Associations between neighborhood-level violence and individual mental disorders: Results from the World Mental Health surveys in five Latin American cities

C. Benjet[a,*], L. Sampson[b], S. Yu[b], R.C. Kessler[b], A. Zaslavsky[b], S. Evans-Lacko[c], S.S. Martins[d], L.H. Andrade[e], S. Aguilar-Gaxiola[f], A. Cía[g], M.E. Medina-Mora[a], J.C. Stagnaro[h], M.Y. Torres de Galvez[i], M.C. Viana[j], S. Galea[b]

[a] Department of Epidemiology and Psychosocial Research, National Institute of Psychiatry Ramón de la Fuente Muñiz, Mexico City, Mexico
[b] Department of Epidemiology, School of Public Health, Boston University, Boston, MA, USA
[c] Health Service and Population Research Department, Kings College London, Institute of Psychiatry, Psychology & Neuroscience, London, UK, PSSRU, London School of Economics and Political Science, London, UK
[d] Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, NY, USA
[e] Núcleo de Epidemiologia Psiquiátrica - LIM 23, Instituto de Psiquiatria Hospital das Clinicas da Faculdade de Medicina da Universidade de São Paulo, Brazil
[f] Center for Reducing Health Disparities, UC Davis Health System, Sacramento, CA, USA
[g] Anxiety Disorders Center, Buenos Aires, Argentina
[h] Departamento de Psiquiatría y Salud Mental, Facultad de Medicina, Universidad de Buenos Aires, Argentina
[i] CES University, Medellin, Colombia
[j] Department of Social Medicine, Postgraduate Program in Public Health, Federal University of Espírito Santo, Vitoria, Brazil

ARTICLE INFO

ABSTRACT

Rapidly urbanizing areas of Latin America experience elevated but unevenly distributed levels of violence. Extensive research suggests that individual exposure to violence is associated with higher odds of both internalizing (anxiety and mood) and externalizing (substance and intermittent explosive) mental disorders. Less research, however, has focused on how neighborhood-level violence, as an indicator of broader neighborhood contexts, might relate to the mental health of residents, independently of an individual's personal exposure. We used multilevel analyses to examine associations of neighborhood-level violence with individual-level past-year mental disorders, controlling for individual-level violence exposure. We used data from 7,251 adults nested in 83 neighborhoods within five large Latin American cities as part of the WHO World Mental Health Surveys. Accounting for individual-level violence exposure, living in neighborhoods with more violence was associated with significantly elevated odds of individual-level internalizing disorders, but not externalizing disorders. Caution should be exercised when making causal inferences regarding the effects of neighborhood-level violence in the absence of experimental interventions. Nevertheless, neighborhood context, including violence, should be considered in the study of mental disorders. These findings are particularly relevant for rapidly urbanizing areas with high levels of violence, such as Latin America.

1. Introduction

Latin America is the most urbanized region of the world, with 80% of its population currently living in urban areas, a dramatic two-fold increase from 40% in 1950 (UN-Habitat, 2012). This rapid urbanization has been accompanied by important challenges such as increasing socioeconomic inequality and violence. Homicide rates in some Latin American countries are as much as three times the global rate (The World Bank, 2011; UNODC, 2013). Interpersonal violence and kidnapping are also more common in Latin America than other regions of the world (Benjet et al., 2016). In large cities, rates of violence vary widely across neighborhoods (UNODC, 2013).

It is widely believed that the physical and social characteristics of neighborhoods can affect the physical and mental health of residents (Diez Roux and Mair, 2010). However, rigorous documentation of such presumed effects is complicated in the absence of experimentation

(Arcaya et al., 2016). A case in point is neighborhood violence, which might affect health either directly, through individual exposure (either as a victim or via witnessing violence to others), or indirectly, as individuals living in violent neighborhoods may experience perceived lack of safety, more daily stress, disruption of social networks, and loss of social capital (Curry et al., 2008; Cutrona et al., 2006). While extensive research has shown that direct exposure to violence is related to increased risk of both internalizing and externalizing mental disorders (Dworkin et al., 2017; Fowler et al., 2009; Wilson and Rosenthal, 2003), much less is known about the effects of neighborhood-level violence on the mental health of individuals who have not experienced such violence directly.

A few notable recent studies have examined the association of local-area crime and violence with mental health (Cuartas and Roy, 2019; Cornaglia et al., 2014; Dustmann and Fasani, 2016; Grinshteyn et al., 2018). Cuartas and Roy – in a sample of adolescents from Bogota, Colombia – recently found that local area homicide rates were associated with posttraumatic stress symptoms and lower scores on a self-reported mental health index, after accounting for direct exposure (Cuartas and Roy, 2019). In two longitudinal surveys of British adults, crime rates – primarily property crime – had an impact upon mental well-being in narrower local areas, whereas violent crimes had an impact upon mental well-being in larger spatial areas from one's residence (Dustmann and Fasani, 2016), consistent with findings in a sample from Australia (Cornaglia et al., 2014). Grinshteyn and colleagues recently found that area-level crime rates were associated to depressive symptoms, but not with other types of mental health symptomatology, in adolescents in the United States (US; Grinshteyn et al., 2018).

This prior research on neighborhood-level violence has mostly assessed, via brief self-report measures, more general mental distress or symptomatology (Cornaglia et al., 2014; Dustmann and Fasani, 2016) or only one type of symptomatology (typically depressive or posttraumatic stress symptoms (Cuartas and Roy, 2019; Lowe et al., 2016). Prior research has also focused on specific populations, such as current or former drug users (Curry et al., 2008), sexual minority youth (Duncan et al., 2014), adolescents (Cuartas and Roy, 2019; Grinshteyn et al., 2018), or the elderly (Joshi et al., 2017; Wilson-Genderson and Pruchno, 2013), as compared to general, representative adult samples.

Finally, neighborhood or local-area differences in violence are likely to be associated with other neighborhood differences, such as overall levels of education, income, unemployment, and migration—potential confounders of the associations between neighborhood-level violence and individual psychopathology (Sampson et al., 2018) that have not been substantially addressed in prior research.

The World Health Organization's (WHO) World Mental Health (WMH) Surveys (http://www.hcp.med.harvard.edu/wmh) provide a unique opportunity to examine the associations between neighborhood-level violence and a wider range of individual internalizing and externalizing mental disorders than previously studied, in a region that is rapidly urbanizing and affected by violence. Our aim was to estimate the associations between neighborhood-level violence and internalizing and externalizing mental disorders, controlling for other neighborhood contextual factors in addition to individual-level (direct) violence exposure, in a representative general population study of 7251 adults residing in 83 neighborhoods across five major cities in Latin America.

2. Methods

2.1. Sample and data collection

Our sample consisted of residents aged 18 years or older who participated in the WMH Surveys in five Latin American countries. Details regarding the survey design and field dates in each country can be found at https://www.hcp.med.harvard.edu/wmh/ftpdir/Neighborhood_violence_web_appendix_tables_Psychiatry_Research.pdf

in Web Table I. The cities included in this analysis were Medellín, Colombia ($n = 1673$); São Paulo, Brazil ($n = 2934$); Buenos Aires, Argentina ($n = 834$); Lima, Peru ($n = 1350$); and Mexico City, Mexico ($n = 460$).

