

**SPATIAL ANALYSIS OF SELF-INDUCED VIOLENCE IN ADOLESCENTS:
SUBSIDY FOR COPING****ANÁLISE ESPACIAL DA VIOLÊNCIA AUTOPROVOCADA EM ADOLESCENTES:
SUBSÍDIO PARA ENFRENTAMENTO****ANÁLISIS ESPACIAL DE LA VIOLENCIA AUTOPROVOCADA EN
ADOLESCENTES: SUBSIDIO PARA ENFRENTAMIENTO**

Paula Daniella de Abreu¹, Firley Poliana da Silva Lúcio², Ednaldo Cavalcante de Araújo³,
Eliane Maria Ribeiro de Vasconcelos⁴, Tarcisio Neves da Cunha⁵, Claudia Benedita dos
Santos⁶

ABSTRACT

Objective: to analyze the correlation between the gross rates of self-induced violence in adolescents and year of occurrence and the spatial pattern of the occurrence of reported cases of self-induced violence in adolescents. **Method:** ecological study with a temporal tendency, developed from data reported in the period from 2009 to 2014 referring to cases of self-violence in adolescents living in the state of Pernambuco, collected by municipality through the *Sistema de Informação de Agravos de Notificação* (Information System for Notifiable Diseases). Data were analyzed with the aid of TerraView program, version 4.2.2, from the municipal cartographic bases of Pernambuco and population quantitative provided by the Brazilian Institute of Geography and Statistics. **Results:** linear statistical correlation was positive between the variables represented by gross rates and year of occurrence, besides the absence of significant spatial association. **Conclusions:** the application of integrated approaches that consider surrounding situations is an important strategy for constructing health actions.

Descriptors: Spatial Analysis; Health Promotion; Violence; Adolescent Behavior; Psychological Adaptation.

1 Nurse. MSc in Nursing from the Federal University of Pernambuco. Recife (PE), Brazil.

2 Nurse. MSc in Nursing from the Federal University of Pernambuco. Recife (PE), Brazil.

3 PhD. Nursing Postgraduate Program - Master's and Doctorate in Nursing, Federal University of Pernambuco/PPGENF/CCS/UFPE. Recife (PE), Brazil.

4 PhD. Nursing Postgraduate Program - Master's and Doctorate in Nursing, Federal University of Pernambuco /PPGENF/CCS/UFPE. Recife (PE), Brazil.

5 Researcher. Oswaldo Cruz Foundation, Occupational Health and Human Ecology Studies Center, Rio de Janeiro, Brazil.

6 PhD. Mother-Child and Public Health Nursing Department. Nursing School of Ribeirão Preto, University of São Paulo (USP).

RESUMO

Objetivo: analisar a correlação entre as taxas brutas de violência autoprovocada em adolescentes e ano de ocorrência e o padrão espacial da ocorrência dos casos notificados de violência autoprovocada em adolescentes. **Método:** estudo ecológico com tendência temporal, desenvolvido a partir de dados notificados no período de 2009 a 2014 referentes aos casos de violência autoprovocada em adolescentes residentes no Estado de Pernambuco, coletados por município pelo Sistema de Informação de Agravos de Notificação. Os dados foram analisados com o auxílio do programa *TerraView*, versão 4.2.2, a partir das bases cartográficas municipais de Pernambuco e quantitativo populacional fornecidos pelo Instituto Brasileiro de Geografia e Estatística. **Resultados:** obteve-se correlação linear estatística positiva entre as variáveis representadas pelas taxas brutas e ano de ocorrência, além da inexistência de associação espacial significativa. **Conclusões:** a aplicação de abordagens integradas que considerem a situação do entorno, configura-se em importante estratégia para construção de ações em saúde.

Descritores: Análise Espacial; Promoção da Saúde; Violência; Comportamento do Adolescente; Enfrentamento.

