Is the self-perception of the built neighborhood associated with fear of falling in community-dwelling older adults?

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ABSTRACT

Introduction: Characteristics of a built neighborhood may aggravett agravett to fear of falling in older adults and this knowledge are important to contribute to developing strategies aimed at reducing fear of falling and their consequences.
Objective: To verify the association between self-perception of built neighborhood characteristics and fear of falling in community-dwelling older adults.
Materials and Methods: This was a cross-sectional study including 308 community-dwelling older adults. The outcome was fear of falling evaluated through Falls Efficacy Scale International. Older adults were classified with high fear of falling when they obtained values ≥ 23 points and classified as low fear of falling with score < 23 point. The built neighborhood variables were evaluated by the adapted Neighborhood Environment Walkability Scale. Multivariable logistic regression was performed to verify associations between the variables.
Results: The prevalence of fear of falling was 48.40%. Significant negative associations were observed between residing near a bus stop, outdoor gyms, safe places to walk during the day, and positive associations between garbage accumulation and/or open sewers and high crime rates and fear of falling.
Conclusion: The association between self-perceived characteristics of built neighborhoods and fear of falling points to the need for improvements in urban infrastructure, especially public spaces, in order to reduce fear of falling in community-dwelling older adults.

1. Introduction

Fear of falling is defined as an exacerbated concern when performing activities of daily living (Lavedán et al., 2018). This condition is common among community-dwelling older adults and the prevalence of fear of falling varies between 45.9% (Vitorino et al., 2019) to 95.2% (Cruz et al., 2017) in Brazilian community-dwelling older adults.

The repercussions related to fear of falling involve greater costs spent on public health (Barros et al., 2015), use of anxiolytic drugs (Lord & Close, 2018) excess hospitalizations (Vitorino et al., 2017), restrictions in range of motion (Lee et al., 2017), decline in postural control and proprioception, increased risk of falls (Kovács et al., 2019), predisposition to depressive symptoms (Kendrick et al., 2016) and disabilities (Ang et al., 2020).

Some studies have associated fear of falling with environmental factors (Curl et al., 2020; Harada et al., 2016; Lee et al., 2018) and highlight the importance of intervening in the environment to reduce fear of falling. The environment has an important influence on the behavior of the older adults and can directly impact the greater risk of fear of falling (Curl et al., 2020). Outdoor places where falls happen are not well elucidated in the literature; however, they are associated with unfavorable weather conditions (rain/storms) (Lee et al., 2019), changes in the leveling of sidewalks and lighting (Chippendale & Boltz, 2018; Curl et al., 2016).

Nevertheless, the above studies (Curl et al., 2020; Harada et al., 2016; Lee et al., 2018) were mostly conducted in countries in Europe

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and North America which have economic, racial, demographic, anthropometric and socio-cultural differences when compared to middle/low income countries. Brazilian studies which aimed to analyze the association of built environment [can be defined as constructs, spaces and products created or modified by individuals (Garin et al., 2014)] with fear of falling have not been found so far. However, some studies have evaluated aspects of the living environment with less social participation (Ferreira et al., 2018), disabilities (Danielewicz et al., 2018), lower mobility (Nascimento et al., 2018) and falls (Pimentel et al., 2018) in the Brazilian older adult population. Studies with extra-individual factors that can aggravate the fear of falling are important to contribute to developing multidimensional strategies to reduce fear of falling and consequently future falls and their negative consequences to the health of the older adult population. Thus, the objective of this study was to verify the association between self-perceived characteristics of built neighborhoods and the fear of falling in community-dwelling Brazilian older adults.

2. Materials and methods

A cross-sectional study was conducted with community-dwelling older adults (60 years or older). Data were extracted from the project "Influence of the physical activity level on physical-functional performance tests in community-dwelling older adults" conducted with older adults of Balneário Arroio do Silva city, located in the state of Santa Catarina, Brazil. Older adults registered in the municipal primary healthcare information system (Strategic Health Management System - *SIGES*) were evaluated (Produced by Ibranet, Tubarão, SC, Brazil). This study was approved by the Research Ethics Committee of the Federal University of Santa Catarina (CAAE no. 87776318.3.0000.0121).

2.1. Population and sample

The sample calculation was performed considering the total number of older adults (n=2833) registered in the three Basic Health Units in the municipality. Thus, an expected prevalence of 50% (due to the great variability in the prevalence of fear of falling between different studies (Vitorino *et al.*, 2019; Cruz; Duque; Leite, 2017), a six-point error, 95% confidence interval (95%CI) and 20% for expected losses were considered for the sample size calculation.

