Is environment perception associated with change in leisure-time physical activity in Brazilian older adults? Results of EpiFloripa Idoso cohort study

A percepção ambiental está associada à mudança na atividade física no lazer de idosos brasileiros? Resultados do estudo de coorte EpiFloripa Idoso

¿Se asocia la percepción del entorno con el cambio en la actividad física en el tiempo libre de los adultos mayores brasileños? Resultados del estudio de cohorte EpiFloripa Idoso

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Abstract

This study aims to analyze the association between perceived characteristics of the neighborhood environment and changes in leisure-time physical activity in Brazilian older adults. Longitudinal analysis was performed considering a population-based study carried out in 2009/2010 with follow-up in 2013/2014. Changes in leisure-time physical activity, obtained with the International Physical Activity Questionnaire *during both waves, were associated with data of environment perception with the* Neighborhood Environment Walkability Scale – Abbreviated *(baseline only) performing multinomial logistic regression. In total, 1,162 older adults (65.2% women, mean age = 73.7 years) participated. Older adults who perceived flat streets, bicycle paths, and high flow of vehicles in the neighborhood were more likely to remain active in leisure time walking. Those who noticed the presence of flat streets also had a greater chance of becoming active than those who did not notice it. Older adults who perceived bicycle paths and sports events were more likely to maintain moderate and vigorous physical activity during leisure time. Furthermore, older adults who noticed parks and squares close to their residence were 0.49 times less likely to become insufficiently active. Brazilian older adults are more active in neighborhoods with more favorable attributes regarding leisure-time physical activity.*

Aging; Built Environment; Physical Activity; Leisure Activities

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Introduction

Older adults tend to reduce physical activity practice with aging [1]. Despite the recognized benefits of regular physical activity to one's physical, mental, and social health, many older adults are still physically inactive or insufficiently active [2,3]. Leisure time activities, that is, activities carried out during free time, are an accessible, inexpensive context which can increase levels of physical activity, especially among older adults, who could have more difficulty in other activities [4,5].

Related to physical activity, environment is even more important for aging considering that older adults are highly affected by changes in the environment caused by urbanization [2,6,7]. The neighborhood environment could therefore significantly promote leisure-time physical activity, especially among older adults, by providing safe and accessible structures [8,9].

Understanding how the place of residence of older adults affects their leisure-time physical activity is essential. Studies which investigated the relationship between characteristics of neighborhood environment and leisure time physical activity in older adults adopted a cross-sectional perspective [10,11]. We thus sought to understand the relationship between the change in leisure time physical activity over the years and the perceived characteristics of the neighborhood environment in older adults. We believe intervention program designs could then improve the neighborhood environment for practicing leisure time physical activity, developing physical activity policies to this population [12,13].

To develop strategies to increase or maintain leisure time physical activity in older adults, we must understand the preferences and patterns of use of this population in their context of residence [2,14]. Considering that population aging and urbanization are growing trends, especially in middle-income countries, the results of this study could help plan long-term interventions in the environment by indicating which attributes might affect leisure time physical activity of older adults over the years. This study thus sought to analyze the association between the perceived characteristics of neighborhood environment and the change in leisure time physical activity in Brazilian older adults.

Methods

A longitudinal population-based study (EpiFloripa Idoso cohort study) was conducted in 2009/2010 with a follow-up in 2013/2014. The study was performed in Florianópolis, capital of the state of Santa Catarina in the Southern Brazil. According to the last demographic census, the municipality has 421,000 inhabitants, out of which 11.4% are aged 60 years and older [15]. The Human Development Index (HDI) in the same year was 0.847, with an item longevity of 0.873 (both considered high). The study was approved by the Human Research Ethics Committee of the Federal University of Santa Catarina (opinion n. 352/2008 at baseline 2009/2010, and CAAE n. 16731313.0.0000.0121 in the follow-up in 2013/2014). All participants provided written informed consent before the research.

Participants

The study population consisted of older adults (60 years old or older) living in the urban area of Florianópolis in 2009/2010. Since the study sought to investigate different health outcomes, our sample size calculation considered the expected prevalence of 50%, a four-point error, 95% confidence interval (95%CI), and design effect (deff) for samples by conglomerates estimated as equal to two. A 20% were added for expected losses and as well as 15% for test associations. The size of the population aged 60 or older was considered as 44,460 individuals according to the population estimate for 2009.

The sample selection process was conducted by conglomerates in two steps. The units of the first step were the census tracts and the units of the second step were the households [15]. Households were systematically drawn and all older adults living in the households chosen were considered as eligible for the survey. All older adults from both genders, aged 60 years or older, and living in the households of the census sectors sampled by the study were considered eligible for the initial study sample.

For the follow-up study, all participants in the initial study sample were considered eligible. Losses to follow-up included older adults who were institutionalized (long-stay institutions, hospitals, and prisons) and those who could not be reached after four visits (one at night and two on weekends).

Older adults who could not respond due to traveling, hospitalization, refusal to participate, or death were also considered as losses. Detailed information on methodological procedures, operational aspects, and study segment strategies have been published elsewhere [16,17].

Procedure

Older adults who refused to respond to the interview were considered as refusals. In the second wave, those who could not be located for lack of telephone number or outdated addresses were counted as losses. Those who refused to participate by telephone were visited at home to confirm their refusal. In cases of older adults with communication difficulties, cognitive impairment, severe illness, or other reason that prevented participation, the guardian or the nearest caregiver was invited to respond to the interview.

Moreover, those who did not participate in the follow-up study, those who moved out between the first and second wave, those who did not answer the physical activity questions, and the older adults who were bedridden during the collection of the follow-up study were excluded. The final sample of older adults interviewed in the two waves allows for a longitudinal analysis of the variables, which will be presented later.

