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Neighborhood and Safety Perceptions: The Urban–Rural Divide in Brazil

Eloá Sales Davanzo[1] · **Marcelo Justus**[1] · **Andréa Rodrigues Ferro**[2]

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Abstract
This study investigates the determinants of self-reported perception of safety by individuals. It emphasizes the differences between urban and rural areas and analyses the effects of neighborhood perceived safety and neighborhood victimization (indirect victimization). Neighbors offer information to one another as they interact, affecting how individuals perceive safety. Data from research on victimization and justice in Brazil for 2009 are used to estimate probit models controlling for socioeconomic variables for individuals and their neighborhoods. Primary sampling units are considered for delimiting neighborhoods and the urban–rural concept is divided into four categories: urban, peri-urban, accessible rural, and remote rural. The results show that neighborhood perceived safety affects an individual's perception of safety and that this effect decreases in rural areas. Regarding neighborhood victimization, the results were not the expected and its relationship with perceived safety and the differences between urban and rural areas could not be significantly assessed.

Keywords Neighborhood perceived safety · Victimization · Subjective analysis · Urban and rural

Resumo
Este estudo investiga os determinantes da percepção de segurança auto reportada pelos indivíduos. Enfatiza a diferença entre as áreas urbanas e rurais e analisa os efeitos da segurança percebida pela vizinhança e da vitimização da vizinhança (vitimização indireta). Os vizinhos oferecem informações uns aos outros à medida que interagem, afetando como cada indivíduo percebe a segurança. Dados da Pesquisa de Vitimização e Justiça no Brasil em 2009 são utilizados para estimação de modelos probit, controlando por variáveis socioeconômicas para indivíduos e suas vizinhanças. Unidades primárias de amostragem são consideradas para delimitação das vizinhanças e o conceito urbano-rural é dividido em quatro categorias: urbano, periurbano, rural acessível e rural remoto. Os resultados mostram que a percepção de segurança da vizinhança afeta a percepção de segurança individual e que esse efeito diminui nas áreas rurais. Em relação à vitimização da vizinhança, os resultados não foram os esperados e a sua relação com a percepção de segurança e as diferenças entre as áreas urbanas e rurais não puderam ser avaliadas.

Palavras-chave Percepção de segurança da vizinhança · Vitimização · Análise subjetiva · Urbano e rural

Introduction

Neighborhood studies have consistently indicated the effect of neighborhoods on one's health, psychological well-being, and other indicators of quality of life. Similarly, the size and quality of social interactions play a major role in determining the effects of a neighborhood on well-being (Nation et al., 2010; Wandersman & Nation, 1998). This sense of well-being is also affected by an individual's perception of safety in the neighborhood, as safety is a primary component of quality of life (Gonzáles et al., 2012; Mijanovich & Weitzman, 2003).

✉ Eloá Sales Davanzo
eloadavanzo@gmail.com

Marcelo Justus
mjustus@unicamp.br

Andréa Rodrigues Ferro
andferro@ufscar.br

[1] Institute of Economics at the University of Campinas, Campinas, Brazil

[2] Federal University of São Carlos, Sorocaba, Brazil

Perceived safety has been explained by subjective evaluations (Austin et al., 2002; Baba & Austin, 1989; Kanan & Pruitt, 2002) and represents an important factor in explaining subjective well-being indicators (Taniguchi & Potter, 2016; Adams, 1992; Lee, 1981; Leslie & Cerin, 2008). People who do not perceive safety in their neighborhood tend to have higher levels of symptoms of anxiety and depression (Norris & Kaniasty, 1994; Wilson-Genderson & Pruchno, 2013).

Given the importance of social interactions in the neighborhood and the exchange of information between neighbors as they interact, the question arises as to whether the relative perceptions and victimization of neighbors influence an individual's perceived safety. This study is thus based on Gori-Maia (2013), who assessed how relative conditions can affect self-reported subjective measures of well-being.

As urban, suburban, and rural communities have different contexts in terms of neighbor relationships (Gans, 1962; Wirth, 1938), it is relevant to investigate whether the effects of neighborhood perceptions in urban–rural areas are different. While the causes of violence vary around the world, there is little doubt that individuals living in rural areas are not immune to acts of violence, particularly in the so-called Global South[1] (Ceccato & Ceccato, 2017). The increase in crime rates in rural areas in recent years (Donnermeyer & Mullen, 1987; Scorzafave et al., 2015), especially for violent offenses, further justifies the importance of this analysis. In Brazil, the highest homicide per firearm rates, for instance, were found in larger urban areas until the 1990 decade. Then, since the early 2000s, the interiorization process of the Brazilian economy and demography led to a dissemination of violence in interior municipalities (Ceccato & Ceccato, 2017). In rural areas, attempted robbery or theft victimization rate increased by 296% between 1988 and 2009. This growth was also observed in urban areas, but to a lower extent (197.5%) (Scrozafave et al., 2015). These trends suggest that the growth of violence in Brazil does not only affect urban areas, and that crime rates may occur in different ways in the urban and rural divide.

Our study contributes to the literature in four main ways. First, its main goal is to deepen the urban–rural analysis based on four categories of urbanization degrees: urban, peri-urban, accessible rural, and remote rural, which will be defined in the next sections. Second, it investigates the effects of the subjective measure of perceived safety. Given that people's relative perceptions to structure their subjective well-being depend on comparing themselves with a reference group (Easterlin, 2001), their assessment of whether or not they feel safe is also expected to be influenced by their relative perception of their neighborhood's safety. Third, it analyzes neighborhood victimization (a measure of indirect victimization) as an influencing factor in perceived safety, meaning that knowing that individuals in the neighborhood were victims of some kind of crime is expected to affect their sense of safety. Indirect victimization occurs when an individual learns or receives reliable information about victimization in the neighborhood as neighbors exchange information when they interact, which leads to increased fear of crime (Lüdemann, 2006 apud Hanslmaier, 2013; Unger & Wandersman, 1985). Fourth, it assesses neighborhood perceived safety based on the grouping of households and their individuals in each of the census units.

Our study aims to test the main hypotheses that relative perceived safety (defined throughout the text as neighborhood perceived safety) and indirect victimization (neighborhood victimization) affect positively and negatively, respectively, an individual's perception of safety, with a view of identifying the different effects for each urbanization category. As secondary hypotheses, it intends to show that neighborhood conditions and an individual's gender also affect their perception of safety. The hypotheses will be presented in more detail further below.

Apart from this introduction, the study includes a literature review in Sect. Theoretical Background, followed by a detailed analysis of the study concept and hypotheses and methodology in Sects. Case Study and Hypothesis and Methodology, respectively. The results are presented in Sect. Results and discussed in Sect. Discussions. Sect. Conclusions concludes the study.

Theoretical Background

Crime, Perceived Safety, and Well-Being

Understanding the consequences of crime on the population's daily life has been a subject of study in the field of criminology. Safety is a primary component of quality of life, which makes the sense of insecurity a social and health problem (Gonzáles et al., 2012; Mijanovich & Weitzman, 2003). According to Hanslmaier (2013), economists and other social scientists have become increasingly interested in revealing the determinants of life satisfaction over the years. Different variables, including crime-related factors, were identified as responsible for influencing subjective well-being.

The indirect impacts of crime on health include a range of negative effects on well-being at an ecological level. Most of these effects usually occur at the neighborhood level through mechanisms that link crime to the physical and social environment, the perceived environment and fear of crime (Loren et al., 2012). People who report a greater

[1] The Global South is made up of countries in Latin and Central America, Africa and most of Asia.

fear of crime and do not perceive safety in their neighborhood tend to have higher levels of symptoms of anxiety and depression (Norris & Kaniasty, 1994; Wilson-Genderson & Pruchno, 2013), report lower levels of happiness (Moore, 2006), and show a lower level of satisfaction with their main work activity (Pedersen & Schmidt, 2009).