Older adults who were bedridden, dependent or those unable to answer questionnaires, residents of care institutions or who had changed their home address were excluded. Older adults not found in their homes were considered as sample losses after three attempts made on different days and times, and refusals were those who did not accept to participate in the study after receiving a visit from the interviewers.

Data collection was carried out between September 2018 and September 2019. The selected older adults were initially contacted by phone and invited to participate in the study with visits to their homes being scheduled. Data were subsequently collected to characterize the sample and apply physical-functional assessment tests as described below.

2.2. Independent variables

2.2.1. Self-reported characteristics of the built neighborhood

The self-reported characteristics of the built neighborhood was evaluated using an adapted version (Salvador et al., 2009) of the scale Neighborhood Environmental Walkability Scale (NEWS) validated for Brazil (Malavasi et al., 2007). This instrument evaluates the perception of individuals regarding different aspects of the environment near their home considering up to 15 minutes walking distance from their residence: infrastructure (presence of sidewalks, green and leisure areas, hills, garbage and open sewage); traffic in the neighborhood (safety and pollution); and general safety in the neighborhood (lighting and safety for walking). Each investigated variable was evaluated in a

dichotomized according to the response provided by the interviewees (presence or absence in the neighborhood) (Salvador et al., 2009).

2.3. Outcome variable

Fear of falling was assessed using the Falls Efficacy Scale International (FES-I), translated and validated for the Brazilian population (Camargos et al., 2010). The evaluated older adults were asked about their concern about the possibility of falling when performing 16 activities. These activities are scored from 1 to 4 (Camargos et al., 2010; Yardley et al., 2005), reaching a total of 64 points. The older adults were classified with high fear of falling when they obtained values $\geq$ 23 points and classified as low fear of falling with score < 23 point (Camargos et al., 2010; Yardley et al., 2005).

2.4. Adjustment variables

The analyzes were adjusted considering the variables in literature review about the topic and if a significant association was found in the bivariate analysis with the outcome. A single adjustment model was tested for the following variables: gender (female and male) (Pimentel et al., 2018; Vitorino et al., 2019;); age group (60-69 years, 70-79 years and 80 years or more) (Ferreira et al., 2018; Vitorino et al., 2019); self-reported health perception (good, regular and bad) (Vitorino et al., 2017; Ferreira et al., 2018); the presence of multimorbidity (Lavedán et al., 2018; Moreira et al., 2020) (two or more self-reported clinical conditions, including pain in the spine or back, arthritis or rheumatism, cancer, diabetes, bronchitis or asthma, heart disease or cardiovascular, chronic renal failure, tuberculosis, cirrhosis, stroke or cerebral ischemia, osteoporosis, hypertension, labyrinthitis, and urinary or fecal incontinence); monthly income (Boyd & Stevens, 2009; Cho et al., 2013; Danielewicz et al., 2018; Ferreira et al., 2018; Kempen et al., 2008) (0-1.5 minimum salaries, $\geq$ 2 minimum salaries); years of formal study (Danielewicz et al., 2018; Ferreira et al., 2018) (0-4 years; 5-8 years; 9 years or more); and years of residence in the neighborhood (Danielewicz et al., 2018; Ferreira et al., 2018) (0-4 years; 5-9 years; 10 years or more)."

2.5. Statical analysis

The data were independently tabulated by two researchers in the Excel software program, and the final version was checked and later inserted in the SPSS database version 23.0 (IBM®, Chicago, IL, USA), adopting a significance level of 5%. Multivariable logistic regression analyzes were performed to test the associations between the variables of built neighborhood and fear of falling, estimating the crude and adjusted odds ratios (OR) with their respective confidence intervals (95% CI). The multicollinearity test required for binomial logistic regression was performed using the variance-inflation factor (VIF) whose value adopted as the cutoff point was > 10 (Maranhão et al., 2015). The test showed an absence of multicollinearity between the independent variables studied, since the highest VIF value observed was 3.84.

3. Results

The sample of the present study was composed of 308 older adults with a predominance of the age group 60-69 years (54.5%), with 178 (57.8%) female and 130 (42.2%) male. The prevalence of fear of falling in the sample was 48.40% according to cut-off values $\geq$ 23 points on FES-I. The socio-demographic, anthropometric and health characteristics of the evaluated older adults are described in Table 1.

