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Life satisfaction and perceived physical activity environment among older adults

Satisfação com a vida e percepção do ambiente de atividade física em adultos mais velhos

AUTHORS

Nicolle Castilho da Silva[1]
Vanessa Pereira Corrêa Rampinelli[2]
Bruna Vanti da Rocha[2]
Ione Jayce Ceola Schneider[1,2]

1 Universidade Federal de Santa Catarina, Department of Physiotherapy, Araranguá, Santa Catarina, Brazil.

2 Universidade Federal de Santa Catarina, Postgraduate Program in Public Health, Florianópolis, Santa Catarina, Brazil.

CORRESPONDING

Vanessa Pereira Corrêa Rampinelli
fisio.vpc@gmail.com
Rodovia Governador Jorge Lacerda, 3201, Jardim das Avenidas, Araranguá, Santa Catarina, Brazil.
Zip code: 88906-072.

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ABSTRACT

Introduction: Due to functional limitations, the neighborhood is the primary location for physical activity for older adults; consequently, environmental perception may influence adherence and life satisfaction. Objective: To investigate the relationship between the perception of physical activity in the neighborhood context and life satisfaction among older adults. Methods: Cross-sectional study using ELSI-Brazil data (2019-21). The association between life satisfaction (outcome) and neighborhood physical activity perception (exposure) was assessed, both self-reported. Analysis included descriptive and bivariate statistics, and Poisson regression (crude and adjusted) with 95% CI. Results: Of the 6,717 participants, 60% (95% CI: 52.4 - 67.2) reported high life satisfaction, and 67.4% (95% CI: 61.7 - 72.6) perceived the neighborhood as pleasant for physical activity. Higher satisfaction was associated with age 60-69, education ≥12 years, having a partner, higher income, absence of cognitive or depressive symptoms, never smoking, heavy alcohol consumption, and being physically active. After adjusting for socioeconomic, clinical, and lifestyle variables, positive environmental perception increased the prevalence of life satisfaction by 21% (PR: 1.21; 95% CI: 1.06 - 1.38). Conclusion: Neighborhoods that favor active mobility increase life satisfaction in older adults. Therefore, planning accessible urban spaces is an essential strategy to promote well-being and healthy aging

Keywords: Neighborhood characteristics; Physical exercise; Health of the elderly; Personal satisfaction.

RESUMO

Introdução: A vizinhança é o local mais utilizado para a prática de atividade física em razão das limitações funcionais de adultos mais velhos; consequentemente, a percepção do ambiente pode interferir em sua adesão e na satisfação com a vida. Objetivo: Investigar a relação entre a percepção da prática de atividade física no contexto da vizinhança e a satisfação com a vida em adultos mais velhos. Métodos: Estudo transversal com dados do ELSI-Brasil (2019-21). Avaliou-se a associação entre satisfação com a vida (desfecho) e percepção de atividade física na vizinhança (exposição), ambos autorreferidos. A análise incluiu estatística descritiva, bivariada e regressão de Poisson (bruta e ajustada), com IC de 95%. Resultados: Dos 6.717 participantes, 60% (IC 95%: 52,4 - 67,2) relataram alta satisfação com a vida e 67,4% (IC 95%: 61,7 - 72,6) percebiam a vizinhança como agradável para atividades físicas. A maior satisfação associou-se a: idade de 60-69 anos, escolaridade ≥ 12 anos, ter parceiro, maior renda, ausência de déficit cognitivo ou depressivo, nunca ter fumado, consumo pesado e ser ativo. Após ajuste por variáveis socioeconômicas, clínicas e de estilo de vida, a percepção ambiental positiva aumentou a prevalência de satisfação com a vida em 21% (RP: 1,21; IC 95%: 1,06 - 1,38). Conclusão: Vizinhanças que favorecem a mobilidade ativa aumentam a satisfação com a vida em idosos. Portanto, planejar espaços urbanos acessíveis é uma estratégia essencial para promover o bem-estar e o envelhecimento saudável.

Palavras-chave: *Características da vizinhança; Exercício físico; Saúde do idoso; Satisfação pessoal.*

Introduction

Life satisfaction can be defined as an individual's ability to subjectively perceive their own reality, through critical and cognitive analysis, with respect to whether there is contentment and pleasure in their lived context[1,2]. This can be influenced by biopsychosocial factors, such as sociodemographic profile, general health status, established social bonds, economic situation, and environment[3].

In older adults, high levels of life satisfaction have been associated with preserved cognitive and functional health[4] and the regular practice of physical activity (PA), which helps to mitigate the biological declines inherent in aging[5-7]. PA can take place in various environ-

ments, but in older populations it predominantly occurs within the neighborhood. This preference is related to the physical and cognitive deficits that affect this population group and lead to limitations in mobility[8].

The neighborhood, in turn, can be understood as a geographically delimited area where an individual lives, moves around, and interacts with the people around them, and which can be influenced by structural, social, and contextual factors[9,10]. Structural factors refer to the characteristics of the built physical environment, such as the presence and quality of sidewalks and green areas. Social factors relate to interpersonal relationships and community dynamics. Finally, contextual factors are related to individual perceptions of the environment, such as the feeling of safety and aesthetic satisfaction with the neighborhood[9-11].

In this sense, the neighborhood is not just a physical space, but also a social environment that shapes behaviors and access to resources[9]. The perception of the neighborhood can encourage physically active behavior, depending on individual experience and the surrounding context. Thus, older adults who perceive their neighborhood as safe, aesthetically pleasing, and with good walkability show greater engagement in PA[11].

In the Brazilian context, a study conducted in Belo Horizonte identified that neighborhoods with a high degree of physical disorder, characterized by the accumulation of garbage and vandalism of public facilities, were associated with a lower prevalence of life satisfaction even after adjusting for individual factors and contextual characteristics. In contrast, a high prevalence of life satisfaction was associated with increased regular PA[6]. Despite its relevance, few studies have investigated the association between neighborhood perception and life satisfaction among older adults in Brazil.

It is known that Brazil faces serious issues related to the uncontrolled growth of urban environments. This phenomenon forcibly displaces a portion of the population to precarious areas and is reflected in the level of satisfaction with the neighborhood, living conditions, and the overall well-being of the population[12]. Given the aging of the Brazilian population and the growth of cities, it is essential to understand the role that the perception of the neighborhood environment plays in life satisfaction among older adults. This analysis would allow us to understand fundamental collective factors for developing public strategies to improve the community environment.