The literature divides the factors that can influence fear of crime and perceived violence into three general areas (Austin et al., 2002). The first, which has demographic effects, includes variables such as sex, age, and socioeconomic status. For this set of factors, research has shown that women experience higher levels of fear of crime than men (Perkins & Taylor, 1996; Skogan & Maxfield, 1981; Toseland, 1982); older people report higher levels of fear of crime and lower levels of perceived safety than young people (Baba & Austin, 1989; Skogan & Maxfield, 1981; Sundeen & Matthieu, 1976); education would have a significant and positive relationship with perceived safety (Austin et al., 1994); and economic status would be associated with lower levels of fear (Lee, 1981; Skogan & Maxfield, 1981; Toseland, 1982).

The second area addresses victimization experiences. The literature shows that people who have been victimized by crime report a higher level of fear than those not victimized (Garofalo, 1979). In addition, being a victim of a crime contributes significantly to perceptions of risks in the neighborhood (Taub et al., 1981).

The third area assesses the social and physical conditions in the neighborhood and in urban areas, which would be linked to the emotional and behavioral results for residents. Factors such as quality of homes, neighborhood dynamics (changes in the age composition and ethnicity of residents), and deterioration of buildings and general areas affect fear of crime levels and perceived safety (Boorah & Carcach, 1997; LaGrange et al., 1992; Lawton, 1997). In addition, the social disorganization theory suggests that an individual's engagement in social processes in the neighborhood can be affected by problems in the community and physical disorder (Nation et al., 2010).

Fear of crime is divided into three components in the literature: cognitive (perceived victimization risk), emotional (feelings about crime), and behavioral (response to victimization risk) (May et al., 2010). The emotional component relates to reactions of fear, while the cognitive component includes individual or collective judgment about victimization risk and safety. This individual judgment should be inferred as perceptions laden with subjective interpretations of reality (Ferraro & LaGrange, 1987). This is the goal of our study: to analyze this individual subjective perception of safety that does not necessarily reflect fear of crime.

Neighborhood Dynamics in Urban and Rural Areas

The literature shows that the relationship between neighbors is a type of social relationship that plays an important role in explaining subjective well-being. The spatial proximity between them facilitates mutual support, building a sense of community that helps to improve people's quality of life (Sarason, 1974; Sirgy & Cornwell, 2002; Taniguchi & Potter, 2016; Unger & Wandersman, 1985).

Likewise, perceived safety is considered a major factor in explaining subjective well-being indicators, such as satisfaction with one's neighborhood, mental and physiological well-being, and life satisfaction (Taniguchi & Potter, 2016; Adams, 1992; Lee, 1981; Leslie & Cerin, 2008). This perception of safety will also be affected by the relationship dynamics between neighbors.

As Taniguchi and Potter (2016) show, individuals who feel safer tend to build greater relationships with their neighbors, while those who do not feel safe will use this relationship to have some type of protection (Dassapoulos et al., 2012). In neighborhoods deemed unsafe, residents tend to talk more about crimes with neighbors and participate in surveillance groups, which reduces their perceived safety and general life satisfaction (Skogan & Maxfield, 1981; Unger & Wandersman, 1985). The chain of expected effects is better outlined in Fig. 1.

However, urban, suburban and rural communities have different contexts concerning the relationship between neighbors (Gans, 1962; Wirth, 1938), which can result in different effects of neighborhood dynamics on the perceived safety of individuals in each type of community.

Investigating rural violence and its consequences is relevant because, despite the increase in crime rates in rural areas (Donnermeyer & Mullen, 1987; Scorzafave et al., 2015), little is documented in the literature on the nature of rural violence and the potential differences in crime rates between urban and rural areas. Similarly, fear of crime does not seem to be addressed as a problem in rural areas (Ceccato, 2017) and studies on crime and victimization are also focused on urban areas, as these problems tend to be more prevalent in urban communities. However, the prevalence of these issues in rural areas is rising nowadays (Muhammad, 2002; Scorzafave et al., 2015), which justifies a major element of contribution by our study.

The literature on neighborhood dynamics has also focused little on rural communities. Lev-Wiesel (2003) showed that the quality and quantity of social interactions were higher among rural residents than those living in the city in Israel. Studies in the United States have shown that the types and extent of behaviors in the neighborhood are limited by factors such as age and income (Wenger, 1990). Nation et al. in turn (2010) found that residents in urban and suburban areas are more likely to discuss neighborhood

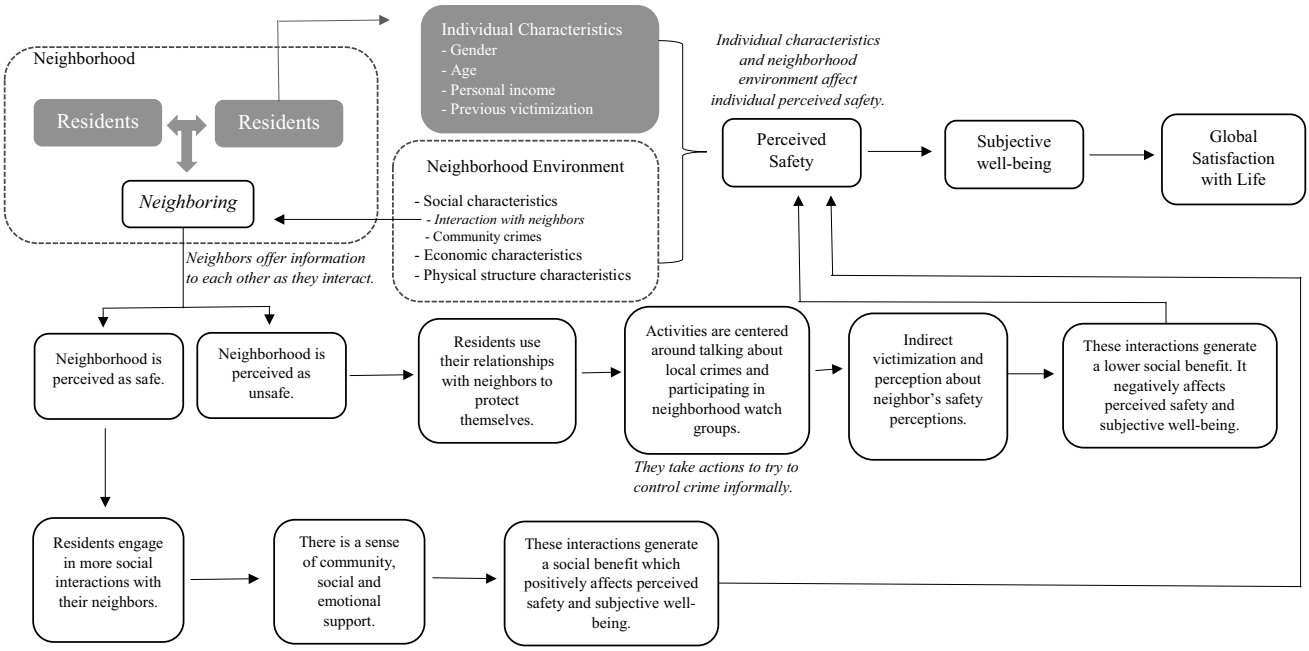

Fig. 1 The effect of relative conditions in the neighborhood on perceived safety Source: elaborated by the authors

problems (including crime and violence) than residents in rural areas. Neighborhood relations in rural areas would be more associated with lending or borrowing everyday items and watching over properties.

