Spatio-temporal distribution of financial/economic violence in a northeastern state of Brazil

Distribuição espaço-temporal da violência financeira/econômica em um estado do nordeste do Brasil

Distribución espacio-temporal de la violencia financiera/económica en un estado del noreste de Brasil

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Abstract
The Ministry of Health defines economic-financial violence (FEV) as destructive actions or omissions of the aggressor that affect the emotional health and survival of family members. Thus, the objective of this research was to analyze the spatio-temporal distribution of FEV in the state of Bahia, Northeastern Brazil. An ecological, time series study (2010-2018) was conducted, using spatio-temporal analysis tools. As a result, we observed that most cases of FEV occurred among women and the chances of the occurrence are higher in households, in adults and the elderly, in addition, there was an increasing trend of cases among males. We identified a heterogeneous distribution in the Bahian territory suggesting the inexistence of a distribution pattern of violence. However, in the spatial-temporal analysis high risk clusters were observed in the south-central region of the state. This work made it possible to identify areas of risk for the occurrence of AFV, especially in the south-central region of Bahia. Besides

characterizing the victimized population, such as adults and the elderly being the most likely to suffer this type of violence.
Keywords: Bahia; Public health; Epidemiology; Unified health system.

Resumo
O Ministério da Saúde define violência econômico-financeira (VEF) como ações destrutivas ou omissões do agressor que atingem a saúde emocional e a sobrevivência dos membros da família. O objetivo desse trabalho foi analisar a distribuição espaço-temporal da VEF no estado da Bahia, Nordeste do Brasil. Realizou-se um estudo ecológico, de séries temporais (2010-2018), utilizando ferramentas de análise espaço-temporal. Como resultado, observou-se que a maioria dos casos de VEF ocorreu entre mulheres e as chances da ocorrência são maiores em domicílios, nos adultos e idosos, além disso, houve uma tendência crescente dos casos entre indivíduos do sexo masculino. Identificamos uma distribuição heterogênea no território baiano sugerindo a inexistência de um padrão de distribuição da violência. No entanto, na análise espaço-temporal foram observados aglomerados de alto risco na região centro-sul do estado. Este trabalho possibilitou identificar áreas de risco para a ocorrência de VEF, principalmente na região centro-sul da Bahia. Além de caracterizar a população vitimada, como adultos e idosos sendo os mais propensos a sofrer esse tipo de violência.
Palavras-chave: Bahia; Saúde pública; Epidemiologia; Sistema único de saúde.

Resumen
El Ministerio de Salud define la violencia económico-financiera (VEF) como acciones u omisiones destructivas del agresor que afectan la salud emocional y la supervivencia de los miembros de la familia. El objetivo de este trabajo fue analizar la distribución espacio-temporal del FEV en el estado de Bahía, Nordeste de Brasil. Se realizó un estudio de series temporales ecológicas (2010-2018) utilizando herramientas de análisis espacio-temporal. Como resultado, se observó que la mayoría de los casos de FEV se presentaron entre mujeres y las posibilidades de ocurrencia son mayores en los hogares, adultos y ancianos, además, hubo una tendencia creciente de casos entre individuos masculinos. Identificamos una distribución heterogénea en el territorio bahiano, lo que sugiere la inexistencia de un patrón de distribución de la violencia. Sin embargo, en el análisis espacio-temporal se observaron conglomerados de alto riesgo en la región centro-sur del estado. Este trabajo permitió identificar áreas de riesgo para la aparición del FEV, principalmente en la región centro-sur de Bahía. Además de caracterizar a la población victimizada, los adultos y las personas mayores son los más propensos a sufrir este tipo de violencia.
Palabras clave: Bahia; Salud pública; Epidemiología; Sistema único de salud.

1. Introduction

Violence is considered a public health problem which, according to the World Health Organization, is defined as the use of physical force or power, against oneself or against other individuals, that results in injury, omission, harm, disability or deprivation. And it can manifest itself in different ways: physical, psychological, sexual violence, abandonment, neglect, self-neglect and financial/economic violence (EFV) (Machado et al., 2014; World Health Organization (WHO), 2008).

