Journal of Transport & Health xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Journal of Transport & Health

journal homepage: www.elsevier.com/locate/jth

Latent analysis of Complete Streets and traffic safety along an urban corridor

Kara E. MacLeod[a,b,*], Rebecca L. Sanders[a,c], Ashleigh Griffin[a,d], Jill F. Cooper[a], David R. Ragland[a]

[a] Safe Transportation Research & Education Center University of California, Berkeley, 2614 Dwight Way #7374, Berkeley, CA 94720, USA
[b] UCLA Fielding School of Public Health, Los Angeles, CA, USA
[c] Toole Design Group, Portland, OR, USA.
[d] Kittelson & Associates, Inc., 354 SW Upper Terrance Dr., Bend, OR 97702, USA.

ARTICLE INFO

Keywords:
Complete Streets
pedestrian safety
traffic safety
typologies
vehicle conflict
Vision Zero

ABSTRACT

Background: To evaluate Complete Street implementations that covary, the present paper aims to: 1) explore the development of typologies of intersections; and 2) examine how these typologies relate to traffic safety.
Methods: The study site is a five-mile segment in Los Angeles County, California. Multiple indicators of environmental features were collected in 2012 and were included in a latent analysis. Latent classes were then analyzed as a predictor of the number of pedestrian injuries/fatalities and injuries/fatalities for all modes in separate models using negative binomial regression and controlling for exposures. Injuries/fatalities for a 6-year period were used (2009-2014), representing the most recent crash data available surrounding the environmental data collection time point. We also examined the role of alcohol.
Results: For a relatively short segment of an urban corridor, we identified two distinct classes of intersections. One class was more complete with respect to pedestrian features but was also associated with indicators of increased potential conflict and was predictive of higher overall injuries/fatalities for all modes. This class also had higher pedestrian volumes but was not predictive of higher pedestrian injuries/fatalities in the final models. The alcohol involvement in crash injuries at these locations did not differ by intersection class but was positively associated with injuries/fatalities for all modes and with severe/fatal injuries for pedestrians in the final models.
Conclusions: Typologies can be used to understand the combination of features and to prioritize locations for treatment. While Complete Streets may help counter pedestrian injury trends, the efforts captured in this data are insufficient for municipalities aiming for Vision Zero. Ideally, future research can examine these intersections after the implementation of additional improvements in order to isolate treatment effects. These findings suggest additional intersection countermeasures are needed, in addition to efforts to address social problems such as alcohol use and traffic safety.

* Corresponding author at: UCLA Fielding School of Public Health, Los Angeles, CA, USA.
E-mail addresses: Kara.E.M@gmail.com (K.E. MacLeod), rsanders@tooledesign.com (R.L. Sanders), agriffin@kittelson.com (A. Griffin), cooperj@berkeley.edu (J.F. Cooper), davidr@berkeley.edu (D.R. Ragland).

http://dx.doi.org/10.1016/j.jth.2017.05.001

1. Introduction

Active transportation can be important for meeting physical activity recommendations (De Nazelle et al., 2011) and active commuting has been associated with lower body mass index (BMI) among adults (Lindström, 2008). Conversely, time spent in cars has been associated with negative health outcomes, including higher BMI (Hoehner et al., 2012; Lopez-Zetina al., 2006) and increased cardiovascular disease-related mortality (Warren et al., 2010). Additionally, there are environmental (De Nazelle et al., 2011) and other benefits to active travel (Mattisson et al., 2014). As such, several national, state, and often local efforts aim to increase active transportation and walking (Office of the Surgeon General, 2015).

Multiple studies indicate that the built environment impacts whether and how much people walk. People who live in walkable neighborhoods walk more than those who do not, controlling for self-selection, and people living in these types of neighborhoods are generally less likely to be overweight or obese (Saelens et al., 2003; Frank et al., 2007). Recent longitudinal studies provide support for building walkable environments to increase physical activity (Hirsch et al., 2014; Knuiman et al., 2014). Well-established environmental dimensions of walkability include population density, land use diversity, connectivity, and destinations that will attract pedestrians (Ewing and Cervero, 2010; Frank et al., 2010; Saelens and Handy, 2008).

