



Association between intersection characteristics and perceived crash risk among school-aged children



Gain Lee, Yuna Park, Jeongseob Kim, Gi-Hyong Cho*

Ulsan National Institute of Science and Technology School of Urban and Environmental Engineering, Korea

ARTICLE INFO

Article history:

Received 18 February 2016

Received in revised form 7 July 2016

Accepted 2 September 2016

Keywords:

Perceived crash risk

Pedestrian

Intersection

Children

Safety

ABSTRACT

This research examined how environmental attributes near intersections influence the perceived crash risk among school-aged children, which provides information on the potential risks of pedestrian crashes that can guide the development of proactive countermeasures. In a sample of 799 children aged 10–12 years old in Korea, the environmental attributes of intersections perceived as having a high risk of producing crashes near elementary schools were investigated using standard negative binomial and zero-inflated negative binomial models. The results showed that a higher number of student crossings, a wider road width, the presence of crosswalks, student-friendly facilities at the intersection, and four-way intersections were significant and positively associated with perceived crash risk among school-aged children. The findings related to building characteristics indicated that a higher number of entrances at an intersection increased the perceived crash risk while higher visibility at the intersection reduced the perception of risk. Associations with traffic-calming measures were weak, suggesting that the measures used in the study areas were not effective in reducing the perceived crash risk. The results of a police-reported crash model showed that school-aged children have a relatively accurate perception of crash risk and that the perceived crash risk of school-aged children may provide valuable information on the intersection characteristics in need of attention near school sites.

© 2016 Elsevier Ltd. All rights reserved.

1. Introduction

Road traffic injuries are one of the leading causes of childhood death and disability worldwide (World Health Organization [WHO], 2007; Peden, 2008). Children are particularly vulnerable to road traffic crashes (Stoker et al., 2015). In low-income and middle-income countries, children account for 30–40% of all road traffic deaths (WHO, 2007). In Korea, the annual number of child fatalities resulting from traffic accidents is decreasing, but the rate is still approximately 50% higher than the fatality rate of other developed countries (Lee and Lee, 2014). In particular, 65% of children killed by traffic accidents are victims of a pedestrian crash.

One of the interventions for reducing pedestrian crashes is the modification of the road environment (Retting et al., 2003; WHO, 2007). The existing literature has focused on identifying the built environment or road design characteristics that potentially increase the hazards for pedestrians. Researchers have reported

that a higher population density (Clifton and Kreamer-Fults, 2007; Dissanayake et al., 2009; Elias and Shiftan, 2014; Rothman et al., 2014), commercial use (Dai et al., 2010; Yu and Zhu, 2015), a greater number of transit stops (Ukkusuri et al., 2012; Yu and Zhu, 2015), a higher number of lanes (Ukkusuri et al., 2012), and the absence of traffic signals (Moudon et al., 2011) or traffic-calming devices (Rothman et al., 2014) were all associated with a higher number of pedestrian crashes. These studies have used police-reported pedestrian crash data as their main source of information on pedestrian crash risk.

In contrast to police-reported pedestrian crashes, risk perception is a subjective assessment of the probability of experiencing a negative event (Lund and Rundmo, 2009). In the field of road safety, risk-perception techniques have been used to examine associations between the behavior of road users and perceived risk and to understand how road users identify risk factors (Diógenes et al., 2010). The main advantage of using perceived crash risk in research is that it provides the possibility of assessing road safety even when crashes have not occurred (Diógenes et al., 2010). Since pedestrian crashes are relatively rare events, perceived crash risk can provide predictive information on the potential risk of pedestrian crashes and guide the development of proactive countermeasures to reduce

* Corresponding author at: School of Urban and Environmental Engineering Building 106, 801-7 Ulsan, Korea.

E-mail address: gicho@unist.ac.kr (G.-H. Cho).

the possibility of such crashes occurring (Schneider et al., 2004). Previous literature has shown that perceived crash risk tends to be positively correlated with police-reported crash risk data (Elvik and Bjørnskau, 2005), but sometimes perceived crash risk can provide information that cannot be addressed only with actual crash data (Cho et al., 2009). Studies on perceived crash risk can provide a better understanding of pedestrian behavior in different road environments (Hine, 1996) and potentially mitigate pedestrian crashes (Diógenes et al., 2010).

The present study examined the road environment factors at intersections associated with perceived crash risk among children by focusing on the school–home journey, which is a point of considerable traffic exposure and risk for children (Stoker et al., 2015). First, we intended to identify locations perceived as having a high risk of crashes near elementary schools and the roadway intersection characteristics associated with perceived crash risk. Then, through a comparison with the intersection characteristics associated with higher police-reported crash risk, this study examines the implications and potential usefulness of perceived crash risk in understanding pedestrian safety. Ultimately, this study aims to inform policy for creating safe routes to school that reduce the crash risk to children in school zones based on the study's findings.

