Association between built environment and the incidence of disability in basic and instrumental activities of daily living in the older adults: Results of a cohort study in southern Brazil

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A B S T R A C T

The aim of this study was to evaluate the association between subjective and objective characteristics of the built environment and the incidence of disability in the activities of daily living in the older adults. A cohort study was conducted with 1196 older adults from Florianopolis, Santa Catarina, Brazil. Incidences were evaluated after four years by the difficulty or inability to perform six basic and nine instrumental activities. The subjective built environment was evaluated by the adapted Neighborhood Environment Walkability Scale and the objective for variables related to the characteristics of streets, sidewalks and land uses in the census tracts. Multilevel Logistic Regression analyzes were performed, where significant positive associations were observed between the presence of hills, and negative associations between safety for walking at night, a high proportion of commercial area, intermediate mixed land use and the incidence of disability in basic activities. The built environment characteristics associated with disability point to the need for improvements in urban infrastructure to promote functional independence in the older adults.

1. Introduction

Disability is related to several problems and/or conditions that negatively affect health, leading to limitations in body structures and functions, as well as restrictions on social participation (World Health Organization, 2001). Among older individuals, disability assessment has been used as a major marker of longevity (World Health Organization, 2005), and is commonly investigated through instruments that assess the degree of difficulty in performing basic (ADL) and instrumental (IADL) activities of daily living (Verbrugge and Jette, 1994; Guralnik et al., 1996).

It is estimated that 46.1% of the older adults in the world have some moderate or severe disability, varying between 41.4% in Europeans and 58.8% in Asians (World Health Organization, 2012). Data of older American adults indicate that disability rates in daily activities range from 2.5% (Rosso et al., 2013) and 37% (Rajan et al., 2013) after three and nine years of follow-up, respectively. Longitudinal studies on disability in low- and middle-income countries are still scarce in the literature, and the most recent study in Brazil found 17.8% of new cases of limitations in at least two daily activities in the older adults of the

EPIDOSO cohort in São Paulo after a three-year follow-up (d'Orsi et al., 2011).

Among the factors capable of potentiating or contributing to the loss of functional capacity in ADL and IADL activities are the built environment characteristics. The built environment can be defined as constructs, spaces and products created or modified by individuals (Garin et al., 2014). In health studies, it is usually measured through objective variables which are usually collected based on administrative boundaries (Wen et al., 2003). They are aimed at identifying, for example, the presence and access to health services, means of transport and locomotion, parks, commercial establishments and the neighborhood design (Freedman et al., 2008; Beard et al., 2009; Philibert et al., 2013a). In addition to these objective characteristics, other subjective characteristics (Bowling and Stafford, 2007; Ferreira et al., 2009) have also been used to evaluate the built environment, including individuals' perceptions about the presence and/or absence of infrastructure for physical and leisure activities, as well as other aspects related to aesthetics, traffic and safety in the neighborhood.

It is believed that residing in neighborhoods with larger proportions of sidewalks and paved streets, as well as greater availability of green

areas for leisure encourages older people to socialize in the community and helps them to stay active in carrying out their daily activities (Schafer and Upenieks, 2015, Vogt et al., 2015). On the other hand, unsafe neighborhoods with few pedestrian lanes and poor lighting tend to limit social interaction, and consequently older adult participation in physical and recreational activities that promote functional independence (Cho et al., 2005; Pampalon et al., 2007). Other characteristics such as the low quality of the residences are also contributing to the presence of disability, since they reflect the general conditions of the built environment, such as deteriorated sidewalks and streets, as well as less sociability in the place (Philibert et al., 2013a).

In a previous systematic review (Danielewicz et al., 2017) it was concluded that there are still few epidemiological studies that have been carried out with older adults which demonstrated significant associations between the built environment and ADL or IADL disabilities. In addition, the analyzed studies included populations from high-income countries, and so far only two studies have been conducted in a middle-income country (Ferreira et al., 2009; Ortiz et al., 2016), both with subjective variables like insecurity and defective sidewalks in the neighborhoods. There is also a need for longitudinal studies, since only one among the seven included in the systematic review evaluated the influence of objective variables on infrastructure and safety in the development of disabilities (Schafer and Upenieks, 2015).

Considering that older adults with disabilities not only have poorer quality of life, but also higher death from all causes (Forman-Hoffman et al., 2015), knowledge about contextual characteristics that may have a positive impact on the reduction of these outcomes becomes essential to encourage prevention policies, which especially involve advances in urban planning and in the actions of social organizations working in communities. Moreover, the creation of supportive environments for older adults is one of the four key areas of action proposed in the 2015 World Health and Aging Report (World Health Organization, 2015), which must be taken into account so that the elderly population can preserve its functional capacity in advanced ages. Therefore, the present study aimed to evaluate the association between subjective and objective characteristics of the built environments and the incidence of ADL and IADL disabilities in older residents in Florianopolis, Brazil.

