination of the relatively high cycling speed while cycling closely together in a bunch; especially among those who cycle with a competitive attitude. This requires good steering skills and alertness on other road users, including fellow sport cyclists in the bunch. Bunch riding itself involves relatively high crash involvement during bicycling compared to cyclists who bicycle alone [8], [9]. It is expected that crash involvement among sport cyclists is related to their level of experience, and how they usually perform their cycling sport; alone or in a bunch with a more or less competitive attitude.

This paper addresses the issue by assessing the relationship between reported involvement in traffic crashes during sport cycling in 2013, the sport cycling experience measured in years and the habitual way (alone or in a bunch, competitive or not) of performing the sport on public roads.

2 METHOD and DATA

2.1 Sample

The present study is a questionnaire-based study with a sample of 2625 Dutch sports cyclists. All were a member of the NTFU, and were recruited through this organization in 2014. Of the invitees, 718 were part of a regular research panel of the NTFU, 261 others had previously expressed an interest in participating in future research, and 1645 received the invitation because they had filed an indemnity insurance claim related to their bike in 2013. The latter was taken as a means to increase the number of sports cyclists who experienced some form of sports cycling related crash in 2013.

The 2625 NTFU members were invited to join the study through an email invitation containing a hyperlink to the questionnaire. Those who followed the link in the email were sent to a webpage from which they could start the questionnaire. The questionnaire was filled in by 1049 respondents; a response rate of 40%. We excluded respondents from further analysis in the case of not finishing the questionnaire, age below 10 years old and not reporting being a sport cyclist (Total N=142). We also excluded off-road sport cyclists (N=121), leaving 786 respondents; 744 men and 42 women. For further analysis we selected

only the male respondents. The main argument is the well documented difference in the traffic crash risk between men and women [1], [2]. As such, it is not justifiable to include the women in our analysis, because there are not enough cases in the sample to make a meaningful statement about this group. Therefore the analyses were performed on 744 male sport cyclists.

2.2 Instrument

The questionnaire included different sets of questions related to the following topics; demographic information: sex and age (in years) and most common type of sports cycling (on the road, off road like mountainbiking, other). Two questions were asked in order to estimate annual distance travelled: frequency of sport cycling in 2013 and the mean distance per cycling trip. Cycling experience was evaluated by asking for how long (in years) the respondents had performed sport cycling. The bunch riding issue was addressed by asking if, and with how many others, one mostly performed sport cycling (alone, in a group of at least 2 cyclists). Respondents were asked to select three arguments from a list of 11. Two arguments were related to a competitive attitude: 'sport cycling for winning/competition' and 'sport cycling for improving my performance'. Other arguments were related to 'health benefit' (2), social interaction (2), recreation (1), motivated by earlier experience or cycling performance of others (3) and combining it with other sports (1). Respondents also reported their crashes involvement retrospectively while sport cycling over the year 2013, as well as some details about the most prominent case. Crashes were not limited to those resulting in injury, any event in which the cyclist fell down or collided was considered a relevant crash. Participants also reported whether or not they were riding in a bunch when they experienced the crash.

2.3 Analyses

Analysis was performed on data from 744 men using SPSS. First we created the variable 'distance travelled annually' by multiplying 'trip frequency' and 'average trip distance', dividing the outcome by two due to the sports cycling season which lasts approximately six months. We categorised the outcomes into four categories of equal intervals as shown in table 1.

The variable 'cycling motivation (competitive, not competitive)' was created by contrasting the respondents who did or did not select one or both of the competitive attitude arguments for sport cycling.

The relationship between experience, bunch riding, competitiveness and possible confounders (distance travelled and age), and the dependent variable (reported involvement in a sport bicycle crash in 2013), were univariately and multivariately analysed in a binary logistic regression model.

3 RESULTS

3.1 Characteristics of reported sport bike crashes

Among the 744 male respondents, 313 reported involvement in a public road crash in 2013. Crashes on non-public roads (17) were excluded. In Table 1 we present some characteristics of the reported crashes; separately for those sport cyclists who reported regular bunch riding or not. The results show that bunch riders are more often involved in bunch riding crashes (76.4%) and non-bunch riders in non-bunch crashes (62.5%). Bunch riders were more frequently involved in collisions with other sport cyclists and they more frequently lost their balance.