Measures

• **Sociodemographic and health variables**

The sociodemographic and health variables were collected at baseline, including gender, age group (60-69, 70-79, and 80 years or older), years of schooling (0-4, 5-9, and 10 or more), marital status (married or single), self-reported morbidities (none, 1, 2, and 3 or more), overweight (no or yes), and residence time in the neighborhood (0-4, 5-9, and 10 years or more). These variables were presented by descriptive statistics and used as covariables in subsequent analyses.

• **Change in walking for leisure time**

The study shows the change in walking for leisure time as a dependent variable. Older adults answered questions about frequency (days of the week) and times per day in which they walked for at least ten continuous minutes during leisure time in the neighborhood. These questions were obtained from the *International Physical Activity Questionnaire* (IPAQ) long version. In the two collections, participants who walked for up to 149 minutes per week for leisure time were considered insufficiently active whereas those who walked for 150 minutes or more per week for leisure time were physically active. The variable "walking change" was constructed based on the longitudinal assessment of the time spent walking in 2009/2010 and 2013/2014 and presented in a qualitative form (remained insufficiently active, became insufficiently active, became active, remained active).

• **Change in moderate or vigorous physical activity in leisure time**

The study shows the change in moderate or vigorous physical activity as a dependent variable. Older adults answered questions from the IPAQ long version about frequency (days of the week) and times per day in which they performed moderate or vigorous physical activity for at least ten continuous minutes in the neighborhood. In the two data collections, older adults who walked for up to 149 minutes per week for leisure time were considered insufficiently active whereas those who walked for 150 minutes or more per week for leisure time were physically active. The variable "walking change" was constructed based on the longitudinal evaluation of the time spent walking in 2009/2010 and 2013/2014 and presented in a qualitative form (remained insufficiently active, became insufficiently active, became active, remained active).

- **Perception of the neighborhood environment**

The perceived environment was assessed with the adaptation of the *Neighborhood Environment Walkability Scale – Abbreviated* (NEWS-A) instrument. For this study, the first data collection considered the 2009 perception of the neighborhood environment considering that changes in this environment in the time between the two collections did not affect the behavior or change the perception of the older adults. To answer the questionnaire, the participants were asked to consider as neighborhood the places they could reach within 15 minutes of their home. The questions had the answer options "yes" and "no" and were organized in blocks and grouped by similar thematic of neighborhood perception, but analyzed separately. These variables were qualitative and dichotomous (yes; no); each group presented questions of perception of the neighborhood environment:

Group of environmental infrastructure issues: (1) Are there sidewalks on most streets near your home? (2) Are the streets near your home flat? (3) Are there many hills in your neighborhood, limiting the number of ways to get from one place to another? (4) Are there bike lanes or pedestrian crossings in your neighborhood that are easily accessible? (5) Are there parks, squares, hiking trails, bike lanes, and/or sports courts near your home? (6) In your neighborhood, do sports events such as guided walks occur?

Group of traffic safety issues: (1) Do cars, buses, trucks, and motorcycles hinder walking or cycling near your home? (2) Are there crosswalks near your home? (3) Do drivers usually stop and let people cross at the pedestrian crossing?

Group of crime-related security issues: (1) Are the streets near your home well-lit at night? (2) During the day, do you feel safe walking, cycling, or playing sports near your home? (3) At night, do you feel safe walking, cycling, or playing sports near your home?

Group of questions about neighborhood esthetics: (1) Are there green spaces with trees in the streets near your home? (2) Are there places with accumulated garbage in the streets near your home? (3) Are there places with open sewage in the streets near your home?

Statistical analysis

The databases of the baseline of the EpiFloripa Idoso cohort study and the follow-up statistical package Stata 13 (https://www.stata.com) were used for statistical analyses. All analyses considered the effect of the sample design by conglomerates, incorporating the sample weights by the *svy* command. To characterize and to present the study sample and outcome prevalence, descriptive statistics were performed using absolute and relative frequencies for qualitative variables and central tendency and dispersion measures for the quantitative variables, with their respective 95%CI. Multinomial logistic regression analyses were performed to assess the associations between the change of physical activity for leisure time and environmental perception variables. The group of older adults who remained insufficiently active in each of the observation contexts was used as a reference category in the analyses. Unadjusted models were tested and then adjusted for all control variables (gender, age, years of schooling, marital status, number of morbidities, overweight, and length of residence in the neighborhood). The associations of each walking category were estimated according to the environmental perception variables described previously. The respective 95%CI were calculated for all investigated associations considering $p < 0.05$ as statistically significant.

