



## Exploring patterns of child pedestrian behaviors at urban intersections

Victoria Gitelman<sup>a,\*</sup>, Sharon Levi<sup>b</sup>, Roby Carmel<sup>a</sup>, Anna Korchatov<sup>a</sup>, Shalom Hakkert<sup>a</sup>

<sup>a</sup> Transportation Research Institute, Technion - Israel Institute of Technology, Haifa, Israel

<sup>b</sup> Beterem - Safe Kids Israel, Petach Tiqwa, Israel



### ARTICLE INFO

#### Keywords:

Child pedestrians  
Behavior observation  
Urban crosswalks  
Distraction  
Riding

### ABSTRACT

Children are more vulnerable as pedestrians due to their cognitive, physical and behavioral traits. However, walking is one of the main forms of travel for children, particularly during leisure hours. Child pedestrian injury primarily occurs in urban areas, with a significant share at crosswalks. This study observed child pedestrian behaviors at crosswalks of urban intersections aiming to characterize their behavior patterns and identify risk factors that may lead to injury. Crossing behaviors of children and adolescents up to age 18, during leisure hours, were video-recorded at 29 crosswalks, on signalized and un-signalized intersections situated on collector roads. Some children used pedestrian crosswalks while riding a bicycle or other non-motorized means; they were also included in the sample. Behaviors of 2930 young road users were encoded and compared by age groups. Multivariate logistic regression models were adjusted to identify factors associated with crossing on red and with non-checking vehicle traffic at un-signalized crosswalks. The findings pointed to different behavior patterns for the various child age groups. Risk-taking behaviors are higher for older children; adolescents aged 14–17 cross more on red, without checking traffic, outside crosswalk boundaries and while distracted. At all types of sites, a fifth of children over the age of 9 crossed by riding, the probability of crossing on red and of non-checking traffic prior to crossing at an un-signalized crosswalk was higher for children riding an electric bicycle or kick-scooter. The non-checking of traffic was also higher when a child is distracted by a mobile phone or other electronic gadget, or carries a big object. Children under age 9 were usually accompanied by adults but still exhibited risk-taking behaviors that apparently mirrored those of the adults. Risk-taking behaviors of young road users should be taken into account in the development of injury prevention programs focusing on child and parent education and training, and by adapting the urban environment to better meet their needs.

### 1. Introduction

Road crashes are a leading cause of unintentional injuries in children worldwide and the leading cause of injury-related death in children aged 1–17 in Israel (Peden, 2008; Nir et al., 2017). Research worldwide found that children are injured as pedestrians at higher rates than other transport modes: about 38% of child mortality in road crashes is as pedestrians (WHO, 2015).

Children are vulnerable road users in urban areas, in particular as pedestrians, traveling to and from schools, community centers, parks, and other neighborhood and city destinations. An analysis of pedestrian crash data in Israeli municipalities, in 2009–2012, revealed that the share of severe injuries among children was consistently higher than among adults, by 1.25 times, on average (Levi et al., 2015). Children comprise, on average, 31% of the total severe pedestrian injuries in urban areas in Israel. The data also showed that most cases of child and

adolescent injuries as pedestrians took place in the afternoon and evening (about 56%), with the highest concentration of injury incidents between 1:00 and 7:00 pm (Levi et al., 2015). In a previous study on child travel patterns in Israel, these hours were identified as the time involving the majority of child travel for leisure purposes of all types (Levi et al., 2013). The findings also indicated that Israeli children are active and independent travelers, from the age of six through adolescence, along various routes throughout the day and making considerable use of walking.

Studies reveal that children and adolescents are particularly vulnerable because of their cognitive traits, physical and behavioral characteristics (Schwebel et al., 2012; Schieber and Thompson, 1996; AAP, 2009; WHO, 2013; Meir et al., 2015). Lack of maturity in cognitive, behavioral, and physical abilities limit their capacity to evaluate risk and make them more susceptible to injuries. In particular, young children below 13, have difficulties in judging vehicle speeds, travel

\* Corresponding author.