Each country's survey team implemented a multi-stage sampling design that included nested geographic areas in hierarchical levels down to the level of households, from which participants were randomly selected (Medina-Mora et al., 2005; Piazza and Fiestas, 2014; Viana et al., 2009). All interviews were administered in person by trained interviewers. Informed consent was obtained from participants and the human subjects committees of each organization conducting the surveys approved the study.

Part I of the survey assessed demographic characteristics and core disorders, and was completed by all participants, while Part II assessed less common mental disorders and detailed lifetime events. The Part II sample consisted of respondents who met lifetime criteria for any Part I core disorder, along with a random 25% of the remaining Part I population. The sample was subsequently weighted to adjust for differential sampling of Part I respondents into Part II, for differential probability of selecting individuals within households, and to match socio-demographic distributions of key variables in each city of interest (Heeringa et al., 2008). The resulting weighted Part II sample thus not only represents the distribution of mental disorders and marital status in the full Part I sample, but also accounts for minor discrepancies between the sample and the general population on demographic distributions such age, gender, and marital status. Our analysis used the weighted Part II sample, totaling 7251 respondents, after eight respondents with missing data on a key covariate were removed.

2.2. Neighborhood definition

Neighborhoods in our sample (used for the multilevel analysis) represent local areas within each city or surrounding metropolitan areas in which respondents lived at the time of the survey. These areas were either the primary or secondary sampling units of the survey design for each city, depending on the sampling structure of each country's survey. These were: in Mexico, census count areas, which are similar to U.S. census tracts; in São Paulo, administrative areas throughout the main city and geographic census clusters in all remaining municipalities of the surrounding metropolitan area; in Medellín, geographic areas called *comunas* and *corregimientos*; in Buenos Aires, census radii; and in Lima, *conglomerados*. Overall, our pooled sample consisted of 83 neighborhoods across five cities, with a mean of 87, a median of 86, and a range of 30–176 respondents per neighborhood.

To address potential concerns that some of our neighborhood samples may be too small to be representative of the true, underlying neighborhood or to provide acceptably accurate estimates of neighborhood context, we ran a sensitivity analysis in which we removed roughly 10% of the overall sample ($n = 720$ respondents) who lived in neighborhoods with the smallest samples in our study (61 or fewer respondents per neighborhood), and repeated all statistical analyses as described below to ensure similar results.

2.3. Individual-level measures

2.3.1. Primary outcomes: internalizing and externalizing disorders

Mental disorders were evaluated with the WHO Composite International Diagnostic Interview (CIDI) Version 3.0 (Kessler and Ustün, 2004) following criteria from the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) (American Psychiatric Association, 2000). Primary outcomes included past-year internalizing disorders (posttraumatic stress (PTSD), panic, specific phobia, social phobia, agoraphobia, adult separation anxiety, generalized anxiety, major depressive, dysthymic, and bipolar/subthreshold bipolar disorders) and past-year externalizing disorders (intermittent explosive disorder and alcohol and drug abuse with or

without dependence). Prior research has demonstrated diagnostic concordance between the CIDI and blinded clinical reappraisal interviews using the Structured Clinical Interview for DSM-IV (First et al., 2002; Haro et al., 2006).

Disorders were also grouped into more specific categories of any past-year mood disorder (major depressive disorder, dysthymic disorder, and bipolar/sub-threshold bipolar disorders); any past-year anxiety disorder (PTSD, panic disorder, specific phobia, social phobia, agoraphobia, adult separation anxiety, and generalized anxiety disorder); and any past-year substance use disorders (alcohol and drug abuse with or without dependence). We ran all models with these three outcomes in addition to any past-year internalizing and any past-year externalizing disorder, to see whether our main results were driven by more specific types of disorders within the larger categories.

2.3.2. Individual-level covariates

Individual-level demographic covariates consisted of: age (35–49 and 50 + vs. 18–34); sex (female vs. male); relative income (individual income divided by median city income, based on Part I survey data from this study); education (above vs. below the national median education level, based on Part I survey data from this study); marital status (currently married vs. not); migrant status (migrant to a large city, defined by self-report); and unemployment status (currently unemployed vs. not).

2.3.3. Violent events

We estimated violent events that were likely to have occurred in respondents' neighborhoods, using the potentially traumatic event list from the PTSD section of the survey. We included events that likely occurred outside of the home and were common enough to statistically model with variation in prevalence across neighborhoods. These events included being beaten up by someone other than a spouse or partner; witnessing someone being badly injured or killed, or unexpectedly seeing a dead body; and being mugged or threatened with a weapon. We collapsed reports of having been either stalked or sexually assaulted/raped into one combined variable, due to the relatively low prevalence of each. Finally, we created an overall violence variable for having experienced any of these events, in addition to having seen atrocities, being kidnapped or held captive, or having purposely injured, tortured, or killed someone else—each of which were too rare to model as predictors by themselves.

To estimate exposure that could reasonably have occurred in respondents' current neighborhoods, but lacking information on how long respondents have resided there, we only counted events that occurred during the past five years. To identify this time frame we used reported ages of occurrence. Age of first occurrence was available for all events, but age of the most recent occurrence was available only for "worst" events (chosen by the respondent) and "random" events (randomly chosen among endorsed events). In the Medellín survey, respondents additionally identified events that happened in the past year. All this information was pooled to construct individual-level (i.e., direct victimization or personally witnessing) past five-year violent events as binary variables.

2.4. Contextual measures

2.4.1. Neighborhood-level fixed effects

We calculated five contextual variables to characterize neighborhood violence, each describing the proportion of residents in each neighborhood in our sample who experienced a particular type of violence in the past five years, using the individual-level variables described above. These constructed variables estimate the proportion in each neighborhood who: were beaten up by someone other than their spouse or partner; witnessed death or serious injury; were mugged or threatened with a weapon; were sexually assaulted or stalked; and experienced any type of violent event. Each of these neighborhood-level

violence prevalence estimates was then recoded into tertiles to classify each neighborhood as high, intermediate, or low on each of these measures, and used as categorical variables in analyses.

We calculated additional contextual variables as potential neighborhood-level confounders, informed by prior research in this sample (Sampson et al., 2018) and in others (Sampson et al., 1997). The following markers of neighborhood instability and access to resources were controlled for as continuous variables: the fraction of neighborhood residents who were migrants to the city; the fraction of neighborhood residents who were unemployed at the time of interview; and the fraction of neighborhood residents whose were highly educated. These contextual variables were created from the individual-level variables described in the previous section.

2.4.2. Random effects

To reflect possible effects of unmeasured neighborhood-level variables, we included random intercepts at the neighborhood level in each model.

2.5. Data analysis

We first used SAS Survey procedures to calculate weighted frequencies and means of all variables of interest and constructed variables (Table 1).

Weighted, multilevel logistic regression models were then run using SAS Proc Glimmix, with past-year internalizing or externalizing disorder as outcomes. First, to evaluate whether neighborhoods varied with regards to past-year internalizing and externalizing disorders of their residents, we ran models including only the neighborhood-level random intercept to calculate the intraclass correlation coefficients (ICCs), which estimate the fraction of variation in the disorder outcomes attributable to the neighborhood level (Ene et al., 2015).

