Violent Victimization in Poor Neighborhoods of Bogotá, Lima, and Santiago: Empirical Test of the Social Disorganization and the Collective Efficacy Theories

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Abstract and Keywords

This chapter tests the collective efficacy theory by examining the influence of household and neighborhood vulnerability, as well as organizational and community mechanisms, on the victimization risk for violent crime in poor neighborhoods of Bogotá (Colombia), Lima (Peru), and Santiago (Chile.) To test the theory, the authors apply a random “Survey on Violence in Neighborhoods” in each of the cities. They confirmed that structural factors such as social vulnerability increase the risk of violent victimization, whereas neighborhood attachment and social cohesion are mediating factors that are key to decreasing said risks. However, the influence of neighborhood residential stability and informal social control has not been verified, and, hence, the collective efficacy theory cannot be confirmed for the neighborhoods included in this study.

Keywords: violent victimization, vulnerability, social disorganization, collective efficacy, neighborhoods and violence in Latin America

Theoretical Background and Hypotheses

From the Social Disorganization Theory to the Collective Efficacy Model

According to Bottoms and Wiles (1999), multilevel studies have become the most common strategy to reconcile the micro-level and macro-level explanations of crime. This approach emerged during the 1980s and ’90s thanks to the development of community surveys and sophisticated statistical tools on hierarchical modeling (Sampson, 1993, 2002, 2012). Allowing researchers to consider both household factors and macro-social factors, this approach has led to a more comprehensive understanding of the victimization phenomenon (Lauritsen, 2001; Miethe & McDowall, 1993; Smith & Jarjoura, 1989; Wilcox & Land, 1996).[1]

Thanks to the vast amount of empirical evidence accumulated by multilevel studies of crime, social disorganization theory (SDT) has experienced a renaissance, achieving a central position in the criminological field (Kubrin & Weitzer, 2003). Based on the idea that social systems display structural characteristics that can be studied independently of individual attributes (Sampson, 2006, 2002), SDT holds that primary relations (family, kinship ties) were substituted by secondary institutions as a consequence of urbanization and population growth at the beginning of the twentieth century (Park & Burgess, 1925). For example, Shaw and McKay (1969) found that in poor neighborhoods of Chicago's inner city, the heterogenic composition of these areas, the frequent mobility of residents, and familial problems affected the community's ability to supervise youth behaviors and exert informal social controls. These *socially disorganized* neighborhoods are usually much more inclined to suffer from high levels of violent crime (Bursik, 1988; Kornhauser, 1978; Sampson & Groves, 1989).

In a revised version of the theory, Bursik and Grasmick (1993) and Kornhauser (1978) argued that the weakness of informal and formal networks and informal controls lead to increased victimization within the community. We should note, however, that some ecological studies later demonstrated that associations between informal networks and crime victimization are not equally significant across different crime types (e.g., Veysey & Messner, 1999; Warner & Wilcox, 1997). Other studies have argued that infrequent interactions among neighbors or weak ties used to be more efficient than strong ties in producing regulatory functions (Bellair, 1997; Carr, 2003), particularly in poor areas where strong ties between law-abiding neighbors and delinquents limit community capacity to control deviant behaviors (Browning et al. 2004). Similarly, Sampson, Raudenbush, and Earls (1997) argued that dense informal networks and solid formal associations are not sufficient to enact social controls. Rather, residents' trust, solidarity, and willingness to intervene are the required elements for producing "collective efficacy," or the ability of a community to deal with crime (Sampson et al., 1997).

Sampson and colleagues developed the collective efficacy model or collective efficacy theory (CET) in the context of the Project on Human Development in Chicago Neighborhoods (PHDCN) (Sampson et al., 1997). With data from a community survey applied in 343 neighborhood clusters, police records, and the 1990 Census data, they found that in areas of high concentrations of poverty, numerous immigrants, and lower residential stability, the risk of violent victimization was higher than in neighborhoods without these characteristics (Sampson, 2012; Sampson et al., 1997). However, when collective efficacy was added to the model, the influence of the other variables decreased or indeed disappeared. Consequently, the authors (Sampson et al., 1997) concluded that collective efficacy largely mediates the negative effect of neighborhood structural conditions on violence. As Rhineberger-Dunn and Carlson (2011) argued, the concept of collective efficacy, an index comprising variables of social cohesion and informal control, is a new model by which to define "social control."

Later studies conducted in Stockholm, Sweden (Sampson & Wikström, 2008) and Brisbane, Australia (Mazerolle et al., 2009) replicated the methodology of the Chicago CEM study and reached similar conclusions. For Sampson (2012), the fact that the CEM was confirmed in cities with different historical, political, and social features indicates that the model should be taken as a valid theory. In favor of this argument, Hipp and Wo (2015, p. 170) have recently pointed out that a great body of international literature has confirmed the negative relationship between neighborhood collective efficacy and crime. Besides the previously cited studies, Hipp and Wo (Hipp & Wo, 2015) mentioned research conducted in Los Angeles by Burchfield and Silver (2013) and in Tianjin, China, by Zhang et al. (2007).

There has, however, been some criticism of the concept and its relation to crime (Hipp & Wo, 2015; Rhineberger-Dunn & Carlson, 2009, 2011; Triplett et al., 2005). Regarding the first criticism, various studies have demonstrated that collective efficacy is a multidimensional concept. Social cohesion and informal control, they argue, are associated but not a part of a single construct (Manzano, 2018; Rhineberger-Dunn and Carlson, 2009; Warner, 2007). In other words, the social ties required to develop informal control are conceptually different from the exercise of that control (Triplett et al., 2005).

Concerning the second criticism, Mellado (2016, p. 33) has argued that the effects of collective efficacy on victimization, crime rates, and perceived violence is ambiguous. For instance, case studies carried out in London (Sutherland et al., 2013) and in the Hague (Bruinsma et al., 2013) have collected evidence refuting the negative relationship between collective efficacy and crime. Moreover, evidence suggests that social cohesion, formal control, and informal control differentially mediate the effects of neighborhood structural conditions on victimization (Rhineberger-Dunn and Carlson, 2009, 2011). Finally, research from Latin America has shown contradictory results, with Sampson himself (2012) admitting that Latin America could be an exception to CEM—a topic developed in the next section.