Thus, the aim of the current study was to investigate whether there is an association between the perception of PA in the neighborhood and life satisfaction in older Brazilian adults. It is expected that higher levels of life satisfaction will be associated with a better perception of PA in the neighborhood, regardless of individual factors.

Methods

Study design and ethical considerations

This is a cross-sectional study with data from the second wave of ELSI-Brazil. ELSI-Brazil is a cohort study with a representative sample of the Brazilian population aged 50 years or older, conducted with the aim of understanding the determinants of health and the aging process in the Brazilian context. ELSI-Brazil is funded by the Ministry of Health and developed by the Oswaldo Cruz Foundation (*Fundação Oswaldo Cruz* - FIOCRUZ) in partnership with the Federal University of Minas Gerais[13]. The study follows the guidelines of the *Strengthening the Reporting of Observational Studies in Epidemiology* (STROBE)[4].

The final sample for ELSI-Brazil comprises residents of 70 municipalities across the five Brazilian regions. The first wave of the study, conducted between 2015 and 2016, interviewed 9,412 individuals. In the second wave, the sample was replaced, resulting in 9,949 participants[15-16]. The second wave of ELSI-Brazil was conducted between August 2019 and March 2021. Due to the covid-19 pandemic, in-person fieldwork was interrupted on March 17, 2020, and subsequent follow-up was carried out through telephone interviews as part of the ELSI-COVID-19 initiative for those who had already participated in the second wave.

The ELSI-Brazil study was approved by the Ethics Committee of the Oswaldo Cruz Foundation - Minas Gerais and registered on Brazil Platform (CAAE: 34649814.3.0000.5091). All participants consented to participate in the study by signing the informed consent form[15].

Participants

In the present study, in order to reduce information bias, eligible participants were those from the second wave of ELSI-Brazil, aged 50 years or older, who directly responded with valid answers to the satisfaction with life without assistance block of questions, as well as those who presented valid answers regarding the perception of PA in the neighborhood. A complete case analysis was adopted, excluding individuals with missing data in any of the covariates used, resulting in

a final sample of 6,717 participants (Figure 1).

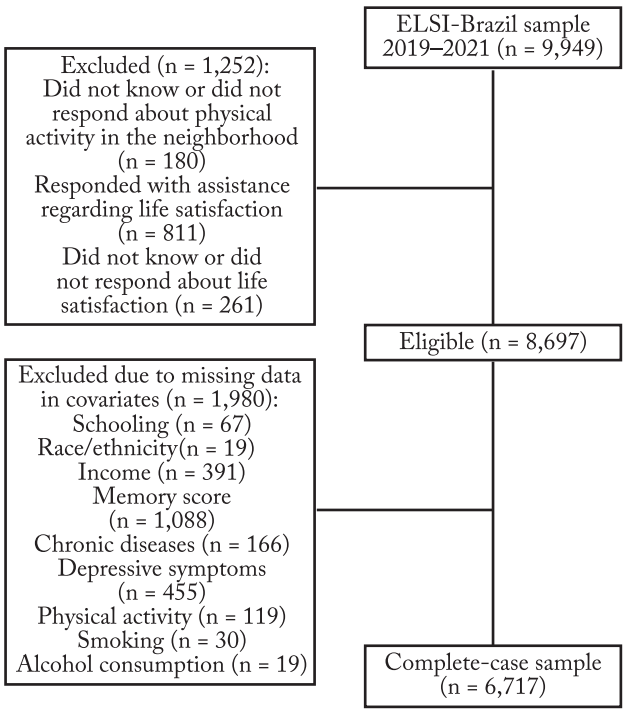

Figure 1 – Flowchart of sample selection considering the inclusion criteria of this study.
* The counts of missing data per covariate are not mutually exclusive; the same participant may have missing information in more than one covariate. Thus, the sum of losses per variable may exceed the total number of excluded complete cases (n = 1,980).

Study procedures

The interviews were conducted in the home using a standardized questionnaire and interviewers trained according to the study protocol. The standardized procedures are detailed in the operations manual available for consultation on the ELSI-Brazil homepage[15,16].

Study variables

The dependent variable was overall life satisfaction, assessed using the Self-Anchoring Ladder Scale[16,17]. This instrument consists of a drawing of a staircase with steps numbered from 1 to 10. The participant was instructed to evaluate their overall life satisfaction and rate it according to the steps.

Step number 10 represents maximum life satisfaction, and step number 1, the lowest level[17,18]. In the present study, based on the median value, responses <8 were considered to indicate low overall life satisfaction, and ≥8 as indicating high overall life satisfaction. The median value was adopted due to the absence of a psychometrically validated cut-off point for the older adult population.

The main exposure was the perception of PA practices in the neighborhood context, assessed through the question "*Is it pleasant to walk, run, or ride a bicycle in your neighborhood?*", with the response options "No"; "More or less"; and "Yes". The responses "No" and "More or less" were grouped into a single category. It is reiterated that the variable related to PA refers to the perception of the neighborhood environment as favorable to active mobility (walking, running, or cycling), not considering the distinction between the different domains of PA.

The sociodemographic adjustment variables were gender (female; male), race/ethnicity (white; black; brown; indigenous; and yellow), marital status (without partner; with partner), education (never studied; 1 to 4 years; 5 to 8 years; 9 to 11 years; 12 years or more), and per capita family income in tertiles (lower tertile; middle tertile; upper tertile).

Variables related to lifestyle habits and health conditions included moderate or vigorous PA, smoking (never smoked; former smoker; current smoker), alcohol consumption (never drunk; current consumption; heavy consumption; binge), non-communicable chronic diseases (none; one condition; two or more conditions), depressive symptoms, and overall memory score[18-22].

The PA variable was assessed using the short version of the International Physical Activity Questionnaire (IPAQ). The classification followed the updated guidelines of the World Health Organization[18], which recommend 150 to 300 minutes of moderate-intensity aerobic activity, or 75 to 150 minutes of vigorous activity, or a combination thereof, per week, for adults and older adults[18]. For analysis purposes, participants were classified as active (≥150 minutes), insufficiently active (<150 minutes), and inactive (does not perform moderate/vigorous PA).

