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Characteristics of neighborhood environment (social cohesion and safety) and common mental disorders in ELSA-Brasil study: a multilevel analysis

Características do ambiente do bairro (coesão social e segurança) e transtornos mentais comuns no estudo ELSA-Brasil: uma análise multinível

Características del ambiente en barrios (cohesión social y seguridad) y trastornos mentales frecuentes en el estudio ELSA-Brasil: un análisis multinivel

Tatiani Secretti [1]
Maria Angélica Antunes Nunes [1]
Maria Inês Schmidt [1]
Markus Chagas Stein [2]
Simone M. Santos [3]

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Abstract

The purpose of this study was to determine if self-reported characteristics of social cohesion and local neighborhood safety positively affect the mental health of their residents, regardless of individual characteristics. A sample of participants in the Brazilian Longitudinal Study of Adult Health *(ELSA-Brasil) baseline was used. The* Clinical Interview Schedule-Revised *(CIS-R) instrument was used for tracking common mental disorders (CMD). Social cohesion and safety were measured by validated scales of neighborhood environment self-reported characteristics. The multilevel logistic regression model was used to estimate the effect in neighborhoods (level 2) and individuals (level 1), as well as the odds ratios for each neighborhood explanatory variable and social characteristics in the CMD. The results showed that part of the variance (2.3%), in the common mental disorders prevalence is attributed to local neighborhoods. The characteristics of social cohesion and safety remained significant, even after the adjustment of individual explanatory variables. This study confirmed the hypothesis that individuals living in neighborhoods where they perceive low social cohesion and safety present a higher chance of developing CMD.*

Mental Disorders; Social Environment; Multilevel Analysis

Correspondence
M. A. A. Nunes
Programa de Pós-graduação em Epidemiologia, Universidade Federal do Rio Grande do Sul.
Rua Ramiro Barcelos 2400, 2º andar, Porto Alegre, RS 90035-003, Brasil.
maanunes@gmail.com

[1] Programa de Pós-graduação em Epidemiologia, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brasil.
[2] Departamento de Estatística, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brasil.
[3] Escola Nacional de Saúde Pública Sergio Arouca, Fundação Oswaldo Cruz, Rio de Janeiro, Brasil.

Introduction

Common mental disorders (CMD) manifest in individuals as a mixture of somatic, anxious and depressive symptoms. They affect normal performance in people's daily activities [1]. They lead to lost workdays due to incapacitation, increased demand for healthcare services, and the generation of significant socioeconomic costs [2]. Thus, they continue to be an important cause of direct and indirect losses to the individual and his/her family [3]. CMD is more frequent among females [4,5,6,7,8] and individuals with a low education and socioeconomic status [6,9].

Considering the determinants only at an individual level has been insufficient to understand the causal mechanisms involved in the health/disease process [10]. Some studies show that the place of residence presents physical and social attributes that affects people's health, and plays an important role in understanding associated factors, such as the emergence of depressive symptoms [11,12,13,14,15]. The neighborhood environment seems to have distinct influences on the health of citizens with similar characteristics, due to economic, cultural, historical, geographical and lifestyle differences [16,17,18].

The neighborhood's attributes effect on mental health can be assessed through multilevel analysis, which investigates the variations within individuals and groups, and the simultaneous contribution of the individual and contextual levels on the outcome of interest [10,13,15,19,20]. Thus, it is possible to analyze whether the variations are determined by phenomena at ecological levels (contextual characteristics common to a group of people constituting the conditions of their location) or by constitutional effects (characteristics related to gender, age and social position of the individuals that make up the group who lives in a certain area) [13,15,20].

Studies using multilevel analysis have shown that mental disorders are associated with regions with higher income inequality, and to individual characteristics [13,21,22,23,24]. Although social characteristics are often mentioned, research on the perception of social cohesion and neighborhood safety is less common [13].

In places with greater social cohesion, there may be greater diffusion of health-related information, due to the degree of interconnectedness, trust, and respect that exists among neighbors [25], which may reinforce healthy behaviors and less substance use [26].

Once the basic needs of food and shelter are met, the attention of an individual naturally goes to the safety or security of their environment [27]. Booth et al. [28] showed that the feeling of being in an unsafe neighborhood acts as a primary stress factor of psychological distress. Individuals concerned about crime in their neighborhood may restrict their activities outdoors and isolate themselves, thus increasing the risk of mental disorders. The perceptions that the neighborhood is safe and socially cohesive as well as a sense of belonging seem to be protective for the elderly, even after controlling for individual variables [29].

In countries with unfavorable socioeconomic status, including Brazil, few studies have assessed the association between perceived social cohesion and neighborhood safety in the prevalence of CMD [14,30].

The main objective of this study is to determine whether self-reported characteristics of social cohesion and safety in the local neighborhood environment affect mental health in the *Brazilian Longitudinal Study of Adult Health* (ELSA-Brasil) group of participants, regardless of individual characteristics. Through multilevel analysis, the level of variation in the CMD is attributed to the local neighborhood level is analyzed, as well as how aspects of social cohesion and safety characteristics of the neighborhood affect mental disorders, after adjusting for individual variables.