The SDT and the CEM in Latin American Crime Studies

Although a great body of literature from the United States and other developed countries has supported the idea that strong informal networks within communities are not sufficient to effectively reduce crime, the persistence of high levels of crime in poor and highly cohesive neighborhoods in Latin America still constitutes a challenge for ecological theories of crime (Manzano, 2009; Villareal & Silva, 2006). This explains why several studies in Latin America have attempted to find socioeconomic and institutional causal factors that explain the region’s crime and violence by comparing their distribution across different aggregated units: countries, cities, and districts (Araya & Sierra, 2002; Arriagada & Morales, 2006; Beato et al., 2004; Dammert & Lunecke, 2002; Gutiérrez et al., 2009). Nonetheless, most of these studies have used only official data and focused on a global analysis of crime rate distribution. As pointed out by Villarreal and Silva (2006) and Manzano (2009), the lack of data on local scales and indicators of community vari-

ables has prevented Latin American researchers from testing ecological theories of crime, such as the SDT and CET.

Just during the past decade, though, new studies have attempted to analyze crime distribution by considering both individual-level and contextual variables (neighborhood, city) as causal factors. In 2006, a Latin American study tested the effect of neighborhood structural characteristics on social cohesion and crime for the first time; it was based on a multilevel design and data collected from a community survey in Belo Horizonte city (Villareal & Silva, 2006). The authors found that poor neighborhoods were highly cohesive, but, contrary to previous literature, a greater cohesion was not associated with lower levels of crime. Instead, dense ties and cohesion were associated with a higher perceived risk of victimization. Nonetheless, as the authors used measures of informal networks (interaction and exchanges among neighbors) instead of social cohesion measures (trust, unity, and shared values), they refuted only the traditional SDT but did not test the CEM.

Later, Alves da Silva (2014) conducted a study in Belo Horizonte (Brazil) based on a 2002 victimization survey and Census data and drew on SDT while testing some of the hypotheses of Sampson and Groves (1989). Silva used the “Census district,” of which there were 200, as a proxy for the neighborhood unit (Silva, 2014). The author claimed to have found evidence supporting the SDT in the study of crime victimization in Brazil but also demonstrated that dense friendship networks are associated with higher rates of rape and that a high level of organizational participation is associated with high levels of property crime. Therefore, despite his claims to the contrary, the results of Silva’s study (2014) do not confirm SDT, even though he states so.

In other fieldwork, Frühling and Gallardo (2012) based their study on the 2010 Santiago community-survey data (University of Chile), which was applied in a sample of 5,860 households within 242 neighborhoods. They observed that “concentrated social disadvantage” at the neighborhood level has a significantly positive effect on victimization rate, and thus concentration of poverty is associated with a higher level of victimization. They also found that informal control has no influence on victimization, which refutes earlier hypotheses of the social disorganization and collective efficacy theories. Using the same dataset from Santiago neighborhoods but performing a different type of analysis, Tocornal and colleagues (2014), as well as Olavarría and Allende (2014), reached similar conclusions. Particularly, Olavarría and Allende found that trust among neighbors was associated with low levels of violent victimization.

Also following the SDT, Vilalta et al. (2016) conducted a comparative study in thirty-five Latin American cities that sought to explain the spatial distribution of delinquency at the inter- and intraurban levels. The conclusions (Vilalta et al., 2016) suggest that: (a) the theory of disorganization provided better explanatory models at the intraurban level than at the interurban level, (b) four structural conditions explained crime distribution in the cities studied (economic deprivation, residential instability, dysfunctional family structures, and alcohol consumption), and (c) these factors operate with different strength and even in different directions at the intraurban level. Unfortunately, as this study did not

collect data directly from local communities or measure variables concerning community or institutional resources, it could not test the mediated factors proposed by the social disorganization or collective efficacy theories.

By contrast, in the her doctoral thesis, Manzano (2014, 2018) was able to empirically test the hypotheses of social disorganization and collective efficacy theories and their applicability to the Latin American context based on the 2010 Santiago-community survey data. She corroborated that the risk of violent victimization is associated with high concentrations of poverty and low levels of residential stability at the neighborhood level, yet these effects are mostly mediated by the influence of institutional and community variables. High levels of neighborhood attachment, collaboration, and social cohesion are associated with a lower likelihood that a household will suffer a violent crime within their residential area, across all types of neighborhoods. Manzano (2018) also demonstrated that the variables associated with informal networks and informal control had no significant association with victimization risk for violent crime. However, the author also found that the influence of variables at the neighborhood level is generally low and proportionally lower than that of individual-level variables. More studies would have to made, she admitted, to either confirm or discard the validity of the tested theories within the Latin American context.

Our study responds to her call by collecting primary-level data from three capital cities of the region. This research, “Violence in Three Latin American Cities: A Comparative Study at the Local Level” (University of Chile, 2013–2016) improved the 2010 Santiago community survey and applied it to a sample of 2,641 people within 81 low-class neighborhoods of the cities of Bogotá, Lima, and Santiago. Based on these data, we sought to answer the question: To what extent do the vulnerability of households, the structural factors of neighborhoods, and the organizational-community resources have an impact on the risk of violent victimization within poor neighborhoods of Bogotá, Lima, and Santiago? Three working hypotheses can be derived from this question, which are also presented in Figure 1.

> *Hypothesis 1 (H1)*: In low-class neighborhoods in Latin America, the vulnerability of households, disadvantaged socioeconomic position, and low residential stability are associated with a higher risk of violent victimization.
>
> *Hypothesis 2 (H2)*: In low-class neighborhoods in Latin America, community mechanisms such as neighborhood attachment, ties, and collaboration are associated with a lower risk of victimization in households. These mechanisms significantly mediate the effects of neighborhood structural variables: degree of social vulnerability and residential stability.
>
> *Hypothesis 3 (H3)*: In low-class neighborhoods in Latin America, organizational mechanisms such as social cohesion and informal social control decrease the risk of violent victimization in households. This effect mitigates the influence of structural variables and community variables already mentioned.

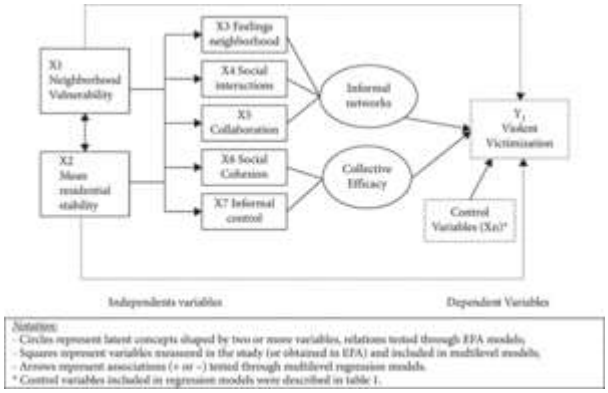

Figure 1 Extended model of social disorganization to explain violent victimization in neighborhoods

Source: Our own elaboration based on literature review and the results Manzano (2014).