While numerous benefits of active travel have been documented, research has also found significant barriers to active travel, including fear of traffic danger (Dill et al., 2006; Schlossberg et al., 2008). This fear is not unfounded: pedestrians and bicyclists lack the protection of motor vehicles (thus the name “vulnerable road users”), and the data bear this out: accounting for exposure, compared to other roadway users, pedestrians are the leading fatally injured mode per person trip (Beck et al., 2007). Most U.S. communities are designed to favor motor vehicles. Reducing conflict with motor vehicles, improving visibility of pedestrians, reducing motor vehicle speeds, and increasing awareness are effective countermeasures (Campbell et al., n.d.). Unfortunately, by designing roadways to facilitate throughput using speeds incompatible with vulnerable road users, many communities have inadvertently prioritized motorists over that of pedestrians and bicyclists. The Complete Streets movement has sought to remedy this trend by encouraging street design that clearly welcomes and accommodates pedestrians, bicyclists, drivers, and transit and truck traffic where applicable. However, as municipalities increasingly adopt the goal of Vision Zero, the impact of improvements associated with the Complete Streets principles are still being evaluated. As people are encouraged to walk and bicycle more to increase physical activity, are they safer doing so?

In an effort to understand mobility and safety in an urban corridor, the California Department of Transportation (Caltrans) initiated this project to examine how environmental features affect pedestrian, bicyclist, and driver safety and mobility. These features can be correlated within an intersection and along a corridor. The present paper focuses on identifying these patterns and how they relate to pedestrian and overall traffic safety.

2. Material and methods

2.1. Study Site

The study site is in Los Angeles County, California, U.S.A. This study was conducted on the five-mile segment (or approximately 8 km) of Santa Monica Boulevard running from the western border of West Hollywood to its intersection with Highway 101 in the City of Los Angeles. Santa Monica Boulevard is a State Route that acts as an urban arterial in Los Angeles. The West Hollywood section is also an urban arterial, but this section was relinquished from the California Department of Transportation to the City of West Hollywood in 1999. A reconstruction project in 2001 included the design of many landscape, pedestrian, and bicyclist features for the West Hollywood section.

Urban arterials or corridors in the U.S. are a type of highway that typically have a high concentration of commercial and retail attractions, often in addition to multi-family residential buildings. Urban arterials act as a magnet for all types of traffic.

2.2. Data

In addition to police reported traffic crash data, data for this study includes an inventory of environmental features (landscape and design features) along with other characteristics of the corridor including speed and vehicle and pedestrian volume.

2.2.1. Environment

The research team developed a checklist to facilitate data gathering. The checklist included elements needed to perform the National Cooperative Highway Research Program's Multimodal Level of Service Analysis for Urban Streets, which assesses how well various roadway users’ needs are met on an urban street. The San Francisco Pedestrian Environmental Quality Index was also used for the facility analysis. Data were recorded on intersection features (e.g. marked crosswalks), segment features (e.g. sidewalk conditions), land use (e.g. business), landscaping (e.g. shade trees), sources of conflict (e.g. crossing distances), and traffic calming measures (e.g. median widths). (See Appendix A for facility checklist).

Data for Santa Monica Boulevard was first collected using Google Maps™ Street View and Google Earth™ to record features and measurements. Data were collected between October 2011 and March 2012. Not all measurements could be recorded using Google Earth™ because of lack of visibility. The measurements and observations were then field verified and completed during a site visit with good weather between Tuesday, March 27, 2012 and Thursday, March 29, 2012. Standard engineering measuring wheels and stop watches were used to measure distance and time. Data was gathered for each of the 80 intersections and for the roadway