RESUMEN

Objetivo: analizar la correlación entre las tasas brutas de violencia auto-provocada en adolescentes y año de ocurrencia y el patrón espacial de la ocurrencia de los casos notificados de violencia auto-provocada en adolescentes. **Método:** estudio ecológico con tendencia temporal, desarrollado a partir de datos notificados en el período de 2009 a 2014 referentes a los casos de violencia auto-provocada en adolescentes residentes en el estado de Pernambuco, recolectados por municipio por el Sistema de Información de Agravios de Notificación. Los datos fueron analizados con la ayuda del programa *TerraView*, versión 4.2.2, a partir de las bases cartográficas municipales de Pernambuco y cuantitativo poblacional proporcionados por el Instituto Brasileño de Geografía y Estadística. **Resultados:** se obtuvo correlación lineal estadística positiva entre las variables representadas por las tasas brutas y año de ocurrencia, además de la inexistencia de asociación espacial significativa. **Conclusiones:** la aplicación de enfoques integrados que consideren la situación del entorno se configura en una importante estrategia para la construcción de acciones en salud.

Descriptorios: Análisis Espacial; Promoción de la Salud; Violencia; Conducta del Adolescente; Adaptación Psicológica.

INTRODUCTION

The term violence has its origin in the Latin *violentia* and can be understood as any situation in which the act of acting over someone or making them act against their will by using power, physical force, or any

form of coercion results or may result in injury, death, psychological harm, disability or deprivation. It is a complex phenomenon, resulting from interpersonal relations built from the sociocultural and political dynamics established in the course of history by power relations, as if the domain

of the stronger over the weaker was natural.¹

Violence is considered a serious public health problem, in addition to being inserted into the set of factors that violate human rights. This event is part of the 17 objectives of sustainable development, in Agenda 30, proposed by the United Nations (UN), which aims to promote peaceful, fair and inclusive societies, free of fear and violence.² This problem occurs worldwide and represents any action or omission which may adversely affect the well-being, physical and/or psychological integrity or freedom and the right to the full development of an individual.³

In Brazil, violence represents a serious social problem that directly affects the quality of life of the population, affecting both the social aspects as health aspects, once situations that cause physical, mental and moral injuries are present in the day-to-day of social relations. In this aspect, the concern to preserve the rights and protection of individuals becomes a prerogative, particularly when it comes to vulnerable groups such as the elderly, women, children and adolescents.⁴

Violence is divided into three categories: interpersonal, collective, and self-inflicted or self-induced injury; this latter results from the violence a person causes to themselves, which may be subdivided into suicidal behavior - thoughts

of suicide, suicide attempts and suicide itself - and self-aggression - acts of self-mutilation, from the mildest forms, such as scratches, cuts and bites, to the most severe, such as amputation of limbs.⁵

Suicide is the second leading cause of death in the world among individuals aged 15 to 29 years. In 2012, the global rate of suicide mortality corresponded to 11.4 deaths per 100,000 inhabitants, representing one death every 40 seconds from this cause. In the same period, Brazil presented rates of six deaths per 100,000 inhabitants, which represents a small portion of the magnitude issue of intentionally self-induced injuries, since some case of this type of violence do not result in death and, thus, are not recorded.⁶

The suicidal behavior directly affects the family group, schools and other social segments, and the adolescent is the most susceptible to this type of violence, by the characteristics of this development phase, seeking situations that may test their limits, thus becoming a group of greater vulnerability.⁷ Thus, the use of spatial analysis, which uses the geoprocessing and Geographic Information Systems, constitutes an instrument for recognizing territories and contexts, because it allows prioritizing areas that are under the responsibility of the Primary Health Care (PHC) and materializing human

interactions, conflicts, health problems and human needs.⁸

In this sense, mapping cases of self-induced violence in certain space allows identifying the frequency, the distribution and the importance of the various factors that contribute to the high rates of mortality from this event.

OBJECTIVE

To analyze the linear correlation between the gross rates of self-induced violence in adolescents and year of occurrence and the spatial pattern of occurrence of self-induced violence in adolescents.

METHOD

This is an ecological study of temporal trend, performed in the state of Pernambuco (PE), with secondary data referring to cases of self-induced violence, in the period from 2009 to 2014.

The population consisted of 866 reported cases of self-induced violence in adolescents aged 10 through 19 years, residents in the state of PE. All data reported in the selected period were included, provided by the Department of Informatics of the Unified Health System (DATASUS), through access to the Information System for Notifiable Diseases (SINAN/SVS/MS).