2. Background

Modifying the road environment is one of the main interventions for reducing the likelihood of children and youth being involved in road traffic crashes (WHO, 2007). Retting et al. (2003) suggested that engineering modifications to reduce pedestrian–vehicle crashes may generally be classified into three approaches: managing vehicle speeds, separating pedestrians and vehicles, and increasing pedestrian visibility. The evidence indicates that higher speed limits (Tiwari et al., 2007), a greater number of transit stops (Pulgurtha and Sambhara, 2011; Ukkusuri et al., 2012), an uncontrolled left-turn lane (Chin and Quddus, 2003), and wide lanes (Noland and Oh, 2004; Goldstein, 2006; Ukkusuri et al., 2012) are all associated with a greater crash risk. Conversely, proper roadway lighting design (Goldstein, 2006), street segments with sidewalks (Berhanu, 2004), and the installation of traffic-calming measures (Ewing, 2001) reduce the rates of vehicle–pedestrian crashes. Some studies have focused on the relationship between neighborhood characteristics and pedestrian safety, reporting that a higher population density (Pulgurtha and Sambhara, 2011), mixed land use (Wier et al., 2009; Dai et al., 2010; Ukkusuri et al., 2012), and retail uses (Wedagama et al., 2006) are associated with a greater frequency of pedestrian crashes.

A relatively small number of studies have examined the environmental attributes associated with pedestrian crashes involving children in general or crashes near schools in particular. Consistent with the results of studies targeting the general population, those studies conducted near schools have reported that a higher population density, mixed land use, and a higher number of transit stops are all associated with an increase of pedestrian crashes involving children (Clifton and Kreamer-Fults, 2007; Dissanayake et al., 2009; Elias and Shiftan, 2014; Yu and Zhu, 2015) while traffic-calming measures (Jones et al., 2005; Rothman et al., 2014) and more sidewalk coverage (Yu and Zhu, 2015) were found to be associated with lower rates of pedestrian crashes.

Whereas a significant body of research has focused on the environmental attributes associated with police-reported pedestrian crashes, the perceived risk from the child's perspective has not received much attention. Unlike police-reported crash data, perceived crash risk can be understood as a multifaceted concept because it involves the subjective interpretation of risks in various transport situations (Deery, 2000). Perceived crash risk is

frequently defined as a level of awareness, with proper awareness toward a prospective risk, allowing individuals to avoid accident risk (Slovic, 1987). The literature examining the perceived risk of different modes of transport has shown that risk perception among the public is broadly correct (Elvik and Bjørnskau, 2005). However, children's ability to accurately identify the potential risk of pedestrian crashes is not always satisfactory (Meir et al., 2015). Often, young children do not correctly understand complex traffic situations in the same way as adults do, and their inaccurate awareness of impending danger increases their risk of being involved in road traffic crashes (WHO, 2007). Understanding the ways in which children perceive potential risks in road environments could provide some important information on children's behavior and this could be used to inform policy, thus improving safety.

Furthermore, the perceived crash risk provides information on potentially hazardous situations prior to their actualization (Meir et al., 2015). In studies on pedestrian crashes, it is often difficult to identify the risk factors associated with crashes using statistical methods since pedestrian crashes are rare events (Diógenes et al., 2010). In such cases, perception information can be used to identify locations where an accident is waiting to happen because a high level of perceived crash risk can imply that there is the potential danger of a crash even at locations where no crashes have yet occurred (Schneider et al., 2004). Cho et al. (2009), for example, examined how perceived and actual crash risk are related to the built environment characteristics in Montgomery County, MD in the Washington DC metropolitan area. Their study found that a low population density and non-mixed land use increase the perception of crash risk, although these characteristics reduce the actual crash risk in the neighborhood. Their results indicated that police-reported crash risk data does not provide complete information on traffic safety because people change their behaviors to avoid exposure to high perceived-risk areas; thus, proactive interventions are desirable where the perceived crash risk is high. Schneider et al. (2004) analyzed perceived crash risk on the campus of the University of North Carolina at Chapel Hill and found that pedestrians reported high perceived risk at locations near the main campus where the actual crash risk was low. The study concluded that high perceived risk implies the need for proactive interventions to prevent future pedestrian crashes.

In sum, the perceived crash risk among children at school sites conveys information that is important for enhancing the road safety of children by addressing the level of awareness for pedestrian crashes and indicating the potential crash risk to children at specific locations. In addition, children's perceived crash risk has a mediating role in achieving the successful implementation of a safe route to school program that encourages walking and bicycling (McMillan, 2005). The literature has shown that some of the factors influencing children's walking to and from school are safety concerns (Timperio et al., 2006; Zhou et al., 2010; Trapp et al., 2012).

However, the relationship between locations perceived as having a high risk of pedestrian crashes and the environmental attributes of school sites has rarely been examined. In particular, few studies have attempted to identify the perceived crash risk for school-aged children. The purpose of this paper, therefore, is to identify locations that school-aged children perceive as dangerous and what environmental factors are associated with their risk perception. Hypothetically, the patterns of perceived crash risk for school-aged children would not be identical to the patterns found in the police-reported crash risk data. Young children may not correctly understand the risk of traffic crashes or it would be difficult to identify the environmental attributes of crash locations using the data from the limited number of police-reported crashes. This study aims to determine the implications of perceived crash risk for pedestrian safety through a comparison with the patterns found in the data for police-reported crashes.

Download English Version:

<https://daneshyari.com/en/article/4978917>

Download Persian Version:

<https://daneshyari.com/article/4978917>

[Daneshyari.com](https://daneshyari.com)