Methods

Sample

The data comes from the baseline of the ELSA-Brasil, collected between 2008 and 2010. The sample is a cohort of 15,105 employees ranging from 35 to 74 years, from which 11,456 are active and retired residents of six state capitals in Brazil [31].

Geo-referencing of the residence from the ELSA-Brasil participants was carried out using two different streets as bases. The first identified the geographic coordinates using the application software GeoMapas (Laboratory of Health Information, Institute of Communication, Scientific Information and Technology in Health, Oswaldo Cruz Foundation, Rio de Janeiro, Brazil), which was connected to the 2012 database of Google Earth (https://www.google.com/earth/), updated in 2014; the second used the National Registry of Addresses for Statistical Purposes (CNEFE – *Cadastro Nacional de Endereços para Fins Estatísticos*) provided by Brazilian Institute of Geography and Statistics (IBGE), which enabled the georeferencing for census tracts. Based on the validation provided by these two methodologies, each participant was allocated to a census tract in the cartographic grid of 2010, belonging to the six host-cities of the Research Centers (RCs) and, consequently, to a local neighborhood [32].

The definition of neighborhood environment for the study of the influence of housing context on health was carried out according to a methodology developed by Santos et al. [33], and adapted based on variables available in the *Demographic Census* of 2010 (IBGE. http://www.ibge.gov.br). A total of 2,929 local neighborhoods within the six capitals were delimited by the SKATER (Spatial K'luster Analysis by Tree Edge Removal) aggregation method, based on the aggregation of census tracts that make up each city, using the free and open source software Terra View (http://www.dpi.inpe.br/terraview). The local neighborhoods are groups of contiguous census tracts that are relatively homogeneous internally and heterogeneous among themselves with regard to the four indicators from the *Demographic Census* of 2010: percentage of population from 0 to 4 years, number of inhabitants/household, mean income of the heads of households and percentage of population in terms of ethnicity/white color. The ELSA-Brasil participants are distributed across 1,902 local neighborhoods [32].

Measures

• Dependent variable

The CMDs were assessed using the *Clinical Interview Schedule-Revised* (CIS-R). CIS-R is a structured interview for the screening of CMD and the possible diagnosis of non-psychotic psychiatric morbidities developed by Lewis et al. [34] for use in community and primary care settings.

CIS-R was validated in its original English language [34], translated, and adapted to Portuguese [35] for the assessment of mental disorders in the ELSA-Brasil cohort.

The full version of CIS-R includes 14 sections on the symptoms of CMD. The total sum of the scores obtained in the 14 sections indicates the presence and severity of CMD. CIS-R score ≥ 12 is usually considered a cutoff for clinically significant psychiatric morbidity.

The diagnosis of specific disorders is obtained through algorithms based on the 10th revision of the International Classification of Diseases (ICD-10) diagnostic criteria [36]. Six diagnostic categories can be obtained: generalized anxiety disorder, depressive episode, any phobia, obsessive-compulsive disorder, panic disorder and mixed anxiety and depression disorder. In this study, CMD outcomes included total CIS-R score ≥ 12, depressive episodes (DE), anxiety disorder (AD) and mixed anxiety and depression disorder (MADD). All diagnostics are in accordance with *Diagnostic and Statistical Manual of Mental Disorders*, 5th edition (DSM-V) and ICD-10 classifications.

• Individual independent variables

The following variables were considered: age (years), gender (male/female), marital status (married, single, separated, widower, other), ethnicity/color (black, brown, white, Asian, indigenous), per capita household income (BRL), education (elementary incomplete, completed elementary, completed high school, completed college), and time residing in the same neighborhood (in years). All this information was self-reported in the first interview.

- **Independent variables of neighborhood context**

The main explanatory variables were comprised of two domains of scales of self-reported measures of the characteristics of the neighborhood environments: social cohesion and safety with regard to crimes. These scales, previously validated in the English language [37,38], were translated and adapted to Portuguese, within the scope of ELSA-Brasil, with adequate psychometric properties [39], similar to those of a US study [38]. The intraclass correlation coefficient was 0.83 (95%CI: 0.78-0.87) for social cohesion, 0.86 (95%CI: 0.82-0.89) for perceived safety, and internal consistency (Cronbach's alpha) of 0.70 for both.

All participants were advised to consider as neighborhood "the general surrounding area of their residence where he/she normally carried out his/her routine activities, such as shopping, going to the park, or visiting neighbors", and then they were asked to indicate their agreement to the statements in each scale, choosing the best response from five options in a Likert scale ranging from "fully agree" to "fully disagree". The social cohesion section is comprised of five questions: (1) "In your neighborhood, people are willing to help their neighbors?"; (2) "Your neighborhood is tightly knit?"; (3) "The people in your neighborhood are trustworthy?"; (4) "In general, people in your neighborhood DO NOT get along with each other?"; (5) "People in your neighborhood DO NOT share the same cultural, behavioral, ethical or moral standards, among others?". The higher the score, the greater the social cohesion. The responses were summoned for each participant in order to create a total score (from 5 to 25), and then classified into tertiles of approximately equal size, with the largest group (3) presenting the greatest perceived social cohesion.

