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Cyclist-motor vehicle collisions before and after implementation of cycle tracks in Toronto, Canada

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Highlights

- Few studies have examined safety effects of cycle tracks in North America and its effects in surrounding areas.
- There were 2.57 times more cyclists on the streets after cycle tracks were installed.
- There was a decreased risk of collision for cyclists on cycle tracks following its implementation.
- Collision rates decreased in surrounding -areas after track implementation, suggesting additional safety benefits.

Abstract

Background

Cycling, as a mode of active transportation, has numerous health and societal benefits, but carries risks of injury when performed on-road with vehicles. Cycle tracks are dedicated lanes with a physical separation or barrier between bicycles and motor vehicles. Studies on the effectiveness of cycle tracks in urban areas in North America, as well as the area-wide effects of cycle tracks are limited.

Aims

Study objectives were to examine the effect of cycle track implementation on cyclist-motor vehicle collisions (CMVC) occurring: (1) on streets treated with new cycle tracks; (2) on streets surrounding new cycle tracks in Toronto, Canada.

Methods

Intervention and outcome data were obtained from the City of Toronto. All police-reported CMVC from 2000 to 2016 were mapped. Analyses were restricted to 2 years pre- and 2 years post-track implementation. Rates were calculated for CMVC on streets with cycle tracks (objective 1) and in five defined areas surrounding cycle tracks (objective 2). Zero-Inflated Poisson regression was used to compare changes to CMVC rates before and after cycle track implementation for both objectives. All models controlled for season of collision and cycle track.

Results

The majority of CMVC on cycle tracks occurred at intersections (75%). The crude CMVC rate increased two-fold after cycle track implementation (IRR = 2.06, 95% CI: 1.51–2.81); however, after accounting for the increase in cycling volumes post-implementation, there was a 38% reduction in the CMVC rate per cyclist-month (IRR = 0.62, 95% CI: 0.44–0.89). On streets between 151 m – 550 m from cycle tracks, there was a significant 35% reduction in CMVC rates per km-month following track implementation (IRR = 0.65, 95% CI: 0.54–0.76).

Conclusions

Cycle track implementation was associated with increased safety for cyclists on cycle tracks, [illegible]e. In addition, there was a significant reduction in CMVC on

streets surrounding cycle tracks between 151 m – 550 m distance from the tracks (a 'safety halo' effect), suggesting an area-wide safety effect of cycle track implementation.

Introduction

As a mode of active transportation, cycling offers a wide range of benefits to the individual and to the environment. Cycling helps increase fitness, promote weight loss and reduce stress (Lusk et al., 2011; Chen, 2015). Cycling can also decrease commuting time, reduce road congestion and reduce traffic-related air pollution (Lusk et al., 2011; Chen, 2015; Winters and Teschke, 2010). In Canada, the percentage of trips by bicycle is only 2%; a figure substantially lower than European countries such as the Netherlands, where the percentage is 27% (Pucher and Buehler, 2008). Given the close proximity between cyclists and traffic, cycling on roads is not without risk. In Toronto, between 2003 and 2016, there were 539 events in which a cyclist was killed or seriously injured as a result of a motor vehicle collision (Bhatia et al., 2016). A cyclist in Canada is twice as likely to be killed by a motor vehicle (per kilometer cycled) than a cyclist in the Netherlands (Pucher and Buehler, 2008).

The City of Toronto recently implemented a Vision Zero Road Safety Initiative – a five-year plan from 2017 to 2021 – with the goal of reducing traffic-related deaths and serious injuries to zero (City of Toronto, 2019a). In addition to Vision Zero, the City has also created a Cycling Network Plan, with the goal of building a more connected and comprehensive cycling network in Toronto (City of Toronto, 2018a). The Network plan includes implementing new bike lanes, cycle tracks and trails, adding new cycling routes, and enhancing existing infrastructure (City of Toronto, 2018a). In Toronto, cycling infrastructure includes cycle tracks, cycle lanes, sharrows, multi-use trails, and contra-flow lanes (City of Toronto, 2018b). Cycle tracks provide a physical separation or barrier between the cyclist and the traffic, whereas cycle lanes are separated from traffic by a painted line and do not have a physical separation or barrier (City of Toronto, 2018b). There has been a recent growth in cycle tracks in the City of Toronto since its first introduction in 2013. Cycle tracks accounted for 25% of new cycling infrastructure that has been built (15 of 60 km of total infrastructure) from 2016 to 2018 and is now the fourth most prevalent cycling infrastructure in the city (City of Toronto, 2019b).

