

Determinants of physical violence by intimate partners against indigenous women: a multi-level analysis

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Abstract *The aim is to evaluate the occurrence of physical violence by an intimate partner among indigenous women in the macro-region of Dourados, Mato Grosso do Sul, and its association with the individual factors of the women and the context of the municipalities in which the violent acts occurred. This work is a cross-sectional study carried out with reports registered in SINAN of indigenous women who suffered physical violence by an intimate partner in the Dourados macro-region, between the years 2009 to 2020. Descriptive statistics of the variables and multilevel logistic regression with random effects of the municipalities of occurrence were performed to determine the factors associated with physical violence by an intimate partner. Age (20 to 29 years and 30 to 39 years) and use of alcohol by the aggressor were positively associated with the occurrence of physical violence by an intimate partner. Pregnancy and the Gini Index were negatively associated. This study demonstrated that, in the Dourados macro-region, physical intimate partner violence against indigenous women occurs at different levels of society in the region. For the improvement of social relations, actions that reaffirm traditional culture and land regularization are important.*

Key words Violence against indigenous women, Multilevel analysis, Intimate partner violence, Social inequality

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Introduction

Intimate partner violence (IPV) refers to any behavior within an intimate relationship that causes physical, psychological, or sexual harm to the victim¹. Among women worldwide, approximately 30% of all women have experienced physical and/or sexual violence perpetrated by their partners over the course of their lives².

The occurrence of IPV is a complex phenomenon, and within a given location, it is necessary to consider the context and social and cultural norms that permeate the act³. According to several IPV researchers, individual factors related to the violent act (age, education, among others) partially explain the process. Therefore, it is necessary to analyze the interaction of IPV with factors related to the family, society, community, and culture in which individuals are inserted to identify the conditions related to the occurrence of the violent act⁴.

Among indigenous peoples, violence is impacted by European domination during the colonial period, which influenced the cultural practices of various peoples, suppressing language and religion, in addition to modifying the traditional family structure. This history of violence has made indigenous peoples vulnerable in relation to other peoples, causing socioeconomic and health inequalities that span several generations⁵.

Indigenous peoples are more likely to experience violence than non-Indigenous people, especially women. In some countries, such as Canada, women are disproportionately victims of violence. IPV is one of the main forms of violence experienced by Indigenous Canadian women, impacting victims, their families, and their communities^{6,7}. In a study conducted in Canada, six in ten Indigenous women have experienced IPV in their lifetime⁵.

The state of Mato Grosso do Sul has the second-largest Indigenous population in Brazil, with more than 116,000 Indigenous people who, in some regions, live in extreme poverty and violence both within and outside their communities^{8,9}. In this context, Indigenous women are affected by multiple forms of violence, particularly IPV¹⁰.

There is currently a lack of studies assessing the occurrence of IPV among Indigenous women and its associated factors. Addressing the contextual factors that permeate Indigenous lands is extremely important in order to understand the influence of non-Indigenous culture on the occurrence of IPV affecting women

in Indigenous territories. Therefore, this study aims to evaluate the occurrence of physical IPV among Indigenous women, reported by the health sector, in the macro-region of Dourados, Mato Grosso do Sul, and its association with the individual factors of the women and contextual factors of the municipalities in which the violent acts occurred.

Methodology

This is a cross-sectional study that analyzed secondary data from Indigenous women, aged 10 years and over, living in the Dourados macro-region, Mato Grosso do Sul, who experienced IPV and were reported to the National Notifiable Diseases Information System (*Sistema de Nacional de Agravos de Notificação* – SINAN) between 2009 and 2020. The data were provided by the Strategic Information Center for Health Surveillance (*Centro de Informações Estratégicas de Vigilância em Saúde* – CIEVS) of the state of Mato Grosso do Sul. A total of 1,384 reports from Indigenous women were analyzed.

The Dourados macro-region is located in the southern region of the state of Mato Grosso do Sul and consists of a population of nearly one million inhabitants distributed across 33 municipalities¹¹. Among Indigenous peoples, the region is predominantly inhabited by the Guarani and Kaiowá ethnic groups. The Terena Indigenous people, who are fewer in number in this region, are concentrated only in the municipality of Dourados¹².

The variables were structured hierarchically, with the first level being individual characteristics, characteristics of the aggressor, and characteristics of the violent act, and the second level being the contextual characteristics of the municipalities in which the acts of violence occurred (socioeconomic and level of violence in society).

The outcome variable was categorized as physical IPV (yes), with physical violence potentially associated with other types of violence. The comparison group consisted of other types of IPV (psychological, sexual, or other) (no), for which there was no record of physical violence. An affirmative response could be given for one or more types of violence. The first-level explanatory variables were divided into three groups:

- **Characteristics of women:** age range (10-19, 20-29, 30-39, 40-49, > 50 years); pregnant (yes; no); marital status (with partner; without partner);

- **Characteristics of the perpetrator:** alcohol consumption by the perpetrator (yes; no);
- **Characteristics of the violent act:** repeated violence (yes; no); place of occurrence (residence, other location);

The contextual variables of illiteracy rate, unemployment rate, average per capita household income, and proportion of low-income individuals were extracted from the 2010 demographic census by the Brazilian Institute of Geography and Statistics (IBGE)⁸.

