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Neighborhood walkability and active ageing: A difference in differences assessment of active transportation over ten years

Oriol Marquet[a,*], J. Aaron Hipp[a], Carme Miralles-Guasch[b]

[a] Department of Parks, Recreation, and Tourism Management and Center for Geospatial Analytics, North Carolina State University, USA
[b] Department of Geography, ICTA (Institute for Science and Environmental Technology) Universitat Autònoma de Barcelona, Spain

A B S T R A C T

The effects of neighborhood morphology and walkability over active travel patterns of ageing older adults are still largely unknown. We used a difference-in-differences design to compare the changes in active transport indicators on older adults ageing for ten years in different areas of the Barcelona Metropolitan Region (Spain). Participants were drawn from two large cross-sectional travel surveys in 2004 and 2014 creating a 10 year span in which they aged from 65–75 y.o. to 75–85 y.o. High walkability was associated with more minutes spent walking, and higher odds of meeting Physical Activity (PA) recommendations. Ageing in low walkable areas, in contrast, was associated with lower amounts of PA derived from transportation.

1. Introduction

Europe has one of the most prominent demographic ageing trends worldwide over the next 20 years (Walker and Maltby, 2012). With the proportion of people over 65 years old expected to triple in the next half-century (Rechel et al., 2013), ageing has become a significant theme in public policies, from planning to public health (Hooper et al., 2015; Tsai et al., 2015). Both active ageing and ageing in place are important strategies for health promotion among people older than 65 years old. According to the WHO (World Health Organization, 2002), 2002 definition, active ageing includes more than just staying mentally and physically active, but also to remain involved and empowered within the community (Rowland, 2013). In the same line, strategies focused on ageing in place aim in part to satisfy the need to avoid unwilling relocation once the ageing process produces a decrease of capabilities, mobility disabilities or loss of independence (Buffel et al., 2012; King et al., 2017).

There is now a growing body of research that describes how the built environment can affect multiple outcomes of the ageing process. For environmental gerontologists, how the environment can support physical activity and maintain the independence of older people while they age is of particular interest (Vine et al., 2012). A general consensus exists that walkable environments provide support for higher amounts of physical activity (Ding et al., 2014; Hajna et al., 2015; Hansen, et al., 2013; King et al., 2011) as well as for higher degrees of independence (Clarke and George, 2005; Clarke and Nieuwenhuijsen, 2009) and social engagement (Beard and Petitot, 2011; Hanibuchi et al., 2012; Lager et al., 2015; Leyden, 2003; Zeitler et al., 2012). Overall it is thought that an age-friendly environment can ease the process towards adapting to older adults' diminishing moving capabilities.

Many critical aspects of active ageing and ageing in place are encompassed on how the local environment supports the movement and transportation needs of the older population (Winters et al., 2015). Transport is a determinant of health inequalities as it contributes to the existence, persistence, and widening of health disparities inside cities (Giles-Corti et al., 2016). Travel behavior is known to be constructed by a combination of socioeconomic characteristics, built environment possibilities, and the existence of

* Corresponding author.
E-mail addresses: omarque@ncsu.edu (O. Marquet), jahipp@ncsu.edu (J.A. Hipp), carme.miralles@uab.cat (C. Miralles-Guasch).

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preferences and habits (De Witte et al., 2013), and thus is subjective to change with personal physical changes experienced while ageing. Differences in individual motility –that is, the potential for mobility (Kaufmann and Bergman, 2004)- are determined in part by earlier life decisions, such as that to move outside the city or to reside in an urban, walkable area (Stjernborg et al., 2014). In these cases, ageing in-place forces individuals to adapt to an often unchanged built environment around them (Zeitler et al., 2012). This inadequacy of the built environment to respond to the diminished travel capabilities exacerbates the inability to maintain a normal transportation lifestyle and has been labeled as becoming a prisoner of space (Rowles, 1978); that as one ages in an environment less conducive to comfortable walking they become more and more confined to their home or residential space. This turns to be especially true in Mediterranean societies where residential mobility is low (Angelini and Laferrère, 2012) and thus the possibilities of moving to a more favorable built environment are less likely.