A recent literature review on the effectiveness of cycle tracks to prevent cyclist-motor vehicle collisions and injuries showed few studies in North America and limited reporting of on the volume of cyclists before and after implementation obertis, 2013). With respect to international studies, most ed 20 years ago, and cyclist volume data were often not

reported (Thomas and DeRobertis, 2013). Furthermore, bike networks in Europe are more common on traffic-calmed local neighborhood roads, as opposed to the bike networks on busy downtown streets in North America (Thomas and DeRobertis, 2013; City of Toronto, 2019c). With respect to Canadian studies, Lusk et al. (2011) showed that cycle tracks were associated with a significant reduction in cycling injuries, compared to streets without any cycling infrastructure (RR = 0.72, 95% CI: 0.60–0.85). Similarly, Teschke et al. (2012) conducted a multi-site case-crossover study and showed that cyclists on cycle tracks had the lowest risk of injury, compared to other cycling infrastructure (RR = 0.11, 95% CI: 0.02–0.54). While previous literature has typically focused on effects associated with cycle tracks on treated segments, to our knowledge, there are no studies on area-wide effects, i.e., the effect of cycle tracks on CMVC rates on surrounding streets. We hypothesised that cyclists may change cycling routes after implementation of cycle tracks, which may then lead to a spatial redistribution of CMVC.

The objectives of this study were: (1) to examine the rates of cyclist-motor vehicle collisions (CMVC) on streets with cycle tracks before and after cycle track implementation in Toronto, Canada; and (2) to examine area-wide effects on CMVC rates on streets surrounding cycle tracks before and after cycle track implementation. A pre-post, naturalistic (quasi) experimental design was used for this study.

Section snippets

Intervention

Cycle tracks were defined as dedicated lanes for cycling, with a physical separation or barrier between the cycling lane and traffic (City of Toronto, 2018b). Implementation dates for cycling tracks (month and year) and geographic location were obtained from the City of Toronto.

Cycling volumes, on the streets that had cycle tracks implemented, were obtained from the City of Toronto (City of Toronto, 2018c, City of Toronto, 2019c). Cycling volume was quantified as the average daily number of

Intervention

Six cycle tracks were implemented in the City of Toronto in 2013 and 2014, spanning a total of 8.81 km: Sherbourne St (2.54 km), Adelaide St West (1.61 km), Richmond St West (1.39 km), Simcoe St (0.69 km), Wellesley St East (1.28 km) and Wellesley St West-Queen's Park (1.30 km). Of these six cycle tracks, three were upgraded from painted bike lanes: Wellesley St East, Wellesley St West-Queen's Park, and Sherbourne St. Only two of the six cycle tracks were one-way: Richmond St West and Adelaide

Discussion

In the two-year period following the installation of 8.81 km of cycle tracks in the City of Toronto, the crude CMVC rate on streets with cycle tracks increased two-fold. Cycle track implementation however, was also associated with a substantial increase in the volume of cyclists. A multivariate model that considered cycling volumes and season showed that the implementation of cycle tracks was associated with a 38% decline in CMVC rate, from 23.7 to 14.6 per 1000 cyclist-months. Streets with no

Conclusions

In summary, this study showed that the installation of cycle tracks in the City of Toronto was associated with two distinct safety benefits. First, cycle tracks were associated with an increase in the volume of cyclists at the locations where cycle tracks were implemented and a reduction in the risk of CMVC, both of which support cycle track implementation as a safe and effective built environment intervention to promote cycling. Second, this study showed a 35% reduction in CMVC on streets at

Ethics approval

This study used publicly available data and was exempt from Research Ethics Board approval

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Declaration of Competing Interest

None.

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> …It may indicate that a protected barrier helps to “legitimize” a cyclist occupying both the traffic and social space on a street, by improving how drivers interact with cyclists. More broadly, bicycle infrastructure, even when implemented in a fragmented fashion, which is the case in the GTHA (i.e., study area for this study), may produce a safety halo-effect that extends subjective safety improvements much beyond the location of infrastructure (Ling et al., 2020). As drivers become more aware of bicycle infrastructure and cyclists of all genders using them, bicycling becomes more socially normalized.…

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