The EFV consists of the illegal and improper use of other people's financial and property resources, such as theft of property and real estate, money looting, deprivation of their own belongings or misuse (Sedziafa et al., 2016). The occurrence of these cases in Brazil is mainly associated with the elderly and women in a vulnerability state, who, in the vast majority, are victims of their own family members (Elisa & Figueiredo, 2014; Santos et al., 2019; Tanski et al., 2022).

The northeast region presents important socioeconomic problems related mainly to social vulnerability. In this region, the poorest population is exposed to greater risk of neglected endemic diseases transmission (Paz et al., 2021; Reis et al., 2022) and violence (Meira et al., 2021). Since the 2000s, an intense process of spreading violence has been observed, with the expansion of organized crime and drug trafficking. In addition, the increase in structural and consequently gender violence and other facets of violence are present in this region.

Several works carried out in the state of Bahia discusses violence, these studies mainly address domestic violence and violence against the elderly, which are linked to gender and also the economic/financial issues (Miura et al., 2018; Montesanti & Thurston, 2015). However, there are few studies focused on financial and economy violence in one of the states with the highest homicide rate in the country (Souza et al., 2020). According to the World Health Organization (WHO), efforts to prevent violence at regional levels are necessary, given that the sub-regional strengthening of data collection and dissemination

work contributes to revealing the real extent of the problem (Barata et al., 2008; WHO, 2014) (Barata et al., 2008; WHO, 2014).

Mapping tools are widely explored to better understand the relationship between health, population and environment, and their application is notable especially in the field of public health, allowing the assessment of various health-related factors, events and phenomena at different geographic scales (Fletcher-Lartey & Caprarelli, 2016). In addition, in recent years, the use of the Geographic Information System has been applied to understand the spatial dynamics of various health problems, providing support for policies and control plans (Banerjee, 2016; Paz et al., 2020; Reis et al., 2022).

With this, given that violence (in all its instances) is globally considered a public health problem. This research aimed to analyze the spatial and spatio-temporal distribution of EFV in the state of Bahia, Brazil.

2. Methodology

We carried out an ecological (Villela & Oliveira, 2018) time-series study (from 2010 to 2018) using spatial analysis tools. Herein, was included all confirmed cases of EFV in Bahia state, and the analysis units consisted of its 417 municipalities. The Bahia is divided into seven mesoregions (North center of Bahia, South center of Bahia, Farwest of Bahia, Salvador metropolitan, Northeast Bahia, South of Bahia and Saint Franciscan valley of Bahia) (Figure 1). This region has the largest territorial area in Northeast of Brazil (564,760.427 km²) and an estimated population of 14,930.634 inhabitants, and human development index (HDI) of 0.660 in 22nd place in the national ranking (Brasil, 2022; Brasil, 2013).