Methodological Framework

Database and Sample Design

This research uses data from the community-survey applied in the study "Violence in Three Latin American Cities," which was administered to adults over eighteen years of age residing in low-class neighborhoods of Bogotá, Lima, and Santiago. These adults were interviewed between February and April of 2015, at the same time in the three cities, as part of the research project developed by the Centre of Studies on Citizen Security, Institute of Public Affairs, University of Chile.

The community survey[2] included questions and scales tested or validated in earlier studies. For instance, the scales related to neighborhood attachment, informal networks, social cohesion, and informal control, among others community resources, were based on the Santiago community survey applied in the 2010 as part of the study "Crime and Urban Violence" (Frühling & Gallardo, 2012; Olavarria et al., 2008) and based on collective efficacy studies (Sampson & Groves, 1989; Sampson et al., 1997). By contrast, the module on victimization and perceived violence was specifically designed for the comparative study on the basis of crime categories defined in national victimization surveys of Chile and Colombia. The victimization questions measured only events occurring in the neighborhood context and highlighted violent acts.

As regards the sample design, the survey was applied in eighty-one small neighborhoods or micro-neighborhoods (MNs).[3] To delimit and select the MNs, a multistage sample design was used with the following stages. First, the census blocks of each city were classified according to their predominant socioeconomic status; after that, only the blocks of middle-low, low, and extremely low (indigence level) status[4] were selected. Second, twenty-five census blocks of said status were randomly selected in each city. These census

blocks were considered as centroids (center points), and two more adjacent blocks in opposite directions were selected. The twenty-five MNs were located on each city map with a view to correcting the area limits according to demographic and geographic criteria.

Third, we conducted a systematic “leaping” to select one in every three housing units, and, within the selected unit, only the main household was interviewed. Finally, we selected thirty individuals meeting certain age and gender prerequisites in each MN or neighborhood. Apart from the twenty-five randomly selected neighborhoods, two more neighborhoods (poor-violent areas with a history of strong social organization) were intentionally chosen in each city, and we interviewed sixty to seventy individuals in each one.[5]

In this way, the total sample of the study consisted of 2,641 cases residing in 81 neighborhoods. They represent the population of each selected neighborhood and the middle-low and low-status population in the cities of Bogotá, Lima, and Santiago with a sample error of +/− 3.3 percent and a 95 percent level of statistical reliability.

Variables Under Study

Dependent Variables

The research analyzed “household victimization for violent crime” as a dependent variable. A household was victimized if the respondent or a member of his or her household suffered three crime events in the twelve months preceding the survey in the neighborhood of residence. The crimes considered were (a) assault or violent robbery (considering only the events in which violence, intimidation, or threat was present), (b) injuries, and (c) homicide.[6] In 18 percent of all households, at least one of the members had been a victim of a violent crime in the neighborhood (see descriptive statistics in Table 1).

Independent-Explanatory Variables

The theoretical concepts included as explanatory variables in this study were mostly measured by means of attitudinal scales (Likert-type scales), which consider more than one statement. Said scales were transformed into continuous variables through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The first analysis allowed us to identify the latent constructs underlying the observational variables measured in the survey of neighborhoods (Bartholomew et al., 2009), whereas the second analysis allowed us to confirm the estimated models and later generate standardized scores. These scores were subsequently used as continuous variables in the multilevel regression models. Both factor analyses were developed by using the MPlus software.

Neighborhood Attachment and Ties Among Neighbors

On the basis of the “systemic community” concept proposed by Kasarda and Janowitz (1974) and the indicators for informal networks defined by Kornhauser (1978), Bursik (1988), and Sampson and Groves (1989), four community variables were tested: neigh-

borhood attachment, informal ties among neighbors, collaboration among neighbors, and associativity. The latent factor linked to the scale "neighborhood attachment" comprised five items, with statements such as "I feel at ease living in this neighborhood" or "I would like my children to grow up in this neighborhood." On the other hand, the variables for informal ties (e.g., "neighbors talk to each other"), collaboration ("neighbors cooperate with maintenance and cleanliness"), and associativity (e.g., "the neighborhood organizations are coordinated") were defined within a factorial model of three associated factors. However, since the associativity factor did not express a significant association with the victimization risk in any of the tested models, it was eliminated from the analysis.

Social Cohesion and Informal Social Control

On the basis of the adapted version of the scales proposed by the Chicago scholars (Sampson et al., 1997), we developed factorial models with two and three factors for the concepts of trust, cohesion, and informal social control. Out of said analysis, the two-factor model was selected since it supported itself both empirically and theoretically. The first factor, "Social Cohesion," comprises three items linked to the trust scale (e.g., "neighbors honor their agreements and commitments") and four items on neighborhood unity (e.g., "neighbors are really close, usually acting with solidarity and collaborating"). The second factor is represented by four statements about informal social control (e.g., "neighbors talk to youths consuming alcohol or drugs in public spaces," or "neighbors intervene when there is a conflict in the neighborhood"). Both factors have only a moderate correlation and result in separate factors, demonstrating that collective efficacy cannot be understood as a unidimensional construct, as argued by Sampson et al. (1997). This confirms the findings of Rhineberger-Dunn and Carlson (2009, 2011) and refutes one of the main assumptions of the CET.

Independent-Control Variables

Five demographic and socioeconomic household characteristics were included as control variables. Using these kinds of variables has been largely supported in victimization studies such as those by Pease and Tseloni (2014), Brookman and Robinson (2012), and Meier and Miethe (1993), among others. Similarly, Jiménez, Manzano, and Mohor (2019) and Manzano (2018) have considered a Social Index of Vulnerability and other "vulnerability" variables such as the presence of children in the home and a female head of household.

- *Social Index of Vulnerability (SOVI)*[7]: This index comprises eight disadvantages related to conditions of household vulnerability (young head of household, children out of school, low-income home, no access to basic services, no access to technologies, overcrowded housing, migrants, home with low connectivity). The sums of these disadvantages were codified into four categories: (1) no vulnerability, (2) low vulnerability (one disadvantage), (3) medium vulnerability (two disadvantages), and (4) high vulnerability (three or more disadvantages).

