Assessing cyclist safety using infrastructure parameters from OpenStreetMap: The case of Leipzig, Marseille and Edinburgh

by **CAMILO CARDONA TORRES**

Motivated by the increasing rates of cycling victims on European roads, and the data availability through the use of Volunteered Geographic Information (VGI), this research explored a new approach of assessing cyclist safety using OpenStreetMap (OSM) data. An inventory of intersections at the city level was obtained, classifying them by number of arms, presence of cycling infrastructure and traffic signals, and cyclist victims. The proposed methodology was implemented in Leipzig (GER), Marseille (FRA) and Edinburgh (GBR), showing that 3-arm and 4-arm intersections with cycling infrastructure and traffic signals have the highest proportions of intersections where cycling victims occur.

BACKGROUND

Several authors have used VGI in their research focused on road infrastructure and cycling safety, demonstrating that some parameters like traffic volume, bicycle volume, intersection size, signal control type, number of intersection arms, bike lanes, and speed limit are significant factors that affect bicycle crashes at the intersections [1, 2].

DATA

Infrastructure data: Collected from OpenStreetMap [3], which is a free, editable map of the whole world that is being built by volunteers.

Crash data: Harmonised database provided by Fraunhofer Institute, including road crashes collected by the police between 2015 and 2017 in Saxony (Germany), France and Great Britain.

METHODS

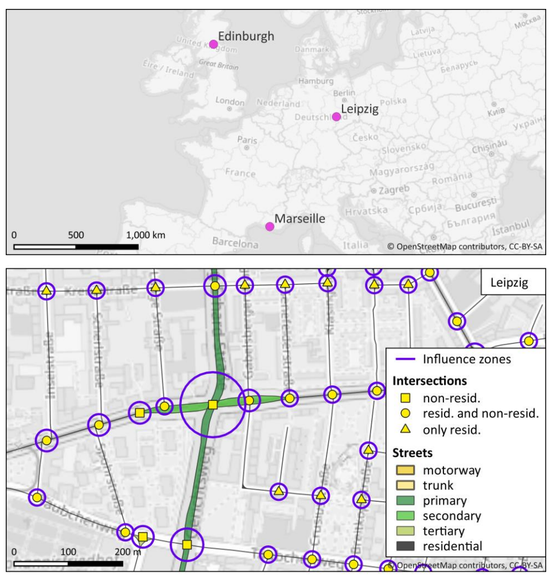
Infrastructure parameters and cyclist victims were assessed at the intersection level in different cities. Traffic network's nodes and ways were imported from OSM using osm2pgsql and pgRouting. Nodes were clustered using several DBSCANs [4] to find the intersections, whereas ways were aggregated to obtain the streets. During this process the road hierarchy was considered.

After defining an influence zone for the intersections, the cyclist victims and the infrastructure parameters were assigned to them. This allowed to classify the intersections based on number of arms, presence of cycling infrastructure and traffic signals.

Based on injury severity, the cyclist victims were split in two groups: slightly injured in one, and seriously injured and killed in the other one. This data led to assess the intersections inventory through a statistical and spatial analysis, including general distribution patterns and hotspots [5].

IMPLEMENTATION

Based on data availability and similarity of area, as well as population density, three cities were chosen: Leipzig (GER), Marseille (FRA), and Edinburgh (GBR). An example of the implementation, and the general count of intersections can be seen in Fig. 1.



	Leipzig	Marseille	Edinburgh
Identified intersections	4,783	5,125	6,254
Cyclist victims (2015-2017)	2,851	118	637
Intersections with cyclist victims	837	48	265

Fig. 1. Localization, clustering of nodes and ways, and general count of intersections in chosen cities

RESULTS

The results of this research included an inventory of intersections at the city level, considering cyclist victims by severity, and infrastructure parameters.

In 3-arm and 4-arm intersections of the chosen cities, the highest percentage of intersections with cyclist victims were the ones with cycling infrastructure and traffic signal (see Fig. 2). For roundabouts in the three cities, the biggest proportions were found when having cycling infrastructure but no traffic signal.

