International journal of basic and applied research

www.pragatipublication.com

ISSN 2249-3352 (P) 2278-0505 (E)

Cosmos Impact Factor-5.86

A Literature Review on Bicycles and Traffic Accidents

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ABSTRACT

The annual death toll from traffic accidents is close to 1.3 million, or an average of 3,287 lives lost every day. More than 6% of all those killed in traffic accidents in the European Union in 2013 were cyclists. Between 2010 and 2013, the overall number of traffic fatalities in the EU dropped by 18%, whereas the number of cyclists killed fell by just 9%. Men make up the vast majority (78%) of deaths among cyclists. When looking at the major nations, Belgium and the Netherlands had the greatest percentage (> 30%) of female cycling deaths. Although there is some consistency throughout the EU, the majority of deaths involving bicycles occur in metropolitan areas (55%). The number of people killed while riding in the European Union has decreased dramatically during the last several years. The number of mishaps has decreased somewhat as a consequence of these efforts. This study provides a literature analysis on the topic of bicycle-motor vehicle collisions and the management of road safety from the perspective of the cyclist's contribution to the increase in such accidents. This article investigates the issue of pedestrian safety in order to pinpoint the technical causes of the uptick in bicycle and automobile accidents, as well as the variables of transport infrastructure, vehicle technical parameters, cycling behavior, and road or street type that contribute to this trend. The frequency and severity of cycling injuries, as well as the anticipated repercussions of decreasing vehicle travelling speeds, are examined by conducting a literature analysis on the injury result of a collision between a cyclist and a vehicle for a particular impact speed.

1. Introduction

The positive effects on health from cycling's status as an active means of transportation are well-documented. However, the security of bikers in busy streets is still a serious issue. The most effective measures to enhance safety can't be determined without first conducting in-depth analyses of the many risk variables and the impacts they may have (Andersen et al., 2000; Higgins, 2005; Mueller et al., 2015). Identifying the role of the driver(s), cyclist(s), vehicle(s), road-way, and environment in a bicycle accident requires a thorough collision analysis (Thomas, DeRobertis, 2013, Jankowska et al., 2014) in order to determine the cause of the accident and the factors that contributed to it. Reconstructions of accidents may help inform suggestions for improving the safety of transportation systems and vehicles (Cao et al., 2014). In order to determine the part played by cyclists and the technical causes of accidents, this article zeroes in on this kind of collision. For the purposes of this article, "cyclist" refers to any anyone who is riding a bicycle and is engaged in a collision with a motor vehicle.

Understanding why people ride bicycles and identifying the elements that cause accidents involving bikers is crucial from a technical and economic perspective. However, there are also barriers to bicycling, such as distance, hazard,

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orography, fitness, climate, vandalism, amenities, and comfort, which counteract the benefits of the former. As shown in Fig. 1 (Fernández-Heredia et al., 2014), a conceptual model of the elements impacting bicycle usage may be characterized in terms of whether they are regarded as a barrier or as an incentive to bicycle use.

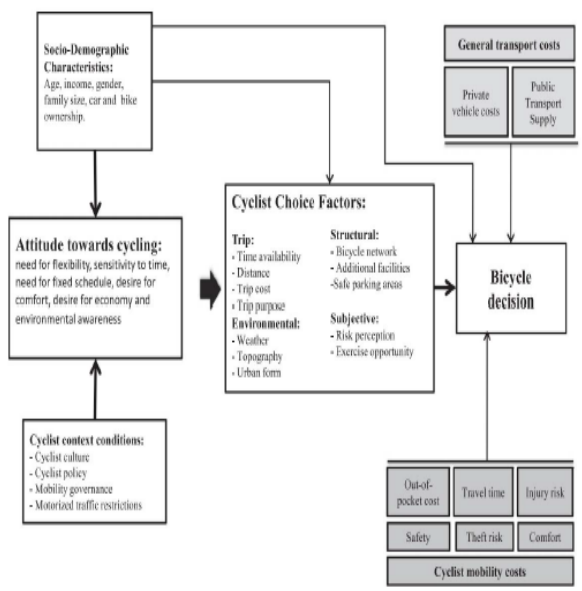

Figure 1 shows a conceptual model (Fernández-Heredia et al., 2014) of the variables that influence bicycle utilization.