Case Study and Hypothesis

Located in Latin America, Brazil is part of the so-called Global South. The country is divided into 26 states and one federal district that comprises 5570 municipalities with a total population of 212 million (IBGE 2010).[2] In the context of violent crimes, the country has historically sustained high homicide rates, with over 628,000 homicides registered in the ten-year period from 2008 to 2018. While the most recent data still show a downward trend in homicide rates (from 31.6 to 27.8 homicides per 100 inhabitants between 2017 and 2018), these rates remain very high (Cerqueira et al., 2020). The vast majority of victims are men (91.8%), while women report the highest prevalence of non-lethal aggressions–which can be explained by gender issues (Cerqueira et al., 2019, 2020).

Within this violent context, the population's sense of safety is expected to be affected, reducing their well-being and quality of life. According to IBGE (2010), this sense of safety is still high within households, but decreases within the neighborhood or city: 78.6% of the Brazilian population feel safe at home, compared to 67.1% in their neighborhood and only 52.8% in the city.

[2] https://www.ibge.gov.br/apps/populacao/projecao/index.html

Urban and Rural Brazil

The problem of escalating violence in Brazil is not limited to urban areas. Although less than 14% of Brazilians live in rural areas, this population has also experienced an increase in violence. In the 1988–2009 period, for example, a 296% rise in attempted robbery/theft victimization in rural areas was seen, with other types of crime also registering an increase, including concluded robbery or theft (16%) and physical assault (94.1%). This upward trend was also observed in urban areas, but with differences depending on the type of crime. Lower growth than rural areas was found for both attempted robbery or theft (197.5%) and physical assault (37.5%) rates. However, in terms of concluded robbery or theft victimization rate, urban areas experienced higher growth rates than rural ones (27.1%) (Scrozafave et al., 2015). These trends suggest that the growth of violence in Brazil does not only affect urban areas, and that crime rates may occur in different ways in the urban and rural divide. Therefore, it is important to analyze the two areas separately.

In our database, the definition of urban and rural is based on the Brazilian 2000 Demographic Census. Urban areas are considered cities, villages, or isolated urban areas. Rural areas are comprised of municipalities outside large metropolitan areas, dispersed settlements, and villages located outside the urban center in municipalities of varying sizes. These places have different characteristics and needs and face challenges in the areas of population, economic structure, crime, and security (Ceccato & Ceccato, 2017).

As a contribution beyond the urban–rural dichotomous analysis, this study will divide Brazil into four areas categorized by their degree of urbanization: *urban*, defined as urbanized areas, cities, and metropolitan areas; *peri-urban*, made up of cities of non-urbanized areas and isolated urban; *accessible rural*, which is an urban extension of a rural agglomerate and rural agglomerates; *remote rural*, comprised of isolated rural agglomerates, other agglomerates, and other rural areas other than agglomerates.[3]

Hypotheses

Due to the chaotic scenario described above, Brazil is a relevant case for studies of crime and its consequences in the Global South. Based on the theoretical background exposed so far, three hypotheses were established.

H1 The subjective measure of an individual's perceived safety (at home, in the neighborhood, and in the municipality) is positively influenced by the neighborhood perceived safety. Given that people's relative perceptions to structure their subjective well-being depend on comparing themselves with a reference group (Easterlin, 2001), we tried to apply the same analysis to the subjective issue of perceived safety.

H2 Based on Nation et al. (2010), which shows that residents in rural areas are less likely to discuss neighborhood problems, we will test the hypothesis that the effect of neighborhood perceived safety on an individual's perceived safety decreases as we move towards more rural areas.

H3 Previous individual victimization affects an individual's perceived safety and this effect increases in more rural areas. The victimization model suggests a direct relationship between being a victim and fear of crime (Crank et al., 2003). As most crimes occur in urban areas (Ceccato & Ceccato, 2017) and perceived safety in rural areas is higher than in urban areas (Scorzafave et al., 2015), we will assume that being a victim in a rural area will make an individual feel more afraid.

H4 The subjective measure of perceived safety (at home, in the neighborhood and in the municipality) is negatively influenced by neighborhood victimization (indirect victimization), that is, by the proportion of individuals who were victims of some kind of crime in their neighborhood. This hypothesis is based on literature, which states that indirect victimization occurs when an individual learns or receives reliable information about victimization in the neighborhood, leading to increased fear of crime (Lüdemann, 2006 apud Hanslmaier, 2013; Unger & Wandersman, 1985). This effect is expected to decrease in more rural areas owing to the same reason described in *H2*.

Methodology

Data and Sample

The analyses for this study were carried out using data from the 2009 National Household Sample Survey (PNAD), a representative national survey. PNAD investigates some socioeconomic characteristics annually, like education, labor market, income, and housing. However, other investigations are made with special supplementary surveys that are applied in variable frequency. This is the case of the Victimization and Justice special survey, which was only conducted in 1988 and 2009. Therefore, we used in our study the most recent database about victimization available. This supplement is relevant because it includes a subjective approach focused on the sense of safety in the Brazilian population. According to IBGE (2010), this approach expands the possibilities for analyzing the issues of victimization and justice, as they reflect the population's sensitivity and attitude towards perceived or experienced safety conditions.

As shown by Zaluar (2009), victimization surveys are important precisely because they allow to know the frequency, nature, and circumstances of crimes and assaults that victimize people, as these cases are not always registered with the police for different reasons. At the same time, they make it possible to analyze the profiles of victims and their offenders, the relationship between them and the circumstances in which the crimes were committed. The types of crimes considered in the PNAD are physical assault, theft, robbery, and attempted theft and robbery.

An important characteristic of the microdata used in this research is the fact that both the individuals who reported the crime and those who did not report the crime of which they were victims responded to the Special Victimization Supplement. As a result, the data considered here are less subject to measurement errors than the official crime data (Sant'Anna et al., 2016).

In the 2009 PNAD, 399,387 people and 153,837 households were surveyed. However, by using the expansion sampling factor, the final sample will include 153,940,337 people (72.24% of the Brazilian population) for the purpose of considering only observations with complete responses (without missing data) for the variable of per capita household income and victimization, apart from considering only those respondents who responded to the supplement and reside in the surveyed household. The sample consists of 51.89% women and 48.11% men aged 10 years or older. The results of the estimations can be generalized for the entire population.

[3] A more detailed definition of the four categories can be found in Appendix Table 7.

The PNAD Sampling Plan: Definition of Neighborhood and Urbanization Categories

The PNAD is conducted based on a probabilistic sample of households obtained in three selection stages: the primary units are the municipalities; the secondary is the census tracts; and the tertiary is the households.

In the first stage, the municipalities are classified as self-representative (probability 1 of belonging to the sample) and non-self-representative. Those belonging to the second category are stratified and, in each stratum, selected with replacement and with probability proportional to the resident population obtained in the 2000 Demographic Census.[4]

In the second stage, the census sectors are selected in each municipality in the sample, also with proportional probability and replacement. In the last stage, households are selected with equiprobability in each census tract.

In this study, the term *neighborhood* refers to the census tracts, and individuals from households in the same census tract are considered *neighbors*. In the victimization supplement, 851 municipalities and 7818 census tracts were selected for investigation.

The urbanization categories were developed based on the census situation code variable, which divides urban and rural areas into eight categories. Based on these categories, we defined four new divisions by degrees of urbanization:

- Urban area: city or town in an urbanized area;
- Peri-urban area: city or town in a non-urbanized area and isolated urban area;
- Accessible rural area: rural agglomerate of urban extension and rural, isolated, populated agglomerate;
- Remote rural area: isolated rural agglomerate, nucleus, other agglomerates, and rural areas other than rural agglomerates.