For the classification of chronic non-communicable diseases (NCDs), the following conditions were considered: systemic arterial hypertension, diabetes mellitus, cardiovascular problems (heart attack, angina, and heart failure), pulmonary conditions (asthma, emphysema, chronic bronchitis, or chronic obstructive pulmonary disease), stroke, chronic renal failure, Parkinson's disease, Alzheimer's disease, osteoporosis, cancer, and rheumatism. The classification was based on the number of self-reported diagnoses: no condition, one condition, or two or more conditions[20].

Depressive symptoms were assessed using the validated short version of the Center for Epidemiologic Studies Depression Scale (CES-D 8). The cutoff point for classification was the presence of four or more depressive symptoms[21].

Cognition was assessed through three domains: memory, verbal fluency, and temporal orientation. Scores from the three tests were standardized using z-scores. The variable related to cognitive behavior was obtained from the average of the scores obtained in the three tests. Scores with a standard deviation (SD) > -1 represented the absence of cognitive deficit, while SD ≤ -1 indicated the presence of cognitive deficit[22].

Statistical analysis

A complete case analysis was performed. Data were analyzed using descriptive statistics, employing measures of central tendency and dispersion for quantitative variables, and absolute and relative frequencies for qualitative variables. The chi-square (χ^2) test was used to test the association between dependent and independent variables.

Crude and adjusted Poisson regression was used to identify prevalence ratios (PR) and their respective 95% confidence intervals (95% CI). Covariates were defined *a priori* based on a conceptual model and the literature, encompassing sociodemographic, behavioral, and health condition domains. All variables were included simultaneously in the adjustment, regardless of statistical significance in the bivariate analysis, in order to control for confounding and ensure comparability of estimates.

Multicollinearity among predictors was assessed using the variance inflation factor (VIF), with a mean value of 1.61, and no severe collinearity. Effect modification was investigated using interaction terms between primary exposure and gender, as well as primary exposure and age group, with adjusted Wald tests. No statistically significant interactions were identified (p = 0.246 and p = 0.844, respectively). Therefore, the interaction terms were not retained in the final model.

A sensitivity analysis was performed, in which we replicated the adjusted model restricting the sample to participants aged 50 to 59 years, in order to assess the robustness of the estimates in a more homogeneous age subgroup. All analyses considered sample weights using the svy command and were performed in Stata 16.1 software.

Results

Of the 9,949 participants in the 2nd wave of the ELSI-Brazil, 6,717 individuals were included in the present study. The details of the individual selection are described in the flowchart (Figure 1). The sample characteristics can be seen in Table 1. Regarding the outcome, the prevalence of high life satisfaction (≥8) was 60% (95% CI: 52.4 - 67.2). As for exposure, 67.4% (95% CI: 61.7 - 72.6) perceived walking, running, or cycling in the neighborhood as enjoyable.

In the bivariate analysis, high satisfaction was more frequent among participants aged 60–69 years (63.0%) and 70–79 years (62.6%) compared to those aged 50–59 years (57.5%; p = 0.048), and among those with an NCD (64.2%) compared to those without an NCD (57.6%; p = 0.012). The prevalence of high satisfaction was similar between women and men (p = 0.989) (Table 1). Figure 2 presents the prevalence of satisfaction according to age groups for each gender. Participants who perceived the environment as pleasant showed a prevalence of 64% (95% CI: 57.5 – 70.1) of high life satisfaction, while among those who did not perceive the environment as pleasant, the prevalence was 51.7% (95% CI: 41.5 – 61.8) (p < 0.001) (Table 1). In the crude analysis, there was a 24% increase in the prevalence of high life satisfaction compared to those who did not perceive PA as enjoyable (PR: 1.24; 95% CI: 1.07 - 1.43). In addition, having eight or fewer years of schooling, being in the middle and lower income tertile, having cognitive deficits, self-reporting four or more depressive symptoms, and being a current smoker were factors that reduced the prevalence of high life satisfaction. Being 60 to 69 years old, having a partner, having an NCD, and moderate or risky alcohol consumption increased the prevalence of the outcome (Table 2).

In the adjusted analysis, the prevalence of high life satisfaction was 21% higher among participants who perceived walking, running, or cycling in their neighborhood environment as enjoyable (PR: 1.21; 95% CI: 1.06 - 1.38). Regarding the other independent variables, the associations remained, except for income, for which the association was attenuated in the final model (Table 2).

Regarding education, participants who had never studied showed a lower prevalence of high life satisfaction (PR: 0.72; 95% CI: 0.59 - 0.86), when compared to the reference category. A reduction in the prevalence of high life satisfaction compared to the reference categories was

Table 1 – Descriptive analysis of participant characteristics and prevalence of overall life satisfaction (≥8 points), ELSI-Brazil 2019-21