Then, we expanded the model to include the tertiled neighborhood-level variable for prevalence of any reported violent event as the main exposure of interest for each outcome (past-year internalizing disorders and externalizing disorders), controlling for both individual-level and neighborhood-level covariates, and retaining the latter covariates in the models when they changed the coefficient of the exposures of interest by 10% or more (a method that has been shown to retain important confounders while keeping models relatively parsimonious; Maldonado and Greenland, 1993).

To explore whether associations with neighborhood-level violence might be attributable to a particular type of violence, we then ran four additional separate models (neighborhood-level tertiled prevalence of being beaten up by someone other than spouse or partner, neighborhood-level tertiled prevalence of witnessing death or someone seriously hurt, neighborhood-level tertiled prevalence of being mugged or threatened with a weapon, and neighborhood-level tertiled prevalence of being sexually assaulted, raped or stalked) for each disorder outcome. For each specific type of neighborhood-level violence of interest, the corresponding individual-level violent event variable was always included in the model in order to remove the effect of each individual's own experience through the neighborhood-level variable. In addition, we controlled for the remaining individual-level violent event variables in every model.

After completing these main analyses, the sensitivity analyses modeling more specific types of disorders as described above, and the sensitivity analyses dropping 10% of individuals living in the smallest neighborhoods as described above, we ran one more set of supplemental models with the same independent variables but with the dependent variable being presence of two or more types of past-year internalizing disorders ($n = 716$, or 5.1% of the weighted sample), as compared with having no or one past-year internalizing disorder ($n = 6535$, or 94.9% of the weighted sample). We ran this supplementary analysis after seeing the main results, in order to assess the presence of a potential dose-response relationship between

Table 1

Distributions of independent and dependent variables among 7251 residents of 5 cities in Latin America.

	Unweighted n	Weighted% for categorical variables or weighted mean for continuous variables
Cities		
Mexico City	460	4.63%
Lima	1350	18.51%
Medellín	1673	21.32%
São Paulo	2934	37.45%
Buenos Aires	834	18.09%
Individual-level variables		
Age 18–34	2832	43.44%
Age 35–49	2443	31.18%
Age 50 +	1976	25.38%
Female	4388	52.60%
Ratio of individual income to median city income	–	1.85
In top 50% of country-level education	4474	66.63%
Currently married	4175	57.83%
Migrant to megacity	3099	38.89%
Unemployed	602	7.88%
Beaten up by someone other than a spouse or partner	126	1.23%
Witnessed someone being badly injured or killed, or unexpectedly saw a dead body	601	7.08%
Mugged or threatened with a weapon	825	11.08%
Been raped, sexually assaulted other than rape, or stalked	198	1.98%
Experienced any violent event [a]	1511	18.97%
Mental disorders		
Any past-year internalizing disorder [b]	2120	17.05%
Any past-year externalizing disorder [c]	492	4.74%
Neighborhood-level variables		*Weighted mean proportion*
% migrants to city	–	38.89%
% unemployed	–	8.98%
% in top 50% of country-level education	–	65.91%

Neighborhood-level violence in the past five years	*Weighted mean proportion within each tertile*		
	Bottom tertile	Middle tertile	Top tertile
% who were beaten up by someone other than spouse or partner	0%	0.97%	2.80%
% who witnessed death or saw someone seriously hurt	2.17%	7.28%	12.07%
% who were mugged or threatened with a weapon	6.08%	10.49%	16.89%
% who were sexually assaulted, raped, or stalked	0.51%	1.48%	4.04%
% who experienced any violent event	11.07%	18.88%	27.55%

[a] Any violent event includes the individual event types listed, in addition to having seen atrocities; being kidnapped or held captive; or having purposely injured, tortured, or killed someone else - each of which were too rare to show by themselves (less than 1%).

[b] Internalizing disorders include anxiety (posttraumatic stress disorder, panic disorder, specific phobia, social phobia, agoraphobia, adult separation anxiety, generalized anxiety disorder) and mood (major depressive disorder, dysthymic disorder and bipolar/sub-threshold bipolar) disorders.

[c] Externalizing disorders include behavioral (intermittent explosive disorder) and substance use (alcohol and drug abuse with or without dependence) disorders.

neighborhood violence and number of past-year internalizing disorders.

Finally, we ran Zero G tests to test the random effects of the intercepts in each model described above (Ene et al., 2015).

3. Results

3.1. Prevalence of mental disorders

Seventeen percent of respondents had a past-year internalizing disorder and 4.7% had a past-year externalizing disorder (Table 1). Past-year prevalence estimates for each specific disorder within these categories, as well as more narrow categories of any mood disorder, any anxiety disorder, and any substance use disorder, can be seen on Web Table II found at https://www.hcp.med.harvard.edu/wmh/ftpdir/

Neighborhood_violence_web_appendix_tables_Psychiatry_Research.pdf, among the total sample and by gender.

3.2. Distributions of independent variables

As can be seen in the top portion of Table 1, slightly more than half of our weighted sample (52.6%) were female and 43.4% were below 35 years old. Other socio-demographic characteristics of the sample are also shown as well as the proportion of individuals experiencing each violent event in the prior five years. Around 19% had experienced any of the relevant violent events assessed. For these estimates by gender, see Web table III found at https://www.hcp.med.harvard.edu/wmh/ftpdir/Neighborhood_violence_web_appendix_tables_Psychiatry_Research.pdf.

The remaining section of Table 1 shows the distribution of contextual fixed effects for both demographic and violence variables. Across neighborhoods, the mean proportion of migrants was 38.9%; the mean proportion of unemployed individuals was 9%; and the mean proportion of residents with relatively high education was 65.9%. For contextual variables of neighborhood violence, the mean proportion of residents who reported any violent event in the past five years in each neighborhood was 11.1%, 18.9%, and 27.6% in the bottom, middle, and top tertile, respectively. The proportion of residents for each specific violent event in each tertile is also shown on Table 1.

3.3. Intraclass correlation coefficients from random-intercept-only models

For past-year internalizing disorder, the ICC was 0.0824, and for past-year externalizing disorder, the ICC was 0.0879 (not shown in tables). In other words, neighborhoods explained roughly 8% of the variance of past-year internalizing disorders and about 9% of the variation of past-year externalizing disorders. The random effects for both outcomes were statistically significant according to the Zero G test ($p < 0.0001$), which supports using multilevel models with random intercepts.

3.4. Past-year internalizing disorder

Table 2 shows five multilevel, multivariable logistic regression models for past-year internalizing disorder, each including a separate neighborhood-level violent event construct of interest, and controlling for city, individual-level demographics, neighborhood-level proportion of migrants, and neighborhood-level education.

In every model, each individual-level violent event was positively associated with past-year internalizing disorders. More specifically, for being beaten up by someone other than a partner, ORs ranged from 2.64 to 2.72; for witnessing death or serious injury, ORs ranged from 1.43 to 1.48; and for experiencing sexual assault, ORs ranged from 2.00 to 2.05. Although not statistically significant, those who were mugged or threatened with a weapon were also more likely to have past-year internalizing disorders (ORs ranged from 1.22 to 1.25).