- *Presence of children in households*: This binary variable measures the presence or absence of children aged 0–18 years (inclusive) in households. The categories for this variable are (1) for one or more children and (0) for no children.
- *Female head of household*: This variable was measured with the question: What gender is the person providing the main income for the household? The answer was codified into two categories: (1) for female head and (0) for male head.
- *Job position of household head*: This variable measures the occupational positions of household heads: (1) employer and professional, (2) salaried employee, (3) informal or independent worker, and (4) out of work, either unemployed or looking for employment.
- *Residential stability in the neighborhood*: The variable "residential stability" was measured through the question: How long (years and/or months) has your family been living in this neighborhood? We initially used a continuous scale, but as the distribution of this variable turned out to be non-normal, we decided to transform it into a binary variable.[8] The category "low stability" (1) refers to a length of residence shorter than six years and "high stability" (0) to a length of residence of six years or longer.

Table 1 Descriptive statistics of study variables

Dependent variables *(Level 1. individuals)*	*N* Valid	%		
Household violent victimization (Yes)	2,641	17.7		
Predictor variables —control	*N* Valid	%		
Level 1. Individuals/Household				
SOVI Index household (ref without vulnerability =0)	2,641			
Low vulnerability (1 disadvantage)		28.3		
Medium vulnerability (2 disadvantages)		22.4		
High vulnerability (3 or more disadvantages)		26.2		

Children at home (Yes = 1)	2,638	65		
Female Household head (Yes = 1)	2,636	24.1		
Working position of household-head (ref. Not working = 0)	2,623			
Manager/employer		10.5		
Employee		42.2		
Informal worker		33.6		
Low residential stability on the neighborhood (ref. 6 years or more = 0)	2,586	16.4		
Predictor Variables—explanatory	*N* Valid	Media	Dev. St.	Min./Max.
Level 1. Individual/household				

Feelings toward neighborhood (gc)	2,640	0.0	1	−4.69/4.41
Collaboration (gc)	2,640	0.0	1	−4.26/4.25
Friendship ties (gc)	2,640	0.0	1	−4.25/3.81
Social cohesion (gc)	2,640	0.0	1	−4.22/4.24
Informal social control (gc)	2,640	0.0	1	−4.75/3.96
Level 2. Neighborhood				
Feelings toward neighborhood (m)	81	0.0	1	−2.23/4.05
Friendship ties (m)	81	0.0	1	−2.57/2.40
Collaboration (m)	81	0.0	1	−2.58/2.59
Social cohesion (m)	81	0.0	1	−2.41/2.42
Informal control (m)	81	0.0	1	−2.36/2.81
Neighborhood vulnerability	81	0.0	1	−1.79/2.10

Mean of residential stability	81	0.0	1	−1.59/2.35

*All continuous scale variables were normalized using Z score transformation.

(gc) The scores of the scales at the individual level were centered toward the group mean (neighborhood).

(m) Average of the group (neighborhood) in the specified scales.

Exogenous Independent Variables at Neighborhood Level

Two other variables were considered as independent or explanatory variables at the neighborhood level: “poverty concentration” and “residential stability.” Both were included in models as proxies for the two structural measures commonly built by multilevel crime from Census data or other external secondary resources.

- *Poverty concentration at neighborhood level*: This variable was measured by using the vulnerability level in the neighborhood as a proxy. To this end, we added up all the SOVI levels of all the households in the sample neighborhood, and then this figure was divided by the maximum value that the total SOVI sum could attain for said neighborhood. This coefficient was denominated “vulnerability degree of neighborhood” or “SOVI neighborhood scale” (Jiménez et al., 2019).
- *Residential stability at neighborhood level*: This variable was obtained by estimating the arithmetic mean at the neighborhood level for the variable “years of family living in the same neighborhood.” This aggregate variable was also considered as an explanatory variable in the regression models (see Table 1).

Independent-Mediating Variables at the Neighborhood Level

To measure the influence of existing community resources (e.g., neighborhood attachment, social cohesion) on the victimization risk of households, the explanatory variables already mentioned were aggregated at the neighborhood level. After calculating the aggregate variables, the individual-level variables were centered toward the mean of each group (neighborhood.) In short, those variables having a mediating role in the models were tested assuming two levels: (1) the individual level, where the scores were standardized and centered toward the mean; and (2) the neighborhood level, estimated on the basis of the group’s mean and then also standardized (using Z scores).

Analysis Strategy: Multilevel Regression Models

To obtain correct estimates and standard errors, the multistage sample design and the resulting sample’s hierarchical structure allow for making statistical adjustments to better observe dependencies between the same group or “clusters.” In this study, level 1 corresponds to individuals who are grouped within MNs or level 2 units. Multilevel regression models are a flexible tool with which to model variances and correlations as they are based on the idea that neighborhood effects have a distribution and can be considered as *random effects*—running counter to the traditional assumption that neighborhood effects are “fixed” (Rabe-Hesketh & Skrondal, 2013; Snijders & Bosker, 2012).

Thanks to the micro-neighborhoods (MNs) identification in the study sample, it was possible to test the hypotheses asserting that certain MNs characteristics impact household victimization or household member victimization in interpersonal violent crime. As Brun-

ton-Smith and Sturgis (2011) explain, this approach allows us to estimate the proportion of the independent variable variation (at the individual level) that corresponds to differences in observations *within* and *between* neighborhoods. Consequently, it is possible to estimate the relative contribution of individual-level variables to the total variation of the dependent variable, as well as the contribution of level 2 measures on MNs (Snijders & Bosker, 2012).

In the following section, we present the results of a series of multilevel regression models with random intercept, which were estimated to test the hypotheses. Specifically, multilevel logistic regression models were employed since the dependent variable is binary (i.e., the occurrence or non-occurrence of a crime event: interpersonal violent victimization). Said models were estimated with the software STATA 11.1.

Study Findings and Discussion

The Influence of Household Variables on Victimization Risk

Considering the results of the interclass correlation coefficient (ICC),[9] we can state that only a small proportion of the variation in interpersonal victimization for violent crime can be attributed to differences between MNs (13 percent) (see Table 2). Therefore, while the neighborhoods under study in Bogotá, Lima, and Santiago do share several characteristics that can explain a lower or higher risk of violent victimization, most of the variation in violent victimization stems from individual and household factors distributed across the population or from community factors not included in this study.

However, within the context of social sciences, ICC values between 5 and 20 percent are considered normal (Raudenbush & Bryk, 2002) and hence the models obtained in this study are statistically significant (see Tables 2 and 3). Moreover, these results confirm the findings of a study on violence in neighborhoods conducted in Santiago, Chile, between 2009 and 2012. In said study, the ICC was 13 percent in multilevel regression models that also measured the victimization risk for violent crime (Manzano, 2014, 2018). Thus, the results obtained in this study are reliable for evaluating the influence of structural and community variables on violent victimization of households.