2. Methods

2.1. Study area and population

This is a longitudinal, population-based cohort study (*EpiFloripa Idoso*) with data from older adults (≥ 60 years) sampled at baseline (2009/2010) and at first follow-up (2013/2014), which investigates the life and health conditions of the older adults of Florianopolis, Brazil. Florianopolis is the capital of the state of Santa Catarina (Southern Brazil), and according to data from the last Demographic Census it had a total population of 433,158 inhabitants, of which 11.5% were older adults. The municipality has the third-highest Human Development Index of all Brazilian municipalities (0.847), indicating high development with respect to longevity, income and education.

2.2. Data source and sampling design

The sample selection was done by a draw in two stages. The primary sampling unit was composed by census tracts, with stratification according to the average income of the head of the family. In the second stage, the units were households.

In 2009/2010, 1911 older adults aged 60 years and over of both genders were considered eligible for the study, of which 1702 were interviewed. The institutionalized older adults were excluded from the sample. In 2013/2014, 1196 older adults were interviewed considering the exclusion of deaths (n = 217), losses (n = 162) and refusals (n = 129) (70.2% of response rate). The identification of deaths was performed using the National Mortality Information System and the losses comprised older adults who were not located after four attempts. Further details on methodological and sampling procedures are published in a previous study (Schneider et al., 2017).

2.3. Study variables

The outcomes were the incidences of ADL and IADL disabilities as evaluated by the *Multidimensional Functional Assessment Questionnaire*, validated in Brazil (Blay et al., 1988). The questionnaire investigates the degree of difficulty (low/large/total) to perform six ADL (getting in/out of bed, eating, walking on the floor, bathing, dressing and toileting) and nine IADL (grooming, climbing stairs, taking medications, walking at home, shopping, preparing hot meals, cutting toenails, get out of a bus/taxi, and cleaning the house). Older adults who reported not being able to perform these or had little or much difficulty in at least one of the investigated activities were classified as having a disability according to previous studies (Cardoso and Costa, 2010; Brito et al., 2014; Gontijo et al., 2016). Incident cases in the ADL disabilities were considered to be older adults who presented little or much difficulty or an inability to perform at least one of the six ADLs investigated during follow-up, from those who did not present disability in both domains (ADLs or IADLs) or who only presented disability in the IADLs at baseline. Similarly, disability incidence in the IADLs included older adults with little or no difficulty or inability to perform at least one of the nine IADLs investigated at follow-up, considering those with no disability in both domains (ADLs and IADLs), or who only presented disability in ADLs at baseline.

The subjective built environment was evaluated at the baseline of the study (2009/2010) by an instrument adapted from Neighborhood Environment Walkability Scale (Saelens et al., 2003), and translated into Brazilian Portuguese (Malavasi et al., 2007). The perceptions (yes/no) of the interviewees were analyzed by six questions about the presence of infrastructure characteristics of the places near their residence (located < 15 min walking): 1) sidewalks; 2) green areas; 3) sidewalk steepness; 4) hills; 5) cycle paths, trails; and 6) parks, athletic courts; and five questions on traffic and safety: 1) traffic as a barrier; 2) drivers' respect to pedestrians on crossings; 3) street lighting; 4) safe to walk during the day; 5) safe to walk at night.

The objective built environment was evaluated through variables elaborated with data from the 2010 Census (Instituto Brasileiro de Geografia e Estatísticas, 2010) and Urban Planning Institute of Florianopolis. Giehl et al. (2016) used the spatial data to compile the variables "mixed land use" and "street density" using ArcGIS 9.3 ESRI® software (ArcMap/ArcInfo, version 9.3, Redlands, CA, Environmental Systems Research Institute). The definition of all analyzed variables can be seen in Chart 1.

The demographic and socioeconomic variables analyzed were self-reported by the older adults during follow-up and included: gender, age, average equalized household income and length of residence in the neighborhood.

2.4. Data analysis

The objective variables of the built environment were grouped with the other individual variables in a single database using the census tract as an identifier variable. Prior to the analysis the respondents' addresses were updated at the follow-up in comparison to the baseline, excluding those who had moved to tracts outside of those sampled by the study.

The descriptive analyzes of the sample distribution considered the incidence outcomes (ADL and IADL) and respective confidence intervals (95% CI) for each of the individual exposure and adjustment variables. The associations between the subjective and objective neighborhood variables with the incidence of each outcome were analyzed using Multilevel Logistic Regression, with their use justified by the Likelihood Ratio Test values for comparison between models (Dupont and Dupont, 2009).