Table 1. Types of sport cycling crashes divided by bunch riders and non-bunch riders

		Bunch rider:	
		Yes	No
		N (%)	N (%)
Crash type:			
	Bunch riding crash	188 (76.4)	25 (37.3)
	Non-bunch riding crash	58 (23.6)	42 (62.5)
Total	(N= 313; 100%)	246(78.6%)	67 (21.4%)
Collision with:			
	Sport cyclist	47 (21.1)	8 (12.5)
	Car	21 (9.4)	6 (9.4)
	Regular cyclist	8 (3.6)	6 (9.4)
	Other	8 (3.6)	7 (10.9)
Single sided crash:			
	Hit object	34 (15.2)	8 (12.5)
	Lost balance	83 (37.2)	21 (32.8)
	Poor road quality	14 (6.3)	2 (3.1)
	Other	8 (3.6)	6 (9.4)
Total	(N=287)	223 (100.0)	64 (100.0)
Unknown	(N=26)	23	3
Total	(N= 313; 100%)	246(78.6%)	67 (21.4%)

3.2 General characteristics of the respondents

The distribution of the characteristics of the respondents are presented in Table 2. Most sport cyclists in our sample engage in bunch riding; 72.6% (N=540). 39 respondents (5.2%) had less than three years of experience and 447 (60.1%) respondents had sport cycling experience of 10 years or more. The age distribution shows that most respondents are between 45 and 65 years of age (62%; N=458); their mean age is 52.7 years old. The distance travelled varies from <3000 km (35.9%) to >9000 km (17.4%) with a mean of approximately 5500 km per year.

In Table 2 also the univariate odds ratios (OR) between each variable and crash involvement are presented. The results show that relatively inexperienced cyclists (for both categories less than 10 years of experience) and those who engage in bunch riding were more often involved in biking crashes. Competitive cycling motivation was slightly, but not significantly, related to higher crash involvement. Age categories and distance travelled showed mixed results, none of which reached levels of significance.

Table 2. Univariate effects of variables on crash involvement.

		Respondents	Crashes N, (%)	OR, (95% CI)	Sig.
		N, (%)			
Bunch riding	Yes	540 (72.6)	246 (78.6)	1.71 (1.22, 2.40)*	<0.01
	No	204 (27.4)	67 (21.4)	.	.
Experience	<3 year	39 (5.2)	24 (7.7)	2.84 (1.45, 5.57)*	<0.01
	3-10 year	258 (34.7)	128 (40.9)	1.75 (1.28, 2.39)*	<0.01
	>10 year	447 (60.1)	161 (51.4)	.	.
Age	<35	60 (8.1)	30 (9.7)	.	.
	35-45	121 (16.3)	61 (19.7)	0.61 (0.32, 1.17)	0.14
	45-55	228 (30.6)	97 (31.3)	0.58 (0.32, 1.02)	0.06
	55-65	230 (30.9)	84 (27.1)	0.74 (0.42, 1.31)	0.30
	>65+	100 (13.4)	38 (12.3)	1.02 (0.55, 1.89)	0.96
	Missing	5 (0.7)			
Distance travelled annually	<3000 km/year	267 (35.9)	111 (35.5)	.	.
	3000-6000 km/year	107 (14.4)	46 (14.7)	0.91 (0.59, 1.39)	0.66
	6000-9000 km/year	240 (32.3)	105 (33.5)	1.09 (0.77, 1.56)	0.62
	>9000 km/year	130 (17.4)	51 (16.3)	1.06 (0.67, 1.67)	0.80
Cycling motivation	Competitive	243 (32.7)	114 (36.4)	1.34 (0.99, 1.83)	0.06
	Non-competitive	501 (67.3)	199 (63.6)	.	.

* Flags a significant effect (p< 0.01)

3.3 Logistic regression model of crash involvement

Table 3 shows the odds ratios for the logistic regression model including all three variables (experience, bunch, competitiveness), while controlling for the covariates age and exposure.

The model shows that 'bunch riding' and 'experience' (for all categories) both independently contributed significantly in explaining crash involvement. The variables cycling motivation, age and exposure did not contribute significantly.

Table 3. Odds ratio's and 95% confidence intervals (95% CI) of the logistic regression model including all three predictors (Experience, Bunch, Competitiveness) controlling for age and exposure, and Involvement in a sport cycling crash as dependent variable.

Independent variables		Odds (95% CI)	Sig.
Bunch riding	Yes	1.79 (1.26, 2.54)*	<0.01
	No	.	.
Experience	<3 year	2.93 (1.42, 6.06)*	0.01
	3-10 year	1.58 (1.11, 2.24)*	0.02
	>10 year	.	.
Age	<35	.	.
	35-45	0.87 (0.42, 1.79)	0.71
	45-55	0.83 (0.44, 1.57)	0.57
	55-65	0.86 (0.47, 1.58)	0.63
	>65	1.14 (0.61, 2.16)	0.68
Distance travelled annually	<3000 km/yr	.	.
	3000-6000km/yr	1.23 (0.71, 1.77)	0.62
	6000-9000K km/yr	1.22 (0.84, 1.78)	0.29
	>9000K km/yr	1.23 (0.77, 1.96)	0.40
Cycling motivation	Competitive	1.19 (0.85, 1.66)	0.31
	Non-competitive	.	.