Table 2 Multilevel logistic models of violent victimization: Null model and control variables

	Odds ratio—Violent victimization (household)			
Fixed effects/Level 1. Individual	Null model		Model 1—Var. control	
Control variables	Coef.	Std. error	Odds ratio	Std. error
SOVI Index household (ref without vulnerability = 0)				
Low vulnerability (1 disadvantage)			0.872	0.142
Medium vulnerability (2 disadvantages)			1.162	0.198
High vulnerability (3 or more disadvantages)			0.752	0.138
Children at home (Yes = 1)			1.297	0.161
Household—woman (Yes = 1)			1.348	0.172

Working position of household-head (ref. Not working = 0)				
Manager/employer			1.971*	0.466
Employee			1.500	0.296
Informal worker			1.514	0.305
Low residential stability in the neighborhood			0.911	0.140
Fixed effects/Level 2. Neighborhood				
Constant	−1.675*	0.099	–	–
Random effects/Level 2. Neighborhood				
L2 variance (ψ): between neighborhoods	0.509	0.127	0.497	0.128
ICC (ρ)	13.4%		13.1%	
Chi-square/Sig.	85.14	0.00	74.66	0.00

N observations/*N* groups	2641	81	2568	81
Min. obs./Mean obs.	26	33	26	32

+ p-value < 0.1, * p-value < 0.05, ** p-value < 0.01.

Table 3 Multilevel logistic models of violent victimization: SD model and CE model

	Odds ratio—Violent victimization (household)			
Fixed effects/Level 1. Individual	M1	M2	M3	M4
Control variables				
SOVI Index household (ref. without vulnerability)				
Low vulnerability (1 disadvantage)	0.872	0.831	0.840	0.838
Medium vulnerability (2 disadvantages)	1.162	1.042	1.041	1.023
High vulnerability (3 or more disadvantages)	0.752	0.647	0.650	0.643
Children at home (Yes = 1)	1.297	1.299	1.304	1.313
Household—woman (Yes = 1)	1.348	1.372	1.360	1.362

Working position of household-head (ref. Not working)				
Manager/employer	1.971*	1.967*	1.867*	1.868*
Employee	1.500	1.519	1.482	1.497
Informal worker	1.514	1.470+	1.451+	1.449+
Low residential stability in the neighborhood	0.911	0.908	0.869	0.861
Explanatory variables				
Feelings toward neighborhood (gc)			0.820*	0.855
Social interactions (gc)			1.141+	1.219
Collaboration (gc)			0.909	0.957
Social cohesion (gc)				0.815
Informal control (gc)				0.998

Fixed effects/Level 2. Neighborhood				
Explanatory variables				
Neighborhood vulnerability		1.312	1.059	0.909
Mean of residential stability		0.937	0.960	0.932
Feelings toward neighborhood (m)			0.679*	0.736
Social interactions (m)			0.832+	0.949
Collaboration (m)			1.032	1.043
Social cohesion (m)				0.671
Informal control (m)				1.182
Random effects/Level 2. Neighborhood				
ICC (ρ)	13.1%	11.7%	8.4%	7.7%

-2 x log likelihood ratio test	87.66 (0.0)	9.46 (0.01)	26.99 (0.0)	10.15 (0.04)
Chi-square (sig.)	74.66 (0.0)	66.11 (0.0)	33.25 (0.0)	28.45 (0.0)
N observations	2,568	2,568	2,567	2,567
N groups/mean obs. per group	81/32	81/32	81/32	81/32

+ p-value < 0.1, * p-value < 0.05, ** p-value < 0.01.

Even though most of the variables introduced were statistically significant (sig < 0.05) in the first multilevel random-intercept model (hereafter M1), they produced only a minor decrease in the ICC (see Table 2). This indicates that while M1 variables could partly explain the variability in violent victimization in the total sample or *between* neighborhoods, they do not allow us to explain variations within neighborhoods.

Within poor urban neighborhoods of the three cities, we did find that the likelihood of being a victim of violent crime is lower in households presenting high vulnerability (three or more SOVI disadvantages) than in households presenting no vulnerability (zero disadvantages). In M1, the level of statistical significance for this vulnerability variable is only 0.1 (90 percent of reliability), though the significance increases to 0.05 and 0.01 in subsequent models. Hence, the association between this variable and the risk of violent victimization of a household can be established with certainty (see Table 3: M2, M3, and M4). This finding goes against the proposed hypothesis, H1.

We also found that households comprising adults and children are more likely to suffer a violent crime than households with no children, as observed in Table 2. In a similar vein, households headed by a woman are more likely to suffer a violent crime than households headed by a man. These findings confirm the results obtained in a similar study made in Santiago across diverse type of neighborhoods (Manzano, 2014, 2018), and are consistent with international evidence that female-headed households and households with children are more vulnerable (Kleinosky et al., 2007; Rygel et al., 2006). More specifically, literature on SDT has argued that lack of adult supervision over children and teenagers in poor neighborhoods exposes them to risky or criminal behavior and/or increases their chance of being victims of crimes (Sampson & Groves, 1989; Shaw & McKay, 1969).

Contrary to expectations and to H1, those households with heads in a privileged position (employer or professional) are more likely to become victims of a violent crime than those households in which the head does not work. Again, the same phenomenon is observed in households where heads are salaried workers, even informal workers, in comparison to households where the head does not work (see M1, Table 2). This finding is supported by international evidence suggesting that households with a better socioeconomic situation can become “targets” for criminals, both in high-income neighborhoods as well as in middle-income and low-income neighborhoods (Pease & Tseloni, 2014).

The variable “family living in the same neighborhood” (longer or shorter than 6 years) did not produce any significant influence on violent crime victimization. These findings are contrary to social disorganization studies, which affirm that individuals (and families) with low residential stability struggle to establishing strong ties with their neighbors and perform fewer collective actions to benefit the community. Therefore, so the theory goes, they would be more exposed to suffering a crime event in the neighborhood. This hypothesis did not prove true in the context of poor Latin American neighborhoods, where the length of residence is generally high or very high, and the residence variable is not significantly associated with violent crimes.

Testing SDT: The Influence of Community Variables

To test H2, we analyzed two structural variables at the neighborhood level: “Degree of social vulnerability” and “Mean of residential stability.” When these variables are included in Model 2, the ICC significantly decreased (from 13 percent to 11.7 percent) for violent victimization (see Table 3). This indicates that these variables contribute to explaining the variability of violent victimization between neighborhoods and within neighborhoods. However, the “degree of vulnerability” variable had the greatest impact since the residential stability variable was not significant.

