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Use of conspicuity aids by cyclists and risk of crashes involving other road users: Population based case-control study

Philip D. Miller[a,b,*], Denise Kendrick[a], Carol Coupland[a], Frank Coffey[b]

[a] Division of Primary Care, School of Medicine, University of Nottingham, The Tower, University Park, Nottingham NG7 2RD, United Kingdom
[b] Emergency Department, Nottingham University Hospitals NHS Trust, Derby Road, Nottingham NG7 2UH, United Kingdom

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ABSTRACT

Background: Cycling can improve health and well-being by reducing inactivity. Concern about collision crashes may be a barrier to participation since collision crashes can lead to significant mortality and morbidity. The conspicuity of cyclists may be a contributory factor in some collision crashes. This study investigated whether increased conspicuity aid use (such as reflective or fluorescent clothing) is associated with a reduced risk of collision crashes for cyclists in a UK city.

Methods: A matched case-control study was undertaken. Cases were adult cyclists involved in a collision crash causing injury. Controls were adult cyclists matched to cases by time of day, day of week and geographical area of travel. Exposures, potential confounders and route were reported by participants. Odds ratios (OR) and 95% confidence intervals were calculated using conditional logistic regression.

Results: 76 cases and 272 controls were included. 69.7% of cases and 65.4% of controls reported using a conspicuity aid on the crash (cases) or index (controls) journey. The unadjusted OR for a collision crash when using any conspicuity aid vs none was 1.2 (95% CI 0.7 to 2.2) and 2.4 (95% CI 1.1 to 5.6) after adjustment for age, gender, index of multiple deprivation score, route risk score and previous bicycle crash.

Conclusion: This study found no evidence that cyclists using conspicuity aids were at reduced risk of a collision crash compared to non-users after adjustment for confounding, but there was some evidence of an increase in risk. Bias and residual confounding from differing route selection and cycling behaviours in users of conspicuity aids are possible explanations for these findings. Conspicuity aids may not be effective in reducing collision crash risk for cyclists in highly-motorised environments when used in the absence of other bicycle crash prevention measures such as increased segregation or lower motor vehicle speeds.

1. Introduction

Regular cycling has been shown to improve health and well-being and has a role in tackling obesity and inactivity (Oja et al., 1998; Andersen et al., 2000; Bucksch, 2005; de Hartog et al., 2010). The total distance travelled by bicycle in Britain has declined from 24 billion kilometres in 1948 to around 5.2 billion kilometres in 2014 which equates to around 1% of all travel (Department for

* Corresponding author at: Division of Primary Care, School of Medicine, University of Nottingham, The Tower, University Park, Nottingham NG7 2RD, United Kingdom.
E-mail addresses: p.miller@nottingham.ac.uk (P.D. Miller), denise.kendrick@nottingham.ac.uk (D. Kendrick), carol.coupland@nottingham.ac.uk (C. Coupland), frank.coffey@nuh.nhs.uk (F. Coffey).

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Transport, 2015). In 2015 the average person travelled 5159 miles by car, 184 miles on foot but only 53 miles by bicycle (Department for Transport, 2016).

Cycle collisions, particularly those involving motorised vehicles, can lead to considerable mortality and morbidity (European Road Safety Observatory, 2008; Rivara and Sattin, 2011). In addition to these direct consequences, participation in cycling may be reduced in highly motorised environments in part because of the widely held view that cycling is dangerous (Department for Transport, 2003). There is emerging evidence that "near-miss" incidents involving no injury are common and act as a considerable disincentive to cycling (Aldred and Crosweller, 2015; Sanders, 2015). Low rates of cycling may increase risk for individual cyclists as increases in numbers of people cycling are associated with lower rates of bicycle crashes for individuals (Jacobson, 2003; Schepers, 2012; Tin et al., 2011).

There is evidence that the conspicuity of cyclists may be a factor in some collision crashes (Knowles, 2010). Late detection by drivers of other road users has been highlighted as the most 'basic driver error' leading to collisions (Rumar, 1990). Many drivers report not being aware of cyclists prior to collisions (Rowe et al., 1995). Detailed analyses of crashes suggest that cyclists may be difficult for drivers to detect owing to their road position, low relative speed and small size (Cowland, 2008). Given these findings it is reasonable to ask whether increasing the conspicuity of cyclists could reduce the incidence of collision crashes.