The first step consisted of a survey of vector files linked to population databases to prepare municipal cartographic bases associated with census information. Then, two spreadsheets regarding population quantitative of the two phases of adolescence from 10 to 14 years and 15 to 19 years of age of the municipalities of the state of PE were generated, segmented in those years, provided by the Brazilian Institute of Geography and Statistics (IBGE). The second step was obtaining the spreadsheets of registered cases of self-induced violence by adolescents residing in PE, in both phases of adolescence by SINAN/SVS/MS. The third step was the organization, formatting of the spreadsheets, orthographic correction and calculation of gross rates.

The analytical phase of the study based on the calculation of gross rates of incidence of cases of self-induced violence in adolescents by municipality of residence and by year of occurrence in the period from 2009 to 2014. These data were analyzed in two ways: the first one consisted of the territorial expression; the second, of the temporal progression in the period from 2009 to 2014. In the territorial analysis, the gross rates were used to calculate the spatial association by means of indices of global and local Moran. In this stage of the analysis, a Bayesian tool was also applied in order to soften the values of rates according

to empirical statistical criterion linked to the influence exerted by the territorial proximity. In the analysis of the temporal progression, the linear correlation was established between the dependent variable represented by gross rates and the independent variable in the year of occurrence.

The data were analyzed with the aid of the program TerraView, version 4.2.2 for the construction of thematic maps from smooth rates by the technique of empirical Bayes and the index of Moran (LisaMap)⁹ The dependent variable of self-induced violence rates per 100,000 inhabitants, was calculated with *Bayesian* smoothing. This type of analysis favors the mitigation of instability and random fluctuations, and possible bias resulting from the identification of the cases to obtain the gross rates, since the estimates in less populous municipalities tend to have high sensitivity to events by mere chance.¹⁰

The first stage of the analysis consisted of the construction of thematic maps from the empirical Bayes global estimator. This analysis is formulated from the calculation of the weighted average between the gross rate of the locality and overall rate of the region. Then, the thematic maps were constructed for the expression of the local Bayesian rates. This analysis represents the estimated location, being built from rates of geographical

neighborhood of the area intended to be estimated.¹⁰

Then, the significance of LisaMap Moran Index - Local Indicator for Spatial Autocorrelation was verified. The local indicator allows analyzing the correlation values of a municipality with its territorial neighborhood, qualifies and quantifies the association in relation to the sociodemographic aspects between the neighboring municipalities. This type of analysis also provides the statistical significance by comparison of the local values, after successive random permutations between the attributes of municipalities. In this way, the p-value greater than 0.05 indicates low significance of the obtained index, if it is lower than 0.05, the correlation is significant, being the areas classified in five different levels of significance: without significance; significance of 0.05 (95% confidence); 0.01 (99% confidence); of 0.001 (99.9% of confidence); and 0.0001 (99.99% of confidence).¹¹

The analysis of the local Moran index allows identifying clusters of the disease with values of similar or anomalous attributes, being more significant the identification of groups in relation to the neighborhood.¹¹

For the presentation of rates of cases of self-induced violence, the *Equal Steps* grouping mode was used, which associates

each class of color scale to a subdivision of minimum and maximum value into five classes with equal intervals for the best interpretation of rates displayed on maps.¹²

For the understanding of the temporal progression of cases of self-

induced violence, the next step was the exploratory data analysis, which intends to obtain implicit information, in addition to unveiling atypical behaviors, from the calculation of the coefficient of correlation:

$$\rho = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sqrt{\sum(x - \bar{x})^2(y - \bar{y})^2}}$$

The coefficient of correlation zero indicates no correlation between the two variables and between -1 and +1 indicates a perfect linear correlation. This value squared (ρ^2) generated the coefficient of determination which expresses the strength of linear association, categorized into: $\rho^2(0.1 - 0.3)$ weak; $\rho^2(0.4 - 0.6)$ moderate; $\rho^2(0.7 - 1)$ strong.¹³

The present study used secondary data, available on the Information System for Notifiable Disease/DATASUS-TABNET and on the Brazilian Institute of Geography and Statistics (IBGE). These systems contain information relating to health services, systematized in spreadsheets, graphs, maps and texts for consultation purposes. Since they are public databases, there was no need for submission to the Research Ethics Committee (REC).