Methods

The determinants of perceived safety will be estimated at three levels—household, neighborhood and municipality—for each of the four defined urbanization categories. Given the binary characteristic of the dependent variable, which equals 1 if individual i feels safe in a given environment j [j = (household, neighborhood, municipality)] and 0 otherwise, the following probit model will be applied:

$$p_{i,j} = \text{Prob}\left[y_{i,j} = 1|x\right] = \phi\left(x_i'\beta\right), \quad (1)$$

where φ is the normal cumulative density function, β is a vector of parameters to be estimated, and x is the set of regressors. This set of regressors was chosen based on the literature on perceived safety, mainly in the three focus areas that were identified as the most relevant ones, namely: demographic effects, victimization experience, and social and physical conditions in the neighborhood and the urban environment (Austin et al., 2002). The neighborhood variables were developed based on Gori-Maia (2013). The variables considered in each of the vectors are shown in Tables 1 and 2.

Regarding victimization, three strategies were chosen for its inclusion in the estimates. First, building on the approach by Austin et al. (2002), a binary for individual victimization was created that equals 1 if the individual was a victim of a crime, regardless of its nature, and 0 otherwise.

In a second step, the neighborhood victimization variable was created that represents the proportion of people in the neighborhood who have been victims of some kind of crime, regardless of its nature, except the individual himself. Finally, the two variables were considered together for analysis in the final estimation.

At first, estimates were made only for the two categories of rural and urban areas. Given that in modeling there is a potential endogeneity problem in the victimization variable, two strategies were used to try and correct this issue: a probit model with instrumental variables (iv-probit) and a bivariate probit model (seemingly unrelated bi-probit), which addresses the problem of endogeneity when the endogenous variable is binary.[5] As a tool to determine an individual's exposure, a proxy was created based on a variable that measures how long he or she takes to travel from home to work. As a tool to determine individual victimization, a binary was created that assumes value 1 if an individual takes more than 1 h to commute and 0 if he or she takes less time (Sant'anna et al., 2016). In this first stage, the probit model provided the best specification, followed by the iv-probit correcting for endogeneity.

When applying the estimates to the four urbanization categories, however, the iv-probit model did not result in a good specification, with the tests indicating weak instruments and no improvement in relation to the probit model.[6] Thus, for the analysis of each of the urbanization categories, the results shown here will be those estimated based on the probit model, which despite the endogeneity issue of the victimization variable, showed good specification and high percentages of correct predictions (PCP).

In addition, we understand that opening up the four categories by a degree of urbanization helps to reduce the heterogeneity problem. As we move to more rural areas, the standard deviation for variables that are relevant and have potential

[4] The most recent Demographic Census available for Brazil at the time of the application of 2009 PNAD.

[5] The results for this first estimation stage can be obtained upon request to the authors.

[6] The results for the iv-probit model for the four urbanization categories can be obtained upon request to the authors.

Table 1 Definition, mean and standard deviation of individual and household variables

Variable	Definition	Mean[a] (SD)[b]
Perceived safety at home	1 if the individual feels safe at his/her home and 0 otherwise	0.787 (0.409)
Perceived safety in the neighborhood	1 if the individual feels safe in his/her neighborhood and 0 otherwise	0.673 (0.468)
Perceived safety in the municipality	1 if the individual feels safe in his/her municipality and 0 otherwise	0.531 (0.498)
Individual victimization	1 if the individual was a victim of robbery, theft, physical aggression or attempted robbery/theft between September 2008 and September 2009 and 0 otherwise	0.101 (0.301)
ln(monthly per capita household income)	Natural logarithmic of the monthly per capita household income	6.010 (0.985)
Woman	1 if the individual is a woman and 0 otherwise	0.517 (0.499)
Schooling	Years of schooling	7.171 (4.403)
Age	Age in years	36.66 (18.48)
White	1 if the individual is Caucasian and 0 otherwise	0.483 (0.499)
Married	1 if the individual is married and 0 otherwise	0.412 (0.492)
Couple with no children	1 if the individual's family composition is a couple with no children and 0 otherwise	0.143 (0.350)
Mother with children under 14 years old	1 if the individual's family composition is a mother with all the children under 14 years old and 0 otherwise	0.030 (0.172)
Apartment	1 if the individual lives in an apartment and 0 otherwise	0.085 (0.279)
Sewage	1 if the household has inappropriate sanitary drain and sewage and 0 otherwise	0.252 (0.434)
Homicide rate	Homicide rate, by Federation Units	26.77 (11.09)

Source: elaborated with PNAD 2009/IBGE data; $n = 153{,}940{,}337$

[a]Average values are in monthly reais (R$) for per capita household income, years for age and schooling, rate for homicide rate and proportion for the further variables

[b]Standard deviation in parentheses

Table 2 Definition, mean and standard deviation of neighborhood variables

Variable	Description	Mean[a] (SD)[b]
Neighborhood perceived safety at home	The share of the population in the neighborhood where the individual lives who feels safe at home	0.771 (0.151)
Neighborhood perceived safety in the neighborhood	The share of the population in the neighborhood where the individual lives who feels safe in the neighborhood	0.661 (0.216)
Neighborhood perceived safety in the municipality	The share of the population in the neighborhood where the individual lives who feels safe in the municipality	0.523 (0.268)
Neighborhood victimization	The share of the population in the neighborhood where the individual lives who was a victim of robbery, theft, physical aggression or attempted robbery/theft between September 2008 and September 2009	0.098 (0.077)
Neighborhood sewage	The share of households in the neighborhood where the individual lives which has inappropriate sanitary drain and sewage	0.249 (0.310)
ln(per capita household income in the neighborhood)	Natural logarithmic of the monthly per capita household income in the neighborhood where the individual lives	5.879 (0.632)
Neighborhood schooling	The share of family heads with secondary education diploma in the neighborhood where the individual lives	0.096 (0.064)

Source: elaborated with PNAD 2009/IBGE data; $n = 153{,}940{,}337$

[a]Average values are in monthly reais (R$) for per capita household income, years for age and schooling and proportion for the further variables

[b]Standard deviation in parentheses

endogeneity problems is reduced, thus indicating greater homogeneity in the samples (see Table 6 in Appendix).

Results

Tables 3, 4 and 5 show the results[7] for an individual's estimated perception of safety at home, in the neighborhood and in the city in the four urbanization categories, respectively. Regarding the quality of fit for the models, the probit shows a good specification in all cases (Wald test χ^2; $p=0.000$).[8]

The variables are divided into two main groups: neighborhood and individual characteristics. The results are estimated as marginal effects, meaning that for each small change in these variables, the probability of an individual reporting to feel safe increases/decreases by a magnitude of percentage points, that is equal to the estimated coefficient times 100. In the case of dummy variables, we analyze the discrete change from 0 to 1. For example, in Table 3, for urban areas, being a woman decreases the probability of an individual reporting to feel safe at home by 3.1 percentage points.

The name of each column represents which victimization variable was included in that estimation. For instance, in the columns named *Individual Victimization*, the results shown are for the estimations that measured previous victimization as previous individual victimization.

The first hypothesis, which postulates a positive effect of neighborhood safety perception on an individual's perception, is confirmed for the three levels of analysis: the greater the proportion of individuals in the same neighborhood who report feeling safe at home and in their neighborhood or municipality, the greater is the probability of an individual also perceives safety at the same locations. For instance, in Table 4, in urban areas, small increases in the proportion of individuals in the same neighborhood who report feeling safe can increase the probability of an individual also reports feeling safe in the neighborhood by 83 percentage points.[9] The literature supports this result based on the assumption that people construct their relative perceptions by comparing themselves with a reference group (Easterlin, 2001) and by exchanging information with their neighbors to build a sense of well-being. In other words, as they interact and exchange information about this sense of feeling, the neighbors who receive this information tend to feel safer too.