Results

The sample was composed of 1,162 older adults (65.2% women) aged from 63 to 107 years old and with a mean age of 73.7 years (SD = 7.12 years) who participated in the longitudinal follow-up, with a follow-up time between 1,862 days (5 years and 1 month) in the longest follow-up and 1,128 days (3 years and 1 month) in the shortest follow-up and an average follow-up period of 1,495 days (around 4 years and 1 month). Out of the 1,705 older adults interviewed at baseline, 217 died, two older adults had duplicated data, and one participant was aged under 60 years. After baseline, 129 refusals and 159 losses resulted in 1,485 older adults eligible for the follow-up study. Moreover, 32 older adults
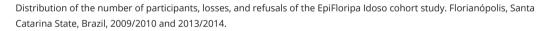
who reported being bedridden in the follow-up study and three individuals who reported no physical activity data were excluded from the analysis. The final sample represented 78.2% of those eligible for the second wave of the study (2013/2014). Figure 1 shows the organization chart related to the waves of data collection and information of losses and refusals.
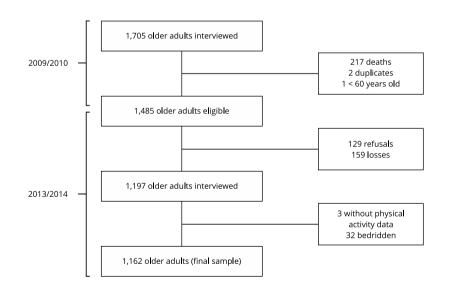
The final sample showed a higher proportion of older adults aged from 70 to 79 years (42.9% vs. 36.1%; p < 0.001) and of those who had lived in the neighborhood for ten years or more (84.3% vs. 77.4%; p < 0.001). The other sociodemographic and health variables did not differ statistically between the samples (Table 1). The final sample had more women participants (65.2%), older adults aged from 70 to 79 years (42.9%), participants with 0 to 4 years of schooling (43%), participants with a partner (55.2%), participants with 3 or more morbidities (59.3%), overweight older adults (72%), and finally, older adults who had lived in the neighborhood for at least ten years (84.3%).

Changes of leisure walking

Regarding walking in leisure time, 79.3% of the older adults maintained their behavior during the follow-up period, in which 71.8% remained insufficiently active (≤ 149 minutes/week) and only 7.5% remained active (≥ 150 minutes/week) (Table 2). Around 8.6% of older adults became active during leisure walking whereas 12.1% became insufficiently active. The percentage of older adults who remained active during leisure walking was higher among men (12.8%), participants aged from 60 to 79 years (12.1%), and among those with 10 years or more of schooling (12.6%). On the other hand, older adults who remained insufficiently active were especially women (74.7%), those aged 80 or over (73.8%), those with 0 to 4 years of schooling (74.6%), and those who had lived in the neighborhood for ten years or more (70.9%). No statistical difference was found between the other categories of sociodemographic and health variables.

Figure 1

Distribution of the number of participants, losses, and refusals of the EpiFloripa Idoso cohort study. Florianópolis, Santa Catarina State, Brazil, 2009/2010 and 2013/2014.

Table 1

Sociodemographic characteristics, health conditions, and physical activity of participants of the EpiFloripa Idoso cohort study. Florianópolis, Santa Catarina State, Brazil, 2009/2010 and 2013/2014.

Characteristics	2009/2010 (n = 1,702)		2013/2014 (n = 1,162)		p-value
	n	% (95%CI)	n	% (95%CI)	
Gender					0.542
Men	614	36.1 (33.9-38.4)	404	34.8 (32.1-37.6)	
Women	1,088	63.9 (61.5-66.1)	758	65.2 (62.4-67.9)	
Age (years)					0.001 *
60-69	850	49.9 (47.5-52.2)	407	35.0 (32.3-37.8)	
70-79	615	36.1 (33.9-38.5)	499	42.9 (40.1-45.8)	
80 or more	237	14.0 (12.4-15.7)	256	22.1 (19.7-24.5)	
Schooling level (years)					0.789
0-4	752	44.2 (41.9-46.6)	500	43.0 (40.2-45.9)	
5-9	338	19.8 (18.0-21.8)	218	18.8 (16.6-21.1)	
10 or more	612	35.0 (33.7-38.3)	444	38.2 (35.4-41.0)	
Marital status					0.086
Married	991	58.2 (55.9-60.6)	642	55.2 (52.4-58.1)	
Single	711	41.8 (39.4-41.1)	520	44.8 (41.9-47.6)	
Comorbidities					0.398
0	120	7.1 (5.9-8.4)	75	6.4 (5.1-8.0)	
1	272	16.0 (14.3-17.8)	184	15.8 (13.8-18.0)	
2	314	18.4 (16.6-20.3)	213	18.3 (16.2-20.6)	
3 or more	996	58.5 (56.1-60.8)	690	59.3 (56.5-62.2)	
Overweight **					0.767
No	455	27.7 (25.5-29.0)	319	28.0 (25.4-30.6)	
Yes	1,189	72.3 (70.1-74.4)	822	72.0 (69.3-74.6)	
Length of residence in the neighborhood (years)					0.001 *
1-4	197	11.6 (10.2-13.2)	81	7.0 (5.6-8.6)	
5-9	186	11.0 (9.5-12.5)	101	8.7 (7.2-10.5)	
10 or more	1,314	77.4 (75.3-79.3)	980	84.3 (82.1-86.3)	
Commuting walking (minutes/week)					0.080
≤ 149	528	45.4 (43.6-49.3)	572	49.3 (46.99-52.6)	
≥ 150	634	54.6 (50.6-56.4)	590	50.7 (47.4-53.1)	
Leisure walking (minutes/week)					0.001 *
≤ 149	950	81.8 (78.7-84.5)	976	84.0 (82.0-86.1)	
≥ 150	212	18.2 (16.3-20.2)	186	16.0 (13.8-18.1)	
Leisure moderate and vigorous intensity physical activity (minutes/week)					0.001 *
≤ 149	990	85.2 (83.7-88.0)	1,030	88.6 (86.6-90.3)	
≥ 150	172	14.8 (12.2-16.8)	132	11.4 (9.7-13.3)	

95%CI: 95% confidence interval.

* Statistically differs at $p < 0.001$;

** Overweight: body mass index $\geq 27.0kg/m^2$, according Lipschitz [41].

Table 2

Change in leisure walking categories in the older adults of the EpiFloripa Idoso cohort study according to sociodemographic and health variables (n = 1,162). Florianópolis, Santa Catarina State, Brazil, 2009/2010 and 2013/2014.