Living in neighborhoods where violent events occur more frequently showed a monotonic relationship with internalizing disorders. More specifically, residing in neighborhoods with a higher proportion of residents who were beaten up by someone other than a partner (OR = 1.38, 95% CI:1.11–1.71 for the middle tertile and OR = 1.50, 95% CI:1.19–1.89 for the top tertile), neighborhoods with a higher proportion of people who saw death or serious injuries (OR = 1.38, 95% CI:1.01–1.88 for the top tertile), neighborhoods with a higher percent of residents who were mugged (OR = 1.36, 95% CI:1.09–1.68 for the top tertile), and neighborhoods with higher proportion of residents who experienced any violent event (OR = 1.43, 95% CI:1.13–1.80 for the middle tertile and OR = 1.60, 95% CI:1.27–2.02 for the top tertile) were each associated with increased odds of any past-year internalizing disorder. The association for sexual violence approached, but did not reach, statistical significance.

In all five models, the random effects of the intercepts varying at the neighborhood level were statistically significant (all p values <0.05; bottom row of table), which illustrates that there was significant random effect variation.

In our supplemental analyses that modeled odds of having two or more types of past-year internalizing disorder compared to no or one type of past-year disorder (found at https://www.hcp.med.harvard. edu/wmh/ftpdir/Neighborhood_violence_web_appendix_tables_ Psychiatry_Research.pdf in Web Table IV), these relationships appeared even stronger, suggesting the potential for a dose-response relationship between neighborhood violence and number of current internalizing disorders. For example, living in neighborhoods with the highest proportion of individuals who were beaten up by someone other than a spouse or partner in the past five years was associated with 67% higher odds of having two or more past-year internalizing disorders (OR: 1.67; 95% CI: 1.19–2.35) compared to one or no disorder, which was higher than the odds ratio of 1.50 (95% CI: 1.19–1.89) for this same tertile of neighborhoods when modeling one or more past-year internalizing disorder in the main analyses. Similarly, living in neighborhoods in the highest tertile of proportions of all other types of violence (and proportion of any violence overall) showed higher odds ratios for having two or more disorders, when compared to the odds ratios from the main analyses modeling one or more type of disorder.

3.5. Past-year externalizing disorder

Table 3 reports five multilevel, multivariable logistic regression models with past-year externalizing disorders as the outcome, controlling for city, individual-level demographics, neighborhood-level proportion of unemployed residents, and neighborhood-level education.

Experiencing various types of violent events in the past five years at the individual level was associated with higher odds of having any past-year externalizing disorder. Being beaten up by someone other than a romantic partner (ORs ranged from 3.77 to 4.07), having witnessed death or serious injuries (ORs ranged from 1.73 to 1.76), and being sexually assaulted or stalked (ORs ranged from 2.56 to 2.71) were each associated with increased odds of having any past-year externalizing disorder.

None of the neighborhood-level violent exposures were significantly associated with past-year externalizing disorder. In four models, random effects variation of the intercepts varied significantly at the neighborhood level.

3.6. Sensitivity analysis

The results of the sensitivity analysis dropping 10% of the participants (20% of the smallest neighborhoods; see Web Tables V–IV found at https://www.hcp.med.harvard.edu/wmh/ftpdir/Neighborhood_ violence_web_appendix_tables_Psychiatry_Research.pdf) were very similar to our original findings, showing that our results were not unduly affected by patterns in areas with very small populations.

Finally, our sensitivity analyses modeling more specific categories of disorder (see Web Tables VII–IX found at https://www.hcp.med. harvard.edu/wmh/ftpdir/Neighborhood_violence_web_appendix_ tables_Psychiatry_Research.pdf) also produced similar results to our original findings with the broader categories of internalizing and externalizing disorder. The relationships we observed for past-year internalizing disorder seem largely driven by past-year anxiety disorder, which showed stronger relationships with neighborhood violence as compared to past-year mood disorder. The odds ratios for mood disorder were in the same direction as, but attenuated compared to, those seen for anxiety disorder or internalizing disorder overall. As expected from our externalizing disorder findings, the results for past-year substance use disorder were generally null.

4. Discussion

Among residents of five large Latin American cities, we found that living in neighborhoods with higher overall prevalence of violence—and living in neighborhoods with higher prevalence of three out of four specific types of violence—was associated, in dose-response relationships, with past-year internalizing disorders when adjusting for individual violence exposure and other confounders. In contrast, we observed no significant associations of neighborhood-level violence with past-year externalizing disorders, despite the significant associations of individual-level violence with externalizing disorders.

These findings are broadly consistent with the findings of Stockdale et al., who reported greater vulnerability to depressive and anxiety disorders (internalizing disorders), but not substance use disorders

Table 2

Multilevel, multivariable logistic regression models with past-year internalizing disorder [a] as the dependent variable among 7251 residents of 5 cities in Latin America. [b].

	Beaten up by someone other than spouse or partner		Witnessed death or saw someone seriously hurt		Mugged or threatened with a weapon	
	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI
Individual-level fixed effects						
Age 35–49	1.18	(1.00, 1.39)	1.19	(1.00, 1.40)	1.19	(1.00, 1.40)
Age 50 +	0.91	(0.74, 1.13)	0.90	(0.73, 1.12)	0.90	(0.73, 1.12)
Female	2.36	(2.06, 2.71)	2.42	(2.11, 2.78)	2.42	(2.11, 2.78)
Ratio of individual income to median city income	1.00	(0.96, 1.03)	1.00	(0.96, 1.03)	1.00	(0.96, 1.03)
In top 50% of country-level education	0.74	(0.63, 0.86)	0.76	(0.65, 0.89)	0.76	(0.65, 0.89)
Married	0.79	(0.67, 0.94)	0.80	(0.68, 0.95)	0.80	(0.68, 0.94)
Migrant to megacity	0.94	(0.81, 1.11)	0.94	(0.81, 1.10)	0.95	(0.81, 1.11)
Unemployed	1.17	(0.92, 1.50)	1.17	(0.91, 1.50)	1.16	(0.91, 1.49)
Beaten up by someone other than a spouse or partner	2.72	(1.56, 4.73)	2.65	(1.50, 4.69)	2.66	(1.51, 4.68)
Witnessed someone being badly injured or killed, or unexpectedly saw a dead body	1.43	(1.06, 1.91)	1.45	(1.08, 1.94)	1.48	(1.11, 1.97)
Mugged or threatened with a weapon	1.25	(0.98, 1.59)	1.25	(0.98, 1.58)	1.22	(0.96, 1.55)
Raped, sexually assaulted other than rape, or stalked	2.04	(1.42, 2.93)	2.04	(1.41, 2.95)	2.04	(1.40, 2.96)
Neighborhood-level fixed effects						
% migrants to city	0.99	(0.99, 1.00)	0.99	(0.99, 1.00)	1.00	(0.99, 1.00)
% in top 50% of country-level education	0.98	(0.97, 0.99)	0.98	(0.97, 0.99)	0.98	(0.97, 0.99)
Middle tertile of% who were beaten up by someone other than spouse or partner	1.38	(1.11, 1.71)				
Top tertile of% who were beaten up by someone other than spouse or partner	1.50	(1.19, 1.89)				
Middle tertile of% who witnessed death or saw someone seriously hurt			1.18	(0.90, 1.55)		
Top tertile of% who witnessed death or saw someone seriously hurt			1.38	(1.01, 1.88)		
Middle tertile of% who were mugged or threatened with a weapon					1.02	(0.79, 1.31)
Top tertile of% who were mugged or threatened with a weapon					1.36	(1.09, 1.68)
Random effects	Variance estimate	Zero G test *p*-value	Variance estimate	Zero G test *p*-value	Variance estimate	Zero G test *p*-value
Intercept	0.0584	0.0004	0.0775	<0.0001	0.0751	<0.0001

