Transportation Research Part D 33 (2014) 17–25

Contents lists available at ScienceDirect

Transportation Research Part D

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

Developing a measure of traffic calming associated with elementary school students' active transport

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ARTICLE INFO

Keywords:
Traffic calming
GIS-measures
Physical activity
Active transport
Walking and biking to school

ABSTRACT

The objective of this study is to develop a measure of traffic calming with nationally available GIS data from NAVTEQ and to validate the traffic calming index with the percentage of children reported by school administrators as walking or biking to school, using data from a nationally representative sample of elementary schools in 2006–2010. Specific models, with and without correlated errors, examined associations of objective GIS measures of the built environment, nationally available from NAVTEQ, with the latent construct of traffic calming. The best fit model for the latent traffic calming construct was determined to be a five factor model including objective measures of intersection density, count of medians/dividers, count of low mobility streets, count of roundabouts, and count of on-street parking availability, with no correlated errors among items. This construct also proved to be a good fit for the full measurement model when the outcome measure of percentage of students walking or biking to school was added to the model. The traffic calming measure was strongly, significantly, and positively correlated with the percentage of students reported as walking or biking to school. Applicability of results to public health and transportation policies and practices are discussed.

Introduction

In the United States and globally, improving levels of physical activity has become a primary goal of public health (U.S. Department of Health and Human Services, 2010; WHO, 2012). Walking and biking are two of the most common forms of physical activity and, when conducted as a means to get from one location to another (as opposed to recreational physical activity), they are referred to as transportation physical activity or active transport. Prior studies have found active transport to be facilitated where supportive built environment infrastructure (including sidewalks, bicycle lanes, and traffic calming elements) exists (Brownson et al., 2009). The fields of transportation and public health have come together in recent years to focus on specific GIS-derived measures of the built environment infrastructure (i.e., land-use and street connectivity) with some studies even combining measures to create indices (Saelens and Handy, 2008). However, many studies to date have been by subjective and survey-based measures of parental perceptions of the built environment (Panter et al., 2010), studies of the built environment in select locations (Tester et al., 2004; de Vries et al., 2010), or meta analyses (Bunn et al., 2003).

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http://dx.doi.org/10.1016/j.trd.2014.08.022
1361-9209/

Even a strong study that validated a GIS-derived measure against a field audit and linked it to physical activity among adults was conducted in a narrow geographic region (Hanja et al., 2013).

While research has established that walking and cycling among adults is increased in more walkable neighborhoods, and those with interconnected streets, higher residential density, and mixed land use increases (Saelens and Handy, 2008), few studies have examined objective measures of the built environment and walking and biking to school among school-aged children. A recent review of 50 walking and 35 pedestrian injury studies found that only traffic calming and presence of playgrounds/recreation areas were consistently associated with more walking and less child pedestrian injury (Rothman et al., 2014). We expect that traffic calming will likely be associated with walking and biking to school among students in our study. We also expect, although previous studies have found mixed results (Braza et al., 2004; Bungum et al., 2009; Kerr et al., 2006) that interconnected streets will be significantly and positively associated with walking and biking to school.

The purpose of this paper is to develop a measure of traffic calming with nationally available GIS data from NAVTEQ and to validate the traffic calming index with a measure of active transport to school, using data from a nationally representative sample of elementary schools in 2006–2010. Analyses used structural equation modeling (SEM), which is a logical methodology for constructing and analyzing the association of objective measures of GIS data with a "latent" construct, and then testing its association with a measure of children's active transport to school.

Data and methods

Sample

The geographic focus for this study was the area surrounding a nationally representative sample of elementary schools. The sample of schools was developed by sampling experts at the Institute for Social Research at the University of Michigan who used sampling frames based on the National Center for Education Statistics (NCES) Common Core of Data (CCD) to identify a nationally representative sample of public elementary schools. Because elementary schools vary in grade composition (e.g., kindergarten to third grade, second to fifth grade), all schools were required to include a third grade. Public schools from all coterminous US states (excluding Alaska and Hawaii) were eligible for sampling. Due to the risk of correlated errors, for schools sampled in multiple years, only the most recent year of data was used. The final sample used in the present study is comprised of a pooled, cross-sectional sample (n = 1686 unique schools) located within 47 of the 48 contiguous states (no schools from WY were represented in the final sample, due to the low population density of that state).

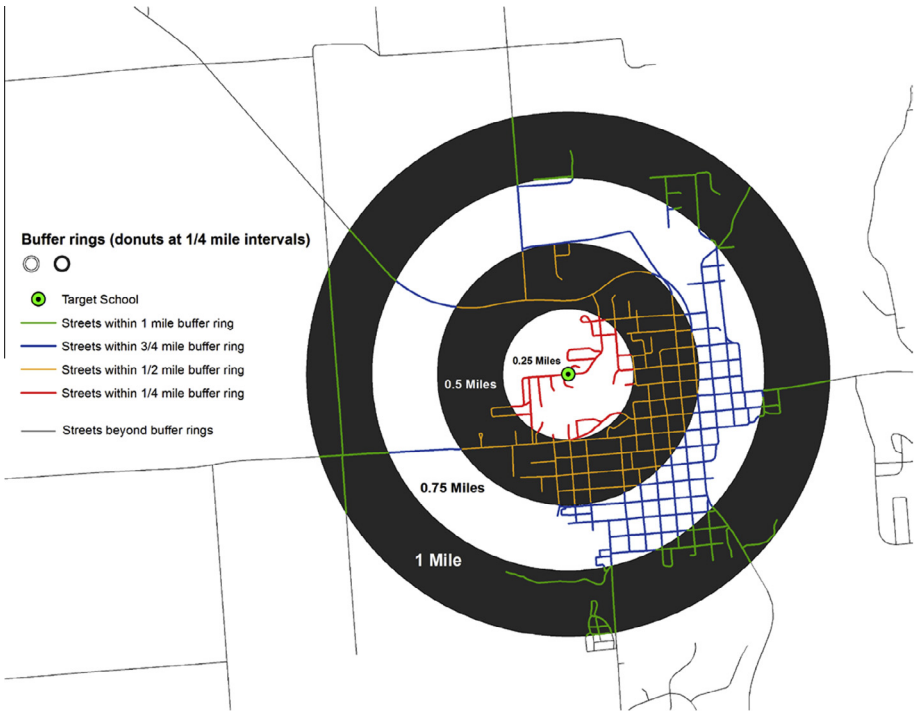

Fig. 1. GIS protocol for ring donut buffer zones.