Characteristics	Remained insufficiently active * (≤ 149 minutes/week)		Became insufficiently active * (≤ 149 minutes/week)		Became active * (≥ 150 minutes/week)		Remained active * (≥ 150 minutes/week)	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Total	835	71.8 (69.2-74.4)	141	12.1 (10.4-14.1)	100	8.6 (7.1-10.4)	86	7.5 (6.0-9.1)
Gender								
Men	256	62.1 (53.4-70.0)	55	15.2 (9.5-23.2)	43	9.9 (6.7-14.5)	50	12.8 (9.4-17.3)
Women	579	74.7 (70.3-78.7)	86	12.6 (9.7-16.2)	57	7.2 (5.7-9.0)	36	5.4 (3.5-8.2)
Age (years)								
60-69	282	68.0 (62.0-73.5)	46	13.2 (9.1-18.7)	43	10.7 (7.8-14.5)	36	8.1 (5.0-11.3)
70-79	359	71.1 (62.8-75.9)	58	12.9 (8.5-18.9)	40	7.9 (5.4-11.3)	42	8.1 (6.8-13.1)
80 or more	194	73.8 (65.9-80.3)	37	15.4 (10.1-22.9)	17	5.8 (2.8-8.7)	8	5.0 (2.8-8.7)
Schooling level (years)								
0-4	383	74.6 (69.9-78.8)	63	14.5 (11.2-18.8)	36	6.6 (4.2-10.4)	18	4.3 (2.4-7.0)
5-9	159	73.0 (65.6-79.3)	27	14.2 (9.0-21.6)	21	6.7 (4.1-10.8)	11	6.1 (3.1-11.4)
10 or more	293	64.7 (56.2-72.3)	51	12.4 (7.2-20.6)	43	10.2 (7.3-14.2)	57	12.6 (8.6-18.2)
Marital status								
Married	442	66.2 (58.3-73.2)	76	14.0 (9.1-21.0)	62	8.9 (6.6-11.9)	62	10.8 (7.7-15.0)
Single	393	75.1 (70.6-79.0)	65	13.0 (10.0-16.7)	38	7.2 (5.2-10.1)	24	4.6 (2.6-8.2)
Comorbidities								
0	44	61.8 (46.5-76.0)	9	10.4 (5.1-20.0)	12	13.1 (6.3-25.3)	10	14.5 (6.0-31.4)
1	117	62.1 (52.0-71.2)	31	18.0 (11.4-27.2)	18	7.8 (4.4-13.4)	18	12.1 (7.2-19.5)
2	155	71.9 (63.6-78.9)	21	11.6 (6.7-19.2)	21	10.7 (6.3-17.5)	16	5.8 (3.3-9.9)
3 or more	519	72.9 (67.2-77.9)	80	13.2 (9.7-17.8)	49	6.9 (5.1-9.3)	42	6.9 (4.6-10.2)
Overweight **								
No	211	64.3 (56.0-71.9)	46	16.3 (10.5-24.4)	33	9.2 (6.2-10.5)	29	10.1 (6.7-15.1)
Yes	605	71.6 (66.3-76.4)	93	12.7 (9.2-17.4)	67	8.0 (6.1-10.9)	57	7.6 (5.2-11.1)
Length of residence in the neighborhood (years)								
1-4	55	67.1 (54.0-77.9)	10	13.8 (7.5-23.9)	7	10.2 (4.6-21.1)	9	8.9 (3.5-20.6)
5-9	65	65.4 (52.7-76.2)	18	17.3 (10.4-27.3)	8	5.9 (2.6-12.8)	10	11.4 (5.8-21.3)
10 or more	715	70.9 (65.2-75.9)	113	13.1 (9.7-17.5)	85	8.3 (6.8-10.2)	67	7.7 (5.3-11.1)

95%CI: 95% confidence interval.

* Classification based in walking for leisure time;

** Overweight: body mass index ≥ 27.0kg/m², according Lipschitz [41].

Table 3 shows the results of the associations between the change in walking during leisure time and the perceived characteristics of the neighborhood environment. After adjusting for control variables, older adults who perceived the presence of flat streets, bicycle lanes, and a high flow of vehicles in the neighborhood were respectively 2.25 (95%CI: 1.30-3.90), 2.07 (95%CI: 1.17-3.64), and 2.36 (95%CI: 1.37-4.07) times more likely to maintain leisure walking than those who did not notice such characteristics. On the other hand, older adults who perceived green spaces close to their residence were 0.52 times less likely (95%CI: 0.28-0.96) to maintain leisure walking than those who did not perceive green spaces. Moreover, older adults who noticed the presence of flat streets (OR = 1.60; 95%CI: 1.08-2.38) also had a greater chance of becoming active than those who did not notice it. No statistically significant associations were found between the other variables of perceived neighborhood environment and the change in walking during leisure.

Table 3

Association of the characteristics of the neighborhood environment and the change in leisure-time walking among the older adults in the EpiFloripa Idoso cohort study. Florianópolis, Santa Catarina State, Brazil, 2009/2010 and 2013/2014.