RESULTS

The present study analyzed the spatial distribution of cases of self-induced violence in adolescents residing in the state of Pernambuco, with data universe composed by 866 reported cases. Figure 1 presents the thematic maps concerning the smooth rates of cases of self-induced violence in adolescents obtained according to the empirical Bayes global estimator for the period from 2009 to 2014, showing in darker tones the municipalities that present higher Bayesian global rates, highlighting the municipality of São Lourenço da Mata with rates of 27.5 and 85.9 for the first and second phase of adolescence, respectively.

Figure 1 – Thematic Map of smooth rates by Global Empirical Bayes, related to cases of self-induced violence from 10 to 14 years and from 15 to 19 years, per 100 thousand inhabitants, in the municipalities of the state of Pernambuco. Recife, Pernambuco, Brazil, 2017.

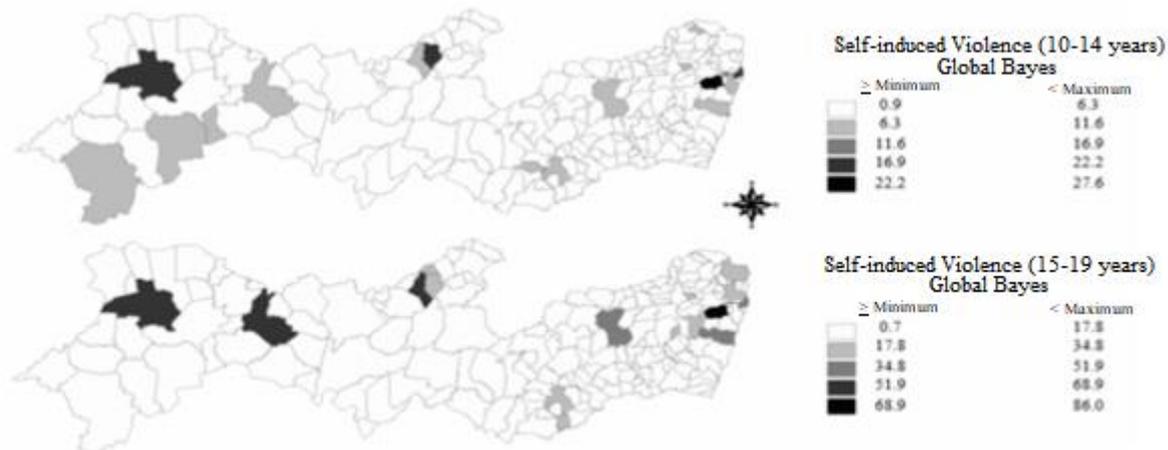
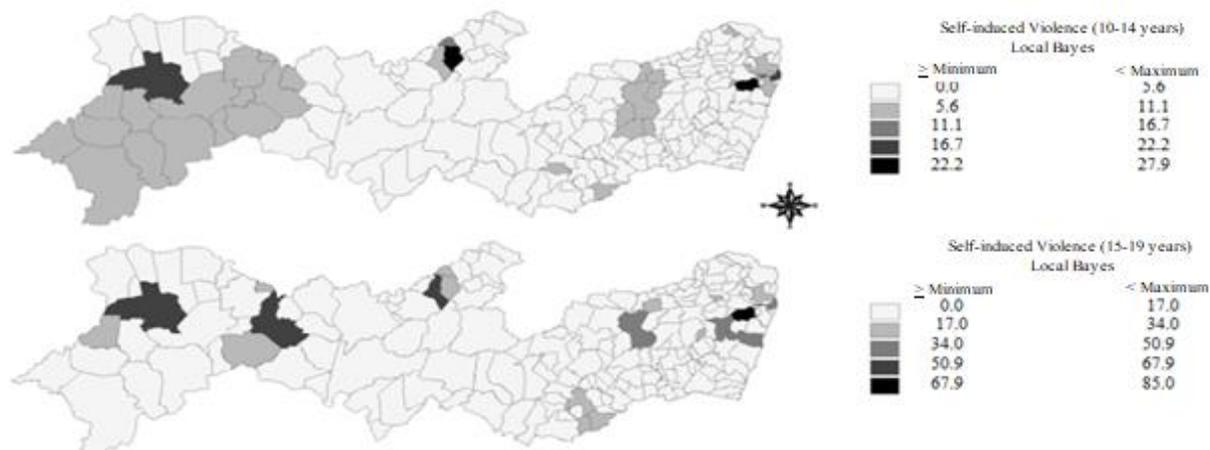


Figure 2 shows the local Bayesian rates, which highlighted the municipalities: São Lourenço da Mata (27.8) and Afogados

da Ingazeira (8.26), for the first phase of adolescence and the municipality of São Lourenço da Mata (84.9) for the second phase.

