iCSC International Cycling Safety Conference

6th Annual International Cycling Safety Conference
21-22 September 2017, Davis, California, USA

Fatal Bicyclist Accidents on Rural Roads

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Keywords: fatal crashes, rural roads, motor vehicle.

1 INTRODUCTION

The popularity of bicycling has increased and during the last years more attention has been given from stakeholders to create a safer environment for bicyclists. According to hospital reported injuries from crashes, bicyclists account for a higher proportion (45%) than any other road user category in Sweden and the percentage of bicycle crashes is steadily increasing [1]. The injury consequences of bicycle crashes are primarily correlated to non-fatal injuries [2]. Bicyclists account for approximately 6% of all road fatalities in the EU [3]. Similar trends have been reported for Sweden separately [1]. The objective was to analyze fatal accidents involving bicyclists killed on Swedish rural roads in order to identify and investigate the potential of different infrastructure and vehicle countermeasures.

2 METHODS

The Swedish Transport Administration (STA) in-depth database of fatal crashes was used to study fatally injured bicyclists (n=76) on rural roads during the period 2006-2015. The mean age, stature and weight of the killed bicyclists were 52, 173 cm and 77 kg. The crashes were classified and divided into groups regarding direction of movement just before the impact for both the motor vehicle and the bicyclist. Similar classification has been used in the CATS project [3].

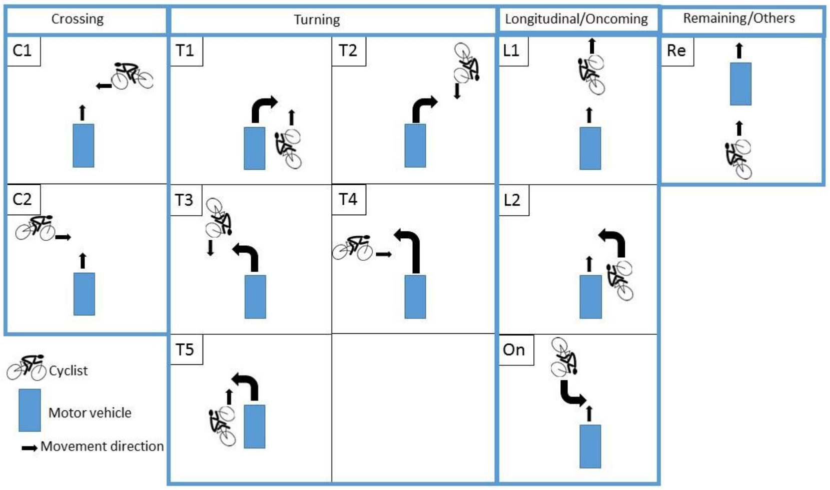

Figure 1: Classification of fatal bicyclist accident scenarios

The potentials of several vehicle and infrastructure safety countermeasures were determined retrospectively for each case by analyzing the entire chain of events leading to the fatal injuries. The method used, the integrated safety chain, is a further development of the Haddon Matrix [4,5].The relevance of infrastructure countermeasures such as separated paths for bicyclists, speed secured crossings for bicyclist was analyzed depending on the road width, traffic flow etc. Projections were made on future fitment of vehicle technologies (Autonomous Emergency Braking or Autonomous Emergency Steering) shown to be effective.

3 RESULTS

The most frequently scenarios were either the crossing or longitudinal scenarios. The analysis showed that in 66% of the accidents, the bicyclist was struck by a passenger car. The mean collision speed (including cars, LGV and HGV) was 70 km/h, and frontal impacts were most common (73%). The majority of crashes occurred during daylight (71 %). However in 12 % of the cases the crash occurred during weather or lighting conditions (heavy rain/snow, fug, dazzling sun etc) that would affect the possibility for a vehicle detection system to detect the bicyclist in time. Furthermore, in 12 % of the cases the view was blocked prior to the crash that could delay the detection of the cyclist by the vehicle system. Most of the crashes occurred when there was no precipitation (dry).

The most common fatal injury was to the head (60%); 71% of the killed bicyclist did not use a helmet, and forensic reports suggested that 37% of them would have survived with it. The bicyclist was often hit from the side (43 %) or from the back (37 %). The analysis showed that 30-34% of the fatalities could have been prevented with bicycle paths, and that further 40% could have been addressed by other interventions such as tunnels/bridges or other speed-reducing measures. Autonomous Emergency Braking (AEB) could have reduced collision speeds to survivable levels in at least 40% of the accidents between a vehicle and a bicyclist. Overall, it was estimated that 59% of the accidents could have been prevented by either infrastructure or vehicle technologies.

4 DISCUSSION AND LIMITATIONS

Fatality rates in road traffic accidents is decreasing in Europe, especially regarding car occupants. However, the number of fatalities among cyclists does not follow the same trend [3]. But there are positive interventions that have been introduced in cars lately that may help. AEB including detection of pedestrians and bicyclist aimed at avoiding or mitigating collisions with vulnerable road users is one example. The present study shows that these systems would have been effective in at least 40% of the crashes. Furthermore, there is a need for safer infrastructure to prevent rural bicycle crashes.

This study had a holistic approach to provide road authorities and vehicle manufacturers with important recommendations for future priorities. While the material used is fully representative, such retrospective studies may have limitations. It is difficult to take into account the possible behavioral adaption that could follow the implementation of certain countermeasures.

5 CONCLUSIONS

95% of bicycle fatalities on rural roads in Sweden could be addressed by either the infrastructure, vehicle technologies, or both. The vast majority was struck by a car. The collision speed of the vehicle is one of the parameters having the highest influence on the risk of fatality for bicyclist. The combination of speed calming road infrastructure, bicycle helmets, more protective car fronts and technologies will be important factors to avoid bicycle fatalities in the future.

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