	Been sexually assaulted, raped, or stalked		Experienced any violent event [c]	
	Odds ratio	95% CI	Odds ratio	95% CI
Individual-level fixed effects				
Age 35–49	1.19	(1.00, 1.40)	1.19	(1.01, 1.40)
Age 50 +	0.90	(0.73, 1.12)	0.91	(0.73, 1.12)
Female	2.43	(2.12, 2.79)	2.43	(2.11, 2.78)
Ratio of individual income to median city income	1.00	(0.96, 1.03)	1.00	(0.96, 1.03)
In top 50% of country-level education	0.76	(0.65, 0.89)	0.76	(0.65, 0.89)
Married	0.80	(0.68, 0.94)	0.80	(0.68, 0.95)
Migrant to megacity	0.95	(0.81, 1.11)	0.95	(0.81, 1.11)
Unemployed	1.17	(0.91, 1.50)	1.15	(0.90, 1.48)
Beaten up by someone other than a spouse or partner	2.65	(1.50, 4.68)	2.64	(1.50, 4.65)
Witnessed someone being badly injured or killed, or unexpectedly saw a dead body	1.48	(1.11, 1.97)	1.46	(1.09, 1.95)
Mugged or threatened with a weapon	1.25	(0.98, 1.59)	1.22	(0.96, 1.55)
Been raped, sexually assaulted other than rape, or stalked	2.00	(1.39, 2.89)	2.05	(1.41, 2.97)
Neighborhood-level fixed effects				
% migrants to city	0.99	(0.98, 1.00)	1.00	(0.99, 1.00)
% in top 50% of country-level education	0.98	(0.96, 0.99)	0.98	(0.97, 0.99)
Middle tertile of% who were sexually assaulted, raped, or stalked	1.00	(0.79, 1.27)		
Top tertile of% who were sexually assaulted, raped, or stalked	1.20	(0.94, 1.53)		
Middle tertile of% who experienced any violent event			1.43	(1.13, 1.80)
Top tertile of% who experienced any violent event			1.60	(1.27, 2.02)
Random effects	Variance estimate	Zero G test *p*-value	Variance estimate	Zero G test *p*-value
Intercept	0.0881	<0.0001	0.0557	0.0039

[a] Internalizing disorders include anxiety (posttraumatic stress disorder, panic disorder, specific phobia, social phobia, agoraphobia, adult separation anxiety, generalized anxiety disorder) and mood (major depressive disorder, dysthymic disorder and bipolar/sub-threshold bipolar) disorders.

[b] Each model controls for city as a fixed effect, in addition to the variables listed above.

[c] Any violent event includes the individual event types listed, in addition to having seen atrocities; being kidnapped or held captive; or having purposely injured, tortured, or killed someone else - each of which were too rare to show by themselves (less than 1%).

(externalizing disorders), among individuals exposed to violence in high-crime neighborhoods in the US (Stockdale et al., 2007). Similarly, a recent study evaluated area-level crime rates and individual-level crime victimization in adolescents from the US and found that while individual crime victimization was associated with all three measures of internalizing, externalizing, and substance use problems, area-level crime rates were associated only with a measure of depressive symptomatology (Grinshteyn et al., 2018).

Our results in Latin American cities and those of the aforementioned studies in the US are consistent with differential mechanisms through

Table 3

Multilevel, multivariable logistic regression models with past-year externalizing disorder [a] as the dependent variable among 7251 residents of 5 cities in Latin America. [b]

	Beaten up by someone other than spouse or partner		Witnessed death or saw someone seriously hurt		Mugged or threatened with a weapon	
	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI
Individual-level fixed effects						
Age 35–49	0.63	(0.50, 0.81)	0.64	(0.50, 0.81)	0.63	(0.49, 0.80)
Age 50+	0.27	(0.17, 0.43)	0.27	(0.17, 0.43)	0.27	(0.16, 0.43)
Female	0.38	(0.30, 0.48)	0.37	(0.29, 0.47)	0.39	(0.31, 0.49)
Ratio of individual income to median city income	1.02	(0.97, 1.07)	1.02	(0.97, 1.07)	1.02	(0.97, 1.07)
In top 50% of country-level education	0.67	(0.53, 0.86)	0.68	(0.53, 0.86)	0.68	(0.54, 0.87)
Married	0.90	(0.69, 1.17)	0.90	(0.69, 1.18)	0.89	(0.68, 1.16)
Migrant to megacity	0.93	(0.69, 1.25)	0.93	(0.70, 1.25)	0.96	(0.71, 1.28)
Unemployed	2.36	(1.66, 3.36)	2.37	(1.66, 3.37)	2.30	(1.61, 3.30)
Beaten up by someone other than a spouse or partner	3.77	(2.44, 5.82)	3.79	(2.40, 5.99)	4.03	(2.57, 6.31)
Witnessed someone being badly injured or killed, or unexpectedly saw a dead body	1.75	(1.27, 2.42)	1.76	(1.27, 2.43)	1.73	(1.25, 2.39)
Mugged or threatened with a weapon	0.91	(0.66, 1.25)	0.90	(0.66, 1.25)	0.92	(0.67, 1.28)
Been raped, sexually assaulted other than rape, or stalked	2.58	(1.40, 4.76)	2.56	(1.39, 4.73)	2.69	(1.49, 4.89)
Neighborhood-level fixed effects						
% unemployed	1.03	(0.99, 1.07)	1.03	(0.99, 1.07)	1.03	(0.99, 1.07)
% in top 50% of country-level education	0.99	(0.97, 1.01)	0.99	(0.97, 1.01)	0.99	(0.97, 1.01)
Middle tertile of% who were beaten up by someone other than spouse or partner	0.93	(0.67, 1.31)				
Top tertile of% who were beaten up by someone other than spouse or partner	1.05	(0.75, 1.46)				
Middle tertile of% who witnessed death or saw someone seriously hurt			0.94	(0.69, 1.27)		
Top tertile of% who witnessed death or saw someone seriously hurt			1.00	(0.70, 1.43)		
Middle tertile of% who were mugged or threatened with a weapon					0.92	(0.68, 1.26)
Top tertile of% who were mugged or threatened with a weapon					0.96	(0.67, 1.38)
Random effects	Variance estimate	Zero G test p-value	Variance estimate	Zero G test p-value	Variance estimate	Zero G test p-value
Intercept	0.0858	0.0307	0.0853	0.0310	0.0870	0.0285