A neighborhood’s degree of vulnerability is positively associated with the victimization risk in violent crime. In other words, within urban low-class neighborhoods, residents living in neighborhoods with a high degree of social vulnerability are more exposed to violent crime than residents of less vulnerable neighborhoods. This result is contrary to the previous finding about the SOVI influence at the household level: that households with a better relative living situation would be *more* likely to be a victim of violent crime. Nonetheless, this finding is consistent with some international evidence. As Pease and Tseloni (2014) demonstrated, the effect of income at the neighborhood level is usually negative; that is, in higher income neighborhoods violent crime rates are lower than in poor areas, whereas within poor areas, individuals/families of higher income are more likely to be victimized. Using multilevel models allows us to better grasp how the same variable can have different effects on victimization risk at the macro or micro level.

As observed in M3, Table 3, the neighborhood’s degree of vulnerability loses significance when community variables are introduced. This finding leads us to conclude that the effect of vulnerability is indirect and mostly mediated by the influence of community variables, which will be analyzed later. These findings are consistent with a great body of literature on social disorganization and collective efficacy (Brunton-Smith & Sturgis, 2011; Mazerolle et al., 2009; Rhineberger-Dunn & Carlson, 2011; Sampson et al., 1997), and they also confirm the results of the Santiago study (Manzano 2014, 2018).

Finally, no association between the variable “mean of residential stability at the neighborhood level” and the risk of violent victimization in households has been detected (see Table 3). This finding accords with those from earlier studies in Latin America (Manzano, 2014; Vilalta & Muggah, 2016) and refutes one of the basic assumptions of SDT.

In Model 3, community variables linked to H2 and the SDT were introduced: sense of neighborhood attachment, neighbors’ interactions, and neighbors’ collaboration (see Table 3). These three variables were considered both as individual and aggregate expressions at the neighborhood level (standardized mean). Including these variables produced a significant reduction in the ICC, implying that they contribute to explaining the variability of household violent victimization between neighborhoods and within neighborhoods.

The variable “neighborhood attachment at the individual level” is significantly associated with violent victimization: the likelihood of violent victimization is lower in those households that express a deeper feeling of neighborhood attachment. A potential interpreta-

tion of this finding is that a greater attachment promotes better and more meaningful relationships with neighbors and a better use of public spaces, which in turn could reduce one's exposure to danger. However, the inverted association could be also suggested (i.e., that residents who have *not* been victimized feel more protected and attached to their surroundings as compared to those who have been victimized). Therefore, victimization and revictimization of individuals and households would tend to produce detachment or estrangement from the neighborhood and hence fewer social ties and greater isolation: a vicious cycle of increased victimization risk.

By contrast, communities that positively view their surroundings are able to promote preventive actions and, in this way, reduce the likelihood of victimization for violent crime. These findings confirm the evidence from ecological studies of crime both internationally (Bursik & Grasmick, 1993; Sampson & Groves, 1989) and in Latin America specifically (Manzano, 2014, 2018; Silva, 2014).

Contradicting the SDT, our findings show that the variable "informal ties among neighbors" at the individual level is associated with victimization for violent crime in models M3 and M4. This association is significant at 0.1 level (90 percent of reliability) in M3, but it increases to 0.05 level (95 percent of reliability) in M4. This finding implies that residents with stronger neighbor ties actually have a higher likelihood of becoming victims in a violent crime or having a household member victimized. However, there is no association between the variable "informal ties among neighbors," measured at the neighborhood level, and violent victimization.

These findings on the role of informal networks indicate that dense friendship ties and a high level of neighborly interaction does not guarantee that conventional, anti-crime values are reproduced (Bellair, 1997; Carr, 2003; Warner, 2007). As argued by Browning and colleagues (2004), networks can be formed by law-abiding neighbors as well as offenders, and therefore various networks may seek goals contrary to the establishment of pacific and crime-free surroundings (Browning et al., 2004). Within the highly vulnerable and violent context of so many Latin-American neighborhoods, offenders may actually receive tacit support for their criminal activities from their close, law-abiding neighbors, who may be unwilling to report offences (Arias, 2006; Lunecke, 2012; McIlwaine & Moser, 2001).

In general, we find that the impact of informal ties has been overstated. The positive influence of informal ties is restricted to the individual level and thus does necessarily impact collective processes at the neighborhood level. And, since it is not possible to claim a causal relationship, it is also feasible to state that, after suffering a violent victimization event, neighbors may tend to increase their interactions with other neighbors in order to search for strategies to face the crime problem.

Furthermore, and again contrary to the expectations of SDT, the results demonstrated that "collaboration among neighbors" does not have any influence on violent crime victimization (see M3 in Table 3). Considering this and previously presented findings, we can refute H2 in the context of poor urban neighborhoods in Latin America, particularly in the cities of Bogotá, Lima, and Santiago. The presence of community mechanisms such as in-

formal ties and neighbor collaboration does *not always* contribute to decreasing the victimization risk for violent crime. In some cases, frequent interactions among neighbors may even limit or inhibit the regulation of behaviors contrary to pacific coexistence. However, deeper feelings of neighborhood attachment, at both the individual and neighborhood levels, are associated with lower risk of violent victimization.

Influence of Social Cohesion and Informal Control on Crime Reduction

Based on the CET, and in an attempt to test H3, two organizational variables were introduced in Model 4: social cohesion and informal social control, both as individual expressions and at the neighborhood level. The inclusion of these variables produced a minor decrease in the ICC of the violent victimization model (see Table 3). Therefore, these organizational factors did impact, if only slightly, violent victimization.

As observed in M4, “social cohesion” perceived at the individual level is inversely associated with the risk of violent victimization to a significant degree. That is, the lower likelihood of violent crime affecting a household is associated with a greater perception of social cohesion. This individual-level perception can be transformed into a collective mechanism as long as it is shared and experienced by a relevant portion of neighborhood residents. At the community level, social cohesion reduces the victimization risk for violent crime with 95 percent statistical certainty (see M4, Table 3). However, the direction of the association is an assumption, and hence it could actually be the lower occurrence of victimization that produces greater social cohesion. Alternatively, both effects could mutually reinforce each other.