E-mail addresses: [trivica@technion.ac.il](mailto:trivica@technion.ac.il) (V. Gitelman), [sharonl@beterem.org](mailto:sharonl@beterem.org) (S. Levi), [robyc@technion.ac.il](mailto:robyc@technion.ac.il) (R. Carmel), [grabarn@technion.ac.il](mailto:grabarn@technion.ac.il) (A. Korchatov), [hakkert@technion.ac.il](mailto:hakkert@technion.ac.il) (S. Hakkert).

<https://doi.org/10.1016/j.aap.2018.09.031>

Received 8 February 2018; Received in revised form 1 July 2018; Accepted 28 September 2018

0001-4575/© 2018 Elsevier Ltd. All rights reserved.

direction and vehicle distance from the crosswalk that impair their ability in selecting crossing gaps (Connely et al., 1998; Foot et al., 1999; MacGregor et al., 1999; Morrongiello et al., 2015). Additionally, young children experience difficulties in orientation in the urban environment and in identification of potential hazards in road-crossing reality (Leden et al., 2006; Meir et al., 2015). Previous research has indicated that children's impulsive behavior places them at a higher risk for road traffic injury than adults (Schwebel et al., 2012). Similarly, crash data in Israel point to higher rates of child pedestrians "darting out" suddenly in the middle of the road or from a hidden point as opposed to adults (Levi et al., 2015).

As children approach adolescence, their abilities begin to be more similar to those of adults; however, the development of necessary skills varies as to age and individual. Even past age 14 there is some concern that teens are not yet as skilled as adults, possibly due to more limited experience (Plumert and Kearney, 2014; O'Neal et al., 2018). Risk-taking behavior, common for both younger children and adolescents, may be deliberate, due to a lack of knowledge, or because of peer pressure (Schieber and Thompson, 1996; Schwebel et al., 2012). In addition, risk-taking among adolescent pedestrians may be further influenced by gender, with higher levels of risk-taking by male teens, and may increase with age, due to a lower perception of dangers in the road environment (Granić, 2009). One of the potential risk-taking behaviors more common among adolescent pedestrians is use of mobile devices. There is initial evidence that distraction due to this type of secondary task may be dangerous for both child and adolescent pedestrians (Stavrinos et al., 2009; Tapiro et al., 2016).

Beyond the inherent vulnerability of child pedestrians due to their personal cognitive, physical and behavioral development, the urban environment is often not designed for safe travel of children. Many roads are characterized by high speeds, heavy traffic volumes, and presence of obstacles that reduce visibility and increase risk of child injury (Schieber and Thompson, 1996; Schieber and Vegega, 2002; Schwebel et al., 2012). The location of schools or other attractions for children and adolescents may contribute to increased risk of pedestrian injury (Schwebel et al., 2012). Moreover, design of pedestrian facilities in urban areas frequently does not account for the limitations and needs of child pedestrians (Leden et al., 2006; Johansson and Leden, 2010; Johansson et al., 2011). Traffic calming measures such as speed humps, elevated crossings, and road narrowing were shown to be effective in providing safer crossing conditions for young pedestrians. Following installation of such measures, drivers ceded the right of way to child pedestrians at a higher rate (Johansson and Leden, 2007).

Parental supervision has the potential to contribute to pedestrian safety for children both by modeling good behaviors and by providing appropriate instructions (Barton and Schwebel, 2007; Morrongiello and Barton, 2009; Morrongiello and Corbett, 2015). However, parents may not provide the necessary skills for safe pedestrian behavior (Rosenbloom et al., 2008; Morrongiello and Barton, 2009; Morrongiello and Corbett, 2015). In addition, parents and other adults tend to overestimate a child's ability and skills proffering less supervision than necessary (Dunne et al., 1992; MacGregor et al., 1999; Morrongiello and Corbett, 2015).