	Been sexually assaulted, raped, or stalked		Experienced any violent event [c]	
	Odds ratio	95% CI	Odds ratio	95% CI
Individual-level fixed effects				
Age 35–49	0.63	(0.50, 0.81)	0.63	(0.50, 0.80)
Age 50+	0.27	(0.16, 0.43)	0.27	(0.16, 0.43)
Female	0.38	(0.30, 0.48)	0.38	(0.30, 0.48)
Ratio of individual income to median city income	1.02	(0.97, 1.07)	1.02	(0.97, 1.07)
In top 50% of country-level education	0.69	(0.54, 0.87)	0.67	(0.53, 0.86)
Married	0.89	(0.68, 1.16)	0.89	(0.68, 1.16)
Migrant to megacity	0.95	(0.72, 1.27)	0.94	(0.71, 1.26)
Unemployed	2.31	(1.62, 3.31)	2.32	(1.62, 3.32)
Beaten up by someone other than a spouse or partner	4.02	(2.58, 6.27)	4.07	(2.61, 6.35)
Witnessed someone being badly injured or killed, or unexpectedly saw a dead body	1.73	(1.25, 2.38)	1.74	(1.26, 2.41)
Mugged or threatened with a weapon	0.91	(0.66, 1.25)	0.92	(0.67, 1.27)
Been raped, sexually assaulted other than rape, or stalked	2.59	(1.44, 4.66)	2.71	(1.49, 4.92)
Neighborhood-level fixed effects				
% unemployed	1.03	(0.99, 1.07)	1.04	(1.00, 1.08)
% in top 50% of country-level education	0.99	(0.97, 1.01)	0.99	(0.97, 1.01)
Middle tertile of% who were sexually assaulted, raped, or stalked	1.17	(0.85, 1.61)		
Top tertile of% who were sexually assaulted, raped, or stalked	1.30	(0.97, 1.74)		
Middle tertile of% who experienced any violent event			0.83	(0.57, 1.19)
Top tertile of% who experienced any violent event			0.87	(0.61, 1.23)
Random effects	Variance estimate	Zero G test p-value	Variance estimate	Zero G test p-value
Intercept	0.0728	0.0564	0.0838	0.0490

[a] Externalizing disorders include behavioral (intermittent explosive disorder) and substance use (alcohol and drug abuse with or without dependence) disorders.

[b] Each model controls for city as a fixed effect, in addition to the variables listed above.

[c] Any violent event includes the individual event types listed, in addition to having seen atrocities; being kidnapped or held captive; or having purposely injured, tortured, or killed someone else - each of which were too rare to show by themselves (less than 1%).

which violence may affect internalizing versus externalizing disorders. For externalizing disorders, the pathway could be primarily through direct individual exposure, whereas for internalizing disorders, the pathways could be both direct and indirect. Neighborhood-level violence may affect perceptions about safety, negativity towards the future, and hopelessness, all of which are symptoms of internalizing disorders. Further, neighborhood violence may impact these disorders through deterioration of social networks, isolation, collective efficacy, and perceptions of neighborhood disorder (Curry et al., 2008; Cutrona et al., 2006; Sampson et al., 1997).

Additionally, the daily stress of violent neighborhoods may affect immune functioning and the methylation of genes implicated in internalizing disorders such as depression and PTSD (Galea et al., 2011; Hughes et al., 2016; Uddin et al., 2011, 2010). Genes may interact with neighborhood characteristics to affect internalizing disorders. For example, one study found a significant interaction between the *ADCYAP1R1* genotype and neighborhood crime that was associated with major depression symptoms in trauma-exposed women (Lowe et al., 2015).

Our findings should be considered in the context of the study's strengths and limitations. While we included a range of types of violence, our measure of neighborhood-level violence was limited by our assumption that the reported violence happened in the neighborhood of the participant, and that the participant has lived in the same neighborhood for the prior five years (we did not have information on duration of residence; we did control for being a rural-to-urban migrant, but were not able to account for movement within cities); it is possible that some of the reported violence happened elsewhere. Additionally, we are likely to have underestimated the prevalence of past five-year violent events, as we were only able to include the first, random, and worst events for which we had recorded ages of occurrence (given that the original surveys were not designed to collect detailed information on violence).

Furthermore, because our measure of neighborhood-level violence is an aggregate of all individual-level violence reports within each neighborhood, our measures of neighborhood-level and individual-level exposure are not independent. However, we statistically controlled for individual-level violence exposure in each model that included neighborhood-level estimates, in efforts to statistically remove the effect of each individual's own violence experience through the neighborhood-level variable. Additionally, while having more objective and independent data on neighborhood violence would be preferable to respondents' reports, there are no comparable statistics at the neighborhood level across these five cities. Further, in the context of Latin America, where confidence and trust in police is limited (Cao and Solomon Zhao, 2005), official statistics greatly underestimate levels of violence. Thus, our approach of using the proportion of respondents in each neighborhood who reported violent events may be more accurate and more objective than the often-used approach of subjective perceptions of neighborhood violence.

We operationalized *neighborhoods* as sampling units, which are typically census tract-type definitions of neighborhoods, which may or may not correspond to individuals' perceptions of what constitutes their neighborhood. Census tracts or groups of blocks are consistent with the conceptualization of neighborhoods as "ecological units nested within successively larger communities" (pp.445; Sampson et al., 2002), and empirical evidence has not shown that the operationalization of neighborhood has affected results in the United States (Sampson et al., 2002), though we do not know whether this also holds for Latin America.

Most importantly, these findings should not be interpreted to make conclusions regarding causality or directionality. Neighborhood violence might affect individual mental health via mechanisms mentioned above like deterioration of social networks or daily stress and immune functioning. However, persons with pre-existing mental health problems might also be concentrated in neighborhoods that are more violent. For example, persons with internalizing disorders might lose their employment or have lower income as a result of their symptoms, forcing them to move into more violent neighborhoods, or making them less able to move out of such areas.

While experimental or quasi-experimental designs generally provide greater evidence of causality and directionality, ethical and practical considerations make manipulating neighborhood-violence exposure unfeasible. Thus, studies such as this one, which leverage population data and carefully control for a number of possible individual-level confounders as well as neighborhood-level confounders, all of which were informed by prior research (Sampson et al., 2018, 1997), can move us closer to estimating the potential effect of neighborhood violence on individual mental disorders. However, there may be other confounders that we omitted. Neighborhood violence is related to numerous neighborhood contextual variables (e.g., political conflict, fragmented infrastructure; Muggah, 2018) that we were unable to measure using WMH data.

While our use of the WMH surveys to address the question of interest has the limitations noted above, the novel contribution of this study is the inclusion of a diversity of violent event types and a wider range of mental health disorders than previously studied in relation to neighborhood-level violence, while also accounting for individual-level exposure to violence and other neighborhood factors, in a unique and growing region of the world.

These findings point to the importance of further research to understand causal dynamics, including longitudinal designs and multivariable models that include multiple aspects of neighborhood violence and other neighborhood characteristics, and which identify modifiable mediators or modifiers that might help mitigate the deleterious effects of neighborhood violence on mental health. For example, it has been found that community efficacy, defined as residents' willingness to intervene for the common good, partially mediates the association of neighborhood disadvantage and residential instability with violence (Sampson et al., 1997), and more recently that resting state connectivity within the central executive network moderates the impact of violence on cardiometabolic health (Miller et al., 2018). Conceivably, such information might lead to the development of interventions that help residents better cope with living in violent neighborhoods. In sum, further research is required to understand mechanisms of action, but these findings suggest that neighborhood context, including violence, should be considered in the study of mental disorders, particularly internalizing disorders.