The association between the perceived characteristics of the built neighborhood and fear of falling are described in Table 2. Significantly lower risk of fear of falling were observed in the crude model among older adults who reported living near supermarkets, convenience stores

Table 1

Social-demographic, anthropometric and health data of the community-dwelling older adults evaluated.

Variables	Total sample N (%)	High Fear of falling N (%)	Low Fear of falling N (%)	P
Gender (N: 308)				
Female	178 (57.8)	105 (59.0)	73 (41.0)	< 0.01
Male	130 (42.2)	44 (33.8)	86 (66.2)	
Age (N: 308)				
60-69 years	168 (54.5)	75 (44.6)	93 (55.4)	0.03
70-79 years	109 (35.4)	52 (47.7)	57 (52.3)	
≥ 80 years	31 (10.1)	22 (71.0)	9 (29.0)	
Income (N: 292)				
0-1.5 minimum salaries	221 (75.7)	118 (53.4)	103 (46.6)	0.06
≥ 2 minimum salaries	71 (24.3)	29 (40.8)	42 (59.2)	
Years of study (N: 308)				
0-4 years	148 (48.1)	88 (59.5)	60 (40.5)	< 0.01
5-8 years	94 (30.5)	39 (41.5)	55 (58.5)	
≥ 9 years	66 (21.4)	22 (33.3)	44 (66.7)	
Years of residence in the neighborhood (N: 307)				
0-4 years	62 (20.2)	30 (48.4)	32 (51.6)	0.87
5-9 years	64 (20.8)	29 (45.3)	35 (54.7)	
≥ 10 years	181 (59.0)	89 (49.2)	92 (50.8)	
Multimorbidity (N: 308)				
No	62 (20.1)	11 (17.7)	51 (82.3)	< 0.01
Yes	246 (79.9)	138 (56.1)	108 (43.9)	
Self-reported health perception (N: 300)				
Good	116 (38.7)	29 (25.0)	87 (75.0)	< 0.01
Regular	135 (45.0)	79 (58.5)	56 (41.5)	
Bad	49 (16.3)	36 (73.5)	13 (26.5)	

N: total sample.

or free markets (OR 0.46; 95%CI 0.24; 0.87); commercial businesses (OR 0.57; 95%CI 0.36; 0.91); bus stops (OR 0.38; 95%CI 0.19; 0.74); parks, squares, walking tracks, bicycle paths and/or sports courts (OR 0.60; 95%CI 0.37; 0.97); outdoor gyms (OR 0.60; 95%CI 0.37; 0.96); gymnasiums and/or clubs (OR 0.47; 95%CI 0.27; 0.89); living in places with sidewalks on most streets (OR 0.56; 95%CI 0.35; 0.89); places with plain streets (OR 0.49; 95%CI 0.26; 0.92); and those who reported safe places to walk during the day (OR 0.26; 95%CI 0.12; 0.54) and night (OR 0.53; 95%CI 0.32; 0.88).

The variables residing near a bus stop (OR 0.46; 95%CI 0.21; 0.99), outdoor gym (OR 0.60; 95%CI 0.35; 0.95), and in places which are safe to walk during the day (OR 0.34; 95%CI 0.15; 0.77) remained as protective factors in the adjusted model. The older adults who reported such characteristics were 54%, 40% and 66% less likely to present fear of falling, respectively, compared to those who did not report these characteristics.

On the other hand, some characteristics of the built neighborhoods were presented as risk factors. Older adults who reported living near places with garbage accumulation and/or places with open sewers (OR 1.94; 95%CI 1.01; 3.71) and in places with high crime rates (OR 2.62; 95%CI 1.50; 4.56) were more likely to report fear of falling in the adjusted model.

4. Discussion

The main results of this study showed that 48.40% of the older adults evaluated reported fear of falling. The final model of logistic regression showed that presence of a bus stop, older adult outdoor gyms, and daytime safety for walking were protective factors to fear of falling. In addition, the accumulation of garbage and/or places with open sewers and a high crime rate increased the risk of fear of falling, independent of the adjustment variables.

Table 2

Multivariable logistic regression analysis between self-perception of the living environment and fear of falling in older adults living in the extreme south of Santa Catarina, Brazil, 2019.