The decline of physical capabilities usually associated with older adults ageing for 10 years makes the reachable travel area shrink (Weiss et al., 2010) and the availability of desired activity locations near the residence even more important (Marquet and Miralles-Guasch, 2015). Ageing from 65–74 to 75–84 years of age is a crucial stage in life, one that sees a drastic reduction of physical capabilities and puts stress on available possibilities of travel (Yen et al., 2014). Supporting seniors' travel capabilities is important in order to sustain their quality of life, including not only their most basic sustenance needs, but also secondary needs like social interaction or leisure, that are also crucial for their well-being (Sikder and Pinjari, 2012). The failure to support travel needs by the local environment can lead to individuals becoming not only more sedentary but also less social (Richard et al., 2009) and can lead eventually to isolation (Stjernborg et al., 2014). In particular, low walkable environments have been found correlated with lower Physical Activity (PA) levels (Michael et al., 2006) and lower frequency of walking (Zeitler et al., 2012). On the other hand a number of studies have found some built environment characteristics, such as, density, land use mix and connectivity, to foster walking for transport in older adults (Frank et al., 2010; Li et al., 2005). Studies have also found how vital environments are to encourage older adults to walk (Marquet and Miralles-Guasch, 2015). Walking for transport is an important source of PA for older adults, who particularly need to remain active in order to prevent chronic disease and maintain everyday basic physical functions (Pahor et al., 2014). The built environment thus has a central role in enabling ageing in place and in facilitating opportunities for the development of healthy behaviors in later life.

A lack of evidence exists however, when it comes to actually understanding how the walkability of the environment can affect healthy travel behaviors after ageing in specific environments for long periods of time. In other words, while the impacts of *living* in a low/high walkable environment have been properly studied, there is no such research on the effects of *ageing* for 5 or 10 years in high/low environments. The focus has thus to change from a static view of the effects of walkability to a dynamic and accumulative view of how spending the ageing life stage in a particular environment can affect healthy behaviors.

The term walkability is often used in the literature to define an environment that meets the necessary morphological and functional features to not only enable walking as an everyday mode of transport, but also to promote it (Leslie et al., 2007). It is usually associated with high levels of population density, land use mix, and measures of connectivity and design (Ewing and Handy, 2009). In particular, there is a need to understand the effects of the environment not in older adults who reside in an environment in a moment of time but in older adults that age through the years in a particular urban environment. The accumulated effects of living in a place with particular conditions can be additive, especially in sensitive life-stages. To better understand these effects, more longitudinal and experimental research is needed to give additional weight to the findings achieved using cross-sectional methods (Beard and Petitot, 2011). Unfortunately, longitudinal studies are scarce and almost all of them include a short follow-up period. A recent review found only two longitudinal studies involving ageing that included ten or more years of follow-up (Beard and Petitot, 2011) Others have found an overall prevalence of cross-sectional studies (Haselwandter et al., 2015). Only Hirsch et al. (2014) provide a notable exception with a longitudinal study that has no parallel on the European context and that does not focus exclusively on seniors. In that situation, the use of alternative methodologies like difference in differences can provide additional findings by mimicking the functioning of longitudinal studies. Difference in Differences (DiD) methods allow us to compare the paralel evolution of trends in two different areas or groups of population. Here we use DiD to address the gap in the literature and to investigate how much of the age-related change in travel behavior is attributable to walkability. By investigating how older adults' travel behavior change as they age across two time points and in two neighborhood designations, we are able to understand the role of low and high walkable environment in the promotion and maintenance of healthy travel habits as we age.

2. Methods

The present study was based on two cross-sectional surveys taken in 2004 and 2014 and covering the Barcelona Metropolitan Region in Spain. The main data source of the study is the EMEF (Enquesta de Mobilitat en dia Feiner) travel survey, an official wide-ranging travel survey taken periodically by the Catalonia (Spain) government as a joint initiative of the Department of Territorial Policy and Public Works and the Metropolitan Transport Authority of Barcelona, Spain. The aim of the survey is to describe the transportation habits of the resident population in the Metropolitan Region of Barcelona. The survey is taken every year, employing a computer-assisted telephone interviewing (CATI) technique to interview a representative sample of the population using simple random sampling. The 2004 edition of the survey had a total sample of 4642 people, while the 2014 edition had a total sample of 8851 (IERMB, 2014). The Barcelona Metropolitan Region offers an appropriate context to study contrasts on walkability effects, given the high disparity of its urban morphology, with highly dense and urbanized walkable areas lying in close proximity to areas developed around sprawled and car oriented environments (Marquet and Miralles-Guasch, 2017).

Using data from the 2004 (T_1) and 2014 (T_2) editions of the EMEF, the present study selects the participants that were between 65 and 74 years of age in the 2004 edition (n = 552; mean age = 69.5; SD = 2.84), and the participants that were between 75 and 84