In terms of public policy, the association of aggregate experiences of violence at the neighborhood level with individual disorders suggests that interventions that reduce individuals' exposure to these experiences might improve the mental health not only of these individuals themselves, but also of other people in their neighborhoods, magnifying their public health impact. Given the high lifetime prevalence of mental disorders across the world (Kessler et al., 2007; Steel et al., 2014), it might be more realistic and effective to target group-level determinants compared to individual-level determinants for preventive interventions, extending mental health interventions to include population policies not typically thought of as mental health interventions. Such interventions might include not only crime reduction strategies but also programs to enhance community stability, cohesion and efficacy. These findings are valuable to call the attention of policy-makers to such aggregate effects, and urge that these are taken into consideration when making policy decisions.

Funding

Ethical standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008

Declaration of Competing Interest

In the past 3 years, Dr. Kessler received support for his epidemiological studies from Sanofi Aventis; was a consultant for Johnson & Johnson Wellness and Prevention, Sage Pharmaceuticals, Shire, Takeda; and served on an advisory board for the Johnson & Johnson Services Inc. Lake Nona Life Project. Kessler is a co-owner of DataStat, Inc., a market research firm that carries out healthcare research. Dr. Evans-Lacko received consulting fees from Lundbeck, unrelated to this work.

Acknowledgments

References

American Psychiatric Association, 2000. Diagnostic and Statistical Manual of Mental Disorders: DSM-IV-TR, Fourth. ed. Washington, DC.

Arcaya, M.C., Tucker-Seeley, R.D., Kim, R., Schnake-Mahl, A., So, M., Subramanian, S.V., 2016. Research on neighborhood effects on health in the United States: a systematic review of study characteristics. Soc. Sci. Med. 168, 16–29. https://doi.org/10.1016/J.SOCSCIMED.2016.08.047.

Benjet, C., Bromet, E., Karam, E.G., Kessler, R.C., McLaughlin, K.A., Ruscio, A.M., Shahly, V., Stein, D.J., Petukhova, M., Hill, E., Alonso, J., Atwoli, L., Bunting, B., Bruffaerts, R., Caldas-de-Almeida, J.M., de Girolamo, G., Florescu, S., Gureje, O., Huang, Y., Lepine, J.P., Kawakami, N., Kovess-Masfety, V., Medina-Mora, M.E., Navarro-Mateu, F., Piazza, M., Posada-Villa, J., Scott, K.M., Shalev, A., Slade, T., ten Have, M., Torres, Y., Viana, M.C., Zarkov, Z., Koenen, K.C., 2016. The epidemiology of traumatic event exposure worldwide: results from the world mental health survey consortium. Psychol. Med. 46, 327–343. https://doi.org/10.1017/S0033291715001981.

Cao, L., Solomon Zhao, J, 2005. Confidence in the police in Latin America. J. Crim. Justice 33, 403–412. https://doi.org/10.1016/j.jcrimjus.2005.06.009.

Cornaglia, F., Feldman, N.E., Leigh, A., 2014. Crime and mental wellbeing. J. Hum. Resour. 49, 110–140. https://doi.org/10.3368/jhr.49.1.110.

Cuartas, J., Roy, A.L., 2019. The latent threat of community violence: indirect exposure to local homicides and adolescents' mental health in Colombia. Am. J. Community Psychol 1–13. https://doi.org/10.1002/ajcp.12335.

Curry, A., Latkin, C., Davey-Rothwell, M., 2008. Pathways to depression: the impact of neighborhood violent crime on inner-city residents in Baltimore, Maryland, USA. Soc. Sci. Med. 67, 23–30. https://doi.org/10.1016/j.socscimed.2008.03.007.

Cutrona, C.E., Wallace, G., Wesner, K.A., 2006. Neighborhood characteristics and depression. Curr. Dir. Psychol. Sci. 15, 188–192. https://doi.org/10.1111/j.1467-8721.2006.00433.x.

Diez Roux, A.V., Mair, C., 2010. Neighborhoods and health. Ann. N. Y. Acad. Sci. 1186, 125–145. https://doi.org/10.1111/j.1749-6632.2009.05333.x.

Duncan, D.T., Hatzenbuehler, M.L., Johnson, R.M., 2014. Neighborhood-level LGBT hate crimes and current illicit drug use among sexual minority youth. Drug Alcohol Depend. 135, 65–70. https://doi.org/10.1016/j.drugalcdep.2013.11.001.

Dustmann, C., Fasani, F., 2016. The effect of local area crime on mental health. Econ. J. 126, 978–1017. https://doi.org/10.1111/ecoj.12205.

Dworkin, E.R., Menon, S.V., Bystrynski, J., Allen, N.E., 2017. Sexual assault victimization and psychopathology: a review and meta-analysis. Clin. Psychol. Rev. 56, 65–81. https://doi.org/10.1016/j.cpr.2017.06.002.

Ene, M., Leighton, E.A., Blue, G.L., Bell, B.A., 2015. Paper 3430-2015 Multilevel Models for Categorical Data Using SAS ® PROC GLIMMIX: The Basics.

First, M.B., Spitzer, R.L., Gibbon, M., Williams, J.B.W., 2002. Structured Clinical Interview For DSM-IV-TR Axis I Disorders, Research Version. Biometrics Research, New York State Psychiatric Institute, New York, NY Patient Edition (SCID-I/P).

Fowler, P.J., Tompsett, C.J., Braciszewski, J.M., Jacques-Tiura, A.J., Baltes, B.B., 2009. Community violence: a meta-analysis on the effect of exposure and mental health outcomes of children and adolescents. Dev. Psychopathol. 21, 227. https://doi.org/10.1017/S0954579409000145.

Galea, S., Uddin, M., Koenen, K., 2011. The urban environment and mental disorders: epigenetic links. Epigenetics 6, 400–404.

Grinshteyn, E.G., Xu, H., Manteuffel, B., Ettner, S.L., 2018. The associations of area-level violent crime rates and self-reported violent crime exposure with adolescent behavioral health. Commun. Ment. Health J. 54, 252–258. https://doi.org/10.1007/s10597-017-0159-y.

Haro, J.M., Arbabzadeh-Bouchez, S., Brugha, T.S., de Girolamo, G., Guyer, M.E., Jin, R., Lepine, J.P., Mazzi, F., Reneses, B., Vilagut, G., Sampson, N.A., Kessler, R.C., 2006. Concordance of the composite international diagnostic interview version 3.0 (CIDI 3.0) with standardized clinical assessments in the WHO world mental health surveys. Int. J. Methods Psychiatr. Res. 15, 167–180.

Heeringa, S.G., Wells, E.J., Hubbard, F., Mneimneh, Z.N., Chiu, W.T., Sampson, N.A., et al., 2008. Sample designs and sampling procedures. In: Kessler, R.C., Üstün, T.B. (Eds.), The WHO World Mental Health Surveys: Global Perspectives on the Epidemiology of Mental Disorders. Cambridge University Press, New York, NY, pp. 14–32.

Hughes, M.M., Connor, T.J., Harkin, A., 2016. Stress-related immune markers in depression: implications for treatment. Int. J. Neuropsychopharmacol. https://doi.org/10.1093/ijnp/pyw001. pyw001.