Variable	n	% (95% CI)	≥8 points % (95%CI)	<8 points % (95%CI)	p* value
Overall life satisfaction					
<8 points	2732	40.0 (32.8 - 47.6)			
≥8 points	3985	60.0 (52.4 - 67.2)			
Pleasant perception of PA in the neighborhood environment.					<0.001
No	2216	32.6 (27.4 - 38.3)	51.7 (41.5 - 61.8)	48.3 (38.1 - 58.5)	
Yes	4501	67.4 (61.7 - 72.6)	64.0 (57.5 - 70.1)	36.0 (29.9 - 42.5)	
Gender					0.989
Female	4028	55.1 (52.6 - 57.5)	60.0 (52.6 - 67.0)	40.0 (33.0 - 47.4)	
Male	2689	44.9 (42.5 - 47.4)	60.0 (51.6 - 67.8)	40.0 (32.2 - 48.4)	
Age group					0.048
50 to 59 years	2153	49.1 (45.5 - 52.7)	57.5 (48.6 - 65.9)	42.5 (34.1 - 51.4)	
60 to 69 years	2467	29.9 (28.2- 31.7)	63.0 (55.3 - 70.1)	37.0 (29.9 - 44.7)	
70 to 79 years	1512	15.3 (13.3 - 17.4)	62.6 (56.2 -68.7)	37.3 (31.2 - 43.8)	
80 years or more	585	5.7 (4.7 - 6.8)	58.9 (51.3 - 66.1)	41.1 (33.9 - 48.7)	
Schooling					<0.001
Never studied	943	11.1 (8.5 - 14.3)	47.9 (38.4 - 57.6)	52.1 (42.4 - 61.6)	
1 to 4 years	2720	38.5 (35.6 - 41.4)	57.5 (48.3- 66.1)	42.5 (33.9 - 51.7)	
5 to 8 years	1342	21.2 (19.4 - 23.1)	58.9 (50.1 - 67.1)	41.1 (32.9 - 49.9)	
9 to 11 years	1315	22.8 (19.8 - 26.2)	67.4 (58.1 - 75.4)	32.6 (24.6 - 41.9)	
12 or more years	397	6.4 (5.4 - 7.7)	73.5 (66.6 - 79.5)	26.5 (20.5 - 33.4)	
Race/ethnicity					0.636
White	2972	44.0 (37.9 - 50.4)	59.6 (50.5 - 68.1)	40.4 (31.9 - 49.5)	
Black	732	11.1 (8.8 - 13.9)	61.5 (53.9 - 68.5)	38.5 (31.5 - 46.1)	
Brown	2962	44.3 (39.1 - 49.6)	59.8 (51.5 - 67.5)	40.2 (32.5 - 48.5)	
Yellow	17	0.24 (0.12 - 0.46)	76.5 (54.3 - 89.9)	23.5 (10.0 - 45.7)	
Indigenous	34	0.31 (0.14 - 0.70)	78.1 (50.7 - 92.5)	21.9 (7.5 - 49.2)	
Marital status					0.014
Without partner	3014	36.7 (33.1 - 40.5)	55.4 (48.8 - 61.9)	44.6 (38.1 - 51.2)	
With partner	3703	63.3 (59.5 - 66.9)	62.6 (53.7 - 70.8)	37.4 (29.2 - 46.3)	
Income					0.003
Lower tertile	2192	35.3 (30.6 - 40.2)	54.9 (46.3 - 63.3)	45.1 (36.7 - 53.7)	
Middle tertile	2293	31.4 (29.1 - 33.8)	57.7 (49.4 - 65.7)	42.3 (34.3 - 50.6)	
Upper tertile	2232	33.3 (29.0 - 37.9)	67.5 (58.4 - 75.4)	32.5 (24.6 - 41.6)	
Memory score					<0.001
SD≤-1	1037	14.4 (10.8 - 18.9)	43.5 (32. 2 - 55.5)	56.5 (44.5 - 67.8)	
SD>-1	5680	85.6 (81.1 - 89.1)	62.8 (55.4 - 69.6)	37.2 (30.4 - 44.6)	
Chronic non-communicable conditions					0.012
None	2404	37.6 (35.1 - 40.1)	57.6 (48.8 - 66.0)	42.4 (34.0 - 51.2)	
One condition	2312	34.0 (32.1 - 35.9)	64.2 (56.7 - 71.0)	35.8 (29.0 - 43.3)	
Two or more	2001	28.4 (26.1 - 30.9)	58.2 (52.4 - 67.2)	41.8 (34.5 - 49.5)	
Depressive symptoms					<0.001
≤ 3 symptoms	5442	80.4 (77.8 - 82.9)	66.4 (58.7 - 73.3)	33.6 (26.7 - 41.3)	
≥4 symptoms	1275	19.6 (17.1 - 22.2)	33.7 (26.9 - 41.2)	66.3 (58.8 - 73.1)	
Smoking					0.024
Never smoked	4444	65.0 (61.5 - 68.3)	61.6 (53.7 - 68.9)	38.4 (31.1 - 46.3)	
Ex-smoker	1424	21.8 (19.1 - 24.7)	60.1 (49.9 - 69.5)	39.9 (30.5 - 50.1)	
Current smoker	849	13.3 (11.9 - 14.8)	52.0 (45.1 - 58.8)	48.0 (41.2 - 54.8)	

Continue…

Continuation of **Table 1 –** Descriptive analysis of participant characteristics and prevalence of overall life satisfaction (≥8 points), ELSI-Brazil 2019-21

Variable	n	% (95% CI)	≥8 points % (95%CI)	<8 points % (95%CI)	p* value
Alcohol Consumption					0.006
Never drunk	5113	72.6 (69.9 - 75.0)	57.1 (49.7 - 64. 2)	42.9 (35.8 - 50.3)	
Current consumption	863	15.3 (12.9 - 18.0)	63. 9 (49.5 - 76.2)	36.1 (23.8 - 50.4)	
Heavy consumption	86	1.5 (1.0 - 2.0)	72.0 (58.3 - 82.5)	28.0 (17.5 - 41.7)	
Episodes of excessive consumption	655	10.6 (8.7 - 12.9)	72.3 (66.0-77.9)	27.7 (22.1 - 34.0)	
Moderate/vigorous intensity PA					0.071
Inactive (does not do)	19	0.3 (0.2 - 0.5)	66.5 (37.4 - 86.8)	33.5 (13.2 – 62.6)	
Insufficiently active (<150 min)	4923	71.7 (66.5 - 76.3)	58.3 (49.5 - 66.6)	41.7 (33.4 - 50.4)	
Active (≥150 min)	1775	28.0 (23.3 - 33.2)	64.2 (58.1 - 69.8)	35.8 (30.2 - 41.9)	

