(Abstract)

Background: Cycling is an attractive form of transport. It is beneficial to the individual as a form of physical activity that may fit more readily into an individual's daily routine, such as for cycling to work and to the shops, than other physical activities such as visiting a gym. Cycling is also beneficial to the wider community and the environment as a result of fewer motorised journeys. Cyclists are seen as vulnerable road users who are frequently in close proximity to larger and faster motorised vehicles. Cycling infrastructure aims to make cycling both more convenient and safer for cyclists. This review is needed to guide transport planning.

Objectives:

1. evaluate the effects of different types of cycling infrastructure on reducing cycling injuries in cyclists, by type of infrastructure;
2. evaluate the effects of cycling infrastructure on reducing the severity of cycling injuries in cyclists;
3. evaluate the effects of cycling infrastructure on reducing cycling injuries in cyclists with respect to age, sex and social group.

Search methods: We ran the most recent search on 2nd March 2015. We searched the Cochrane Injuries Group Specialised Register, CENTRAL (The Cochrane Library), MEDLINE (OvidSP), Embase Classic + Embase(OvidSP), PubMed and 10 other databases. We searched websites, handsearched conference proceedings, screened reference lists of included studies and previously published reviews and contacted relevant organisations.

Selection criteria: We included randomised controlled trials, cluster randomised controlled trials, controlled before-after studies, and interrupted time series studies which evaluated the effect of cycling infrastructure (such as cycle lanes, tracks or paths, speed

management, roundabout design) on cyclist injury or collision rates. Studies had to include a comparator, that is, either no infrastructure or a different type of infrastructure. We excluded studies that assessed collisions that occurred as a result of competitive cycling.

Data collection and analysis: Two review authors examined the titles and abstracts of papers obtained from searches to determine eligibility. Two review authors extracted data from the included trials and assessed the risk of bias. We carried out a meta-analysis using the random-effects model where at least three studies reported the same intervention and outcome. Where there were sufficient studies, as a secondary analysis we accounted for changes in cyclist exposure in the calculation of the rate ratios. We rated the quality of the evidence as 'high', 'moderate', 'low' or 'very low' according to the GRADE approach for the installation of cycle routes and networks.

Main results: We identified 21 studies for inclusion in the review: 20 controlled before-after (CBA) studies and one interrupted time series (ITS) study. These evaluated a range of infrastructure including cycle lanes, advanced stop lines, use of colour, cycle tracks, cycle paths, management of the road network, speed management, cycle routes and networks, roundabout design and packages of measures. No studies reported medically-attended or self-reported injuries. There was no evidence that cycle lanes reduce the rate of cycle collisions (rate ratio 1.21, 95% CI 0.70 to 2.08). Taking into account cycle flow, there was no difference in collisions for cyclists using cycle routes and networks compared with cyclists not using cycle routes and networks (RR 0.40, 95% CI 0.15 to 1.05). There was statistically significant heterogeneity between the studies (I-2 = 75%, Chi(2) = 8.00 df = 2, P = 0.02) for the analysis adjusted for cycle flow. We judged the quality of the evidence

regarding cycle routes and networks as very low and we are very uncertain about the estimate. These analyses are based on findings from CBA studies.

From data presented narratively, the use of 20 mph speed restrictions in urban areas may be effective at reducing cyclist collisions. Redesigning specific parts of cycle routes that may be particularly busy or complex in terms of traffic movement may be beneficial to cyclists in terms of reducing the risk of collision. Generally, the conversion of intersections to roundabouts may increase the number of cycle collisions. In particular, the conversion of intersections to roundabouts with cycle lanes marked as part of the circulating carriageway increased cycle collisions. However, the conversion of intersections with and without signals to roundabouts with cycle paths may reduce the odds of collision. Both continuing a cycle lane across the mouth of a side road with a give way line onto the main road, and cycle tracks, may increase the risk of injury collisions in cyclists. However, these conclusions are uncertain, being based on a narrative review of findings from included studies. There is a lack of evidence that cycle paths or advanced stop lines either reduce or increase injury collisions in cyclists. There is also insufficient evidence to draw any robust conclusions concerning the effect of cycling infrastructure on cycling collisions in terms of severity of injury, sex, age, and level of social deprivation of the casualty.

In terms of quality of the evidence, there was little matching of intervention and control sites. In many studies, the comparability of the control area to the intervention site was unclear and few studies provided information on other cycling infrastructures that may be in place in the control and intervention areas. The majority of studies analysed data routinely collected by organisations external

to the study team, thus reducing the risk of bias in terms of systematic differences in assessing outcomes between the control and intervention groups. Some authors did not take regression-to-mean effects into account when examining changes in collisions. Longer data collection periods pre-and post-installation would allow for regression-to-mean effects and also seasonal and time trends in traffic volume to be observed. Few studies adjusted cycle collision rates for exposure.

Authors' conclusions: Generally, there is a lack of high quality evidence to be able to draw firm conclusions as to the effect of cycling infrastructure on cycling collisions. There is a lack of rigorous evaluation of cycling infrastructure