* Flags a significant effect

4 DISCUSSION

4.1 Main findings

Relatively inexperienced sport cyclists get involved in sport cycling crashes more frequently when compared to the more experienced sport cyclists. This effect occurred irrespective of their age. Increased experience up to 10 years seems to reduce crash involvement.

In addition, those who frequently engage in bunch riding when practicing sport cycling have higher crash involvement. This finding is illustrated by the reported circumstances of the crashes, showing that 78.6% of the crashes happened to frequent bunch riders. Bunch riding collisions were frequently a collision with other sport cyclists.

Having a competitive attitude towards sport cycling just almost reached the $p=0.05$ level of significance in our univariate model, indicating a slight tendency that having a competitive attitude increases crash involvement. Exposure was not found to contribute significantly to crash involvement. These main findings are discussed under the interpretations section.

4.2 Strengths and limitations

The data collected in this study were obtained through self-report of respondents. It is conceivable that either social desirability or errors of recall resulted in an over- or underreporting of cycling crashes. Besides this, cyclists might report crashes or falls without serious injury consequences. Self-report measures are cited as being more complete than regular injury registration based on police records or hospital databases. These databases are in fact documented as underestimating the frequency of bicycle crashes, because less serious injuries remain out of the scope of these registrations [9].

We know from bunch, and non-bunch riders the proportion of crashes during bunch riding. But we do not have for each group information about their proportion of distance travelled in a bunch or not. Therefore we cannot compute the actual crash risk during bunch riding. In future studies more detailed information about distance travelled could give a more complete picture about actual crash risk during bunch riding.

Another possible limitation is the existence of potential representativeness bias. The data were sampled from members of the NTFU, and as such might represent those cyclists who are more than averagely committed to the sport. Compared to the known characteristics of the general population of sport cyclists (18 years and over) our study population tends to be older (52.7 compared to 42 years old), more experienced and cycling more km per year (about 5500 compared to 3000). Because in this study we analyse the interrelation between variables, the differences between the populations will not violate the generalizability of the results, moreover because we also put age, experience and distance travelled in the logistic regression model.

A second source of representativeness bias comes from the sport cyclists with crashes; we specifically selected a group of respondents because they experienced a cycling accident in 2013. As such, the number of crashes in the current sample are higher than the numbers in the population at large. We chose this method of sampling because it provided a large group of sport cyclists with crashes. However, the presented odds ratios are an indication of the actual crash involvement variations in the general population of male sport cyclists.

Interpretations

This study identified two major contributors to crash involvement among sport cyclists; bunch riding and experience. This is in line with previous research [9], which indicated a higher crash risk for bunch riding among regular cyclists. The present study extends this finding to the sport cycling community.

Increased sport cycling experience was found to be associated with reduced crash involvement, irrespective of age. With regard to the influx of new and inexperienced sport cyclists due to its

increased popularity this may contribute to an increase of crashes and injuries. Training interventions could be a way to reduce crash involvement among inexperienced bunch riding sport cyclists. In fact, regarding this there are already several instructions available on the Internet¹. This often takes the form of training videos, in which experienced sport cyclists explain best practices and techniques for riding in a bunch safely. The efficacy of such interventions is not scientifically established [10]. Further research is required to fully understand whether and in what form these interventions are effective in reducing crashes on public roads.

Competitiveness did not show a significant effect on crash involvement, but a trend was visible in which competitiveness led to a slightly increased level of crash involvement. We have to remark that the competitiveness measure in our study was based on self-reported motives for cycling, not on the actual behaviour itself. It is unclear how well the applied measure actually describes a competitive mode of behaviour whilst cycling, like high speed, frequent overtaking and short following distance (headways) in a bunch. Future research focusing more on the actual behaviour is required to further clarify the role of competitiveness.

Annual distance travelled had no significant effect on crash involvement and showed no clear trend in both the multivariate and univariate models. This finding deserves some consideration; if there is no difference in crash involvement regardless of distance travelled annually, then risk (the number of crashes per km) is lower for cyclists who travel greater distances on an annual basis. One explanation for this effect could come from experience. Additional analysis showed that more experienced cyclists generally travelled greater distances, while less experienced cyclists generally travelled shorter distances annually. This tendency could explain the lack of a statistically significant effect for the distance travelled annually.

5 CONCLUSIONS

Both bunch riding and relatively few years of sport cycling experience were found to increase sport cyclist crash involvement on public roads.

We recommend an evaluation of the effectiveness of available training material aimed to help new sport cyclists ride in a bunch safely, as this could help reduce crash involvement for new bunch riding sport cyclists. Future research focusing on the actual behaviour is required to further clarify the role of competitiveness related to crash involvement.

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