In general, pedestrian behaviors is one of the road safety topics that has been extensively researched in the literature. As a result, common knowledge on the general pedestrian population is often applied to child pedestrian behaviors, limitations and needs. Further empirical findings targeting child pedestrians are required for better understanding of the phenomenon and in order to tailor appropriate injury prevention measures, with a particular focus on the detailed characteristics of crossing pedestrians and urban site conditions.

Field observational studies have been utilized to explore child pedestrian behaviors in various types of urban environment and traffic composition (Zeedyk and Kelly, 2003; Leden et al., 2006; Johansson and Leden, 2007; Rosenbloom et al., 2008; Mendoza et al., 2010). Additional forms include self-reports (e.g. Koekemoer et al., 2017) and

simulation studies (e.g. Meir et al., 2015; Morrongiello and Corbett, 2015; Tapiro et al., 2016). However, previous research with observational surveys frequently used a limited scope of data on child pedestrian behaviors. Some larger scale observational studies considered the impacts on child crossing behaviors of specific infrastructure measures such as speed cushions before pedestrian crossings (Johansson et al., 2011) or count-down pedestrian signals at signalized intersections (Fu and Zou, 2016). Recently, video-based data collection has been applied for a limited number of observational child pedestrian studies (Johansson and Leden, 2007; Morrongiello and Barton, 2009; Johansson et al., 2011; Fu and Zou, 2016).

This study intended to add to existing research on observations of child and adolescent pedestrian behaviors in real-time conditions, by conducting data collection at a variety of typical urban settings where children are most likely to be observed and where higher rates of child pedestrian injuries occur. The study aimed to characterize the behavior patterns of young pedestrians at crosswalks of different types of urban intersections and identify risk factors that may lead to road injury. In the current study, video-based data were captured on a substantial sample of children, allowing for more detailed investigation of various safety related behaviors, including interactions with the environment and other road users. An additional motivation of this study was the collection and analysis of local data on child pedestrian behaviors for planning safety interventions. It should be noted that the study observations revealed that some children used pedestrian crosswalks while riding a bicycle or other non-motorized means. Such cases were included in the study analyses as they characterize the actual use of pedestrian crosswalks by children.

## 2. Methodology

### 2.1. Study sites

Following previous analyses of pedestrian crashes in urban areas and child travel activities (Levi et al., 2013, 2015), this study focused on crossing behaviors of pedestrians under age 18, during leisure hours. In Israel, the traffic laws require that drivers slow down at crosswalks and stop if the pedestrian shows intent to cross; this includes standing near the crossing and preparation for crossing as well as actually stepping onto the crosswalk. Pedestrians and particularly children at schools, are instructed to stop prior to crossing a road and check for vehicles. Road safety messaging and education publicize that child pedestrians may not cross roads independently until age nine. In addition, the traffic laws prohibit using pedestrian facilities for cycling. A cyclist is required to get off the bicycle and walk across the crosswalk while wheeling the bicycle. The regulations also limit the use of electric bicycles to children above the age of 14 (at the time of observations; since May 2016 - above 16).

The data were collected through field observations, by means of video-recording. To select observational sites we sought pedestrian crosswalks at urban intersections, with a higher potential to observe children and teenagers, in the afternoon and evening hours. Such sites were selected on collector roads situated at the boundaries of neighborhoods or in city centers close to attractions such as community centers, public parks and shopping malls. The study focused on collector roads, characterized by substantial traffic volumes and higher pedestrian activities. Previous research indicated that such streets are associated with higher concentrations of pedestrian crashes in urban areas in Israel (Gitelman et al., 2012).

The study sites were chosen from the typical urban road settings in Israel, including: (1) signalized intersections, with a divided road layout in the junction area (two or more lanes per travel direction and a built median); (2) un-signalized intersections on undivided roads (with one traffic lane in each direction, no median), and (3) un-signalized intersections on divided roads (with two lanes in each travel direction and a built median). The sites were selected in three cities representing

Download English Version:

<https://daneshyari.com/en/article/11012366>

Download Persian Version:

<https://daneshyari.com/article/11012366>

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