Neighborhood environment characteristics *	Became insufficiently active (≤ 149 minutes/week)		Became active (≥ 150 minutes/week)		Remained active (≥ 150 minutes/week)	
	Adjusted ** OR (95%CI)	p-value	Adjusted ** OR (95%CI)	p-value	Adjusted ** OR (95%CI)	p-value
Infrastructure for physical activity						
Presence of sidewalks (n = 1,153)	1.10 (0.49-2.46)	0.821	1.10 (0.66-1.84)	0.709	1.24 (0.51-3.00)	0.636
Presence of flat streets (n = 1,153)	1.06 (0.65-1.74)	0.817	1.60 (1.08-2.38)	0.021 ***	2.25 (1.30-3.90)	0.004 ***
Presence of hills (n = 1,153)	1.48 (0.88-2.48)	0.136	1.15 (0.65-2.06)	0.622	1.41 (0.75-2.69)	0.284
Presence of bike lanes (n = 1,148)	1.44 (0.68-3.02)	0.335	1.10 (0.70-1.75)	0.666	2.07 (1.17-3.64)	0.012 ***
Presence of parks or squares (n = 1,150)	0.87 (0.50-1.51)	0.618	1.41 (0.90-2.23)	0.135	0.64 (0.35-1.19)	0.159
Sports events (n = 1,148)	1.01 (0.62-1.64)	0.984	0.64 (0.36-1.13)	0.121	0.57 (0.25-1.31)	0.183
Traffic-related safety						
Presence of high vehicle flow (n = 1,147)	1.03 (0.63-1.68)	0.898	1.46 (0.81-2.63)	0.200	2.36 (1.37-4.07)	0.002 ***
Presence of crosswalk (n = 1,151)	0.72 (0.45-1.15)	0.171	1.01 (0.62-1.64)	0.966	1.16 (0.62-2.16)	0.646
Drivers stop for pedestrians (n = 727)	1.37 (0.70-2.68)	0.351	1.55 (0.76-3.15)	0.221	1.43 (0.68-3.00)	0.343
Security related to crime						
Presence of illuminated streets (n = 1,152)	0.90 (0.40-2.02)	0.801	0.67 (0.33-1.32)	0.243	1.19 (0.38-3.74)	0.763
Safety for day walk (n = 1,149)	1.41 (0.89-2.24)	0.145	1.89 (0.86-4.15)	0.110	1.81 (0.94-3.50)	0.074
Safety for night walk (n = 1,138)	0.94 (0.60-1.48)	0.807	1.00 (0.54-1.84)	0.997	0.99 (0.59-1.68)	0.985
Neighborhood's esthetics						
Presence of green spaces (n = 1,152)	0.92 (0.58-1.46)	0.723	1.05 (0.59-1.87)	0.861	0.52 (0.28-0.96)	0.037 ***
Presence of accumulated garbage (n = 1,152)	1.07 (0.61-1.87)	0.807	1.49 (0.71-3.11)	0.284	1.08 (0.58-2.03)	0.794
Presence of open sewage (n = 1,153)	0.62 (0.24-1.57)	0.308	0.89 (0.44-1.81)	0.753	0.85 (0.36-2.00)	0.713

95%CI: 95% confidence interval; OR: odds ratio.

* All associations used the "no" answer category as a reference in the variables of environmental perception;

** Adjusted for sex, age, schooling level, marital status, comorbidities, overweight, and length of residence in the neighborhood;

*** p-value < 0.05.

Change in moderate or vigorous physical activity in leisure time

Around 76.6% of the older adults remained insufficiently active (≤ 149 minutes/week) and only 4.9% of the older adults remained active (≥ 150 minutes/week). Moreover, 8.1% older adults became active in moderate and vigorous physical activity during leisure time while 10.4% became insufficiently active. Older adults who remained active in moderate and vigorous physical activity during leisure time were mostly men (6.8%), those aged from 60 to 79 years old (7.3%), those with 10 years or more of schooling (8.7%), and those who had lived in the neighborhood for 5 to 9 years (7.9%). On the other hand, older adults who remained insufficiently active in moderate and vigorous physical activity were especially women (79.3%), those aged 80 or over (85.7%), with 0 to 4 years of schooling (84.5%), and who were not overweight (82.4%). No statistical difference was found between the other categories of sociodemographic and health variables (Table 4).

Table 5 shows the results of the associations between the change in moderate and vigorous physical activity and the perceived characteristics of the neighborhood environment. Multinomial logistic regression analysis showed that after adjusting for confounding variables older adults who perceived the presence of bicycle lanes and sports events in the neighborhood were, respectively, 2.34 (95%CI: 1.26-4.34) and 3.05 (95%CI: 1.49-6.25) times more likely to maintain moderate and vigorous physical activity than those who did not notice such characteristics. Furthermore, older adults who perceived parks and squares close to their residence were 0.49 (95%CI: 0.26-0.91) times less likely to become

Table 4

Change in the categories of moderate and vigorous physical activity in leisure time for the older adults in the EpiFloripa Idoso cohort study according to sociodemographic and health variables (n = 1,162). Florianópolis, Santa Catarina State, Brazil, 2009/2010 and 2013/2014.