In contrast, “informal social control” measured at the individual level seems to have a negative association with victimization risk. However, this relationship is not statistically significant, as observed in M4, Table 3. When informal social control is analyzed at the aggregate level, the association with victimization is positive (i.e., it could be associated with greater crime levels). Nonetheless, this association also is not statistically significant. Explained differently, the exercise of regulatory actions (e.g., neighbors intervene when there is a conflict in the local area) does not seem to influence the victimization risk for violent crime in the poor neighborhoods under review.

Under the CET, when neighborhood residents share common values and expectations—for instance, the desire for a crime-free environment—they can develop social control actions that reduce crime (Sampson, 2012; Sampson et al., 1997). Neighborhood residents can thus become a collective with effective resources to combat crime and violence (Rhineberger-Dunn and Carlson, 2011; Sampson, 2012). However, while studies have confirmed the relationship between social cohesion and lower violent victimization, the association between informal control and victimization has not been proved significant across different contexts.

To better understand why no connection has been found between informal social control and violent victimization risk, we must consider alternative hypotheses. Because this is a cross-sectional study and the neighborhood sample is centered on poor urban sectors, we can assume that ties between internal informal networks and external networks/institutions are weak in these areas. These conditions make it challenging to perform safe and sustainable actions of social control like those proposed by Vélez (2001) and Carr (2003). In these contexts, it is more feasible that victimization would lead households to band together with neighbors and take certain measures to reduce crime. This form of social control is reactive and, for that reason, might not necessarily be sustainable over time. In other words, sporadic expressions of informal social control do not guarantee the establishment of organized and effective crime-fighting communities. Undoubtedly, this hypothesis requires an in-depth analysis in future studies.

In sum, the multilevel models tested for poor neighborhoods of Bogotá, Lima, and Santiago demonstrated that high degrees of neighborhood vulnerability are directly and positively associated with a high risk of violent victimization. Nonetheless, the influence of this variable is mediated by the effect of community and organizational variables, particularly by “sense of neighborhood attachment” and “social cohesion,” which have effects at the individual as well as neighborhood levels. This finding was confirmed through linear regression models in which community variables are considered dependent variables at neighborhood level (see Table 4).

These linear regression models corroborated that the “degree of neighborhood vulnerability” is negatively associated with “neighborhood attachment,” “informal ties,” and “social cohesion,” but it does not have any relationship with “informal social control” or with “collaboration.” Furthermore, the “mean of residential stability” was not directly associated with the risk of violent victimization, nor is it indirectly associated with community variables (see Table 4).

Table 4 Linear regression models by mediating variables: Neighborhood level

Explanatory variables	**Feelings toward neighborhood**	**Social interactions**	**Collaboration**	**Social cohesion**	**Informal control**
	Coef. B st.	**Coef. B st.**	**Coef. B st.**	**Coef. B st.**	**Coef. B st.**
Neighborhood vulnerability	−0.597*	−0.275	−0.101	−0.656*	0.138
Mean of residential stability	−0.097	0.200	0.040	0.002	0.081
F-square (sig.)	16.54 (0.0)	8.40 (0.0)	0.66 (0.5)	32.27 (0.0)	0.52 (0.5)
R-square (adjusted)	0.280	0.156	−0.009	0.439	−0.012
N observations	81	81	81	81	81

+ p-value < 0.1, * p-value < 0.05, ** p-value < 0.01.

Table 5 Linear regression models of violent victimization by cities: Neighborhood level

	Bogotá	**Lima**	**Santiago**
Explanatory variables	**Coef. B st.**	**Coef. B st.**	**Coef. B st.**
Neighborhood vulnerability	−0.144*	−0.184*	0.336*
Mean of residential stability	−0.130*	0.222*	−0.315*
Feelings toward neighborhood (m)	−0.636*	−0.529*	0.416*
Social interactions (m)	0.007	−0.363*	0.219*
Collaboration (m)	0.108*	0.084*	−0.429*
Social cohesion (m)	−0.282*	0.180*	−0.218*
Informal control (m)	0.194*	0.140*	0.050
F-square (sig.)	158.93 (0.0)	86.52 (0.0)	51.18 (0.0)
R-square (adjusted)	0.55	0.41	0.29
N observations	891	880	870

+ p-value < 0.1, * p-value < 0.05, ** p-value < 0.01.

All of this means that the greater the vulnerability levels in neighborhoods, the lower the possibilities for generating or strengthening community resources. Having fewer community resources, in particular “neighborhood attachment” and “social cohesion,” tends to increase violent crime in a local context. However, those resources, limited though they may be, can be activated in poor and vulnerable neighborhoods and possibly reduce violent crime. Meanwhile, “informal social control” is not a mediating factor between vulnerability and violent victimization. Therefore, the CET is refuted in the context of Latin American neighborhoods, a finding in line with prior studies in the region (Frühling & Gallardo 2012, Vilalta & Muggah, 2016, Manzano, 2014, 2018).

The two previous community variables—"neighborhood attachment" and "social cohesion"—were significant in most multilevel models, considering the whole sample. However, when the last model was tested comparing the three cities (with neighborhood level data), the previous association expresses diverse significance and directions. Thus, "neighborhood attachment" was negatively associated with victimization rates in Bogotá and Lima, while in Santiago higher attachment increased violent victimization. In addition, "social cohesion" clearly lowers violent crime in Bogotá and Santiago, whereas in Perú the opposite occurs. Last, in all three cities, "informal control" is positively associated with violent victimization, which runs contrary to theories and other research around the world (see Table 5). Again, therefore, the findings refute the CET.

Beyond the community mechanisms analyzed here, the differences between the three cities can be traced to historical, political, and institutional factors, among others. Teasing out these differences exceeds the scope of this chapter, but since this study involves quantitative and qualitative data from cities and neighborhoods, it is highly likely that future publications will address these issues and other potential hypotheses.

Conclusion

The ecological studies of crime developed in Latin America have made theoretical contributions, produced valuable results, and proved or refuted hypotheses; however, the data are still insufficient and findings are often inconsistent. For example, while Silva (Silva, 2014; Villareal & Silva, 2006) and others have confirmed some social disorganization hypotheses, the research study from the University of Chile (Frühling & Gallardo 2012, Olavarría & Allende 2014, Manzano, 2014, 2018) and the present study have refuted most of the key SDT *and* CET hypotheses.

Broadly, it has been demonstrated that crime, particularly violent crime, is determined to a great extent by structural variables—demographic and socioeconomic—in contexts of poverty and vulnerability. However, apart from acting directly to increase in crime levels, these variables can also promote or inhibit community resources, which are crucial explanatory or mitigating factors vis-à-vis crime in certain territories. What remains to be clarified is which variables intervene at the individual and/or community level. To answer this question, three working hypotheses (based on existing research) were proposed in this study. The conclusions with respect to these hypotheses are presented here.