The perceived safety domain was comprised of three questions: (1) "You feel safe walking day or night in your neighborhood?"; (2) "Violence is a problem in your neighborhood?"; (3) "Your neighborhood is safe with regard to crimes?". The higher the score, the greater the perceived safety. The total safety score was added (from 3 to 12) and later divided into approximately equal tertiles, with the largest group (3) showing greater perceived safety with regard to crimes.

Of the 15,105 baseline participants, 11,456 lived in the host cities of the RCs, having been allocated to a certain geographic unit of the local neighborhood. Of those individuals who reported antidepressant use (n = 751), those who did not respond to any question of the social cohesion or perceived safety domain (n = 32) and those who were missing in any of the outcomes (n = 110) were excluded. Those who were lacking any of the covariates (n = 171) were also excluded. This resulted in a sample of 10,392 participants, distributed across 1855 local neighborhoods. The number of participants per neighborhood varied from 1 to 125, and 28.3% of the local neighborhoods had only one participant.

Statistical analysis

Descriptive analyses of individual and neighborhood environment characteristics as well as the prevalence of CMD (total score CIS-R ≥ 12), DE, AD, and MADD were performed. In the bivariate analysis, the associations between the disorders, the individual explanatory variables and neighborhood characteristics were verified. Pearson's chi-square test was performed for linear tendency, when the exposure variable presented more than two categories, and Student's t test was performed for continuous variables.

As for multivariate analyses, non-hierarchical logistic regression model was applied first, for individual-level variables. The variables were analyzed collectively in the model, and those that did not present statistical significance at a 95% confidence level were not included in the final model. Subsequently, analyses were performed using hierarchical or multilevel models. The logistic model of random intercepts was adopted because the outcomes of this study – total scores in the CIS-R ≥ 12, for DE, AD and MADD – have binary responses [40]. The results using traditional (non-hierarchical) logistic models are very similar to individual-level associations from the multilevel models shown in this paper. It is possible to find more results at an individual-level in Secretti [41]. However, despite them being common in the literature, traditional models would not be appropriate here because of the correlated outcomes assumption within neighborhoods. Multilevel modeling was chosen because this method takes into account the hierarchical structure of the data, as it determines the relationships between the variables and aggregates' information regarding the correlation between individuals,

associated with the same level of aggregation [42]. Thus, this method allows for the estimation of random independent effects for two or more levels [17,43].

The evaluation of mental disorders was carried out according to the recommendations of Snijders & Bosker [44] and Rasbash et al. [45] with a hierarchical structure containing two levels, in which the 10,392 individuals constituted the units of the first level, and the 1,855 neighborhoods the units of the second level. Thus, mental disorders in individuals may vary according to explanatory variables, which can be measured in the first level (characteristics of the individuals) or in the second (characteristics of the local neighborhoods), allowing for the estimation of individual or contextual effects.

The multilevel model consists of a fixed component, indicating the magnitude of the associations between variables; and a random component, which shows the differences between components of the second level and variances at different levels [46].

In order to compare the geographic aggregation levels to the variability of CMD (total score in the CIS-R ≥ 12), DE, AD and MADD, empty logistic regression models with two hierarchical levels were adjusted. In order to obtain more accurate estimates and fewer biases, models were adjusted using the RIGLS (Restricted Iterative Generalized Least Squares) algorithm and by adopting the second-order PQL (Penalized Quasi Likelihood) estimation method [43,47,48]. In order to measure the parsimony between each model, the respective AIC (Akaike Information Criterion) was estimated.

Subsequently, the neighborhood environment characteristics were successively incorporated into the model. After maintaining the contextual variables, which presented statistical significance at the 95% confidence level, the individual variables were incorporated, which allowed for the adjustment of estimated parameters for neighborhood characteristics based on individual characteristics.

The variability of the outcome attributed to the contextual neighborhood level was assessed by the variance partition coefficient (VPC) or the intraclass correlation coefficient (ICC). The VPC can be used to measure the homogeneity of two or more measurements and is interpreted as the estimate of the proportion of the total variability that is attributed to the study outcome.

In this study, VPC represents the proportion of the variance between the local neighborhoods compared to the total variation, that is, this correlation shows how much of the variation in the CMD (CMD, DE, AD, and MADD) of the participants is explained by differences between each of their neighborhoods. This coefficient ranges from 0 to 1. When it is close to 0, it means that the neighborhoods are homogeneous with each other and that the chance of the participants to report mental disorders is not dependent from the neighborhood to which they belong. When the coefficient is close to 1, it indicates that all variability in the chances of having a mental disorder is due to differences between neighborhoods. In this case, individual characteristics do not contribute to the chances of reporting CMD.

The analyses were performed in the software R 3.0.2 (http://www.r-project.org).