Characteristics	Remained insufficiently active * (≤ 149 minutes/week)		Became insufficiently active * (≤ 149 minutes/week)		Became active * (≥ 150 minutes/week)		Remained active * (≥ 150 minutes/week)	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Total	903	76.6 (72.1-80.5)	123	10.4 (7.8-13.6)	87	8.1 (6.1-10.8)	49	4.9 (3.5-6.9)
Gender								
Men	300	71.8 (63.9-78.5)	44	10.6 (7.1-15.5)	38	10.9 (7.1-16.3)	22	6.8 (4.1-11.0)
Women	603	79.3 (75.1-83.0)	79	10.2 (7.8-13.3)	49	6.6 (4.7-9.1)	27	3.8 (2.55.8)
Age (years)								
60-69	304	74.5 (67.6-80.4)	44	10.4 (6.5-16.1)	33	7.7 (5.3-11.2)	26	7.3 (4.8-10.9)
70-79	381	73.3 (68.3-77.8)	55	11.3 (7.5-16.5)	45	10.8 (7.3-15.8)	18	4.6 (2.4-8.5)
80 or more	218	85.7 (79.7-90.2)	24	8.6 (5.4-13.5)	9	3.7 (1.9-7.1)	5	1.9 (0.8-4.6)
Schooling level (years)								
0-4	426	84.5 (80.5-87.9)	38	7.7 (5.3-11.1)	26	5.7 (3.6-9.1)	10	1.9 (0.9-4.0)
5-9	177	81.7 (74.6-87.1)	28	11.9 (8.0-17.5)	9	4.0 (2.0-7.7)	4	2.4 (0.6-8.3)
10 or more	300	67.2 (59.6-73.9)	57	12.1 (8.1-17.7)	52	12.1 (8.2-17.3)	35	8.7 (6.0-12.4)
Marital status								
Married	493	75.1 (68.4-80.7)	76	12.0 (8.7-16.5)	45	7.5 (5.2-10.8)	28	5.3 (3.4-8.3)
Single	410	78.5 (74.7-81.9)	47	8.2 (5.9-11.2)	42	8.9 (6.4-12.4)	21	4.4 (2.67.3)
Comorbidities								
0	52	71.3 (57.7-81.8)	9	12.8 (5.2-28.1)	6	7.9 (3.3-17.7)	8	8.0 (3.5-17.5)
1	136	72.6 (63.8-79.9)	24	14.6 (8.6-23.6)	14	6.6 (3.3-12.6)	10	6.2 (3.2-11.9)
2	161	74.6 (67.6-80.5)	24	9.3 (6.0-14.1)	18	11.2 (6.8-18.1)	10	4.8 (2.5-9.0)
3 or more	554	79.0 (74.6-82.8)	66	9.1 (6.7-12.3)	49	7.7 (5.2-11.1)	21	4.2 (2.4-7.2)
Overweight **								
No	259	82.4 (76.6-87.0)	32	8.0 (5.3-11.8)	16	6.1 (3.6-10.1)	12	3.4 (1.9-6.2)
Yes	626	74.0 (69.0-78.5)	90	11.4 (8.4-15.4)	70	9.0 (6.8-11.9)	36	5.5 (3.5-8.5)
Length of residence in the neighborhood (years)								
1-4	65	75.8 (63.3-85.0)	5	5.5 (2.2-13.5)	9	15.2 (8.3-26.0)	2	3.5 (0.7-15.2)
5-9	70	66.8 (53.6-77.7)	17	19.2 (11.1-31.3)	8	6.1 (2.7-12.3)	6	7.9 (3.4-17.4)
10 or more	768	77.8 (73.5-81.6)	101	9.7 (7.3-12.7)	70	7.8 (5.8-10.4)	41	4.7 (3.4-6.4)

95%CI: 95% confidence interval.

* Classification based in walking for leisure time;

** Overweight: body mass index ≥ 27.0kg/m^2, according Lipschitz [41].

insufficiently active. Those who felt safe to walk at night in the neighborhood (OR = 0.67; 95%CI: 0.47-1.63) had a lower chance of becoming insufficiently active than those who felt unsafe in relation to those who remained insufficiently active (reference category). No statistically significant associations were found between the other variables of perceived neighborhood environment and the change in moderate and vigorous physical activity.

Table 5

Association of the characteristics of the neighborhood environment with the change in moderate and vigorous physical activity in the older adults in the EpiFloripa Idoso cohort study. Florianópolis, Santa Catarina State, Brazil, 2009/2010 and 2013/2014.

Neighborhood environment characteristics *	Became insufficiently active (≤ 149 minutes/week)		Became active (≥ 150 minutes/week)		Remained active (≥ 150 minutes/week)	
	Adjusted ** OR (95%CI)	p-value	Adjusted ** OR (95%CI)	p-value	Adjusted ** OR (95%CI)	p-value
Infrastructure for physical activity						
Presence of sidewalks (n = 1,153)	1.21 (0.53-2.75)	0.638	1.96 (0.79-4.86)	0.146	1.59 (0.59-4.22)	0.348
Presence of flat streets (n = 1,153)	0.73 (0.44-1.22)	0.235	0.95 (0.50-1.81)	0.883	0.69 (0.39-1.20)	0.189
Presence of hills (n = 1,153)	1.23 (0.79-1.91)	0.347	0.66 (0.37-1.21)	0.179	0.60 (0.31-1.18)	0.140
Presence of bike lanes (n = 1,148)	0.93 (0.51-1.71)	0.829	1.52 (0.84-2.77)	0.163	2.34 (1.26-4.34)	0.008 ***
Presence of parks or squares (n = 1,150)	0.49 (0.26-0.91)	0.026 ***	1.68 (0.94-2.99)	0.077	0.96 (0.46-2.00)	0.922
Sports events (n = 1,148)	0.66 (0.37-1.18)	0.159	1.19 (0.62-2.30)	0.593	3.05 (1.49-6.25)	0.003 ***
Traffic-related safety						
Presence of high vehicle flow (n = 1,147)	0.81 (0.53-1.21)	0.302	1.36 (0.73-2.55)	0.328	0.86 (0.42-1.77)	0.680
Presence of crosswalk (n = 1,151)	0.76 (0.43-1.36)	0.362	1.06 (0.53-2.10)	0.869	0.89 (0.40-2.00)	0.774
Drivers stop for pedestrians (n = 727)	1.25 (0.72-2.19)	0.422	0.90 (0.46-1.79)	0.771	0.88 (0.36-2.17)	0.783
Security related to crime						
Presence of illuminated streets (n = 1,152)	1.25 (0.52-3.02)	0.616	1.40 (0.57-3.41)	0.456	1.53 (0.40-5.91)	0.530
Safety for day walk (n = 1,149)	1.50 (0.80-2.80)	0.198	1.29 (0.51-3.27)	0.583	0.90 (0.43-1.88)	0.778
Safety for night walk (n = 1,138)	0.67 (0.47-1.63)	0.026 ***	1.64 (0.90-2.99)	0.102	0.98 (0.44-2.21)	0.967
Neighborhood's esthetics						
Presence of green spaces (n = 1,152)	0.86 (0.53-1.39)	0.532	1.39 (0.68-2.84)	0.360	1.03 (0.54-1.95)	0.928
Presence of accumulated garbage (n = 1,152)	1.08 (0.57-2.03)	0.816	0.70 (0.41-1.20)	0.195	0.53 (0.92-1.49)	0.228
Presence of open sewage (n = 1,153)	0.63 (0.26-1.56)	0.382	1.27 (0.69-2.35)	0.434	0.71 (0.23-2.14)	0.535