Figure 1 - Map representing Brazil and highlighting the study area: the Bahia and its mesoregions in colours.
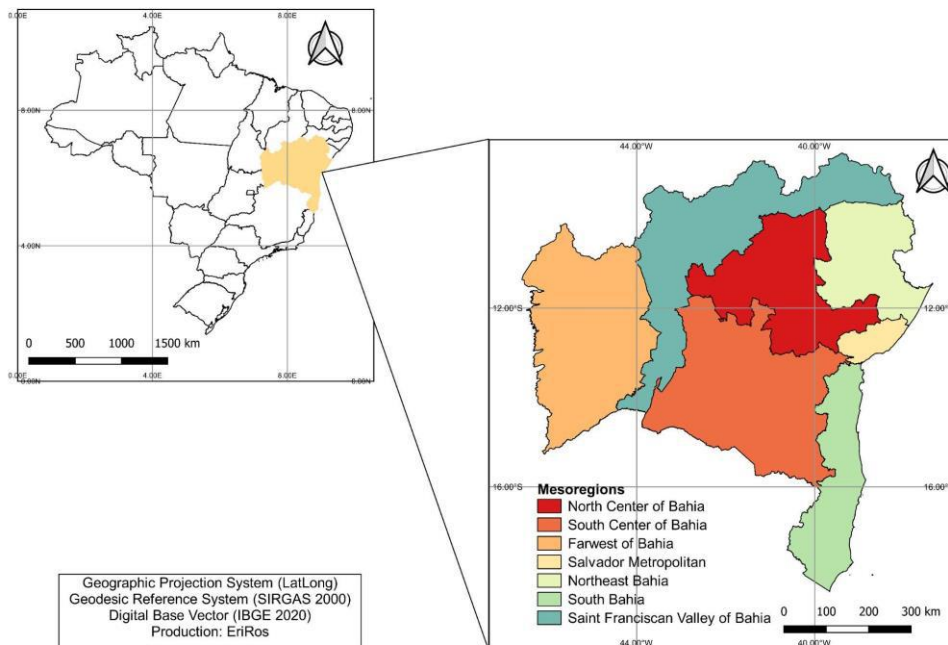
Source: Authors (2023).

Data Sources

The number of cases, clinical and demographic characteristics of the cases were obtained from the database of the Notifiable Diseases Information System (SINAN), a platform supplied by the Brazilian Ministry of Health. Population estimates and the digital cartographic grid (in shapefile extension), segmented by municipalities and states, of the Universal

Transversal Mercator (UTM) system, horizontal Terra Datum model (SIRGAS 2000), population data of NRB for the study period were collected from the databases of the Brazilian Institute of Geography and Statistics (IBGE).

Variables and Measures

The prevalence rate of EFV (calculated per 100,000 inhabitants) was considered the main dependent variable of the study. This rate was calculated at the state and municipal levels. The crude rates were obtained by calculating the average of cases divided by the population estimate in the central year of the study (2014) and multiplied by 100,000. Additionally, the variables sex, age, skin color (whites and nonwhites: blacks, browns and indigenous), place of occurrence, educational level and clinical outcome were used for the descriptive epidemiological characterization of the population. We performed a bivariate analysis of the factors associated with EFV. For variables with only two categories, the variables were compared with each other. For variables with more than two categories, each was compared against the category with the lowest number of records. Was also calculated the Odds Ratio (OR) and 95% confidence intervals (CI 95%) for all variables studied, using the chi-square test (x^2). Were excluded all missing and incomplete data from analyses. Statistical analyses were performed using GraphPad Prism (8.0) and results were considered statistically significant when p-value <0.05 was obtained.

Time Trend Analysis

Time trends in the EFV prevalence rates were used according to age groups and gender, and analyzed using segmented linear regression (joinpoint). This method allows for verify changes in the trend of the data over time by adjusting the data for a time series form the smallest number of possible joinpoints. Herewith, was calculated the annual percentage changes (APC) for each segmented period and the average annual percentage changes (AAPC) for the entire period, when there was more than one significant inflection, and their respective 95%CI. The time trends were considered statistically significant when the APC and AAPC had a *p*-value <0.05 and the 95%CI did not include zero. Was used the Monte Carlo permutation test to choose the best segment of each model, applying 999 simulations, considering the best model to be that the highest residue coefficient of determination (R2). The results were interpreted as follows, time trends with significant and positive APC/AAPC were considered increasing; those with significant and negative APC/AAPC, decreasing and when there was no significant result, the trends were classified as stable (Antunes & Cardoso, 2015; Kim et al., 2000).

Spatial and Spatiotemporal Analysis

Maps were constructed representing the crude prevalence rate according to the study period. Subsequently, we used the Local Empirical Bayesian method to smooth the prevalence rate. This method corrects possible random fluctuations in space, and provides greater stability to the rates obtained. The results were represented on choropleth maps, according to the prevalence rate parameter: low (<100.0/100,000 inhabitants); moderate (100.1 to 200.0); high (200.1 to 300.0); and very high (>300.0). To prepare the maps, the QGIS software version 3.18.2 was used, with the cartographic projection corresponding to the Universal Reference System SIRGAS 2000.