* p-value of the chi-square test. Legend: PA: Physical activity

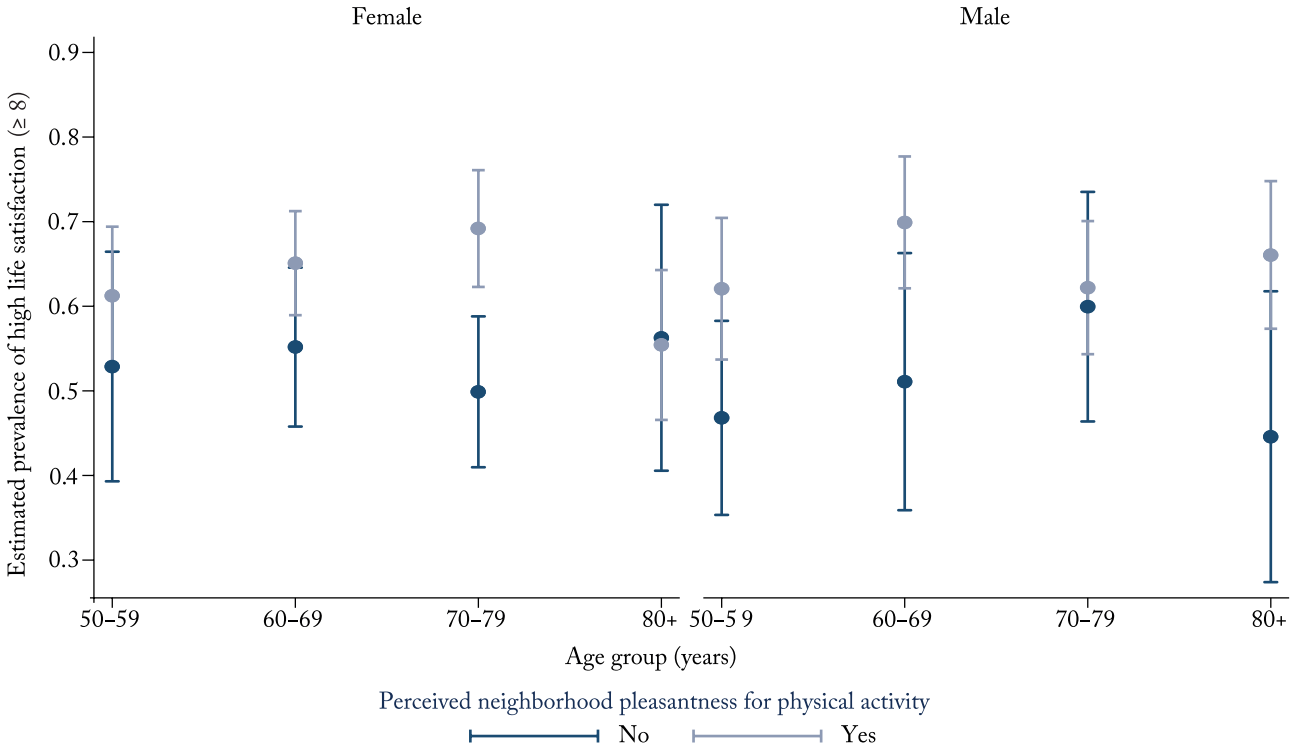

Figure 2 – Estimated prevalence of high life satisfaction (≥8 points) according to perception of how pleasant it is to walk/run/cycle in the neighborhood, stratified by gender and age group, ELSI-Brazil, 2019-21
Note: Estimates obtained by weighted logistic regression (svy) on the sample of complete cases (n = 6,717). Bars represent 95%CI.

also observed among those classified as having cognitive deficits (PR: 0.72; 95% CI: 0.60 - 0.80), with 4 or more depressive symptoms (PR: 0.53; 95% CI: 0.47 - 0.60), and current smokers (PR: 0.89; 95% CI: 0.80 - 0.98).

On the other hand, there was a higher prevalence of high life satisfaction among individuals aged 70 to 79 years (PR: 1.13; 95% CI: 1.01 - 1.25), among those with a partner (PR: 1.10; 95% CI: 1.02 - 1.19), and among participants with a non-communicable chronic illness (PR: 1.11; 95% CI: 1.0 - 1.19) compared to the respective reference categories. Furthermore, it was observed that at-risk alcohol consumers (PR: 1.29; 95% CI: 1.03 - 1.19) had an increased prevalence compared to non-consumers. The adjusted prevalence ratios are shown in Figure 3.

In the sensitivity analysis restricted to the 50–59 age group (n = 2,153), high life satisfaction maintained a similar direction and magnitude (PR = 1.20; 95% CI: 1.04–1.39) to the estimates observed in the total sample.

Discussion

The current study analyzed data from 6,717 individu-

Table 2 – Crude and adjusted analysis of overall life satisfaction, ELSI-Brazil, 2019-21

Variable	Overall life satisfaction	
	Crude PR (95% CI)	Adjusted PR (95% CI)*
Pleasant perception of PA in the neighborhood environment.		
No	1	1
Yes	1.24 (1.07 - 1.43)	1.21 (1.06-1.38)
Gender		
Female	1	1
Male	0.99 (0.94-1.06)	0.90 (0.84-0.96)
Age group		
50 to 59 years	1	1
60 to 69 years	1.10 (1.02-1.18)	1.08 (1.01-1.16)
70 to 79 years	1.09 (0.98-1.21)	1.13 (1.01-1.25)
80 years or more	1.02 (0.89-1.18)	1.09 (0.94-1.26)
Schooling		
12 or more years	1	1
9 to 11 years	0.91 (0.83-1.01)	0.99 (0.90 - 1.09)
5 to 8 years	0.80 (0.71-0.90)	0.89 (0.79 - 1.00)
1 to 4 years	0.78 (0.68-0.89)	0.87 (0.76 - 0.99)
Never studied	0.65 (0.53-0.80)	0.72 (0.59 - 0.86)
Race/ethnicity		
White	1	1
Black	1.03 (0.92-1.16)	1.11 (1.00 - 1.22)
Brown	1.00 (0.89-1.13)	1.07 (0.97 - 1.18)
Yellow	1.12 (0.97-1.69)	1.14 (0.85 - 1.54)
Indigenous	1.31 (0.99-1.73)	1.23 (1.03 - 1.46)
Marital status		
Without partner	1	1
With partner	1.13 (1.03-1.23)	1.10 (1.02 - 1.19)
Income		
Lower tertile	1	1
Middle tertile	0.85 (0.78-0.94)	0.93 (0.86 - 0.99)
Lower tertile	0.81 (0.71-0.94)	0.92 (0.82 - 1.02)
Memory score		
Standard deviation >-1	1	1
Standard deviation ≤ -1	0.69 (0.55-0.87)	0.72 (0.60 - 0.86)
Chronic non-communicable conditions		
None	1	1
One	1.11 (1.03-1.20)	1.11 (1.03 - 1.19)
Two or more	1.01 (0.92-1.11)	1.08 (0.98 - 1.18)
Depressive symptoms		
≤ 3 symptoms	1	1
≥4 symptoms	0.51 (0.59-0.74)	0.53 (0.47 - 0.60)
Smoking		
Never smoked	1	1
Ex-smoker	0.97 (0.88-1.08)	0.97 (0.89 - 1.07)
Current smoker	0.84 (0.76-0.94)	0.89 (0.80 - 0.99)
Alcohol Consumption		
Never drunk	1	1
Current consumption	1.12 (0.97-1.29)	1.05 (0.93 - 1.18)
Heavy consumption	1.26 (1.03-1.55)	1.22 (1.02 - 1.47)
Episodes of excessive consumption	1.27 (1.13-1.42)	1.29 (1.14 - 1.47)
Moderate/intense PA		
≥150 min	1	1
<150 min	0.91 (0.82-1.00)	1.00 (0.91 - 1.10)
Does not perform moderate/ intense PA	1.04 (0.68-1.58)	1.29 (0.85 - 1.95)