95%CI: 95% confidence interval; OR: odds ratio.

* All associations used the "no" answer category as a reference in the variables of environmental perception;

** Adjusted for sex, age, schooling level, marital status, comorbidities, overweight, and length of residence in the neighborhood;

*** p-value < 0.05.

Discussion

The results of this study show that 7.5% older adults maintained leisure walking and 4.9% maintained moderate and vigorous physical activity in leisure time after an average period of four years. This shows that many older adults remained or became insufficiently active during leisure time, supporting the hypothesis that few of them remain physically active as they age. Another important result indicates that the characteristics of the environment associated with the outcomes differ regarding the intensity of physical activity (walking vs. moderate or vigorous physical activity) even in the same leisure time domain. Overall, in older adults, the perceived presence of flat streets, bike lanes, high flow of vehicles, and green spaces was associated with maintaining or becoming active in leisure walking, whereas perceived sports events and bicycle lanes were associated with moderate or vigorous physical activity.

Regarding sociodemographic variables, over the years, the prevalence of older adults significantly differed regarding age, schooling level, and length of residence in the neighborhood. These findings corroborate the study by Koeneman et al. [18], which shows that physical activity levels generally decrease with increasing age, indicating that engagement in walking and other activities would decrease over time. The results on schooling levels corroborate cross-sectional studies which show that longer schooling time is related to a higher level of physical activity [19,20,21,22].

Previous studies have confirmed the hypothesis that the associations between characteristics of the perceived environment and the practice of physical activities are mediated by sociodemographic

characteristics [23,24]. Regarding the change in leisure walking, this study showed that older adults who perceive the presence of flat streets, bicycle lanes, a high flow of vehicles in the neighborhood, and green spaces close to their residence are more likely to remain or become active. The presence of flat streets was positively associated with remaining or becoming sufficiently active during leisure walking in older adults. These characteristics are related to infrastructure and, as aforementioned, environments with better attributes can encourage the practice of walking [2,25].

This study found that residents of neighborhoods with bicycle lanes have a greater chance of staying physically active during leisure walking, corroborating other studies [26]. Bicycle lanes possibly encourage walking during leisure since they are related to aspects of easier access to facilities for physical activity, increasing the chances of walking as a form of leisure [27]. The incentive to walk during leisure thus benefits strategies that guarantee the existence of adequate spaces (e.g., hiking trails, bicycle lanes, public squares, spaces for practicing sports, and leisure) for practicing physical activity. It is about investing in issues related to urban planning and mobility and trying to minimize inequalities and inequities in the access to healthy public spaces [28].

Regarding the flow of vehicles, studies have suggested that residential proximity to roads with a high flow of vehicles or areas with high traffic density is associated with positive health conditions [29,30]. A greater flow of vehicles in transit may be related to greater population density and more areas for visitation or contemplation. Learning the factors associated with physical activity in the older adults while considering a high exposure to traffic can help understand differential risks in several subgroups of this population and create more efficient socioenvironmental policies.

Green spaces were associated with staying active in leisure walking, contradicting the study that reveals positive associations between this characteristic of the neighborhood environment and leisure physical activity [10] because of the low (or no) cost of use, the presence of pleasant spaces linked to nature, the contact with other physically active people, and greater interaction and social cohesion. Furthermore, places with more trees and green spaces are associated with a lower frequency of crimes, aggression, and violence [31].

This study did not find, however, an association between the perception of safety and change in leisure walking such as other cross-sectional studies conducted in middle-income countries [10,11] – possibly because the population of the city in which our study was conducted has a low demographic density, with 493,000 inhabitants [15]. Becker & Kassouf [32] support the hypothesis that the city size is decisive for the crime rate, and the larger the population, the higher the crime rates. Thus, in large urban centers, the perception of security can affect the decision to take a walk more than in smaller cities.

The study also found that older adults who perceive bicycle lanes and sports events held near the residence are more likely to maintain physical activity of moderate and vigorous intensity during leisure. No associations were found between the characteristics of the environment and becoming active in physical activities of moderate and vigorous intensity during leisure time. Moreover, the results showed that older adults who perceive parks and squares close to their home are less likely to become insufficiently active over the years. In a study of 1,209 adults and older adults, men who agreed with the statement "I have easy access to places where I can do physical activity" were more likely to be physically active in vigorous leisure activities [33].

Older adults who perceive parks and squares close to their home are less likely to become insufficiently active in moderate and vigorous leisure activities than those who do not perceive these locations. Studies showed that the presence of parks is associated with benefits that go beyond physical and mental health [34,35,36], including social (expansion of social interaction), economic (expansion of restaurants and shops nearby), and environmental (reduction of air pollution) benefits [37]. In short, the data suggest that expanding access to public leisure spaces is essential for promoting collective health and maintaining active behavior.