Variables	Fear of Falling Crude OR (CI 95%)	Adjusted[a] OR (CI 95%)
Supermarket, convenience store/warehouse and fairs (N: 308)		
No	1.00	1.00
Yes	**0.46 (0.24; 0.87)**	0.69 (0.33; 1.41)
Commercial establishments (N: 308)		
No	1.00	1.00
Yes	**0.57 (0.36; 0.91)**	0.70 (0.40; 1.21)
Food Establishments (N: 308)		
No	1.00	1.00
Yes	0.66 (0.40; 1.08)	0.88 (0.49; 1.58)
Health posts and community centers (N: 307)		
No	1.00	1.00
Yes	0.72 (0.45; 1.15)	1.17 (0.67; 2.02)
Bus stop (N: 308)		
No	1.00	1.00
Yes	**0.38 (0.19; 0.74)**	**0.46 (0.21; 0.99)**
Parks, squares, hiking trails, bike path and/or sports courts (N: 307)		
No	1.00	1.00
Yes	**0.60 (0.37; 0.97)**	0.77 (0.44; 1.34)
Gyms/equipment for outdoor physical activity (N: 307)		
No	1.00	1.00
Yes	**0.60 (0.37; 0.96)**	**0.60 (0.35; 1.05)**
Use of an outdoor gym for physical activity (N: 118)		
No	1.00	1.00
Yes	1.24 (0.45; 3.42)	1.82 (0.51; 6.11)
Gyms and/or clubs (N: 298)		
No	1.00	1.00
Yes	**0.47 (0.27; 0.80)**	0.63 (0.33; 1.18)
Sidewalks on most streets (N: 307)		
No	1.00	1.00
Yes	**0.56 (0.35; 0.89)**	0.73 (0.43; 1.26)
Sidewalk care (N: 304)		
No	1.00	1.00
Yes	0.66 (0.41; 1.07)	0.72 (0.41; 1.27)
Green area (N: 306)		
No	1.00	1.00
Yes	0.81 (0.51; 1.29)	0.76 (0.45; 1.31)
Plain streets (N: 307)		
No	1.00	1.00
Yes	**0.49 (0.26; 0.92)**	0.51 (0.24; 1.06)
Accumulation of garbage and/or places with open sewers (N: 307)		
No	1.00	1.00
Yes	**1.80 (1.03; 3.15)**	**1.94 (1.01; 3.71)**
Transit as a barrier to walking or bicycling (N: 308)		
No	1.00	1.00
Yes	1.00 (0.54; 1.86)	1.13 (0.55; 2.31)
Pedestrian lanes, signs or footbridges (N: 308)		
No	1.00	1.00
Yes	0.61 (0.36; 1.04)	0.66 (0.35; 1.24)
Motorists respect pedestrians (N: 78)		
No	1.00	1.00
Yes	1.23 (0.48; 3.15)	0.64 (0.17; 2.36)
Street lighting (N: 306)		
No	1.00	1.00
Yes	1.36 (0.71; 2.61)	1.37 (0.66; 2.87)
Daytime safety for walking (N: 307)		
No	1.00	1.00
Yes	**0.26 (0.12; 0.54)**	**0.34 (0.15; 0.77)**
Night-time safety for walking (N: 305)		
No	1.00	1.00
Yes	**0.53 (0. 32; 0.88)**	0.66 (0.36; 1.19)
High crime level (N: 307)		
No	1.00	1.00
Yes	**2.96 (1.82; 4.82)**	**2.62 (1.50; 4.56)**

[a] Adjusted for the variables sex, age group, length of residence in the neighborhood, schooling, self-perception of health and multimorbidity. CI 95%: 95% confidence interval. N: total sample.

Similar data to those obtained in this study regarding the prevalence of fear of falling were verified by Vitorino et al. (2019) who evaluated the prevalence of fear of falling of 40.5% in Itajubá, located in the southern region of Minas Gerais/Brazil (Vitorino et al., 2019). The value found in a study (Lopes et al., 2009) conducted with older adult residents of Minas Gerais (Brazil), the value found was 90.48% and due high prevalence found in this region (for example), checking which factors are leading the older adults to have more fear of falling. In this same study, for example, these results were justified by the fact that the sample largely consisted of women who are known to present fear of falling more frequently than men (Chang et al., 2016; Hoang et al., 2017; Pohl et al., 2015; Sampaio et al., 2017; Utida et al., 2016; Vitorino et al., 2017). In addition, men underestimate fear of falling to avoid social stigmatization (Hoang et al., 2017).