Subsequently, for the spatiotemporal scan analysis, the method of retrospective analysis was used, with the application of the Poisson distribution method, which verifies high-risk clusters of the prevalence rate in space and time. In this analysis, the segregation time parameters per year were considered, without overlapping clusters and with a maximum spatial cluster size of 50% of the population at risk and 50% for the temporal cluster in the period studied. Also, the likelihood ratio test was used for cluster detection. Results were considered statistically significant when p <0.005 and using 999 Monte Carlo simulations (Kulldorff, 1997). Analyzes were performed using SatScan software version 9.7 and maps were created using QGIS software version 3.18.2.

3. Results

During the period of this study (2010-2018), 61,211 cases of violence were recorded in the Bahia state, of these 2,035 were registered EFV most cases of this type of violence occurred between females (91,1%) and non-white people (73.5%) Table 1. When verified statistical analysis of association between sociodemographic factors and cases of EFV using the total number of cases in each category during study period. It was observed that women are 4 times more likely (OR= 4.9; CI95%= 4.2 to 5.8) to suffer EFV than men (OR= 0.2; CI95%= 0.1 to 0.2) and the most important the chance of occurring at home is greater (OR= 5.4; CI CI95%= 4.3 to 6.8) compared to other places. Additionally, adults and seniors between 40-59 years (OR= 11.1; CI95%=7.3 to 17.4) and over 60 years of age (OR= 9.7; CI95%=6.2 to 14.9) were more likely to suffer from this type of violence Table 1.

Table 1 - Statistical analysis of association between socioeconomic factors and cases of financial/economic violence in the Northeast region of Brazil, 2010-2018.

Financial/economic violence Yes (n=2,035) No (n= 59,176)					
Variables	**Yes**	**No**	**%**	**OR (CI95%)**	*p*-value
Place of occurrence					
Residence	1,778	23,177	87.3	5.4 (4.3 to 6.8)	<0.0001
Public highway	107	11,288	5.3	0.6 (0.5 to 0,9)	0.008
Others	76	5,401	3.8	-	
Unknown	74	19,310	3.6		
Sex					
Male	183	19,508	8.9	0.2 (0.1 to 0.2)	<0.0001
Female	1,852	39,651	91.1	4.9 (4.2 to 5.8)	<0.0001
Unknown	-	17	-		
Race/Colour					
White	304	3,681	14.9	1.7 (1.5 to 2.0)	<0.0001
Non-white	1,494	32,353	73.5	0.5 (0.4 to 0.6)	<0.0001
Unknown	237	23,142	11.6		
Education level					
<8 years	768	12,333	37.7	1.3 (1.2 to 1.5)	<0.0001
≥8 years	752	8,886	36.9	0.7 (0.6 to 0.8)	<0.0001
Not applicable	36	4,601	1.8		
Unknown	479	33,356	23.6		
Outcome					
Hospital discharge	861	16,707	42.4	11.7 (4.1 to 35.2)	<0.0001
Abandonment	7	185	0.35	8.6 (2.3 to 30.8)	<0.0001
Death	3	683	0.14	-	
Unknown	1165	41,601	57.2		
Age group (years old)					
≤4	22	3,330	1.1	-	
5-19	163	21,933	8	1.1 (0.7 to 1.7)	<0.605
20-39	1,081	22,956	53.2	7.1 (4.7 to 11.0)	<0.0001
40-59	548	7,415	26.9	11.1 (7.3 to 17.4)	<0.0001
≥60	220	3,433	10.8	9.7 (6.2 to 14.9)	<0.0001
Unknown	1	109	0.04		

OR = odds ratio; CI = confidence interval. Source: Authors (2023).