The Gini Index and Municipal Human Development Index (MHDI) variables for 2010 were collected from the Human Development Atlas (United Nations Development Program - UNDP)¹³.

The male homicide rate was used to determine community-based violence. Data were collected from the Ministry of Health's Mortality Information System (SIM/MS). Codes X85-Y09 from Chapter XX - External causes of morbidity and mortality of the International Statistical Classification of Diseases and Related Health Problems (ICD) - 10th Edition were used to determine male homicides. The male homicide rate in each municipality was calculated as follows:

Male homicide rate:

$$\frac{(\text{N}^\circ \text{ of male homicides})}{(\text{Estimated male population})} \times 100 \text{ mil}$$

For statistical analysis, a descriptive analysis of the variables was first performed, presenting the frequencies and proportions of the categorical variables. The chi-square test was used to compare proportions according to the type of violence (physical and other forms of violence). Missing data, unfilled values, and unknown data were not evaluated. Because the values obtained presented diverse scales, the continuous variables underwent a normalization process using the following methodology:

$$X'_i = \frac{(X_i - X_{\min})}{(X_{\max} - X_{\min})}$$

Where: for each $i \in \{1, \dots, n\}$. Here, $X_{\max}$ is the largest entry of the vector X and $X_{\min}$ the smallest entry.

For data analysis, a multilevel logistic regression model was used, expanded by including random effects (municipality of occurrence). This modeling aimed to estimate the likelihood of Indigenous women experiencing physical intimate partner violence, considering the effect of municipalities.

For the multilevel analysis, the model was constructed according to the following five steps:

Step 1: construction of the model with no explanatory variables, using only the intercept (null model). This model indicated the likelihood of Indigenous women experiencing physical IPV, as compared to Indigenous women who experienced other types of IPV. This initial model served as the basis for the analyses of subsequent models.

Step 2: construction of a bivariate model with individual and contextual characteristics.

Statistically significant variables were entered into the multivariate model.

Step 3: all explanatory variables from the first level (individual) were introduced. This model assumed that the coefficients of the explanatory variables are fixed for all municipalities, that is, the individual characteristics of indigenous women are the same for all municipalities.

Step 4: the second-level (aggregate) explanatory variables were entered. This model aimed to quantify the influence of municipal characteristics on the likelihood of Indigenous women being victims of physical IPV.

Step 5: all coefficients were evaluated as to whether or not the first-level variables had significant variance components among the second-level units¹⁴.

To assess model fit, the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) were used. To estimate the variance of IPV against Indigenous women at the community level, the intraclass correlation coefficient (ICC) of the multilevel logistic regression was calculated, as follows:

$$\rho = \frac{\sigma_{00}^2}{\sigma_{00}^2 + \frac{\pi^2}{3}}$$

Where: σ_{00}^2 is the variance of the residual error at the aggregate level (level 2) e ($\pi = 3.1415926$) is the individual-level variance in the logistic model.

Fixed effects with their 95% confidence intervals (95%CI) and random effects were calculated and presented. The significance of including the random effect was assessed by comparing the models with and without the presence of the random effect of municipalities, using analysis of variance (ANOVA). R software, version 4.1.2, was used for statistical analyses. The R software libraries used were lmer for multilevel logistic regression and lattice to generate the random effects graph. A 5% significance level was adopted for all statistical tests.

The study was approved by the Research Ethics Committee of the Sergio Arouca National School of Public Health of the Oswaldo Cruz Foundation (CEP/ENSP-FIOCRUZ – opinion no. 5,274,177) and by the National Research Ethics Commission (CONEP – opinion no. 5,469,695). The State Health Department of the State of Mato Grosso do Sul signed the letter of consent for the research to be carried out, and the CIEVS provided the de-identified data from SINAN.

Results

Of the 33 municipalities in the Dourados macro-region, 22 municipalities reported violence against Indigenous women in the SINAN (Figure 1).

Table 1 shows that 68.2% of the Indigenous women experienced physical violence by an intimate partner. Of these, 33.9% were between 20 and 29 years of age, 14.1% were pregnant, and 86.3% had a partner. Regarding the perpetrator, 88.3% ($p < 0.001$) were under the influence of

alcohol. In the analysis of violent acts, repeated violence was present in 63.4% of the reports of physical violence. According to the place of occurrence, 90% of cases occurred at home. The differences in proportions were not significant for the variables of repeated violence ($p = 0.262$) and place of occurrence ($p = 0.437$) (Table 1). Table 2 presents the results of the multilevel logistic regression analysis, demonstrating the extent to which individual variables, the perpetrator, the violent act, and contextual characteristics are associated with IPV violence, including the random effect of the municipality of occurrence. The intraclass correlation coefficient (ICC) showed that 10.9% of the variation is related to the city of occurrence.