In this study, the security to walk at night was inversely associated with becoming insufficiently active in moderate and vigorous leisure-time activities. That is, older adults who feel safe to walk in the neighborhood at night are less likely to become insufficiently active than those who feel unsafe. This sense of security in the neighborhood can be related to trust in neighbors, to the risk of being a victim of crimes, and to the general satisfaction with the neighborhood, which, if positive, contributes to the social interaction of residents [38,39].

This study has limitations. The follow-up period lasted an average of four years, which could hinder detecting major changes in behavior related to physical activity. Furthermore, since environmental characteristics perceptions (that is, subjective assessments) were obtained with a questionnaire, the data may be subject to memory bias and the questions may have different indications for different people. This study also has positive points. To the authors' knowledge, this is the first study in Brazil investigating the association between perceived neighborhood characteristics and the level of leisure-time physical activity in older adults from a longitudinal perspective, showing environmental factors associated with the practice of physical activity and contributing to the scientific knowledge in the country. Another positive aspect was the use of a cut-off point to classify the levels of physical activity according to international recommendations – despite having no specific recommendation for walking and moderate and vigorous activities (both during leisure and commuting) –, increasing the comparability of this study with previous works [22,40] and future studies. Moreover, the study high response rate and random selection of the sample contributed to its internal validity, decreasing the chance of systematic errors. The sample reproduced the population structure of the municipality according to gender and age group using the last census of the Brazilian Institute of Geography and Statistics (IBGE) [15], ensuring the extrapolation of the results to the population.

Policies and public investments for better urban infrastructure can significantly affect levels of physical activity in older adults. Though the greatest health benefits are associated with the regular practice of moderate or vigorous physical activity, less than 5% of the studied sample remains active in this context. This aggravating fact indicates that strategies for the inclusion and maintenance of older adults in activities of this intensity should be prioritized.

Contributors

F. T. Paiva Neto contributed to the study design, data collection and analysis, interpretation and discussion of the results, and review of the manuscript. S. C. Confortin contributed to data analysis, interpretation of the results, writing, and review of the manuscript. A. C. B. Santos contributed to data collection and interpretation of results. E. d'Orsi contributed to data collection and review of the manuscript. C. R. Rech contributed to the study design, interpretation and discussion of the results, and review of the manuscript. All the authors approved the final version of the manuscript.

Additional informations

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Resumo

Este estudo teve como objetivo analisar a associação entre a percepção das características do ambiente do bairro e a mudança na atividade física no lazer de idosos brasileiros. Esta análise longitudinal foi realizada a partir de um estudo de base populacional realizado em 2009/2010 com acompanhamento em 2013/2014. Alterações na atividade física durante o lazer, obtidas com o Questionário Internacional de Atividade Física *durante ambas as ondas, estiveram associadas a dados de percepção ambiental da* Escala Abreviada de Caminhabilidade do Ambiente de Bairro *(somente na linha de base) através de uma regressão logística multinomial. Participaram do estudo 1.162 idosos (65,2% mulheres, média de 73,7 anos). Idosos que perceberam a presença de ruas planas, ciclovias e alto fluxo de veículos em seus bairros estiveram mais propensos a permanecer ativos em caminhadas de lazer. Além disso, a presença de ruas planas também esteve associada a maior chance de os idosos se tornarem ativos em comparação com aqueles que não perceberam. Idosos que perceberam a presença de ciclovias e eventos esportivos estiveram mais propensos a permanecerem ativos em atividade física moderada ou vigorosa em seu lazer. Além disso, idosos que percebem parques e praças próximas à sua residência tiveram 0,49 vezes menos chances de se tornarem insuficientemente ativos. Idosos brasileiros são mais ativos em bairros que apresentam atributos mais favoráveis à atividade física no lazer.*

Envelhecimento; Ambiente Construído; Atividade Física; Atividades de Lazer

Resumen

Este estudio tiene como objetivo analizar la asociación entre la percepción de las características del entorno del barrio y el cambio en la actividad física en tiempo libre en los adultos mayores brasileños. El análisis longitudinal se realizó considerando un estudio de base poblacional realizado en 2009/2010 con seguimiento en 2013/2014. Los cambios en la actividad física en tiempo libre, obtenidos con el Cuestionario Internacional de Actividad Física *durante ambas olas, se asociaron con los datos de la percepción del entorno con la* Escala Abreviada de Caminabilidad del Entorno Vecinal *(sólo en la línea de base) realizando una regresión logística multinomial. Participaron 1.162 adultos mayores (65,2% mujeres, edad media de 73,7 años). Se observó que las personas mayores que percibían la presencia de calles planas, carriles para bicicletas y un alto flujo de vehículos en el barrio presentaban tiempos más probables de permanecer activos en el tiempo de ocio caminando. Además, la presencia de calles planas también se asoció a una mayor probabilidad de que los adultos mayores se mantuvieran activos en comparación con los que no lo percibieron. Las personas mayores que percibieron la presencia de carriles para bicicletas y la presencia de eventos deportivos presentaron, veces más, la probabilidad de permanecer activos en la actividad física moderada y vigorosa en el tiempo libre. Además, los adultos mayores que perciben parques y plazas cerca de su residencia tenían 0,49 veces menos probabilidades de ser insuficientemente activos. Los adultos mayores brasileños son más activos en los barrios que presentan atributos más favorables en cuanto a la actividad física en el tiempo libre.*

Envejecimiento; Entorno Construido; Actividad Física; Actividades Recreativas