It is also worth stressing that the greatest effect of this neighborhood perception is found for perceived safety in the municipality in the four categories of urbanization under analysis. It means that for an individual, the way his/her neighborhood perceives safety in the municipality influences more his/her perception of safety than in locations such as their homes or neighborhood. Given this high influence, this could indicate that, if the safety in the municipality increases (due to a public policy, for instance), the exchange of information between neighbors about how safe they feel can help to reduce the feeling of insecurity that occurs when an individual leaves his or her home, resulting in a higher wellbeing for the entire population.

The second hypothesis, which is relevant to the contribution of our work as it explores the effects for each urbanization category established, provides mixed results. It is partially confirmed for perceived safety at home and in the neighborhood: the relationship between neighborhood perceived safety and individual's perception of safety decreases in rural areas, but the result for accessible rural is lower than remote rural.

While in urban areas the increase in the proportion of individuals who feel safe at home (Table 3) increases the individual's propensity to feel safe at home by 74.3 percentage points when individual victimization is considered, in accessible rural and remote rural areas this effect corresponds to 58.6 and 70.4 percentage points, respectively. This difference increases at the neighborhood level, with the effect in more urban areas equaling to an increase of 83.0 percentage points in an individual's propensity to feel safe in the neighborhood, up from 70.3 in remote rural areas. These results show that the perception of safety by the neighborhood influences the individual perceived safety in urban areas more than in rural ones. Considering that information exchange in the relationship between neighbors is an important factor to understand relative perceptions, this result can be justified based on Nation et al. (2010), who show that residents in rural areas are less likely to discuss neighborhood problems, including crime and violence in the community. Thus, as the exchange of these perceptions is lower, its effect on individual perception also tends to be lower.

The models were estimated considering three possibilities for the victimization analysis. First, only previous individual victimization was considered. Then, only neighborhood victimization (indirect victimization) was considered and finally, the two were analyzed together. The central hypothesis about the negative effect of previous individual victimization was confirmed by the results, which were statistically significant for the three levels of analysis and for the four urbanization categories. However, the results for the magnitude of this effect were mixed. The hypothesis that the effect of previous individual victimization would be greater in more rural areas was only corroborated for perceived safety at home.

[7] Tables with complete estimates and test statistics can be requested from the authors.

[8] See Cameron and Triverdi (2009).

[9] When previous individual victimization is included in the modeling.

Table 3 Marginal effects[a] of the neighborhood and individual characteristics on individual perceived safety at home[b]

	Urban			Peri-urban			Accessible Rural			Remote Rural		
	Individual victimiz	Neighborhood victimiz	Total victimiz	Individual victimiz	Neighborhood victimiz	Total victimiz	Individual victimiz	Neighborhood victimiz	Total victimiz	Individual victimiz	Neighborhood victimiz	Total victimiz
Neighborhood perceived safety	0.743*** (0.005)	0.754*** (0.005)	0.747*** (0.005)	0.775*** (0.048)	0.773*** (0.048)	0.771*** (0.048)	0.586*** (0.039)	0.599*** (0.042)	0.588*** (0.042)	0.704*** (0.014)	0.726*** (0.015)	0.719*** (0.015)
Neighborhood sewage	− 0.015** (0.004)	− 0.014*** (0.004)	− 0.015*** (0.004)	0.063* (0.036)	0.062 (0.036)	0.065* (0.036)	− 0.042* (0.022)	− 0.045** (0.022)	− 0.042* (0.022)	0.021*** (0.008)	0.024*** (0.008)	0.024 (0.008)
ln(per capita household income in the neighborhood)	− 0.051*** (0.001)	− 0.052*** (0.001)	− 0.053*** (0.001)	− 0.094*** (0.011)	− 0.092*** (0.011)	− 0.092*** (0.011)	− 0.020 (0.017)	− 0.019** (0.018)	− 0.020 (0.018)	− 0.040*** (0.005)	− 0.042*** (0.005)	− 0.044*** (0.006)
Neighborhood schooling	0.080*** (0.013)	0.072*** (0.014)	0.076*** (0.014)	0.126 (0.089)	0.117 (0.095)	0.132 (0.090)	− 0.331 (0.140)	− 0.352 (0.144)	− 0.334 (0.142)	0.222*** (0.056)	0.167*** (0.056)	0.184*** (0.056)
Neighborhood victimization		− 0.044*** (0.011)	0.034*** (0.010)		− 0.091 (0.096)	− 0.056 (0.096)		− 0.055 (0.121)	0.010 (0.112)		0.066 (0.045)	0.140** (0.045)
Individual victimization	− 0.120*** (0.002)		− 0.121*** (0.002)	− 0.110*** (0.019)		− 0.109*** (0.019)	− 0.111*** (0.017)		− 0.111*** (0.018)	− 0.130*** (0.007)		− 0.132*** (0.007)
Woman	− 0.031*** (0.001)	− 0.027*** (0.001)	− 0.031*** (0.001)	− 0.035*** (0.012)	− 0.030*** (0.012)	− 0.035*** (0.012)	− 0.020** (0.010)	− 0.017 (0.010)	− 0.020** (0.010)	− 0.015*** (0.003)	− 0.010*** (0.003)	− 0.016*** (0.003)
White	0.002 (0.001)	0.003** (0.001)	0.003 (0.001)	0.001 (0.013)	0.0004 (0.013)	0.001 (0.013)	− 0.015 (0.011)	− 0.012 (0.011)	− 0.015 (0.011)	− 0.001 (0.004)	− 0.0007 (0.004)	− 0.001 (0.004)
Married	− 0.0009 (0.002)	0.006 (0.002)	− 0.0008 (0.002)	− 0.012 (0.014)	− 0.010 (0.014)	− 0.012 (0.014)	0.036*** (0.011)	0.037*** (0.011)	0.036*** (0.011)	− 0.001 (0.004)	− 0.003 (0.004)	− 0.0008 (0.004)
Couple without kids	− 0.020*** (0.002)	− 0.020*** (0.002)	− 0.020*** (0.002)	− 0.011 (0.020)	− 0.007 (0.020)	− 0.011 (0.020)	− 0.036 (0.015)	− 0.039 (0.015)	− 0.036 (0.015)	− 0.011** (0.005)	− 0.011** (0.005)	− 0.011** (0.005)
Couple with kids > 14 years old	− 0.017*** (0.002)	− 0.017*** (0.002)	− 0.017*** (0.002)	0.019 (0.015)	0.014 (0.015)	0.019 (0.015)	− 0.021 (0.012)	− 0.024** (0.012)	− 0.021* (0.012)	− 0.022*** (0.004)	− 0.024*** (0.004)	− 0.022*** (0.004)
Single mother with kids > 14 years old	− 0.012*** (0.004)	− 0.017*** (0.004)	− 0.012*** (0.004)	− 0.059* (0.031)	− 0.064** (0.031)	− 0.060* (0.031)	− 0.0669** (0.028)	− 0.075*** (0.029)	− 0.066** (0.028)	− 0.035*** (0.012)	− 0.045*** (0.012)	− 0.035*** (0.012)
Individual's schooling	0.0003 (0.0002)	− 0.0002 (0.000)	0.0003 (0.000)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	− 0.001 (0.001)	− 0.002 (0.001)	− 0.001 (0.001)	− 0.0003 (0.000)	− 0.0007 (0.000)	− 0.0003 (0.000)
ln(per capita household income)	0.028*** (0.001)	0.028*** (0.001)	0.028*** (0.001)	0.045*** (0.008)	0.043*** (0.008)	0.045*** (0.008)	0.017** (0.006)	0.015** (0.006)	0.017* (0.006)	0.0007 (0.002)	− 0.002 (0.002)	− 0.0007 (0.002)
Homicide Rate	− 0.0006 (0.0007)	− 0.0002 (0.000)	− 0.0005 (0.000)	0.001 (0.004)	0.001 (0.004)	0.001 (0.004)	− 0.015*** (0.005)	− 0.014*** (0.005)	− 0.015*** (0.005)	0.004 (0.002)	0.004 (0.002)	0.004 (0.002)
n	262,452			5,062			7,074			41,548		
Pseudo R^2	0.106	0.096	0.106	0.101	0.094	0.101	0.098	0.091	0.098	0.115	0.104	0.115
Wald test (χ^2)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