Thereafter, was analysed the temporal trends in crude prevalence rate in state Bahia and considering the sociodemographic variables in the total period of the study. The state showed stable trend during the period, from 2009 to 2018 (APC= 6.2; CI95%= -3.9 to 17.4) as well as the prevalence rate in different age groups. Interestingly, the male sex presented an increasing trend during all time studied (APC= 12.2; CI95%= 6.0 to 18.8) Table 2.

Table 2 - Time trends in crude prevalence rate by state, sex, age group, in the state Bahia, 2010-2018.

Indicator	Period	APC (95%CI)	Trend
Crude prevalence rate in the general population (per 100,000 inhabitants)			
Bahia	2009-2018	6.2 (-3.9 to 17.4)	Stable
Crude prevalence rate by sex (per 100,000 population)			
Male	2009-2018	12.2 (6.0 to 18.8)*	Increasing
Female	2009-2018	6.2 (-4.4 to 18.1)	Stable
Crude detection rate by age group (per 100,000 inhabitants)			
≤4 years old	2009-2018	0.3 (-12 to 15.0)	Stable
5-19 years old	2009-2018	7.1 (-0.5 to 15.2)	Stable
20-39 years old	2009-2018	5.0 (-5.6 to 16.8)	Stable
40-59 years old	2009-2018	5.6 (-4.5 to 16.8)	Stable
≥60 years old	2009-2018	10.2 (-0.4 to 22.5)	Stable

APC: annual percentage change; *Statistically significant trend; *p*-value <0.05. Source: Authors (2023).

Afterwards, we performed a spatial analysis at the municipal level of the crude prevalence rate of EFV (Figure 2A). Herein, we observed a heterogeneous distribution of cases across the Bahia. After smoothing rates by the local empirical Bayesian method, the statewide dispersion continued with higher cases concentration in the South center of Bahia (Figure 2B). We identified two spatiotemporal clusters with the use of spatial scanning statistics which can be viewed in Figure 2C and listed in Table 3. The primary spatiotemporal cluster (cluster 1) encompassed 782 new cases that occurred in the South center of Bahia in eight location, they are Vitória da Conquista, Barra do Choça, Caatiba, Itambé, Itapetinga, Macarani, Ribeirão do Largo and Encruzilhada, between the years 2012-2016, with an annual prevalence rate of 31.2/100,000 and RR=32.85. Whereas, the secondary cluster (cluster 2) contained 172 new cases occurred only in one location: at Feira de Santana, with an annual prevalence of 13.9/100,000 and RR= 9.94 (Table 3).

Figure 2 - Spatial and spatiotemporal distribution of prevalence rate of financial/economic violence in the municipalities of Bahia (2010-2018). (A) Gross prevalence rate of financial/economic violence. (B) Gross prevalence rate of financial/economic violence smoothed. (C) Space-time scan analysis.
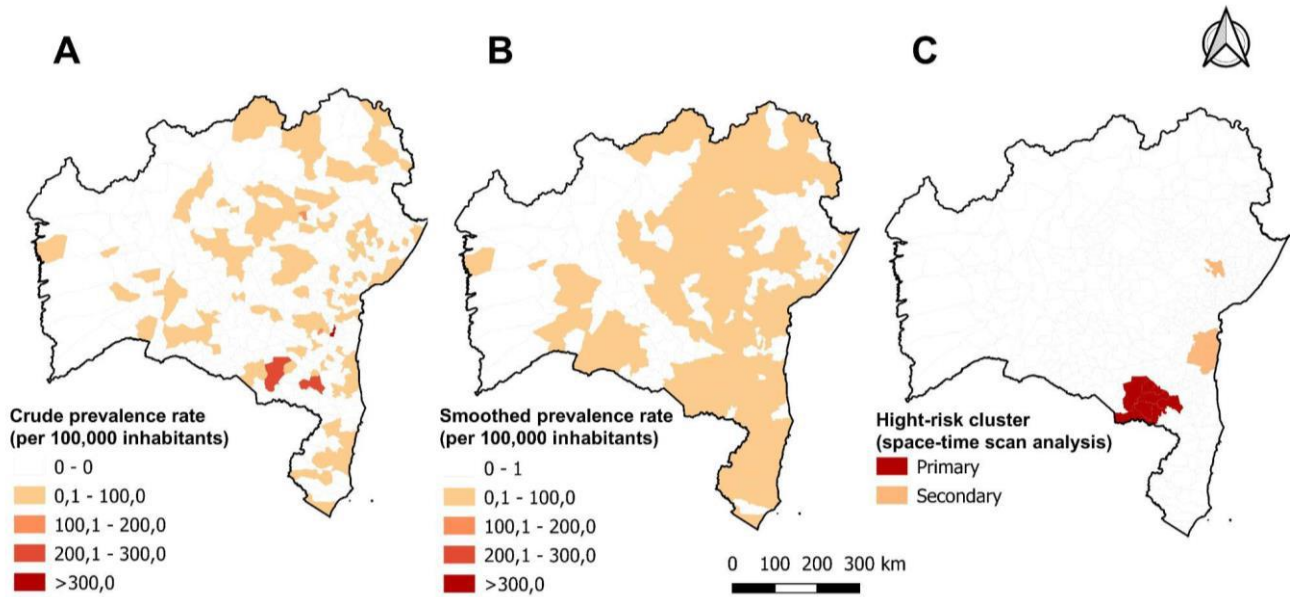
Source: Authors (2023).