Some studies have shown the association of environmental factors to fear of falling (Curl et al., 2020; Filiatrault et al., 2009; Harada et al., 2016; Lee et al., 2018; Merom et al., 2015; Pimentel et al., 2018). Pimentel et al. (2018) showed that community-dwelling older adults who perceives the neighborhood as very insecure in relation to violence were 1.11 times more likely (95%CI 0.99; 1.24) to falling than older adults who reported better safety in their neighborhood. The findings of the present study show that older adults who reported safety for walking during the day in their neighborhood had lower odds of fear of falling, when compared to the others evaluated. The findings of the present study show that older adults who reported safety to walk during the day in their neighborhood had lower odds of fear of falling when compared to the other evaluated neighborhoods. These findings may be related to older adults feeling more comfortable, safe, and less anxious when performing activities in their neighborhood, which may be associated with a sense of help being available if a possible fall occurs (Lee et al., 2018).

Merom et al. (2015) reported that older adults living near bus stops or places with public transportation had lower chances of presenting fear of falling (OR 0.79; 95%CI 0.35; 1.81), which also corroborates the findings of this study. The fact that living near places with public transportation decreases the probability of being afraid of falling may be related to greater social involvement and accessibility (Gregg et al., 2000) and smaller stretches to walk, which translates into lower exposure to risk factors (Merom et al., 2015).

Curl et al. (2016) developed a checklist containing risk factors for falls in the open air and mentioned the accumulation of garbage as one of these factors. Nicklett, Lohman and Smith (2017) described that the absence of trash (OR 0.95; 95%CI 0.91; 0.99) decreased the odds of the older adults reporting a fear of falling. This finding was related to the fact that garbage accumulation interferes with performing physical activity and social involvement in the neighborhood. Another explanation is related to the fact that garbage accumulation is directly related to the lack of resources in the neighborhood, in which a lack of safe spaces to walk, damaged sidewalks and benches, and poor quality public transportation which can increase the possibility of the individual acquiring fear of falling (Nicklett; Lohman; Smith (2017).

A high crime rate proved to be another risk factor for fear of falling in several studies (Curl et al., 2016, 2020; Harada et al., 2016; Lee et al., 2018). Lee et al. (2018) highlighted that individuals who reported higher crime in the neighborhood were approximately four times more likely (OR 4.36; 95%CI 2.08; 9.12) to report fear of falling than older adults living in neighborhoods with low crime. Harada et al. (2016) also found an association between fear of falling and high crime in older adults living environment, thus corroborating the data in this study. A potential explanation for this is due to the fact that high crime rates trigger psychological suffering in older adults (such as anxiety and depression) (Ní Mhaoláin et al., 2012), directly interfering in the motivation and practice of physical exercise and consequent fear of falling (Harada et al., 2016). In addition, Lee et al. (2018) inferred that older adults living in higher crime neighborhoods were afraid to fall due to external factors and individual behaviors such as fear of being assaulted or being

a victim in a crime, self-perception problems, and slower walking due to aging (Chippendale & Boltz, 2018). Furthermore, high crime rates can lead to mental health issues (Won et al., 2016), which contribute to limited community involvement decreased mobility and lead to an increased fear of falling (Lavedán et al., 2018).

The findings of this study could contribute to developing actions aimed at preventing fear of falling in older adults and their respective consequences. They might also serve to generate knowledge for professionals such as urban architects, civil engineers, government authorities, and rehabilitation professionals which could help prevent fear of falling in community-dwelling older adults (Curl et al., 2016). This knowledge is of paramount importance in preventive strategies for older adults involved in physiotherapy to be used to detect places with potential dangers and help them identify alternative routes. Further research should be conducted in other Brazilian municipalities and regions since the country has continental dimensions with distinct urbanization processes. In addition, longitudinal studies on the relationship between neighborhood physical and social environment and falls in the Brazilian context are still required. Another limitation is that some variables (presence of co-morbidities and self-perception in health) were collected through self-reporting, which may vary according to the individual's physical and mental state.

5. Conclusion

The association between self-perceived characteristics of built environments and fear of falling points to the need for improvements in urban infrastructure, especially public spaces, in order to reduce fear of falling in community-dwelling older adults.

Authors' statement

Jaquelini Betta Canever: conceptualization; methodology; verification; preview; writing (revision, editing and original draft). Amanda Aparecida Oliveira Leopoldino: conceptualization; methodology; verification; preview; writing (revision, editing and original draft). Ana Lúcia Danielewicz: conceptualization; formal analysis; investigation; methodology; project management; supervision; verification; writing (proofreading and editing). Núbia Carelli Pereira de Avelar: conceptualization; formal analysis; investigation; methodology; project management; supervision; verification; writing (proofreading and editing).

Submission declaration and verification

That the work described has not been published previously that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder.

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Declarations of Competing Interest

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