[a] *dy/dx* represents a discrete change of the *dummy* variable from 0 to 1

[b] Dummy variables for states were used and robust standard− errors are in parentheses

***, ** and * denote significance at 1%, 5% and 10% respectively

Regarding perceived safety at home, the greatest effect was found in remote rural areas, where the fact of having been a victim of a crime reduces an individual's probability to say they feel safe at home by 13.0 percentage points, compared to 12.0 percentage points in urban areas. Concerning perceived safety in the neighborhood, the greatest effect of victimization is found in urban areas, while for perceived safety in the municipality the greatest effect is found in accessible rural areas. These mixed results do not allow us to conclude that previous victimization decreases the probability of feeling safe in a higher magnitude in rural areas, requiring further investigation.

Regarding the hypothesis that neighborhood victimization has a lower effect on perceived safety in more rural areas, it could not be corroborated. Concerning perceived safety at home, the hypothesis could not be assessed since neighborhood victimization was only significant in urban areas. A similar scenario is found in the municipality, where neighborhood victimization was only significant in accessible rural areas. About perceived safety in the neighborhood, the hypothesis was not corroborated. Neighborhood victimization was only significant for urban and remote rural areas, but with greater magnitude in the latter.

The results are uncertain when we consider the estimation with the variables of previous individual victimization and neighborhood victimization jointly. Previous individual victimization has a negative effect, while neighborhood victimization has a positive effect on perceived safety. This is likely due to collinearity between the two variables inserted in the model, so these results are not considered robust for the analysis. Including the type of crime of which the individual was a victim may be an interesting approach for testing this hypothesis in future research.

In addition to the results aligned with the hypotheses developed, it is worth noting the results that corroborate the literature regarding the fact that women are more fearful of crime (Perkins & Taylor, 1996; Skogan & Maxfield, 1981; Toseland, 1982). The female group's perceived safety is lower than that of men, whether at home and in their neighborhood or municipality and in urban or rural areas. The effect, however, decreases as we move to more rural areas, which is an interesting finding that should be a focus of future research. For single women with children, the relationship with perceived safety at home is negative: these women feel less safe at home than others in different family compositions. It is interesting to observe that this relationship is higher in rural areas (mainly in remote rural), which can also be further investigated in future research. Regarding perceived safety in the neighborhood and the municipality, this relationship is not clear since some results were not significant.

Although the literature indicates that individual income and schooling increase safety perceptions and reduce fear of crime (Austin et al., 1994; Lee, 1981), these relationships could not be fully corroborated in our study. The positive and significant relationship with income was only observed in urban areas in the three levels of safety perceptions. Therefore, it was not possible to analyze the differences with rural areas. The relationship between safety perceptions and schooling, when significant, was negative and very low.

Per capita income of neighbors presented an unexpected signal, although significant: the relationship is negative with safety perception at home, in the neighborhood, and the municipality. Neighborhood schooling, measured by the proportion of family heads in the neighborhood with at least a high school degree, was significant in few models. Concerning the perception of safety at home, for instance, the relationship is significant only in urban and remote rural areas. In the first, the increase in the proportion of neighbors with at least a high school degree leads to an 8.0 percentage point increase in an individual's likelihood of saying they feel safe at home, compared to an increase of 22.2 percentage points in remote rural areas.

It was not possible to assess the relationship between homicide rate and perception of safety since it was significant only for remote rural areas. In this case, although the expected negative relationship was verified, it had a low magnitude (approximately 1.5 percentage points). We hypothesize that we could not assess this relationship since the homicide rate data was measured for each federation unit and not for the census sectors delimited as neighborhoods in our study.

Discussions

The results show robust evidence of the positive relationship between neighborhood perceived safety and an individual's perceived safety. The hypothesis that the magnitude of this relationship would diminish in more rural areas was partially confirmed in the estimates for perceived safety in the household and in the neighborhood. For perceived safety in the municipality, a similar result is only obtained when individual victimization is considered. The lesser effect of previous individual victimization in more rural areas was partly confirmed (except for perceived safety in the municipality).

Neighborhood victimization (indirect victimization) did not produce the expected results. The indirect victimization model suggests that those who engage in social interactions and are concerned about crime-related problems have higher levels of fear (Skogan & Maxfield, 1981). Likewise, indirect victimization occurs when an individual learns or receives reliable information about victimization in the neighborhood, leading to increased fear of crime (Unger & Wandersman, 1985). If fear of crime is higher, the perception of safety diminishes.

Table 4 Marginal effects[a] of the neighborhood and individual characteristics on individual perceived safety in the neighborhood[b]