Results

Table 1 shows the sociodemographic characteristics and the self-reported measures of social cohesion and neighborhood safety. Among all 10,392 participants, mean age was 52.5 years of age (SD = 9.2), predominantly female (54.7%), ethnicity/white (53.5%), marital status – married (65.1%) and with completed college education (58.6%). The average per capita income was BRL 1,886.5 (SD = 1,494.8). The length of time residing in the neighborhood ranged from 0 to 74 years, and, on average, participants lived in the same neighborhood for 17.6 years (SD = 14.5).

The prevalence of CMD was 24.4% in this study. CMD was associated with gender, age, ethnicity/color, education, marital status and per capita family income. There was also an association with self-reported neighborhood characteristics, social cohesion and safety, as described in Table 1.

DE showed a prevalence of 3.6% and the prevalence of anxiety disorder was 11.7%. Both outcomes showed significant bivariate associations with all of the individual-level variables considered. MADD, with a prevalence of 12.3%, was statistically associated with all variables except marital status.

Perceptions of social cohesion and safety were associated with CMD, DE, AD and MADD (Table 1).

Table 2 presents information on the estimates of the parameters of the random component from various multilevel logistic regression models. By means of variance and estimated VPCs, it can be

Table 1

Characteristics of the participants in the baseline. *Brazilian Longitudinal Study of Adult Health* (ELSA-Brasil), 2008-2010.

Characteristics	Total	Common mental disorders (total score CIS-R ≥ 12)	Depressive episodes	Anxiety disorder	Mixed anxiety and depressive disorder
Total	10,392	2,534 (24.4)	377 (3.6)	1,220 (11.7)	1,275 (12.3)
Individual level					
Gender *					
Male	4,706 (45.3)	803 (31.7)	102 (27.1)	372 (30.5)	417 (32.7)
Female	5,686 (54.7)	1,731 (68.3)	275 (72.9)	848 (69.5)	858 (67.3)
Age (years) *	52.5 ± 9.2	51.0 ± 8.7	51.2 ± 8.6	51.4 ± 8.8	51.0 ± 8.8
Ethnicity/Color **					
Black	1,636 (15.7)	497 (19.6)	68 (18) ***	217 (17.8)	257 (20.2)
Brown	2,849 (27.4)	813 (32.1)	118 (31.3)	364 (29.8)	413 (32.4)
White	5,540 (53.3)	1,152 (45.5)	180 (47.7)	600 (49.2)	566 (44.4)
Yellow	277 (2.7)	45 (1.8)	8 (2.1)	25 (2.0)	25 (2.0)
Indigenous	90 (1.0)	27 (1.1)	3 (1.0)	14 (1.1)	14 (1.1)
Education *					
Elementary incomplete	485 (4.7)	127 (5)	16 (4.2)	71 (5.8)	52 (4.1)
Completed elementary	601 (5.8)	172 (6.8)	31 (8.2)	73 (6.0)	84 (6.6)
Completed high school	3,251 (31.3)	972 (38.4)	164 (43.5)	460 (37.7)	445 (34.9)
University degree	6,055 (58.3)	1,263 (49.8)	166 (44.0)	616 (50.5)	694 (54.4)
Marital status **					
Married or lives with someone	6,765 (65.1)	1,511 (59.6)	194 (51.5)	715 (58.6)	805 (63.1) ***
Single	1,706 (16.4)	512 (20.2)	91 (24.1)	256 (21.0)	224 (17.6)
Separated or divorced	1,132 (10.9)	267 (10.5)	37 (9.8)	121 (9.9)	143 (11.2)
Widower	420 (4.0)	133 (5.2)	25 (6.6)	67 (5.5)	58 (4.5)
Other	369 (3.6)	111 (4.4)	30 (8.0)	61 (5.0)	45 (3.5)
Per capita income (BRL) *	1,886.5 ± 1,494.8	1,549.9 ± 1288.2	1,454.3 ± 1,313.2	1,555.1 ± 1,297.4	1,633.2 ± 1,293.1
Neighborhood level					
Time residing in the neighborhood (years) #	17.6 ± 14.5 (0-74)	17.3 ± 14.7	16.2 ± 14.2	17.4 ± 15.0	17.3 ± 14.5
Social cohesion *	17.3 ± 3.6	16.6 ± 3.8	16.3 ± 4.2	16.7 ± 3.9	16.7 ± 3.7
Lower tertile	5.16 ± 2.30	1,233 (48.7)	192 (50.9)	562 (46.1)	602 (47.2)
Middle tertile	16.19 ± 0.80	754 (29.8)	102 (27.1)	359 (29.4)	395 (31)
Upper tertile	19.25 ± 1.60	547 (21.6)	83 (22.0)	299 (24.5)	278 (21.8)
Safety *	9.3 ± 3.2	8.8 ± 3.2	8.5 ± 3.3	8.6 ± 3.2	8.8 ± 3.2
Lower tertile	3.8 ± 1.8	1,158 (45.7)	182 (48.3)	568 (46.6)	562 (44.1)
Middle tertile	8.11 ± 0.70	870 (34.3)	126 (33.4)	416 (34.1)	454 (35.6)
Upper tertile	11.15 ± 1.10	506 (20.0)	69 (18.3)	236 (19.3)	259 (20.3)

Notes: n (%) ou mean ± standard deviation (SD). Difference between the groups tested by chi-square, significant if $p < 0.05$.