*Adjusted for all model variables. Legend: PA: Physical activity

Consistent with these results, a study conducted with 181 older Chinese adults identified that perceiving the neighborhood environment as pleasant for walking increased scores for life satisfaction and happiness[25]. Thus, the results reinforce the central role of environmental perception as a facilitator of subjective well-being. Beyond the benefits related to well-being and PA, pleasant neighborhoods for walking promote a sense of identity and social connection, as they enable interaction and community engagement[24,25].

On the other hand, a perception of insecurity in the neighborhood has been identified as a barrier to the regular practice of PA by older adults. The fear of experiencing violence is reflected in decreased participation in outdoor activities in the neighborhood environment[26]. Although most available studies have been conducted in sociocultural contexts of other countries, these findings demonstrate that neighborhood perception can influence PA-related behaviors in different populations and interfere with other outcomes, such as sedentary behavior time and feelings of loneliness[11,25].

A positive perception of the neighborhood is also associated with social cohesion. In this context, social cohesion is characterized by the social networks established between neighbors and by the feeling of belonging to the place where one lives[27]. People who perceive their neighborhood as less cohesive also exhibit poorer physical health and well-being, which can be attributed to a higher prevalence of anxiety symptoms and fewer reports of PA. Thus, less concern about neighborhood safety, coupled with increased sociability, can reduce the impact that daily stressors have on well-being and, consequently, on physical and mental health conditions.

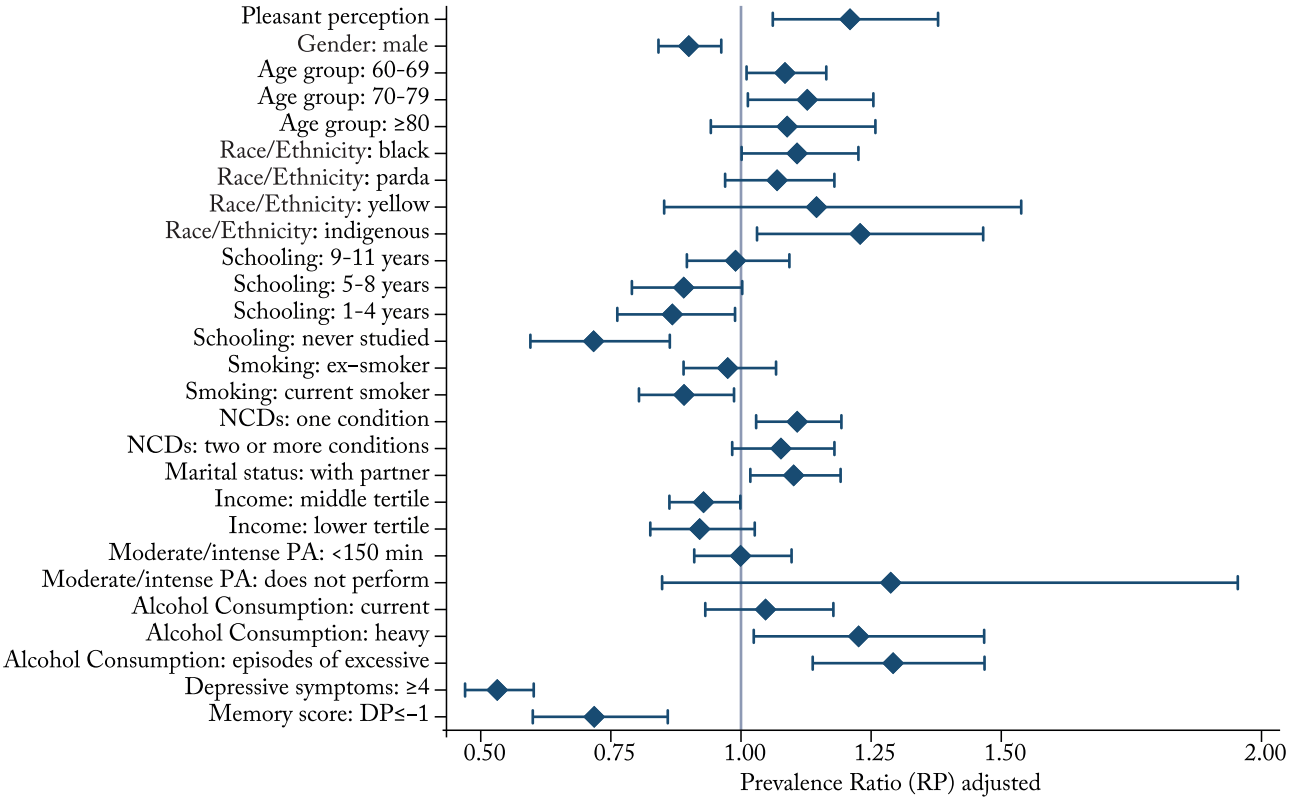

Figure 3 – Association between perception of neighborhood favorable to walking/running/cycling and high life satisfaction (≥8 points), estimated by Poisson regression and weighting for the sample design (svy), ELSI-Brazil 2019–2021 (n = 6,717)
Note: the points represent the PR and the horizontal bars represent the 95% confidence intervals (95% CI). The vertical line at PR=1 indicates no association. NCDs: Chronic non-communicable diseases; PA: Physical activity

Social cohesion can influence life satisfaction through the instrumental support provided in adverse situations, as it increases interpersonal security, strengthens bonds, and combats the tendency towards social isolation, a condition frequently observed among older adults[28]. Thus, social cohesion is associated with less negative affect, loneliness, and depressive symptoms in this population[29]. These findings showing that individual mental health conditions, depressive symptoms, and cognitive deficits negatively influence life satisfaction. The perception of physical and mental vulnerability can intensify feelings of dissatisfaction with life and the aging process[30,31], This also reduces the protective role of social cohesion. Furthermore, the presence of depressive symptoms can trigger a series of physical comorbidities, favoring multimorbidity and limitations in activities of daily living[32,33]. Such limitations may mediate the relationship between cognitive deficits and life satisfaction, contributing to reduced well-being in more cohesive neighborhoods[34].