	Urban			Peri− urban			Accessible rural			Remote rural		
	Individual victimiz	Neighborhood victimiz	Total victimiz	Individual victimiz	Neighborhood victimiz	Total victimiz	Individual victimiz	Neighborhood victimiz	Total victimiz	Individual victimiz	Neighborhood victimiz	Total victimiz
Neighborhood perceived safety	0.830*** (0.003)	0.844*** (0.004)	0.836*** (0.004)	0.849*** (0.039)	0.852*** (0.039)	0.849*** (0.039)	0.688*** (0.032)	0.731*** (0.037)	0.719*** (0.037)	0.703*** (0.010)	0.736*** (0.011)	0.728*** (0.011)
Neighborhood sewage	− 0.014*** (0.005)	− 0.013*** (0.005)	− 0.014*** (0.005)	0.088** (0.038)	0.084 (0.039)	0.088** (0.039)	− 0.060 (0.024)	− 0.055** (0.024)	− 0.053** (0.024)	0.010 (0.008)	0.014 (0.008)	0.014 (0.008)
ln(per capita household income in the neighborhood)	− 0.036*** (0.001)	− 0.037*** (0.001)	− 0.037*** (0.001)	− 0.089*** (0.010)	− 0.088*** (0.010)	− 0.089*** (0.010)	0.006 (0.020)	0.001 (0.021)	0.0001 (0.020)	− 0.029*** (0.006)	− 0.035*** (0.006)	− 0.037*** (0.006)
Neighborhood schooling	0.069*** (0.015)	0.062*** (0.015)	0.065*** (0.015)	0.057 (0.084)	0.041 (0.088)	0.057 (0.085)	− 0.287* (0.157)	− 0.352** (0.161)	− 0.331** (0.159)	0.268*** (0.059)	0.198*** (0.060)	0.213*** (0.060)
Neighborhood victimization		− 0.039*** (0.013)	0.048*** (0.013)		− 0.045 (0.107)	0.001 (0.106)		0.164 (0.144)	0.235 (0.143)		0.194*** (0.049)	0.263*** (0.049)
Individual victimization	− 0.149*** (0.002)		− 0.150*** (0.002)	− 0.143*** (0.022)		− 0.143*** (0.022)	− 0.133*** (0.020)		− 0.135*** (0.020)	− 0.136*** (0.008)		− 0.139*** (0.008)
Woman	− 0.042*** (0.001)	− 0.037*** (0.001)	− 0.042*** (0.001)	− 0.052*** (0.013)	− 0.046*** (0.013)	− 0.052*** (0.013)	− 0.015 (0.010)	− 0.011 (0.010)	− 0.015 (0.010)	− 0.017*** (0.003)	− 0.012*** (0.003)	− 0.017*** (0.003)
White	− 0.003 (0.002)	− 0.002 (0.002)	− 0.003 (0.002)	0.00006 (0.015)	− 0.002 (0.015)	0.000 (0.015)	− 0.012 (0.011)	− 0.009 (0.012)	− 0.012 (0.011)	− 0.001 (0.004)	− 0.0003 (0.004)	− 0.0008 (0.004)
Married	− 0.010*** (0.002)	− 0.008*** (0.002)	− 0.010*** (0.002)	− 0.029* (0.016)	− 0.026 (0.016)	− 0.029* (0.016)	0.032*** (0.012)	0.034*** (0.012)	0.033*** (0.012)	− 0.007* (0.004)	− 0.006 (0.004)	− 0.006 (0.004)
Couple without kids	− 0.008*** (0.002)	− 0.008*** (0.002)	− 0.008*** (0.002)	0.013 (0.021)	0.017 (0.021)	0.013 (0.021)	− 0.042* (0.016)	− 0.045*** (0.016)	− 0.042* (0.016)	− 0.008 (0.005)	− 0.007 (0.005)	− 0.008 (0.005)
Couple with kids > 14 years old	− 0.014*** (0.002)	− 0.014*** (0.002)	− 0.014*** (0.002)	0.045*** (0.016)	0.039** (0.016)	0.045*** (0.016)	− 0.029** (0.013)	− 0.032 (0.013)	− 0.028** (0.013)	− 0.017*** (0.004)	− 0.018*** (0.004)	− 0.017*** (0.004)
Single mother with kids > 14 years old	− 0.004 (0.005)	− 0.008* (0.005)	− 0.004 (0.005)	− 0.018 (0.037)	− 0.023 (0.037)	− 0.018 (0.037)	− 0.059* (0.031)	− 0.069** (0.031)	− 0.058* (0.031)	− 0.028** (0.013)	− 0.038*** (0.013)	− 0.028** (0.013)
Individual's schooling	− 0.0006 (0.000)	− 0.001*** (0.000)	− 0.0006 (0.000)	0.0001 (0.001)	− 0.0004 (0.001)	0.0001 (0.001)	− 0.002* (0.001)	− 0.003** (0.007)	− 0.002* (0.001)	− 0.0005 (0.0005)	− 0.0009 (0.000)	− 0.0005 (0.000)
ln(per capita household income)	0.019*** (0.001)	0.018*** (0.001)	0.019*** (0.001)	0.032*** (0.009)	0.012 (0.008)	0.032*** (0.009)	− 0.002 (0.006)	− 0.003 (0.007)	− 0.001 (0.007)	− 0.008*** (0.002)	− 0.009*** (0.002)	− 0.008*** (0.002)
Homicide Rate	− 0.001 (0.000)	− 0.0004 (0.000)	− 0.0008 (0.000)	0.001 (0.004)	0.001 (0.004)	0.001 (0.004)	− 0.014*** (0.005)	− 0.013 (0.005)	− 0.013 (0.005)	0.001 (0.002)	0.002 (0.002)	0.002 (0.002)
n	262,452			5,062			7,074			41,548		
Pseudo R^2	0.152	0.142	0.152	0.146	0.138	0.146	0.151	0.145	0.152	0.170	0.162	0.171
Wald test (χ^2)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

[a] *dy/dx* represents a discrete change of the *dummy* variable from 0 to 1

[b] Dummy variables for states were used and robust standard− errors in parentheses

***, ** and * denote significance at 1%, 5% and 10%, respectively

Table 5 Marginal effects[a] of the neighborhood and individual characteristics on individual perceived safety in the municipality[b]

	Urban			Peri− urban			Accessible rural			Remote rural		
	Individual victimiz	Neighborhood victimiz	Total victimiz	Individual victimiz	Neighborhood victimiz	Total victimiz	Individual victimiz	Neighborhood victimiz	Total victimiz	Individual victimiz	Neighborhood victimiz	Total victimiz
Neighborhood perceived safety	0.8665*** (0.002)	0.880*** (0.003)	0.873*** (0.003)	0.878*** (0.031)	0.876*** (0.032)	0.873*** (0.032)	0.838*** (0.025)	0.894*** (0.029)	0.882*** (0.029)	0.835*** (0.008)	0.851*** (0.009)	0.846*** (0.009)
Neighborhood sewage	− 0.014*** (0.005)	− 0.012* (0.005)	− 0.013*** (0.005)	0.108*** (0.041)	0.108* (0.042)	0.111*** (0.041)	− 0.100** (0.026)	− 0.087* (0.026)	− 0.085*** (0.025)	0.038*** (0.009)	0.040*** (0.010)	0.039*** (0.009)
ln(per capita household income in the neighborhood)	− 0.023*** (0.001)	− 0.024*** (0.002)	− 0.025*** (0.002)	− 0.065*** (0.009)	− 0.062*** (0.010)	− 0.063*** (0.010)	− 0.002 (0.020)	− 0.006 (0.021)	− 0.008 (0.021)	− 0.030*** (0.007)	− 0.030*** (0.007)	− 0.034*** (0.007)
Neighborhood schooling	0.046*** (0.016)	0.039 (0.016)	0.041 (0.016)	0.006 (0.087)	0.002 (0.088)	0.011 (0.087)	0.012 (0.174)	− 0.068 (0.176)	− 0.063 (0.174)	0.359*** (0.071)	0.315*** (0.072)	0.330*** (0.072)
Neighborhood victimization		− 0.007 (0.013)	0.071*** (0.013)		− 0.118 (0.112)	− 0.086 (0.113)		0.332** (0.150)	0.431*** (0.149)		0.081 (0.058)	0.136 (0.058)
Individual victimization	− 0.141*** (0.003)		− 0.142*** (0.003)	− 0.115*** (0.025)		− 0.114*** (0.025)	− 0.186*** (0.023)		− 0.191*** (0.024)	− 0.120*** (0.010)		− 0.121*** (0.010)
Woman	− 0.041*** (0.001)	0.037*** (0.001)	− 0.041*** (0.001)	− 0.035*** (0.014)	− 0.030** (0.014)	− 0.035 (0.014)	− 0.027 (0.011)	− 0.022** (0.011)	− 0.027*** (0.011)	− 0.017*** (0.004)	− 0.013*** (0.004)	− 0.017*** (0.004)
White	0.0001 (0.002)	0.001 (0.002)	0.0004 (0.002)	− 0.006 (0.016)	− 0.008 (0.016)	− 0.006 (0.016)	0.005 (0.012)	0.008 (0.012)	0.005 (0.012)	− 0.001 (0.004)	− 0.001 (0.004)	− 0.001 (0.004)
Married	− 0.020*** (0.002)	− 0.018*** (0.002)	− 0.019*** (0.002)	− 0.010 (0.017)	− 0.007 (0.017)	− 0.009 (0.017)	0.010 (0.013)	0.012 (0.013)	0.011 (0.013)	− 0.019*** (0.005)	− 0.018*** (0.005)	− 0.018*** (0.005)
Couple without kids	0.0005 (0.002)	− 0.0004 (0.002)	0.0006 (0.002)	− 0.010 (0.022)	− 0.006 (0.022)	− 0.010 (0.022)	− 0.007 (0.018)	− 0.010 (0.018)	− 0.007 (0.018)	− 0.007 (0.006)	− 0.007 (0.006)	− 0.007 (0.006)
Couple with kids > 14 years old	− 0.015*** (0.002)	− 0.015*** (0.002)	− 0.015*** (0.002)	0.044 (0.018)	0.040** (0.018)	0.044 (0.018)	− 0.016 (0.014)	− 0.020 (0.014)	− 0.016 (0.014)	− 0.014*** (0.005)	− 0.016*** (0.005)	− 0.014*** (0.005)
Single mother with kids > 14 years old	− 0.014*** (0.005)	− 0.018*** (0.005)	− 0.014*** (0.005)	0.013 (0.039)	0.010 (0.039)	0.013 (0.036)	− 0.055 (0.031)	− 0.066** (0.031)	− 0.055 (0.031)	− 0.007 (0.015)	− 0.015 (0.015)	− 0.008 (0.015)
Individual's schooling	− 0.002*** (0.000)	− 0.003*** (0.000)	− 0.002*** (0.000)	− 0.003 (0.002)	− 0.003* (0.002)	− 0.003 (0.002)	− 0.002* (0.001)	− 0.003** (0.001)	− 0.003* (0.001)	− 0.001 (0.000)	− 0.001** (0.000)	− 0.001 (0.000)
ln(per capita household income)	0.010*** (0.001)	0.009*** (0.001)	0.010*** (0.001)	0.028*** (0.009)	0.028*** (0.009)	0.028*** (0.009)	0.004 (0.007)	0.002 (0.007)	0.005 (0.007)	− 0.001 (0.002)	− 0.002 (0.002)	− 0.001 (0.002)
Homicide Rate	− 0.0005 (0.000)	0.0001 (0.000)	− 0.0001 (0.000)	0.0006 (0.005)	0.0005 (0.005)	0.0008 (0.005)	− 0.008 (0.005)	− 0.006 (0.005)	− 0.006 (0.005)	0.007 (0.003)	0.008 (0.003)	0.008 (0.003)
n	262,452			5,062			7,074			41,548		
Pseudo R	0.218	0.210	0.218	0.170	0.167	0.170	0.227	0.220	0.228	0.186	0.182	0.186
LR test (χ^2)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