Table 3 - Spatiotemporal clusters of the prevalence rate of financial/economic violence per 100,000 inhabitants in the municipalities of Bahia, 2010-2018.

Variables / Clusters	Primary	Secondary	Tertiary
Period	2012-2016	2017-2018	2016-2018
Number of locations	8	1	15
Number of new cases	782	172	28
Expected new cases	38.00	18.73	11.36
Annual prevalence rate*	31.2	13.9	3.7
RR	32.85	9.94	2.48
LLR	1,781.491	234.070	8.684
***p*-value**	< 0.001	< 0.001	0.499

RR – relative risk for the cluster compared with the rest of the region; LLR – likelihood ratio; *Annual prevalence rate per 100,000 population during the cluster period. Source: Authors (2023).

4. Discussion and Final Considerations

To date, this is the first study that sought to assess the sociodemographic characteristics, temporal trends, spatial and spatio-temporal dynamics of EFV cases in a state of Brazil. Intrafamily violence is present in the Federal Constitution and the Family Health teams assume the responsibility for solving and preventing these attitudes, since they can cause physical and psychological damage to victims (Brasil, 1988). Thus, studies that direct actions, mainly in one of the Northeastern states, that most report cases of financial and economic violence, are necessary.

In this study, we observed that most cases of EFV occurred among women and its occurrence is higher in homes and in adults and elderly people. However, a high number of EFV cases was observed among young people aged between 20-39 years old, with the most common form of violence in this group being related to damaged, stolen or destroyed material things (Kutin et al., 2017).

The greater chances of this type of violence happening in homes indicate to a relationship with intrafamily violence and further reinforce that woman and elderly people are the most vulnerable groups (Machado et al., 2014). However, EFV against elderly men is more associated with public environments and practiced by strangers (Santos et al., 2019).

In elderly people, financial violence occurs due to dependence on the administration of their monetary assets, this can be attributed to physical and cognitive disabilities, mainly associated with illness (Santos et al., 2019). Violence is an aggravating factor to the assaulted individual health because it is related to physical and mental abuse that can result in injury, trauma or even death (Elisa & Figueiredo, 2014).

The EFV against elderly males is prevalent in the state of São Paulo (Alarcon et al., 2019) and in the Federal District (Oliveira et al., 2012). These data corroborate Melchiorre et al. (2016) which states that this type of violence is also more frequent in European men. A different scenario from the one found in the state of Bahia, evidenced in this study, where women between 40 and 59 years old were eleven times more likely to suffer this type of violence, in Piauí in the year 2014, women were also the ones who registered the most police reports at the protection police station and safety for the elderly in Teresina (Damasceno et al., 2016).

