Landscape and Urban Planning 167 (2017) 240–248

Contents lists available at ScienceDirect

Landscape and Urban Planning

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

Research Paper

Reliability between online raters with varying familiarities of a region: Microscale Audit of Pedestrian Streetscapes (MAPS)

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ARTICLE INFO

Keywords:
Microscale audit
Streetscapes
Pedestrian
Physical activity
walkability

ABSTRACT

Background: To test inter-rater reliability of the online Microscale Audit of Pedestrian Streetscapes (MAPS) tool between raters with varying familiarities of Phoenix, Arizona.
Methods: The online MAPS tool, based on the MAPS in-field audit tool and scoring system, was used for audits. Sixty route pairs, 141 segment pairs, and 92 crossing pairs in Phoenix were included. Each route, segment or crossing was audited by two independent raters: one rater in Phoenix and the other in San Diego, California, respectively. Item, subscale scores, and total scores reliability analyses were computed using Kappa or intra-class correlation coefficient (ICC).
Results: The route overall score had substantial reliability (ICC: 0.832). Of the route subscale and overall scores, sixteen out of twenty had moderate to substantial reliability (ICC: 0.616–0.906), and the four subscales had fair reliability (ICC: 0.409–0.563). Sixteen out of twenty scores in segment and crossing sections demonstrated fair to substantial reliability (ICC: 0.448–0.897), and the remaining four had slight reliability (ICC: 0.348–0.364).
Conclusions: Most of the online MAPS items, subscales, and overall scores demonstrated fair to substantial reliability between raters with varied familiarities of the Phoenix area.
Results: support use of online MAPS to measure microscale elements of the built environment by raters unfamiliar with a region.

1. Introduction

Physical inactivity is one of the most important public health issues in the U.S. and internationally, due to its contribution to premature mortality and economic costs (Janssen, Carson, Lee, Katzmarzyk, & Blair, 2013; Jia & Lubetkin, 2014). A growing body of research indicates linkage between elements of the built environment and physical activity (Adams et al., 2012; Brownson, Hoehner, Day, Forsyth, & Sallis, 2009; Davison & Lawson, 2006; Rutt & Coleman, 2005; Sallis et al., 2009, 2015). Researchers have shown that macro-level features of the built environment, including regional land-use patterns, residential densities, and access to parks and public transportation, shape access to opportunities for physical activity (Li et al., 2008; Nagel, Carlson, Bosworth, & Michael, 2008; Troped, Wilson, Matthews, Cromley, & Melly, 2010). Diverse combinations of objectively-measured built environment features have been positively and consistently related to physical activity (Sallis et al., 2016) and walking behaviors (Adams et al., 2015; Kaczynski, 2010), and results appear robust across children (Kurka et al., 2015) and older adults (Adams et al., 2012; Kerr et al., 2014).

Elements of built environment for a region can be measured at the landscape or microscale level (e.g., sidewalk presence and qualities, street furniture, aesthetic, natural and cultural qualities of the built environment), using field or online direct observation or audits. Microscale audits of specific neighborhoods or routes are desired to capture details of a local context at a higher resolution and reflect people's experiences with the environment (Brownson et al., 2009). Numerous microscale audit tools have been developed to evaluate how

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http://dx.doi.org/10.1016/j.landurbplan.2017.06.014
Received 5 November 2016; Received in revised form 20 June 2017; Accepted 22 June 2017

built environment elements associate with residents' physical activity, and several have demonstrated good inter-rater reliability (Bethlehem et al., 2014; Clifton, Livi Smith, & Rodriguez, 2007; Millstein et al., 2013; Pikora et al., 2002). One validated instrument for assessing detailed attributes of the built environment relevant to physical activity is the Microscale Audit of Pedestrian Streetscapes (MAPS) tool (Millstein et al., 2013). The items and subscales of the in-field MAPS tool have demonstrated moderate to substantial reliability, and the scoring represents a conceptual framework for microscale elements. MAPS has been used to examine associations of microscale attributes with physical activity, and findings show strong and positive associations for four age groups in three U.S. cities, even after accounting for macro-level features (Cain et al., 2014). Additional studies are needed to assess the reliability and validity of MAPS in different regions and cities. At present, the use of MAPS is also limited by need for a field visit to directly observe and score the physical environment, which can be time intensive, expensive, and sometimes unsafe.

Web-based virtual mapping tools like Google Street View, which integrate photos in a geospatial framework, provide rich visual evidence of urban areas and can potentially reduce the burdens of in-field auditing. Testing the reliability of virtual audit tools evaluates consistency in measurements across different raters with diverse backgrounds and knowledge of a region, and offers potential to more efficiently implement audits across large or geographically dispersed areas (Brownson et al., 2009). A few recent studies (Ben-Joseph, Lee, Cromley, Laden, & Troped, 2013; Bethlehem et al., 2014; Griew et al., 2013; Kelly, Wilson, Baker, Miller, & Schootman, 2013) have shown acceptable reliability between in-field audits and online image-based audits for measuring microscale characteristics. Web-based virtual tools have proven to be good alternatives to field audits, with higher agreement for objectively verifiable elements (i.e., presence of infrastructure and equipment) and lower agreement for subjectively assessed items (i.e., aesthetics) (Charreire, 2014). Online auditing opens the possibility of observers auditing locations far from their actual locations, even places they have never physically visited. However, no studies could be found that examined inter-rater reliability between observers with varying familiarities of a region (living in vs. outside of a region).