Regarding H1, and contrary to expectations, the findings demonstrate that the "vulnerability condition of households" in Latin American low-class neighborhoods (measured through the SOVI index) is not directly associated with a greater risk of violent victimization in households. On the contrary, those families having a lower or null vulnerability within poor neighborhoods present a lower victimization risk. This finding was additionally confirmed by the influence of the household head's job position: a privileged position was associated with a higher victimization risk. This evidence suggests that households in better socioeconomic situations are "targeted" by criminals across different types of neighborhoods. However, this study also proved that increased vulnerability stemming

from such variables as “female household head” and “presence of children” may increase the risk of violent victimization for households within residential areas.

Concerning H2, the findings showed that only the structural variable “degree of neighborhood vulnerability” had a significant influence on violent victimization, increasing the risk for families living in vulnerable areas. The variable “mean of residential stability,” however, was not relevant in any model. In addition, results demonstrated that the influence of “neighborhood vulnerability” was largely mediated by the community variable “neighborhood attachment.” In fact, only “sense of neighborhood attachment” is significantly associated with lowering the risk for violent victimization crime.

With respect to attachment, if neighbors perceive themselves as enjoying their surroundings and as not compelled to live there, they might more willingly generate ties with others or participate in community activities to advance the common good. If this greater individual appreciation for the neighborhood is transformed into a collective perception, greater care for common spaces and greater cooperation will result. It is highly likely that these kinds of behaviors are associated with a lower victimization risk for violent crime.

However, only informal ties measured at the individual level are positively associated with the victimization risk for violent crime, but this association is weak. This finding implies that higher interaction levels among neighbors would be associated with a higher likelihood of victimization. However, as this variable is significant only at the individual level in some models, it is not possible to assert whether informal ties may gradually be changed into a collective resource capable of reducing violent crime in the community.

Also contrary to the SDT, we found that collaboration among neighbors does not have any influence on violent victimization. Therefore, the presence of community mechanisms such as informal ties and collaboration among neighbors does *not always* contribute to diminishing the victimization risk for violent crime. Frequent interaction among neighbors can increase risk if these ties lead to a reluctance to report crime.

Regarding H3, we can assert that social cohesion, at both individual and neighborhood levels, reduces victimization risk in violent crime. In contrast, informal social control is not associated with violent victimization. In addition, in models with neighborhood-level data, the “degree of neighborhood vulnerability” only directly and negatively influences “social cohesion,” implying that the last variable can mediate the effect between the structural variable (i.e., vulnerability) and violent victimization, but this kind of relationships was not observed in the case of “informal social control.” Thus, the main component of CET—the effect of informal control in reducing violent crimes—cannot be proved and, instead, the mediator role of this variable was refuted in the two complementary models.

Social cohesion and neighborhood attachment are the two variables—at the individual and neighborhood levels—that can significantly reduce crime. Both also play a mediating role with regard to the structural variable “degree of neighborhood vulnerability”; as a result, they would tend to be lower in more vulnerable neighborhoods, increasing the likelihood of victimization for violent crime. Nonetheless, after controlling for neighbor-

hood structural variables, neighborhood attachment and social cohesion are still significant. Consequently, these community resources can contribute to preventing crimes even in poor and vulnerable neighborhoods.

Finally, even though there are elements from the SDT and CET that address the multicausal nature of violence and the influence of both micro and macro social factors, these theories have been developed in contexts very different from Latin American neighborhoods. As a result, they cannot be taken as valid in our region without critical revisions and rigorous empirical tests. As the present study demonstrated, most of the SDT and CET hypotheses cannot in fact explain the distribution of violent crime within poor neighborhoods in Latin America.

Future studies should continue this regional focus and address some limitations in our study. First, the cross-sectional nature of the data inhibits assessments about the causal relationships between variables; longitudinal and preferable experimental design studies would improve the quality of the evidence. Second, to introduce a third (city) level within the multilevel model, researchers would need more cases per neighborhood and more neighborhoods per city, and also some cities-levels variables would have to be estimated and tested in models.

Third, using the same dataset, alternative hypotheses based on the same or alternative theoretical framework should be tested. Finally, scholars should undertake ecological Latin American studies that are based on original theories, use mixed methods, and that develop new measures of complex concepts such as social cohesion, informal control, and the nexus between formal and informal control.

Whatever the method, new research in this criminological field will improve our understanding of the pervasive phenomenon of violence and its concentration in specific vulnerable neighborhoods of the Latin American region. This knowledge, in turn, will produce more coherent and effective crime prevention policies.

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Notes:

(1.) This chapter includes part of the results of the study "Violence in Three Latin American Cities: A Comparative Study in Neighborhoods of Bogotá, Lima, and Santiago," funded by the International Development Research Centre from Canada (IDCR) and the Department for International Development (UKAID).

(2.) The survey had seven modules and a total of 100 questions. Module 1: selection and characterization of survey respondents; Module 2: identification with the neighborhood; Module 3: institutional satisfaction and trust; Module 4: satisfaction and links with the police; Module 5: social ties; Module 6: victimization, violence, and incivilities; and Module 7: socioeconomic characterization of households.

(3.) A *micro-neighborhood* is a small geographical area within the limits of a district where residents can become acquainted and establish ties with their neighbors. This area can be covered with a fifteen-minute walk, yet some services and institutional resources can be located outside the area (Olavarría et al., 2008).

(4.) In Santiago, these classifications correspond to status C3, D, and E; in Lima, status C, D, and E; in Bogotá, 1, 2, and 3.

(5.) These areas were intentionally oversampled since a case study with mixed methodology was being carried out in parallel in these neighborhoods.

(6.) Defined as “intentional death of a household member provoked by another individual.”

(7.) To learn more about how this index was constructed, please see Jiménez García et al. (2019).

(8.) We decided on the six-year cutoff point from other victimization studies that included Census data. Censuses commonly address residential stability through asking if a person or family has lived in the same residential area for more than five or six years.

(9.) The interclass correlation coefficient (ICC) formula for logistic models is $\rho: \psi/\psi + \pi^{2/3}$, where the numerator is ψ or the intercept variance, and the denominator is the total residual variance obtained from the sum between the intercept variance and the Pi number elevated to 2/3. In linear models, we have both the intercept variance and the residual variance, so the formula we employ is $\rho: \psi/\psi + \varsigma$ (Rabe-Hesketh & Skrondal, 2013).

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