* p-value less than 0.05 for all outcomes;

** The p-value is not less than 0.05 for all outcomes;

*** p-value greater than 0.05;

Variable not associated with all outcomes.

Table 2

Variance and standard error parameters of the different multilevel regression models for prevalence of common mental disorders (CMD), depressive episodes (DE), anxiety disorder (AD) and mixed anxiety and depression disorder (MADD), and neighborhoods. *Brazilian Longitudinal Study of Adult Health* (ELSA-Brasil), 2008-2010.

	Models			
	Model empty	**Model 1**	**Model 2**	**Model 3***
CMD (CIS-R ≥ 12)				
Variance (SE)	0.078 (0.023)	0.054 (0.073)	0.051 (0.085)	0.0124 (< 0.001)
VPC	0.023	0.016	0.015	0.0038
AIC	11,538.2	11,493.2	11,458.1	10,942.3
DE				
Variance (SE)	< 0.001 (0.052)	< 0.001 (0.162)	< 0.001 (0.192)	< 0.001 (0.303)
VPC	< 0.001	< 0.001	< 0.001	< 0.001
AIC	3,246.8	3.247,6	3,245.2	3,124.6
AD				
Variance (SE)	0.0103 (0.032)	< 0.001 (0.090)	< 0.001 (0.106)	0.0124 (0.165)
VPC	0.0031	< 0.001	< 0.001	0.004
AIC	7,521.6	7,528.5	7,525.2	7,313.0
MADD				
Variance (SE)	0.0543 (0.034)	0.0473 (0.092)	0.0475 (0.1095)	0.0118 (0.1617)
VPC	0.016	0.014	0.014	0.004
AIC	7,739.3	7,714.3	7,698.9	7,545.7

AIC: Akaike Information Criterion; CIS-R: *Clinical Interview Schedule-Revised*; SE: standard error; VPC: variance partition coefficient.

Note: Model empty: no neighborhood or individual-level variables; Model 1: social cohesion for neighborhood; Model 2: social cohesion and neighborhood safety; Model 3: neighborhood level and individual level variables.

* Individual level variables: gender, age, ethinicity/color, marital status, education and icome.

observed that the variance of the random effect related to the neighborhood level in the null model was of 0.078, corresponding to a VPC of 2.3%. This result indicates that 2.3% of the variance in CMD was attributed to variability in the second level (neighborhoods, statistically significant in the empty model), signaling the presence of effects from the local neighborhoods. The variance in the random effect of the second level decreased to 0.012 (VPC to 0.38%) with the inclusion of explanatory variables in the final model, increasing the model's explanatory power of the variability by 84% when considering individual and neighborhood variables.

In the analyses, the random effect of a third level (research center), which proved to be significant for CMD (COV = 0.45), was tested, indicating that the chance of participants presenting mental disorders would be independent of the host city of the research center to which they belong. It can be said that this small variation between centers was already expected, hence opting to perform the adjustment of the models by research center and not as a third level.

The DE, AD and MADD categories did not have random neighborhood effects (second level).

As the neighborhood and individual characteristics were incorporated into the models, there was a better explanation of the general variability of the CMD, DE, AD and MADD outcomes, mainly due to the inclusion of the individual variables. In order to measure the parsimony between each model, the respective AIC were estimated. Therefore, the final model was one that, besides containing significant variables ($p \leq 0.05$), presented less variability in the disorders among neighborhoods. For all outcomes, the most parsimonious model, containing contextual and individual variables, was model 3, for having a lower AIC.

Tables 3 and 4 show the results of the fixed parameters of the models for CMD, DE, AD and MADD, with odds ratios (OR) estimated for each of the variables included in the models and their

Table 3

Estimates of the fixed effects of multilevel logistic regression models for common mental disorders (CMD) and depressive episodes (DE). *Brazilian Longitudinal Study of Adult Health* (ELSA-Brasil), 2008-2010.