In addition to aspects related to mental health, lifestyle habits also contribute independently to life satisfaction. Although risky alcohol consumption was associated with a higher prevalence of high life satisfaction in this study, this finding should be interpreted with caution. Evidence suggests that this association is often mediated by socialization processes, in which alcohol consumption occurs in contexts of social interaction and belonging, and not by the effect of alcohol itself[35,36]. In this sense, this result may indicate limitations in the neighborhood environment regarding the availability of spaces and leisure activities that promote socialization, well-being, and community engagement without the centrality of alcohol consumption. Studies indicate that participation in social, cultural, and PA is associated with greater life satisfaction and better mental health in older adults, regardless of alcohol use[28,29].

Thus, expanding public policies aimed at creating inclusive and socially active community environments can represent a relevant strategy for promoting well-being and healthy aging. On the other hand, being a current smoker reduced the prevalence of high life satisfaction. Older adults are highly vulnerable to the detrimental effects of smoking, resulting in cardiovascular, respiratory, and neurological damage[37]. Furthermore, the habit of smoking can function as a

coping strategy for feelings of isolation, given the immediate pleasure provided by nicotine.

These habits, although appearing as independent factors, may be linked to underlying socioeconomic conditions, among which low levels of education stand out. In the Brazilian context, low educational levels are associated with social inequality, as well as reduced access to health services[38], which can lead to worse living conditions and greater vulnerability. Older adults with fewer years of schooling are more susceptible to the deficits inherent in aging and have less control over their own lives. Education contributes to the development of cognitive skills and self-management, strengthening autonomy, decision-making, and reducing functional decline[39]. These mechanisms can influence both life satisfaction and the adoption of healthy behaviors. In the present study, we observed a dose-response relationship between education and high life satisfaction, even after adjustments, suggesting that the former may act as a marker of structural inequalities, including in the context of residence. Thus, low educational attainment may not only reflect individual vulnerability, but also neighborhoods perceived as less conducive to PA, which negatively impacts the subjective well-being of older Brazilians. It should be noted that the cross-sectional design and the absence of detailed indicators of the residential environment prevent direct testing of these mechanisms.

Among the limitations of the present study, the cross-sectional design stands out, preventing the establishment of temporality and, consequently, inferences of causality between life satisfaction and the perception of conditions favorable to the practice of PA in the neighborhood. Furthermore, there is a risk of information bias, since the measures were obtained through self-report, and are therefore subject to information bias and social desirability. The primary exposure was measured by a single question, with subsequent grouping of categories, which may not capture the multidimensionality of the perceived environment and increase the likelihood of measurement error and non-differential classification. Although this measure is frequently used in population surveys because it summarizes key elements of walkability and active mobility, it does not encompass other forms of PA performed by older adults in the territory (for example, recreational activities, use of public spaces, and active social interactions).

Furthermore, activities such as running and cycling tend to be less frequent in this age group and, therefore, should be interpreted with caution, potentially serving more as an indicator of the perceived quality of the urban environment than as a description of habitual behavior. Although PA was included as an adjustment variable, it was investigated using the IPAQ (short version), in which there is no precise discrimination of the different domains and contexts of practice, so the classification used may not adequately reflect the dimension related to the construct investigated. Added to this is the lack of more detailed information on the structural and social characteristics of the neighborhoods, which could broaden understanding of the interactions between the environment, active behavior, and well-being. Additionally, the data from the second wave of ELSI-Brazil were collected between 2019 and 2021, a period that includes the context of the covid-19 pandemic, which may have simultaneously influenced life satisfaction, mobility patterns, use of public spaces, and PA, as well as perception of the neighborhood. This scenario could introduce a period effect, limiting comparability with non-pandemic contexts and the generalization of findings to situations of greater social normality. Finally, the sample included individuals aged 50 and older, encompassing a broad and potentially heterogeneous age range in terms of health conditions, functionality, mobility, and social participation, which may modify the magnitude of the associations during aging. However, sensitivity analyses restricted to the 50-59 age range produced estimates consistent with the main model, suggesting robustness of the central finding in the face of age heterogeneity.

The strengths of the current study include the sample size and national representativeness, encompassing all five Brazilian regions. Although it was not possible to perform analyses with intra-urban variations, the scope and sample design lend robustness to the estimates. Furthermore, this study stands out for presenting results on the relationship between the perception of the neighborhood environment and life satisfaction in the context of a Latin American country, where there is still a scarcity of research with a similar focus. By using a database harmonized with other aging studies, the findings facilitate international comparisons and contextualize Brazil within the debate on active aging. Finally, in addition to active aging, this is a topic with direct implications for health promotion and urban planning that is more favorable to mobility, social participation, and safety.

In conclusion, the perception that the neighborhood

is a pleasant environment for walking, running, or cycling was associated with greater life satisfaction in older adults, which is also related to sociodemographic and health factors. These findings suggest that the perception of environmental support for active mobility in the residential environment may be linked to subjective well-being in this population. Thus, strategies aimed at promoting environments that favor active mobility could contribute to better levels of life satisfaction in older adults.

Conflicts of interest

The authors declare no conflicts of interest.

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Authors' contribution

Silva NC: Conceptualization; Methodology; Research; Writing the original manuscript; Writing - revision and editing; Approval of the final version of the manuscript. Rampinelli VPC: Conceptualization; Methodology; Writing the original manuscript; Writing - revision and editing; Approval of the final version of the manuscript. Rocha BV: Conceptualization; Original manuscript writing; Writing - revision and editing; Approval of the final version of the manuscript. Schneider IJC: Conceptualization; Methodology; Data analysis; Research; Supervision; Original manuscript writing; Writing - revision and editing; Approval of the final version of the manuscript.