Moderate to low-cost retro-reflective and fluorescent clothing and accessories are widely available for use by cyclists. There are a considerable variety of configurations of such materials in use by cyclists, many of which include both modes of action incorporated in parts of jackets or trousers or worn over other clothing ("snap-wraps", gilets or "Sam Browne" belts etc). A systematic review examining the literature concerning the effectiveness of conspicuity aids found test-circuit and simulated studies only and concluded that they can increase the distances at which drivers can detect and then recognise cyclists and pedestrians (Kwan and Mapstone, 2004). The review found no studies which reported the effectiveness of conspicuity aids in reducing collision crashes for cyclists. The use of such aids by cyclists is poorly understood. One study found relatively low rates of use by urban cyclists observed in a Canadian city during daylight hours (Hagel et al., 2007). Other published findings suggest that cyclists estimate the potential for such clothing to increase conspicuity to be greater than do car drivers (Wood et al., 2009). It has also been suggested that some cyclists may assume that the use of lights alone may be sufficient to make them conspicuous at night and therefore that there is little benefit in using additional conspicuity apparel (Wood et al., 2012).

There is some evidence that the use of conspicuity aids is associated with a reduction in odds in both motorcyclists and cyclists although this is inconsistent. A case-control study of crash-involved motorcyclists in New Zealand reported a 37% reduction in the odds of a crash for riders who were using conspicuity aids at the time of the crash compared to those who did not (OR 0.63; 95% CI; 0.42 to 0.94) (Wells et al., 2004). An analysis of data collected via an online survey from cyclists in a public cycling event in New Zealand also suggested that there may be a protective effect of conspicuity aid use with a 28% reduction in the odds of a crash for cyclists who reported always wearing fluorescent colours compared to those who reported never wearing them (Thornley et al., 2008). Both studies included crashes where the rider lost control with no other road user being involved despite it being unlikely that conspicuity is a causal factor in incidents of this type. More recently a re-analysis of longer-term follow-up data from the bicycle study in New Zealand restricted to bicycle/motor-vehicle collision crashes showed an increased risk for cyclists using greater amounts of conspicuity aids in some geographical regions but not in others (Tin et al., 2015). An analysis of Canadian cyclists injured in collisions involving motor vehicles compared to cyclist-only crashes found light-coloured upper body clothing to be protective in daylight (Hagel et al., 2014). Fluorescent and reflective clothing in various combinations was not found to reduce crash risk in daylight or darkness, whilst red/yellow/orange upper body clothing and having tail lights on were both associated with an increased odds of collision in darkness. There was a reduction in the risk of hospitalisation among cyclists using one or more conspicuity aids (adjusted OR 0.21; 95% CI 0.04–1.00) and this was significant for those using two or more aids (adjusted OR 0.10; 95% CI 0.02–0.41).

The study reported in this paper was designed to investigate the relationship between the use of conspicuity aids and the risk of injury requiring emergency department assessment or treatment after a crash for cyclists involving other road users in an urban setting in the UK.

2. Material and methods

2.1. Study design

A matched case-control study was undertaken as described in the published protocol (Not Shown for Review Purposes).

2.2. Selection of cases

Cases were adult cyclists, aged 16 and over, involved in a crash resulting from a collision or attempted evasion of a collision with another road user and who attended the emergency department (ED) at the Nottingham University Hospitals Trust for assessment and treatment of their injuries. Cyclists were eligible for inclusion if they were commuting to work (defined as making a journey to or from their place of work or study or on a work or study related trip) or for utility purposes (defined as travelling for a purpose such as shopping where they would park or dismount in a public place at some point during their journey). Cyclists were excluded if they were travelling for leisure, training or competitive purposes owing to the likely differences between such cyclists and commuter or utility cyclists and also the practical difficulty of recruiting similar controls engaged in these activities. In addition cases were excluded if they had been fatally injured, if their crash occurred between 11 pm and 5am or if their crash occurred outside the study catchment area (the catchment area of Nottingham University Hospitals NHS Trust ED).