Characteristics	CMD (CIS-R ≥ 12)			DE		
	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)
Neighborhood level						
Social cohesion						
Upper tertile	1.0	1.0	1.0	1.0	1.0	1.0
Middle tertile	1.2 * (1.1-1.4)	1.2 * (1.1-1.4)	1.2 * (1.1-1.3)	1.3 (0.9-1.7)	1.3 (0.9-1.7)	1.2 (0.9-1.6)
Lower tertile	1.4 * (1.3-1.6)	1.3 * (1.2-1.5)	1.2 * (1.1-1.3)	1.4 * (1.1-1.8)	1.3 (0.9-1.7)	1.1 (0.9-1.5)
Safety						
Upper tertile		1.0	1.0		1.0	1.0
Middle tertile		1.1 (0.9-1.3)	1.1 (0.9-1.3)		1.2 (0.9-1.6)	1.2 (0.9-1.6)
Lower tertile		1.5 * (1.3-1.7)	1.4 * (1.3-1.6)		1.4 * (1.1-1.9)	1.4 * (1.1-1.9)
Individual level						
Gender						
Male			1.0			1.0
Female			2.1 * (1.9-2.4)			2.1 * (1.7-2.7)
Age (years)						
65-74			1.0			1.0
55-64			1.2 (0.9-1.4)			1.0 (0.7-1.9)
45-54			1.6 * (1.3-1.9)			1.2 (0.8-1.9)
35-44			1.7 * (1.4-2.1)			1.3 (0.8-2.0)
Marital status						
Married or lives with someone			1.0			1.0
Separated or divorced			1.3 * (1.2-1.5)			1.7 * (1.3-2.2)
Widower			1.0 (0.8-1.1)			1.1 (0.8-1.7)
Single			1.4 * (1.1-1.7)			1.8 * (1.1-2.8)
Other			1.3 * (1.0-1.4)			2.7 * (1.8-4.0)
Per capita income						
Upper tertile			1.0			1.0
Middle tertile			1.3 * (1.1-1.4)			1.4 * (1.0-1.9)
Lower tertile			1.8 * (1.5-2.0)			1.9 * (1.4-2.6)
Education						
University degree			1.0			1.0
Completed high school			1.2 * (1.1-1.4)			1.6 * (1.2-2.0)
Completed elementary			1.3 * (1.1-1.6)			1.9 * (1.2-2.9)
Elementary incomplete			1.2 (0.9-1.6)			1.2 (0.7-2.1)

95%CI: 95% confidence interval; CIS-R: *Clinical Interview Schedule-Revised*; OR: odds ratio.

Note: Model 1: social cohesion for neighborhood; Model 2: social cohesion and neighborhood safety; Model 3: neighborhood level and individual level variables.

* Significant estimates with $p < 0.05$.

respective 95% confidence intervals (95%CI). Table 3 shows that the perceived social cohesion of the neighborhood was associated with CMD in the final model (model 3). Participants in neighborhoods with low social cohesion and neighborhoods with medium social cohesion were more likely to have CMD than those in neighborhoods with social cohesion in the upper tertile (18% and 17%, respectively). Participants from neighborhoods with a perception of low-safety (lower tertile) had a 43% higher chance of having CMD.

Table 4

Estimates of the fixed effects of multilevel logistic regression models for anxiety disorder (AD) and mixed anxiety and depressive disorder (MADD). *Brazilian Longitudinal Study of Adult Health* (ELSA-Brasil), 2008-2010.

Characteristics	AD			MADD		
	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)
Neighborhood level						
Social cohesion						
Upper tertile	1.0	1.0	1.0	1.0	1.0	1.0
Middle tertile	0.9 (0.8-1.1)	0.9 (0.8-1.1)	0.9 (0.8-1.1)	1.3 * (1.1-1.5)	1.2 * (1.1-1.5)	1.2 * (1.0-1.4)
Lower tertile	1.1 (0.9-1.3)	1.1 (0.9-1.3)	1.0 (0.9-1.2)	1.3 * (1.1-1.6)	1.2 * (1.0-1.4)	1.2 (0.9-1.4)
Security guards						
Upper tertile		1.0	1.0		1.0	1.0
Middle tertile		1.1(0.9-1.3)	1.1 (0.9-1.3)		1.2 (1.0-1.4)	1.2 (0.9-1.4)
Lower tertile		1.2 * (1.1-1.5)	1.2 * (1.0-1.4)		1.4 * (1.2-1.7)	1.4 * (1.2-1.6)
Individual level						
Gender						
Male			1.0			1.0
Female			2.0 * (1.8-2.3)			1.9 * (1.6-2.1)
Age (years)						
65-74			1.0			1.0
55-64			1.0 (0.8-1.3)			1.2 (0.9-1.5)
45-54			1.3 * (1.0-1.6)			1.4 * (1.1-1.8)
35-44			1.3 * (1.0-1.7)			1.5 * (1.2-1.9)
Marital status						
Married or lives with someone			1.0			-
Separated or divorced			1.3 * (1.1-1.6)			-
Widower			0.9 (0.7-1.1)			-
Single			1.3 (0.9-1.8)			-
Other			1.5 * (1.1-2.0)			-
Ethnicity/Color						
White			-			1.0
Not white			-			1.3 * (1.1-1.5)
Per capita income			-			
Upper tertile			1.0			1.0
Middle tertile			1.3 * (1.1-1.6)			1.1 (0.9-1.3)
Lower tertile			1.7 * (1.4-2.1)			1.4 * (1.2-1.7)
Education						
University degree			1.0			1.0
Completed high school			1.2 (0.9-1.3)			1.0 (0.8-1.1)
Elementary completed			1.1 (0.8-1.4)			1.1 (0.8-1.4)
Incomplete elementary			1.4 * (1.0-1.7)			0.9 (0.6-1.2)

95%CI: 95% confidence interval; CIS-R: *Clinical Interview Schedule-Revised*; OR: odds ratio.