Cyclists have less safety protections than other road users. According to Schepers and Wolt (2012), roughly half of all crashes involving a single bicycle are caused by infrastructure issues, such as the rider going off the road or colliding with an obstacle, the bicycle skidding due to a slippery road surface, or the rider being unable to stabilize the bike or stay on the bike due to an uneven road surface. There is a tremendous disparity in speed and mass between bicyclists and motorists on the road. Because of these variations, bikers are particularly at risk. As a result of their lack of protection against the greater speed and mass of motor vehicles, cyclists are often severely injured or killed in incidents with other road users (Piatkowski et al., 2015). Countries that are becoming more motorized and that have high rates of riding also have a significant issue with collisions involving cyclists and motor vehicles (Kirolos et al., 2015). Cyclists are often seen to be defenseless road users because to their lack of a protected car cabin. The frequency of bicycle accidents is likely higher than what is shown in police statistics. Since bicycle helmets are the only known technique of reducing brain injuries in the event of an accident, they should be heavily promoted (Juhra et al., 2012). It's also important to think about things like the weather and the pavement. In order to recreate an accident and establish whether or not the driver could have prevented it, information on the road conditions must be gathered and analyzed.

Bicycle-vehicle collisions are the primary topic of safety studies. There are a few distinct varieties of bicycle accidents, as shown by studies on accident reconstruction. According to the data, one common form of collision involves a car coming from the other direction making a right turn in front of a bike who is proceeding straight.

Another cause of car accidents is human error, namely when drivers cause them by weaving across several lanes of traffic to turn right. More over fifty percent of all vehicle turns occurred at signalized intersections. Cyclists are second most likely to be involved in an accident when cars turn left in front of them at a T-intersection. As the third biggest cause of accidents, vehicle-to-cyclist collisions occur most often when both are traveling in the same direction. It's common for drivers to make a left turn onto a side street right in front of cyclists. Additionally, right-side passenger-cyclist sideswipe collisions are prevalent (Kooijman et al., 2011; Heesch et al., 2011).

The majority of road infrastructures were designed for cars (Sipos, 2014), making it difficult to safeguard cyclists who use them to travel on or alongside roads, cross them, or make directional changes at intersections (Shinar, 2012). The need to safeguard bikers has grown in recent years. The safety of the most vulnerable road users is a joint

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priority for several government agencies and scientific researchers.

2. Procedures and Methodology

Transport and its supporting infrastructure have become as essential to contemporary life. According to reports of traffic incidents, the number of bikers engaged in injuries is rising. Accidents on the road, as well as early fatalities and physical/mental impairments, are increasingly being linked to inadequate transportation options. The resulting strain on public resources and the rising price of medical care are also important factors. Researchers, law enforcement officers, and accident reconstructionists are looking at what factors lead to bicycle collisions (Kirolos et al. 2015; Liu and Tung 2014; Shinar 2012).

A shocking 35% of cyclist deaths in the EU in 2010 were recorded during the warm summer months when riding conditions are at their best. It's possible that the high severity incidents are linked to the slick wet conditions that characterize many European winters. The actual quantity of bicycles on the road at these times decreases the chance of deadly accidents. Instead of being an indicator of progress in learning to avoid danger, inclement weather is more likely to blame (Wegman, Zhang, & Dijkstra, 2012). Some studies use unique questionnaires issued to cyclists who have been involved in an accident and received medical attention at an emergency room after riding their bikes (Schepers, Wolt, 2012) in an effort to identify road issues and cycling behavior. Researchers have used video recordings to study cyclists' actions in traffic. Research on cycling behavior and the development of better car priority laws should benefit from this kind of video analysis (Wang, Mitani, & Yamanaka, 2012). For instance, the eyes of test subjects, namely their contrast sensitivity, were analyzed in a lab setting (Fabriek et al., 2012).

3. Results

Based on an examination of EU-wide statistics, it seems that in 2010, the Netherlands (21%), Hungary (12%), and Slovenia (12%) had the highest rates of bicycle-related deaths. In comparison, bikers account for a negligible percentage (2% in each country) of traffic accident deaths in Greece and Ireland. Men make up the vast majority (78%) of deaths among cyclists. The Netherlands had the greatest rate of female bike deaths in Belgium (>30%), while Romania had the lowest rate (7%). It shows that, as the population ages, a disproportionate number of elderly cyclists in EU nations are killed in traffic accidents (50%). Analysis of the age distribution of accidents in the European Union reveals a rise in deaths of cyclists between the ages of 12 and 17, when young people are more inclined to go on self-directed, solo bicycle journeys. The overall death toll is going down. After that point, however, there is a precipitous drop in the mortality rate (Fig. 2).