Figure 2 – Thematic Map of smooth rates by Local Empirical Bayes, related to cases of self-induced violence from 10 to 14 years and from 15 to 19 years, per 100 thousand inhabitants, in the municipalities of the state of Pernambuco. Recife, Pernambuco, Brazil, 2017.



The Moran index showed no significant spatial association for both age groups of adolescence, with expressed index value equal to 0.0558706 and p-value

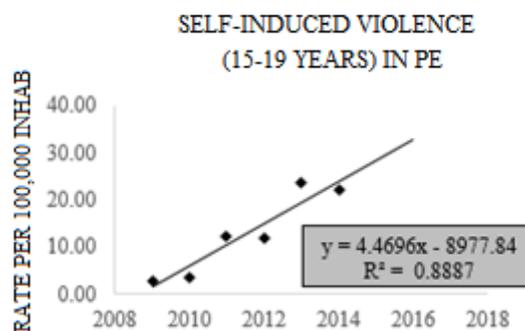
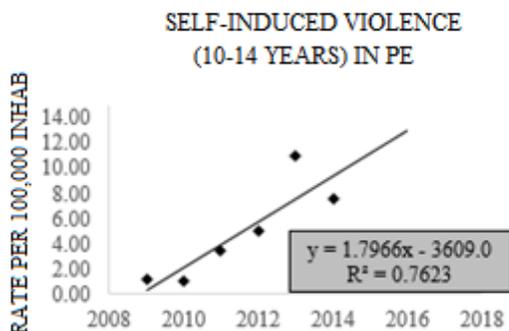
equal to 0.98 (10-14 years of age), and index value equal to 0.0737699 and p-value equal to 0,075 (15-19 years of age).

In relation to the linear correlation between the rates of violence and the years,

there is a statistically positive correlation for the occurrence of this phenomenon, thus classifying as the strength of the association in strong, which allowed predicting the

evolution of rates until the year 2016 for the two phases that comprises the adolescence, as shown in charts 1 and 2:

Charts 1 and 2 – Linear Correlation, in the period from 2009 to 2014 and prediction up to 2017 of cases of self-induced violence in adolescents residing in the state of Pernambuco. Recife, Pernambuco, Brazil, 2017.



DISCUSSION

Self-induced violence is generally used to describe various types of behaviors and intentions, including attempted suicide, suicidal ideations and light (scratches) or severe (extirpation of a limb) self-injuries in response to intolerable tension. The risk factors include socioeconomic disadvantages and psychiatric diseases, particularly depression, substance abuse and anxiety disorders. Cultural aspects of some societies can protect against suicide and self-injury and explain some of the international variations in the rates of these events.¹⁴

In the world, the impact of morbidity and mortality from external

causes, including self-induced violence, represents one of the major concerns for State leaders. Violence in the second phase of adolescence is in the ranking of the five leading causes of mortality worldwide, affecting 4 million adolescents who attempt suicide each year, and approximately 100,000 committed suicide itself.¹⁵

The rates of self-induced injury, such as suicide, vary between countries. In the Western countries, 5-9% of adolescents reported having performed self-injury¹⁴; in countries that have low or medium economic level, the highest rates of homicide focused on the region of the Americas (28.5 homicides per 100 thousand people), followed by the African Region

(10.9 homicides per 100 thousand persons).¹⁶

In Brazil, the Mortality Information System recorded in the historical series from 2009 to 2014 around 185,393 cases of deaths from violence for the age range from 10 to 19 years, and 59% of the total corresponded to the second phase of adolescence and 61% of adolescents belonging to females in the same age group.¹⁷ In the global scope, a study carried out in London showed that self-injury is more prevalent in young people aged 15-19 years, with predominance of females, as well as demonstrated that up to 1/3 of the people who self-mutilate has the potential to do it again in the same year and are 50 times more likely to commit suicide.¹⁸ These findings corroborate a study conducted in Chile, in which the suicidal ideation among adolescents is around 10 to 30%, with a predominance of females for the consummation of the act (suicide itself).¹⁵