The hotspots allowed to identify statistically significant intersections with cyclist victims in the three cities (see Fig. 3). In Leipzig, the hotspots were concentrated in the city center; whereas in Marseille and Edinburgh, the hotspots were rather spread around it.

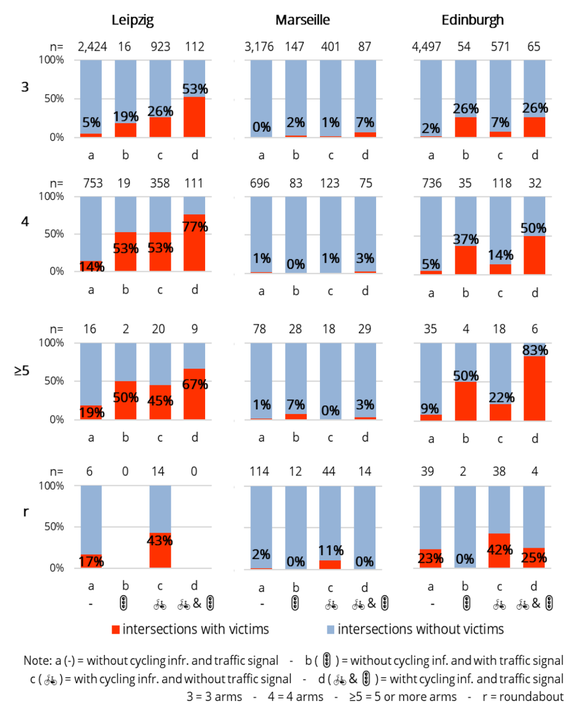


Fig. 2. Intersections with cyclist victims (%)

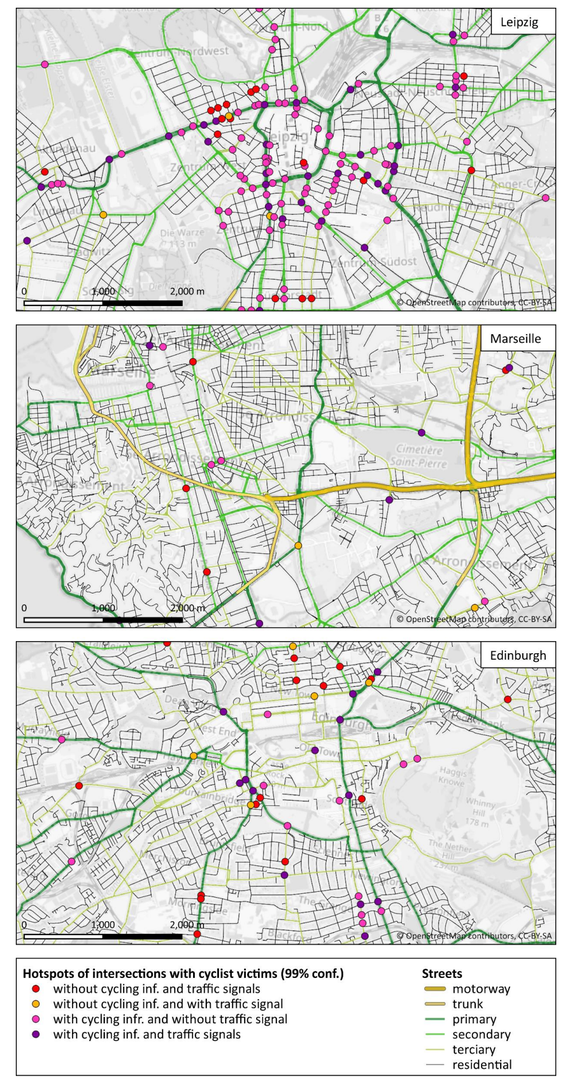


Fig. 3. Hotspots of intersections with cyclist victims

CONCLUSIONS

Using OSM data, it was possible to obtain an inventory of the road intersections and identify cycling safety patterns associated with infrastructure data in three cities.

More researchers are encouraged to use OSM in their analysis worldwide, since it is freely accessible and constantly updated. Data correctness and availability must be considered. Further research might include more infrastructure parameters and use of additional data (e.g., traffic volumes).

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