Although females were more likely to experience EFV, males showed a growing trend in this study. Women have historically been victims of violence due to personal, situational and sociocultural factors that shape violence and affect their health (Thurston & Vissandjée, 2006). As with interpersonal violence, the greater chances of financial/economic violence in women may have occurred in relationships in which there is a difference in income between the partners, since the absence of their own income puts them at risk of financial dependence (Montesanti & Thurston, 2015).

However, intimate partner violence varies and can be influenced by several factors around the world. But overall, high levels of financial inclusion among women are associated with low levels of intimate partner violence (McDougal et al., 2019). The risk of financial violence in females can also be influenced by cultural conservatism coming from their partners, since economic autonomy among women increases the risk of some type of violence, when married to conservative partners, which can guide a protective factor, when they receive smaller amounts than their spouses (Leite et al., 2019).

However, gender is a critical determinant of women's health (Montesanti & Thurston, 2015) and economic violence is associated with increased depression, anxiety (Davila et al., 2021; Sedziafa et al., 2016), decreased life quality (Adams et al., 2019), as well as having a negative effect on women's cardiovascular health (Tenkorang & Owusu, 2019). However, the consequences of violence on men's health are no less important, since victims also suffer physical and mental abuse, in addition, men are less likely to report symptoms and seek medical attention (Melchiorre et al., 2016).

In addition to the vulnerability of gender and age, another extremely important and risk factor for the occurrence of EFV is poverty and uncertain financial confrontation, which potentiate the negative effects on the quality of life and health of individuals who experience them at any population (Adams et al., 2019; Fawole, 2008).

Through the maps of spatial analysis, we identified a heterogeneous distribution in the territory of Bahia, suggesting the non-existence of a violence distribution pattern. However, in the space-time analysis, high-risk clusters were observed in the south central region of the state. Mainly the southern region is marked by cocoa cultivation, although this monoculture is a source of income for many families, its decline over the years has caused the population to migrate to urban centers, a phenomenon linked to factors such as lack of professional qualification and insufficient socioeconomic power intensifies the socio-spatial exclusion of these people (Bahia de Aguiar et al., 2019; Borges, 2021; WHO, 2008).

The authors suggest that the increase in cases of EFV in this region is associated with the historical process of migration and the financial crisis caused by the fall of cocoa, in addition with the low government effort to solve the social problems of the locality.

Social inequality is often pointed out in Brazil as one of the main causes of violence and crime, and poverty and social exclusion are considered to be driving forces for violence in general (Souza, 2019). Although EFV is included in this context, it could be avoided, since it occurs mostly within the family, as evidenced in this study. Preventive actions as a way of raising awareness among the population could reduce the number of cases.

The EFV necessitate to be discussed in society and in health centers, this type of aggressiveness directly interferes with the individual's health, some victims even have anxiety, depression and psychosomatic symptoms (Yau et al., 2020).

The main limitation of the study is related to underreporting, despite the efficiency of Brazilian health programs, incomplete reporting or even non-reporting remains a problem found in studies like this, in addition to the scarcity of published works on the subject of EFV. However, works using geospatial tools are important for mapping priority areas and this study pointed to the regions of the state of Bahia that most have violence cases.

This research made it possible to identify areas at risk for the occurrence of violence, in addition to characterizing the victim population, with adults and elderly people most likely to suffer EFV. In addition, the trend of the study period and age groups were stable, but it was increasing for males, with this, prevention measures should be directed mainly to this group and, according to the spatial analysis, to the central-south region from Bahia.

It is important to emphasize that this study was developed before the Coronavirus pandemic and that the number of cases of violence in this period has probably increased due to greater personal contact between family members. Therefore, it is necessary to carry out new research that can show a more current scenario and also expand the study area to observe priority areas in other states or even throughout Brazil.

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