Statement regarding the use of artificial intelligence tools in the article writing process

For the preparation of this manuscript, the ChatGPT 5.0 artificial intelligence tool was used to review the text. The authors declare that all material derived from this process has been reviewed and they assume full responsibility for all content of the manuscript.

Availability of research data and other materials

The original database is available at the following link: https://elsi.cpqrr.fiocruz.br/banco-de-dados/

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Reviewers' assessment

The reviews of this article were originally conducted in Portuguese. This version has been translated using ChatGPT and subsequently reviewed by the Chief Editors.

Reviewer A

Anonymous

The present study investigated the relationship between the perception of physical activity practice within the neighborhood context and life satisfaction among middle-aged and older adults. The research question is well defined, the method is appropriate, and the interpretation of the results is adequate. The study is relevant not only in the Brazilian context but also internationally, given the scarcity of studies of this nature and scale using data from developing countries.

General comment

- I would like to suggest revising the terms "older adults" and "older populations," replacing them with "elderly" and "elderly population." As the study also includes middle-aged adults, it would be recommended to specify this where appropriate.

Introduction

- I suggest that the authors provide examples of elements that constitute the neighborhood and contribute to both physical activity levels and life satisfaction. What are they specifically referring to? At least one example of each factor (structural, social, and contextual) would help illustrate relevant aspects for the reader.

Methods

- Page 6, lines 118 to 124:
- The choice of criterion for defining high and low life satisfaction seems questionable, since 8 is a relatively high score. Please justify the use of the median instead of a cutoff point based on the literature using the same questionnaire in other populations.

Discussion

- Page 11, lines 245 to 251:
- The result regarding high alcohol consumption and life satisfaction is interesting. In general, I agree with the argument that there is a socialization component involved. On the other hand, from a health perspective, this result may serve as a warning about possible limitations regarding spaces and/or leisure activities in the neighborhood that promote socialization and well-being without involving alcohol consumption. Is there any literature in this area?
- Page 12–13, lines 265 to 280: The authors use a variable related to physical activity reduced to "walking, running, or cycling." Could this choice be a limitation in the context of the study population? Especially regarding running and cycling... Do the authors have any suggestions for future studies to collect information on neighborhood physical activity in a more comprehensive way?

Final decision

- Major revisions required.

Reviewer B

Anonymous

- The study shows coherence between objectives, methods, results, and conclusions. It has scientific relevance and contributes to the relationships between physical activity, public health, and urban planning. It meets the recommendations of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE), with approximately 85% compliance. I recommend acceptance of the article provided that it addresses the following requests:
- To minimize the risk of bias, please present the strategies for handling missing data and the exclusion criteria.
- Present tests for multicollinearity and interactions.
- Present sensitivity analysis results, if performed.

Final decision

- Major revisions required.

Reviewer C

Debora Priscila Lima de Oliveira

Pernambucana Faculty of Health

- Initially, the authors are to be congratulated for submitting the manuscript, which addresses a relevant and current topic in the field of health and aging. Investigating life satisfaction associated with physi-

cal activity in older adults contributes to advancing knowledge about factors related to well-being in this population, with potential scientific and practical impact. Below are corrections and suggestions aimed at improving the manuscript.

- A general revision of the manuscript is recommended regarding formatting, spelling, and content, as well as standardizing paragraph length. Considering that the sample was collected during the COVID-19 pandemic, the absence of mention of this context is noted, which is particularly relevant in subjective analyses such as life satisfaction, which may have been influenced by the historical moment. In addition, the manuscript addresses physical activity without specifying the dimension assessed (leisure, transportation, occupational, or domestic). In some sections, the terms "elderly" and "older adults" are used interchangeably; a clearer characterization of the sample is recommended, since individuals aged 50 differ from those aged 80 or older. If available, it is also suggested to include information about neighborhood characteristics, as structural and social aspects (lighting, sidewalks, safety, among others) are relevant to understanding life satisfaction. It should also be noted that intersectionality is not limited to age.

Title

- It is suggested to revise the term "in the neighborhood," which may create ambiguity, as it is unclear whether it refers to physical activity performed in the neighborhood or the perception of the neighborhood as an environment for physical activity.

Abstract

- Lines 17 and 18: there is repetition of the term "self-report"; it is recommended to streamline this information.
- Line 21: it is suggested to better detail the results, specifying characteristics of individuals with higher satisfaction (sex, age group, presence of NCDs).
- Line 25: clarify which dimension of physical activity was assessed.
- Review the keywords, ensuring they are included in the Health Sciences Descriptors (DeCS), are in alphabetical order, and do not repeat terms from the title.

Introduction

- Line 61: clarify whether the level of satisfaction refers to older adults, elderly individuals, or both, considering the sample presented.
- Line 66: revise the wording, as the relationship between adherence and physical activity practice is unclear.
- Line 75: better explain the concept of a "pleasant neighborhood."

Methods

- Line 77: clarify what is meant by "physical disorder."
- Line 104: indicate whether the 70 municipalities are evenly distributed across the five regions of the country.
- Lines 111–114: considering that household interviews were conducted during the COVID-19 pandemic, specify the precautions taken to avoid contamination.
- Line 116: justify the exclusive inclusion of individuals living in urban areas.
- Line 141: adjust the information, considering that physical activity recommendations changed during the data collection period.

Results

- It is suggested to include graphs to facilitate visualization of the results.

Discussion

- Line 228: clarify which other outcomes are being referred to.
- Line 238: clarify the relationship between mental vulnerability, neighborhood satisfaction, and the presence of NCDs.
- Line 258: explain whether and how low education is related to lower neighborhood satisfaction.
- Line 265: revise and expand the study limitations, including the pandemic context, lack of specification of physical activity dimension, and age heterogeneity of the sample.

Conclusion

- Line 283: the statement "The perception of the neighborhood environment was associated with life satisfaction" is broad. It is recommended to make the conclusion more specific to the study findings, avoiding generalizations about neighborhood aspects that were not directly assessed.

Final decision

- Major revisions required.