Joshi, S., Mooney, S.J., Rundle, A.G., Quinn, J.W., Beard, J.R., Cerdá, M., 2017. Pathways from neighborhood poverty to depression among older adults. Health Place 43, 138–143. https://doi.org/10.1016/j.healthplace.2016.12.003.

Kessler, R.C., Angermeyer, M., Anthony, J.C., DE Graaf, R., Demyttenaere, K., Gasquet, I., DE Girolamo, G., Gluzman, S., Gureje, O., Haro, J.M., Kawakami, N., Karam, A., Levinson, D., Medina Mora, M.E., Oakley Browne, M.A., Posada-Villa, J., Stein, D.J., Adley Tsang, C.H., Aguilar-Gaxiola, S., Alonso, J., Lee, S., Heeringa, S., Pennell, B.-.E., Berglund, P., Gruber, M.J., Petukhova, M., Chatterji, S., Üstün, T.B., 2007. Lifetime prevalence and age-of-onset distributions of mental disorders in the World Health Organization's world mental health survey initiative. World Psychiatry 6, 168–176.

Kessler, R.C., Ustün, T.B., 2004. The world mental health (WMH) survey initiative version of the World Health Organization (WHO) composite international diagnostic interview (CIDI). Int. J. Methods Psychiatr. Res. 13, 93–121.

Lowe, S.R., Pothen, J., Quinn, J.W., Rundle, A, Bradley, B., Galea, S., Ressler, K.J., Koenen, K.C., 2015. Gene-by-social-environment interaction (GxSE) between ADCYAP1R1 genotype and neighborhood crime predicts major depression symptoms in trauma-exposed women. J. Affect. Disord. 187, 147–150. https://doi.org/10.1016/j.jad.2015.08.002.

Lowe, S.R., Quinn, J.W., Richards, C.A., Pothen, J., Rundle, A., Galea, S., Ressler, K.J., Koenen, K.C., Bradley, B., 2016. Childhood trauma and neighborhood-level crime interact in predicting adult posttraumatic stress and major depression symptoms. Child Abuse. Negl. 51, 212–222. https://doi.org/10.1016/j.chiabu.2015.10.007.

Maldonado, G., Greenland, S., 1993. Simulation study of confounder-selection strategies. Am. J. Epidemiol. 138, 923–936. https://doi.org/10.1093/oxfordjournals.aje.a116813.

Medina-Mora, M.E., Borges, G., Lara, C., Benjet, C., Blanco, J., Fleiz, C., Villatoro, J., Rojas, E., Zambrano, J., 2005. Prevalence, service use, and demographic correlates of 12-month DSM-IV psychiatric disorders in Mexico: results from the Mexican national comorbidity survey. Psychol. Med. 35, 1773. https://doi.org/10.1017/S0033291705005672.

Miller, G.E., Chen, E., Armstrong, C.C., Carroll, A.L., Ozturk, S., Rydland, K.J., Brody, G.H., Parrish, T.B., Nusslock, R., 2018. Functional connectivity in central executive network protects youth against cardiometabolic risks linked with neighborhood violence. Proc. Natl. Acad. Sci. U. S. A. 115, 12063–12068. https://doi.org/10.1073/pnas.1810067115.

Muggah, R., 2018. Latin America's Cities Are Ready to Take off. But their Infrastructure is

Failing them [WWW Document]URL. https://www.weforum.org/agenda/2018/06/latin-america-cities-urbanization-infrastructure-failing-robert-muggah/ (accessed 12.5.18).

Piazza, M., Fiestas, F., 2014. [Annual prevalence of mental disorders and use of mental health services in Peru: results of the world mental health survey, 2005]. Rev. Peru. Med. Exp. Salud Publica 31, 30–38.

Sampson, L., Martins, S.S., Yu, S., Chiavegatto Filho, A.D.P., Andrade, L.H., Viana, M.C., Medina-Mora, M.E., Benjet, C., Torres, Y., Piazza, M., Aguilar-Gaxiola, S., Cia, A.H., Stagnaro, J.C., Zaslavsky, A.M., Kessler, R.C., Galea, S., 2018. The relationship between neighborhood-level socioeconomic characteristics and individual mental disorders in five cities in Latin America: multilevel models from the world mental health surveys. Soc. Psychiatry Psychiatr. Epidemiol. https://doi.org/10.1007/s00127-018-1595-x.

Sampson, R.J., Morenoff, J.D., Gannon-Rowley, T., 2002. Assessing "Neighborhood effects": social processes and new directions in research. Annu. Rev. Sociol. 28, 443–478. https://doi.org/10.1146/annurev.soc.28.110601.141114.

Sampson, R.J., Raudenbush, S.W., Earls, F., 1997. Neighborhoods and violent crime: a multilevel study of collective efficacy. Science 277, 918–924.

Steel, Z., Marnane, C., Iranpour, C., Chey, T., Jackson, J.W., Patel, V., Silove, D., 2014. The global prevalence of common mental disorders: a systematic review and meta-analysis 1980–2013. Int. J. Epidemiol. 43, 476–493. https://doi.org/10.1093/ije/dyu038.

Stockdale, S.E., Wells, K.B., Tang, L., Belin, T.R., Zhang, L., Sherbourne, C.D., 2007. The importance of social context: neighborhood stressors, stress-buffering mechanisms, and alcohol, drug, and mental health disorders. Soc. Sci. Med. 65, 1867–1881.

https://doi.org/10.1016/j.socscimed.2007.05.045.

The World Bank, 2011. Violence in the city : understanding and supporting community responses to urban violence.

Uddin, M., Aiello, A.E., Wildman, D.E., Koenen, K.C., Pawelec, G., de los Santos, R., Goldmann, E., Galea, S., 2010. Epigenetic and immune function profiles associated with posttraumatic stress disorder. Proc. Natl. Acad. Sci. 107, 9470–9475. https://doi.org/10.1073/pnas.0910794107.

Uddin, M., Koenen, K.C., Aiello, A.E., Wildman, D.E., de los Santos, R., Galea, S., 2011. Epigenetic and inflammatory marker profiles associated with depression in a community-based epidemiologic sample. Psychol. Med. 41, 997–1007. https://doi.org/10.1017/S0033291710001674.

UN-Habitat, 2012. The State of Latin American and Caribbean Cities 2012 : Towards a New Urban Transition.

UNODC, 2013. Global Study on homicide 2013.

Viana, M.C., Teixeira, M.G., Beraldi, F., Bassani, I.de S., Andrade, L.H., 2009. São paulo megacity mental health survey - a population-based epidemiological study of psychiatric morbidity in the são paulo metropolitan area: aims, design and field implementation. Rev. Bras. Psiquiatr. 31, 375–386.

Wilson-Genderson, M., Pruchno, R., 2013. Effects of neighborhood violence and perceptions of neighborhood safety on depressive symptoms of older adults. Soc. Sci. Med. 85, 43–49. https://doi.org/10.1016/j.socscimed.2013.02.028.

Wilson, W.C., Rosenthal, B.S., 2003. The relationship between exposure to community violence and psychological distress among adolescents: a meta-analysis. Violence Vict. 18, 335–352.