[a] *dy/dx* represents a discrete change of the *dummy* variable from 0 to 1

[b] Dummy variables for states were used and robust standard− errors are in parentheses

***, ** and * denote significance at 1%, 5% and 10%, respectively

This relationship between neighbors is a type of social relationship that plays an important role in explaining subjective well-being. The relationship in rural communities, however, is yet to be studied in detail. The available results show that these dynamics of interaction between neighbors in rural areas are not based on exchanges of information about problems in the neighborhood (Nation et al., 2010), which can decrease the effect of neighborhood (relative) perception on individual perception.

Our study has limitations in the analysis of neighborhood dynamics, which may have affected the results for indirect victimization. The literature mentions, for example, that there is an inverse relationship between integration between neighbors and fear. Hunter and Baumer (1982) show that people are less afraid when they are able to differentiate their neighbors from strangers in the neighborhood, while Harper and Gillespie (1997) identified that in rural areas, this support network often comes from family and friends and not from neighbors. Further deepening the understanding of the relationship dynamics in rural communities is thus relevant for producing more robust results on the importance of increasing perceived safety to ensure a sense of well-being and quality of life among people.

Regarding limitations, we first discuss our database. Whilst our study does not intend to elaborate a conjunctural analysis, but rather to build a cross-section analysis as a source of information to understand the relationship between the considered variables, we understand that the time lag involved is a limitation to be listed. The inclusion of a variable to measure the influence of local media on safety perceptions, although very relevant, was not possible due to the lack of data for the considered period.

An important limitation is our victimization variable. This variable was built without considering the different types of crime that an individual was a previous victim. According to Ferraro and LaGrange (1987), consider the types of crime can bring important differences to the perception of safety and fear analysis. Although PNAD database classifies three types of crime (attempted robbery or theft, concluded robbery or theft and physical assault), our methodological strategy was not to make this distinction at first. Therefore, we leave this suggestion to future research.

Conclusions

This study aimed to assess the effect of neighborhood perceived safety and neighborhood victimization (indirect victimization) on an individual's perception of safety, taking Brazil as the object of study. As a new contribution, our study sought to analyze the different effects on perceived safety in urban and rural areas within four urbanization categories.

The study started from the idea that neighborhoods are environments of important interaction between their residents. In interacting socially, neighbors exchange relevant information about their own perception of security and previous victimization, which will build a subjective analysis of an individual's perceived safety.

From the results, it can be concluded that investing in public security can improve the population's general quality of life and well-being. With an increased perception of safety, the population will suffer less from psychological distress and will tend to invest more in their health and build relationships of trust with their neighbors, creating a sense of community that plays a major role in improving well-being.

The extension of this analysis to rural areas, which have been witnessing an increase in crime rates, is important so that public security interventions are not restricted to urban areas only. Increasing public security will not only reduce the risk of victimization for the population as a whole, but also improve subjective measures of well-being and quality of life.

Appendix

(See Tables 6, 7).

Table 6 Mean and standard deviation of variables by urbanization level category

Variable	Urban		Peri-urban		Accessible rural		Remote rural	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Perceived safety at home	0.776	0.416	0.796	0.402	0.818	0.385	0.847	0.359
Perceived safety in the neighborhood	0.647	0.477	0.699	0.458	0.749	0.433	0.811	0.391
Perceived safety in the municipality	0.499	0.500	0.565	0.495	0.595	0.490	0.706	0.455
Neighbor's perceived safety at home	0.760	0.154	0.773	0.150	0.800	0.134	0.830	0.119
Neighbor's perceived safety in the neighborhood	0.637	0.217	0.682	0.202	0.731	0.194	0.789	0.162
Neighbor's perceived safety in the municipality	0.490	0.264	0.555	0.246	0.601	0.257	0.702	0.216
Individual victimization	0.112	0.315	0.087	0.282	0.060	0.238	0.043	0.204
Neighbors victimization	0.106	0.079	0.08'''0	0.064	0.067	0.054	0.055	0.045
ln(per capita household income)	6.127	0.953	5.968	0.921	5.395	0.876	5.418	0.939
ln(per capita household income in the neighborhood)	5.959	0.628	5.745	0.775	5.385	0.890	5.469	0.481
Woman	0.525	0.499	0.507	0.499	0.495	0.499	0.473	0.499
Homicide Rate	26.26	10.90	25.09	11.15	31.03	11.47	29.25	11.66
n	262,452		5,062		7,074		41,548	
	126,694,167		2,104,583		3,390,009		21,497,578	

Source: elaborated by the authors

Table 7 Definition of degrees of urbanization

Category	Definition
Urban	Defined by buildings, streets, intense human occupation, and affected by changes resulting from urban development
Peri-urban	Area legally defined as urban and characterized by predominantly rural occupations; Area delimited by law and separated from the district headquarters by rural area or another legal limit
Accessible rural	Located in less than 1 km from an effectively urbanized area or city, village, or rural agglomerate[a] defined as an urban extension. It is an extension of an area effectively urbanized with inhabited land, popular housing, or developed core next to industrial, commercial, or service settlements. Also includes rural agglomerates located farther than 1 km from the effectively urbanized area and rural agglomerates with at least one settlement of goods for frequent consumption, at least one school, at least one healthcare unit, and at least one religious temple
Remote rural	Includes private or business rural agglomerates (linked to a unique landowner); not private rural agglomerate that does not have all the services and types of equipment (healthcare unit, for instance) listed on Accessible Rural definition; and rural zones (areas external to the urban perimeter), agglomerates excluded

Source: Adapted from IBGE (2000)

[a]Rural agglomerate is characterized by a set of permanent and adjacent buildings forming a continuously built area, with recognizable streets or arranged along a communication route

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Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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