Note: Model 1: social cohesion for neighborhood; Model 2: social cohesion and neighborhood safety; Model 3: neighborhood level and individual level variables.

* Significant estimates with $p < 0.05$.

At the individual level, the chance of CMD (114%) in women is higher than in men. Individuals in the age groups ranging from 35 to 44 and from 45 to 54 years of age were identified as having a higher chance of CMD when compared to those older than 74 years (74% and 57%, respectively). Being single, separated or divorced represents a greater chance of CMD compared to being married (36% and

31%, respectively). Having completed elementary and high school education means a higher chance of CMD, compared to individuals with a university degree (32% and 21%, respectively). Another relevant fact is that having low (lower tertile) and average (middle tertile) household income corresponds to a higher tendency to develop CMD, in relation to those with the highest per capita household income (upper tertile – 78% and 26% respectively).

Participants from neighborhoods perceived to be less safe (lower tertile) presented a greater chance (43%) of DE, compared with those in the tertile perceiving in areas perceived as safer.

According to Table 4, participants in neighborhoods perceived to be less safe (lower tertile) presented a higher chance (22%) of AD, and 40% higher chance of MADD, when compared with those in neighborhoods with a higher perception of safety.

After adjusting for individual characteristics, neighborhood environment characteristics (social cohesion and safety) associations with mental disorders were attenuated.

Tests were carried out to verify interactions between social cohesion and safety; however, no interaction was significant. The length of time that participants lived in the same neighborhood was not included, as it did not present statistical significance.

Discussion

This study presents evidence of the association between perceived social cohesion and safety of neighborhoods with common mental disorders, even after adjustment for individual variables. Our findings are in agreement with studies which show that individuals living in neighborhoods with perceived low social cohesion report low level of psychological well-being [49] and higher scores for depression [50,51]. These results confirm findings from the *Multi-Ethnic Study of Atherosclerosis* (MESA), where participants who reported living in a neighbourhood with lower social cohesion had significantly higher scores for depression [52]. Regarding the perception of safety, our findings support the hypothesis that individuals living in neighborhoods perceived to be less safe present higher scores for depressive symptoms [53] and higher psychological distress [11,28].

Estimates of the intra-neighborhood correlation coefficient indicated that most of the variation in the prevalence of CMD (97.7%) occurred at the individual level and that 2.3% was due to variation between neighborhoods. Possibly, there are other characteristics related to the local neighborhoods that were not contemplated in the analysis, which could influence the chances of CMD. Roh et al. [53], through a hierarchical analysis, observed that, with the inclusion of neighborhood variables, there was an additional 4% of variation in depressive symptoms. Araya et al. [49], through a multilevel technique, showed that social cohesion and confidence in the neighborhood demonstrated significant associations with scores for psychological well-being, after adjusting for the individual variables. These factors, however, showed little variation at the neighborhood level, which indicated a stronger individual influence.

The relationships between individual variables and the outcomes considered in the final model reinforce the individual determinants found in the literature. Accordingly, it was possible to observe a higher chance of CMD in female participants [4,5,6,7,8,54], in young adults [55,56] with a low educational level [6,9], and low income [4,5,57].

Additionally, our OR estimates showed a significant variation in CMD compared to the level of social cohesion and perceived safety in the neighborhood, which could not be fully explained by individual factors such as per capita income, education, age, sex, ethnicity/color and marital status. We considered the level of social interconnectedness of the neighborhood environment and not other forms of connection or social support, such as social cohesion at work and social support from family and friends. Results from one study suggest that closest social connections represent an improved experience of health benefits [58].

Our study has some strengths, including a focus on a relatively large and well-characterized sample of civil servants from major urban areas in Brazil, being one of the largest studies in a middle/upper income country.

This study used a structured psychiatric interview (CIS-R) administered by lay interviewers who underwent intensive training and were closely supervised during fieldwork. Efforts were

made to reduce ascertainment bias arising from cultural and clinical invalidity through careful translation and back-translation procedures. Previous research has shown that careful attention to translation and conceptual validity enables the use of ethic instruments with reasonable confidence across cultures [34].

In addition, the use of VPC statistics with binary outcome permits comparing the amount of variation of a given outcome at different contextual levels. Also noteworthy is the unique use of the contextual and spatial analysis unit by the local neighborhoods, which included groups of more homogeneous collective profiles, both from a socioeconomic point of view and population size [59]. The construction of these neighborhood sub-sections, according to the literature, is still scarce compared to administrative units or census tracts. One of the most relevant results was to show the importance of the neighborhood environment characteristics that are related to the presence of mental disorders in the respective residents, evidenced by the variance attributed to the local neighborhoods level.

In Brazil, to date, no study was found on characteristics of the social environment such as perception of social cohesion and safety in the neighborhood, as an indicator of CMD. Through the multilevel modeling in this study, it was possible to show the variance at the local neighborhood level. Considering the multidisciplinary approach in mental disorders, this method provided a better visualization of the contribution of each level (contextual and individual) in terms of the variation of CMD.