The aim of the current study was to test inter-rater reliability of the online MAPS tool between independent raters from Phoenix, Arizona vs. San Diego, California with inherently different familiarities of the Phoenix metro region. We conducted the analysis in three levels, including the levels of individual MAPS items, subscales, and total scores (sum of positive and negative subscales) to evaluate reliabilities for different levels within the MAPS tool. We hypothesized that the online MAPS tool could be used reliably at all levels to measure microscale elements of the built environment by raters with different familiarities of the Phoenix metro area.

2. Methods

2.1. Sample

A total of 60 routes were selected and evaluated using MAPS in the Phoenix metro area, which is located in the southwestern United States, in the south-central portion of the U.S. state of Arizona. To ensure variability in neighborhood elements, all Census block groups from Maricopa County, Arizona were classified using a 2 by 2 matrix considering the macro-level factors of walkability and socioeconomic status (SES). Walkability was defined by a block group-level composite of GIS (geographic information systems)-measured net residential density, land use mix, and street connectivity. SES was defined using block group-level median household incomes. An equal number of routes were selected for each cell in the walkability by SES matrix. Residential routes consisted of a pre-determined quarter mile route from an origin residential parcel toward a pre-selected non-residential destination (i.e., a cluster of commercial land uses) (Millstein et al., 2013). A quarter mile route was used to standardize the audit distance and limit observation time. Commercial routes consisted of a street segment in front of a pre-selected commercial cluster, defined by three or more commercial destinations, with the street bounded by two intersections. More details about route selection and definitions have been published previously (Kurka et al., 2016).

2.2. Measures

The online version of the MAPS tool, henceforth called the online MAPS tool, was based on the MAPS in-field tool and developed for use with Google Street View. The in-field version of the MAPS tool was developed from prior measures to assess streetscapes for physical activity (Millstein et al., 2013). In the Millstein et al. study, the research team collected microscale environmental data in urban and suburban neighborhoods in Seattle/King County, Washington, San Diego County, California and five counties in the Baltimore, MD/Washington, DC region. Their in-field study included 290 routes, 516 segments, and 319 crossings (Millstein et al., 2013).

Based on the in-field version of MAPS, the purpose for the development of the current online MAPS tool was to take advantage of growing source of online street view data in the U.S. and internationally. Paralleling the four sections of the original MAPS tool (Millstein et al., 2013), the online MAPS tool consisted of: a) an overall route, b) street segments, c) crossings, and d) cul-de-sacs. Route-level variables summarized characteristics for the whole route, including items related to land use and destinations, transit stops, street amenities, traffic calming, aesthetics, and the social environment. Street segment-level variables were collected on every segment on the route and consisted of sidewalks, pedestrian buffers, sidewalk slope, bicycle infrastructure, sidewalk visibility from buildings, street trees, shade, and building aesthetics, setbacks and overall height. Street crossing variables were measured at every intersection or crossing on the route, and included crosswalks, slopes, width of crossings, crossing signals, and pedestrian protection. Cul-de-sac variables were assessed only when one or more cul-de-sacs were present within 400 feet of the participant's home. The cul-de-sacs section assessed the potential recreational environment within a cul-de-sac and included items about the size and condition of the surface area, slope, surveillance from surrounding homes, and amenities. The number of segments, crossings and cul-de-sacs varied by route.

A previously developed conceptual system for scoring the MAPS in-field audit tool was also applied to group items into subscales (Millstein et al., 2013). The scoring system was guided by a combination of factors thought to influence physical activity: safety, aesthetics, destinations, land use, recreational facilities, transportation, etc. The subscale scores were computed by summing those related items' scores. The subscales were then sorted by their expected positive or negative effects on physical activity to create these valence scores. Finally, an overall section score was calculated for each of the main sections.

Google Earth is a free geographic software program which views satellite images in excellent resolution, depicting anywhere on the face of the earth. It displays ground-level views of streets and buildings via car-mounted 360° cameras (Google Street View), as well as satellite images allowing a perpendicular or oblique angle view of streets, buildings, and landscapes (Google Aerial View). In this study, Google Street View was the main tool used for measuring microscale features. The assessments were conducted by traveling the assigned route while scanning the forward-looking arc of 180° approximately every 100 feet and recording features and details along the designated route. Google Aerial View was used only when characteristics were harder to view in images from Google Street View or blocked by obstructions along the street, such as trees or the building setback from the sidewalk. Raters were required to use the most recent layer of information on Google Earth and record the date of the images during the audit. Raters