The Brazilian Northeast region has 37,560 registered cases of self-induced violence, with predominance of the number of records in the age group from 15-19 years (24,405 cases), with a percentage of 48% of female victims. This fact makes this region occupy the second place in the national ranking of cases involving this disease.¹⁷

The state of Pernambuco, according to the aforementioned results, follows the global and national epidemiological trend,

occupying the first place among states of the Northeast region of the country, with the highest percentage of cases of self-induced violence, both in relation to the age group from 15-19 years, with 5,928 (59.3%) as in relation to gender, with 3,586 (60.5%) of the total of recorded cases.¹⁷

The visualization of thematic maps by global and local Bayesian empirical estimator, for the period from 2009 to 2014, allowed identifying the areas where the event most occurred, although there was no spatial dependence of the cases, according to Moran index, which means that areas surrounding the municipalities with high/moderate or low gross rates of self-induced violence in adolescents will not necessarily have the same pattern. The epidemiological picture of cases of self-induced violence in the state of PE showed that, in the studied population, this phenomenon was more evident in the metropolitan mid-region. This finding may have occurred because this region is undergoing an expressive urbanization process, which permeates the social inequalities.

The linear correlation was positive for the occurrence of self-induced violence in adolescents living in the state. The high increase in cases over the years indicated an increasing linear trend for self-harm behaviors. The numerous consequences of this practice reflect on the biopsychosocial

development of adolescents and can result in health damage with repercussion in personal and relational formation.

The actions of coping with behavior tendentious to self-harm involve intersectoral participation, multidisciplinary approaches, evaluation of the actions developed, as well as strategies to identify triggering points that lead to self-harm. Not least, it also includes identifying socio-cultural, environmental and individual protection factors; such factors have the potential to help adolescents deal with a better balance in the face of stressful situations, so that the establishment of protection factors in the various segments that permeate the adolescent context is an effective strategy to reduce this phenomenon.¹⁹

In order to promote quality of life, education, protection and recovery of health and prevention of damages, the MH qualifies the professionals who may be in greater contact with this population group, through manuals directed to the primary care multiprofessional team, mental health, emergency doctors, media professionals, professors and school employees; the contents are arranged in such a way as to lead these professionals to act appropriately against the situation of self-harm.²⁰

The school environment constitutes an important social space for the exchange of knowledge. The support of friends and

the welcoming of educators contribute to the strengthening of the resilient processes of adolescents. Therefore, the multiprofessional team should be able to identify the structural and functional resources of the community environment and the psychosocial processes that may interfere in the health/disease process, in order to propose educational and participative actions for the promotion of mental health.

Education must be in line with reality in order to incite the epistemological curiosity of adolescents. Teaching must be a percussion of criticality, which permeates the worldview, and be linked to the learner's demands. Therefore, liberating education, based on dialogue, arouses fascination, knowledge and autonomy to adolescents when facing social adversities.

A limitation of the present study was the probable underreporting of cases of self-induced violence in adolescents living in PE. The management of Health Information Systems may differ between municipalities and result in loss of information, and data conduction, from the identification of the suspected cases by the multiprofessional team, diagnosis, notification and handling of the digitized data, are essential stages for the epidemiological analysis of this event.

The contribution of this study bases on the visualization of the areas with the highest rates of self-induced violence of the

study population, in order to support the planning of coping strategies, in an articulated way between the health care network and the community. Therefore, the knowledge of professionals and their sensitivity to enter and recognize the situations generating great stress directly influences the reduction of the involvement of this serious event.

CONCLUSION

The visualization of the thematic maps by global and local empirical estimators for the period from 2009 to 2014 allowed identifying areas of risk and their neighborhoods, allowing the application of integrated approaches that take into account the environment situation visibly free of risk. The vision of the phenomenon integrated with the environment is an important epidemiological tool to develop control and coping actions.

In this way, geoprocessing enables the health action plan to be strengthened, based on the principle of equity for the promotion of interconnected strategies among sectors and social actors. In this sense, the multiprofessional health team plays an essential role in building links, welcoming, articulating the health care network and building educational strategies with a view to psychosocial strengthening

and promoting resilience among adolescents.

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