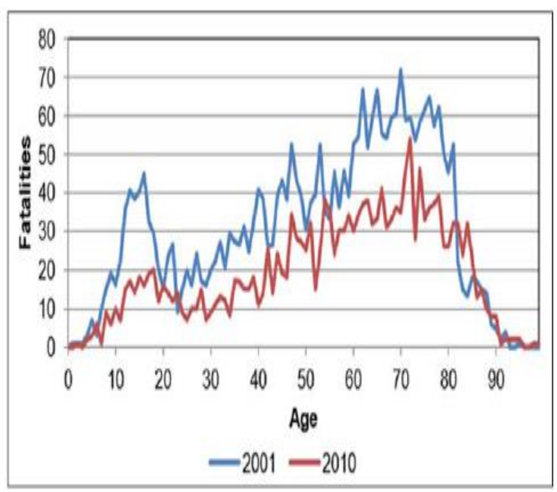

Figure 2: A comparison of bike deaths in the EU-19 by age group during a 10-year period(2009 statistics for NL, NI, and SE)

CARE Database/European Commission (Request received in October 2012)

According to the results of a temporal distribution study performed on the incidents, the following can be said about the distribution of cycling deaths throughout 24 hours in EU nations. Between the hours of 2:00 and 6:00 p.m., 28% of all cycling deaths happened in different nations. Also, more cyclists are killed in incidents between 08:00 and 12:00 and 12:00 and 16:00 than during any other four-hour period (24% and 23%, respectively). Compared to other means of transportation, the number of fatalities involving bicycles is highest between the hours of 08:00 and 18:00 and lowest between the hours of 22:00 and 07:00. According to the numbers, about a third of all fatal bicycle accidents in EU nations occurred under low-light conditions.

The percentage was more than 40% in the worst-off nations.

Across EU nations, 55% of deaths involving bicycles occurred in metropolitan settings, however this varied greatly from country to country. The Netherlands (63%) and Germany (51%), however, had the greatest rates of bike deaths at intersections. The majority (55%) of deaths involving cyclists at intersections happened at crossroads, whereas just 7% occurred at T-junctions or staggered intersections. Crossroads account for more than half of all deaths involving cyclists in Germany, the Netherlands, and Poland. T-intersections and staggered junctions account for 52% of all bike deaths in the UK. This suggests that about 40% of bike deaths occur at intersections. The greatest incidence of fatalities at intersections include cyclists. Next most common are deaths involving buses/coaches (32%) and mopeds (30%) at intersections (Mitsakis et al., 2015). When compared, 15% of all automobile occupant deaths occurred at intersections.

Bicycle riders, along with those riding on buses and coaches, have a disproportionate share of their deaths occur at intersections when compared to other forms of transportation.

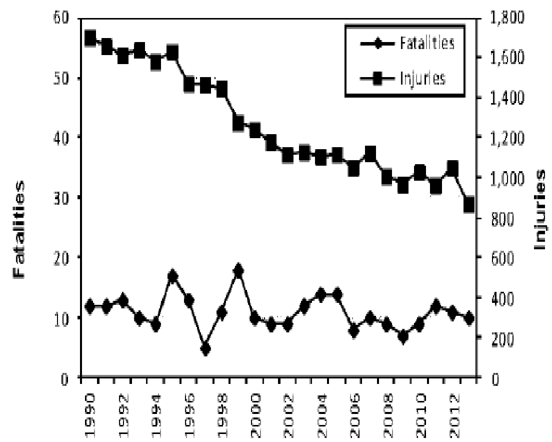

Figure 3: Fatalities and Injuries among Cyclists The National Safety Council is the source.

4. Conclusion

Bicycle safety research is increasingly aware that it has to include exposure, yet appropriate exposure data are typically absent, making findings difficult to understand and compare. The lack of information on low-impact bicycle incidents in studies that include exposure makes it hard to assess safety across age groups or against various kinds of infrastructure. Recent studies that have examined collision sites have indicated that the aesthetics of the surrounding infrastructure have a factor in the occurrence of accidents. Most bicycle accidents involve the rider losing stability at moderate speeds, often while getting on or off the bike. Elderly cyclists, cyclists with physical issues, and cyclists with less riding experience all have a much higher probability. Children and teenagers are a vulnerable demographic group that has received little attention in the past literature. The study of bicycle accidents is only getting started. There seems to be a need for more study to establish preventative strategies, since the number of critically wounded victims is disproportionately high in nations with high rates of cycling. Several potential avenues for further study have been suggested. Crash types, such as those involving visual features, may be studied in more detail to uncover hidden causes and facilitate the creation of mitigation strategies (Fabriek et al., 2012).

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