Regarding study limitations, due to cohort purposes and the verification of the emergence of new cases in the longitudinal study, individuals who were already using antidepressants were excluded from this baseline section sample. Thus, the prevalence presented would not represent the prevalence of the original population. We performed a sensitivity analysis by including the participants that reported antidepressant use. There were very small changes in the strength of associations between outcomes and contextual variables. Most of the odds ratios were attenuated to social cohesion, with the exception of MADD, which showed a modest increase. Moreover, the opposite happens when we look at associations with safety, they were slightly higher, especially for DE, but in general smaller for MADD. The VPCs from models for CMD were 0.4% higher on average, and for the other outcomes VPCs did not show much difference.

In addition, we note the restrictions of the neighborhood environment characteristics considered, social cohesion and safety, which may cause underestimation of the contextual component of variation in the CMD, since socioeconomic and physical characteristics of the environment were not analyzed. Moreover, individual variables, because of their proximal nature, had stronger associations with the outcomes than the contextual (distal) variables.

A portion of the sample analyzed in this study had neighborhoods with only one participant, which may have limited the statistical power of the analyses, since the higher the number of observations within the groups, the better the consistency of the measurements referred in the level of each group is [60]. In this sense, the power to evidence the contrasts among residential areas of the participants may have been reduced and findings are limited to populations with characteristics similar to those of this study. A sensitivity analysis was also conducted to evaluate the impact of excluding neighborhoods with only one participant. The outcomes tended to show slightly lower associations with contextual variables than the results presented here. We did not find a substantial difference in the VPCs.

Another limitation is the cross-sectional design, which does not allow for a causal relationship between exposure and outcome (reverse causality). There is also the possibility of a bias arising from exposure measured through self-reports, which are susceptible to individual perceptions and objective reality. Depressed individuals may perceive less social cohesion and less safety.

Finally, the absence of CIS-R criterion validation and the specific population of civil servants requires caution in the external validity of the results.

Conclusion

The present findings support the hypothesis that the perception of low social cohesion and low safety in the neighborhood pose a risk to mental health. This study adds to the recognition of the importance of the social context, as a determinant of CMD.

Greater understanding of the role of the social context as well as identifying the most effective way to intervene on them to improve mental health will require efforts between researchers, communities, and policy makers.

Contributors

T. Secretti participated in study design, statistical analysis, data interpretation, and drafted the manuscript. M. A. A. Nunes, M. I. Schmidt and S. M. Santos participated in study design and contributed with intellectual content to the paper. M. C. Stein performed the statistical analysis, data interpretation and revised the manuscript.

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Resumo

O objetivo do estudo foi determinar se características auto-referidas de coesão social e segurança local dos bairros afetam positivamente a saúde mental de seus residentes, independentemente de características individuais. Uma amostra de participantes da linha de base do Estudo Longitudinal de Saúde do Adulto *(ELSA-Brasil) foi usada. O instrumento* Clinical Interview Schedule-Revised *(CIS-R) foi usado para identificar transtornos mentais comuns (TMC). A coesão social e segurança foram medidos por meio de escalas validadas de características auto-relatadas do ambiente do bairro. Um modelo de regressão logística multinível foi usado para estimar os efeitos nos bairros (nível 2) e nos indivíduos (nível 1), bem como os odds ratios para cara variável explicativa de bairro e características sociais nos TMC. Os resultados demonstram que parte da variância (2,3%) da prevalência de TCM é atribuível aos bairros. As características de coesão social e segurança permaneceram significativas mesmo depois do ajuste de características explicativas individuais. Este estudo confirma a hipótese de que indivíduos que residem em bairros onde percebem baixa coesão social e segurança têm maior chance de desenvolver TCM.*

Transtornos Mentais; Meio Social; Análise Multinível

Resumen

El objetivo de este estudio fue determinar si las características autoinformadas de cohesión social y seguridad local en barrios afectan positivamente la salud mental de sus residentes, independientemente de sus características individuales. Se utilizó como punto de partida una muestra de participantes del Estudio Longitudinal de Salud del Adulto *(ELSA-Brasil). Además, se utilizó la herramienta* Clinical Interview Schedule-Revised *(CIS-R) para realizar un seguimiento de los trastornos mentales más comunes (TMC). La cohesión social y seguridad se midieron mediante escalas validadas de características autoinformadas del vecindario. El modelo de regresión logística multinivel se usó para estimar el efecto en los barrios (nivel 2) e individuos (nivel 1), así como las odds ratios para cada variable explicatoria de barrio y características sociales en los TMC. Los resultados mostraron que parte de la varianza (2,3%) en la prevalencia de TMC es atribuida a los barrios. Las características de cohesión social y seguridad fueron significativas, incluso después del ajuste de las variables individuales explicatorias. Este estudio confirmó la hipótesis de que los individuos que viven en barrios, donde percibían una baja cohesión social y seguridad, presentan una probabilidad más alta de desarrollar TMC.*

Trastornos Mentales; Medio Social; Análisis Multinivel

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