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Child pedestrian street-crossing behaviors outside a primary school: Developing observational methodologies and data from a case study in Changsha, China

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ABSTRACT

Background: Child pedestrian injury is a significant global public health challenge, and prevention programming requires an understanding of the context children face when crossing the street. Methods to understand children's behavior in real-world pedestrian settings are sparse in low- and middle-income countries.

Methods: Children in grades 1–6 were videotaped crossing a three-lane street outside their school in Changsha, China. Tapes were coded to collect: (1) extent of adult supervision, (2) whom children crossed the street with, and (3) safe behaviors exhibited by children.

Results: Observational videotape methods yielded data that could be reliably coded to understand Chinese children's behavior crossing the street outside their primary school. In total, we observed 216 child pedestrians crossing the street, including 105 girls, 105 boys, and 6 for whom gender could not be determined. 51% of observations occurred in the morning before school and 49% in the afternoon after school. Children encountered a busy and somewhat-chaotic traffic environment. Adults were always present to help, but children appeared to heed adult advice concerning the crossing only about 70% of the time. Fewer than 1/3 of children looked at oncoming traffic before they entered a lane and over 1/3 entered a lane with moving traffic approaching.

Conclusion: Observational methods of coding videotaped behavior proved effective to understand and code children's risk and safety while crossing the street outside their primary school. At the street environment we studied, we found that children's pedestrian behavior involved significant risk.

1. Introduction

Injury is the leading cause of death for children ages 1–19 in China, accounting for 52.5% of all deaths in 2015 (Institute for Health Metrics and Evaluation). Among injury causes, transportation injury is one of the top two causes of Chinese child injury death, with Global Burden of Disease 2010 estimates suggesting 34% of Chinese pediatric (age 6–9) road traffic deaths occur to pedestrians rather than other road users (Institute for Health Metrics and Evaluation). Of additional concern, pedestrian injury rates are

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increasing in China. Ma and colleagues recently reported a pedestrian injury increase of 44% in China from 2006 to 2010 (Ma et al., 2015) and GBD 2015 estimates indicate a pedestrian mortality of 5.25 per 100,000 population in China (Institute for Health Metrics and Evaluation). A recent national survey found that about 40% of Chinese children in grades 4–6 walk to school (Sun et al., 2015).

Development of child pedestrian safety programs requires an understanding of the ecological and environmental context children face when crossing the street, and what behaviors children display during their crossings. Such detailed evidence is lacking for China and many other low- and middle-income countries (LMIC), as a large portion of published research on child pedestrian behavior has been conducted in developed nations such as the United States, United Kingdom, France, and Australia, where children face ecological street environments very different from that in LMIC (Karsch et al., 2012).

To address the absence of data on child pedestrian street-crossing in China, the most populated middle-income country, existing methodologies must be adapted to describe the ecological environment faced by Chinese children crossing to school, and to analyze the behaviors children display in such environments. We conducted an observational case study to evaluate the feasibility of adapting existing observational strategies from high-income countries to analyze behavior, risk and safety of children crossing the street near their school in Changsha, China.

We had two primary goals. First, we evaluated the feasibility of applying behavioral observation methodology developed in high-income countries to a more complex pedestrian environment in China. Second, we sought to offer empirical data on three topics relevant to children's safety while crossing the street near their school in a case study: (1) whom children physically cross the street with, (2) the extent of adult supervision during the crossing, and (3) the extent of safe behaviors exhibited by children.

2. Methods

2.1. Site

This research was conducted in a public street location outside an elementary school in Changsha, Hunan Province, China. The school served students in grades 1–6, suggesting children crossing the street to school were about ages 6–12. Children crossed at a marked pedestrian crosswalk (“zebra crossing”) that was about 9.5 m wide and located in a mid-block unsignalized location. Chinese law dictates drivers should yield to pedestrians in marked crosswalks (Hu, 2003), but in practice such yielding is uncommon and the law is rarely enforced by authorities. The crosswalk spanned a three-lane thoroughfare. The two lanes closest to the school were one-way, with varied traffic including buses, trucks, cars, two-wheeled motorcycles, electric bikes, and bicycles. During busy hours of school drop-off and pick-up, the near lane closest to the school gate was typically occupied by parked vehicles. The far lane, located on the opposite side of the street from the school, was bi-directional for public bus and two-wheeled vehicle traffic only.

As in most urban Chinese settings, the school was located in a crowded urban area amidst a densely-populated neighborhood. The neighborhood included wide sidewalks, busy major thoroughfares, and smaller arteries having multi-use passage by pedestrians, bicyclists, motorcyclists, and motor vehicles. Traffic at the street-crossing we observed was dense and nearly constant.

Pilot observations suggested adult pedestrians often crossed the street in front of the school one lane at a time, waiting in the middle of the street for a safe gap to enter the next lane. Vehicles slowed or yielded to pedestrians on some occasions. A volunteer adult crossing guard was always present during school drop-off and pick-up times, and a uniformed police officer was sometimes present as well.

2.2. Procedure

Research assistants placed a digital camera with a wide-angle lens on the opposite side of the street from where children were crossing. Thus, a camera was located near the school in the morning as children crossed to enter school and on the opposite side of the street in the afternoon as children departed from school. Not all children crossed the street, as some were walking to their home or a bus stop that was located on the same side of street as the school. Recording lasted for about 10 min for each session (slightly longer for morning hours, when children arrived across a wider time window, than for afternoon hours when all children left school at about the same time), capturing all children who crossed the street to and from school during peak hours.

Our goal was to obtain sufficient data to observe patterns in children's behavior, and to obtain approximately similar amounts of crossings (about 100) in both the morning and the afternoon. To accomplish these goals, we recorded children's crossing behaviors for 3 morning and 2 afternoon sessions, totaling 59 min of recording when children were actively crossing the street to or from school. To obtain maximum variability in behavior and sampling, we selected four different days of the week for recording (Monday and Thursday afternoons and Tuesday, Wednesday, and Thursday mornings). To achieve variation in weather, family behavior, and to some degree in sampling, we recorded in three different months that spanned two academic school years (one recording in April 2016, three in June 2016, and one in August 2016). Weather in Changsha is temperate, so the weather was warm during all recordings. We avoided rainy days.

In total, we observed 216 child crossings, 111 in the morning and 105 in the afternoon. Vehicle traffic density was 26.08 vehicles per minute and child pedestrian density was 4.06 pedestrians per minute. All study protocols were reviewed and approved by the Institutional Review Boards at University of Alabama at Birmingham, USA, and Central South University, China. Informed consent was waived by the review boards, as we were observing behaviors in a public location.

Digital recordings were viewed by research assistants to gather information about children's behavior and the environmental context. Different research assistants were assigned to code different variables; in total, about 6 coders were involved in the work. Recordings were repeatedly viewed with attention to individual pedestrians on multiple variables. To establish reliability of data

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