In model 1, bivariate analysis of the first-level variables was performed, and in the second level, the variables of age, 20 to 29 years (OR 2.03, 95%CI 1.39; 2.97), 30 to 39 years (OR 2.43, 95%CI 1.61; 3.66), 40 to 49 years (OR 2.85, 95%CI 1.61; 4.80), pregnant (OR 0.42, 95%CI 0.29; 0.60), alcohol intake (OR 2.75, 95%CI 1.90; 3.97), and Gini Index (OR 0.72, 95%CI 0.54; 0.96) were statistically associated with physical

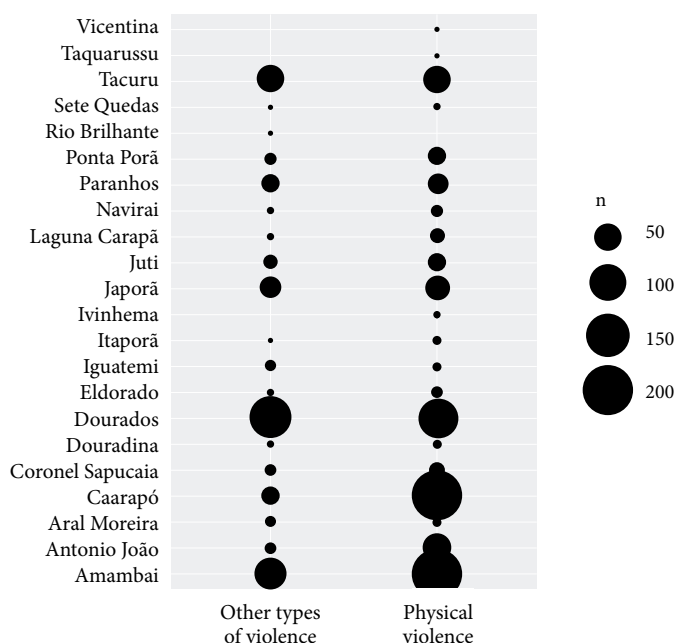


Figure 1. Intimate partner violence among Indigenous women in the Dourados macro-region, according to municipality of occurrence and nature of violence, 2009 to 2020.

Source: SINAN.

Table 1. Absolute and proportional distribution of the characteristics of Indigenous women with reports of intimate partner violence (IPV), according to type of violence, in the Dourados macro-region, 2009 to 2020.

Variables (N. of cases)	Physical violence		Non- physical violence		Total		p-value
	944 (68.2%)		440 (31.8%)		1,384 (100%)		
Woman's characteristics	N	%	N	%	N	%	
Age (,1384)							< 0.001
10 to 19	170	18.0	199	45.5	369	26.7	
20 to 29	320	33.9	101	23.0	421	30.4	
30 to 39	259	27.4	72	16.4	331	23.9	
40 to 49	112	11.9	36	8.2	148	10.7	
≥ 50	83	8.8	32	7.3	115	8.3	
Pregnant (1214)							< 0.001
No	705	85.9	234	59.5	939	77.3	
Yes	116	14.1	159	40.5	275	22.7	
Marital Status (1220)							0.032
No partner	115	13.7	70	18.4	185	15.2	
With partner	725	86.3	310	81.6	1.035	84.8	
Characteristic of the aggressor							
Alcohol intake (aggressor) (1164)							0.001
No	97	11.7	82	24.7	179	15.4	
Yes	735	88.3	250	75.3	985	84.6	
Characteristics of the violent act							
Repeated violence (1023)							0.262
No	264	36.6	99	32.9	363	35.5	
Yes	458	63.4	202	67.1	660	64.5	
Place of occurrence (1235)							0.437
Other location	89	10.0	30	8.6	119	9.6	
At home	797	90.0	319	91.4	1116	90.4	

Source: Authors.

IPV and were added to the multiple analysis (Table 2). In model 2, a multiple model with level 1 variables of age, pregnancy, and alcohol consumption remained statistically significant. In this model, 10.9% of the violent acts were attributed to municipalities. In model 3, in the random effect analysis of municipalities with the inclusion of the Gini index variable, 7.9% of violence was attributed to municipalities. In model 4, a multivariate analysis was performed with level 1 variables and the level 2 Gini index. The results demonstrate that age, with the age range between 20 and 29 years (OR 1.59, 95%CI 1.07; 2.37), 30 and 39 years (OR 1.75, 95%CI 1.13; 2.70), and 40 and 49 years (OR 1.98, 95%CI 1.15; 3.42) continued to be associated with the occurrence of physical IPV. They also demonstrated the protective effect of pregnancy compared to non-pregnant women (OR

0.56, 95%CI 0.38; 0.83), an increased chance of experiencing violence when the aggressor consumed alcohol (OR 2.08, 95%CI 1.40; 3.09), and a Gini coefficient (OR 0.69, 95%CI 0.53; 0.92), representing a lower chance of experiencing violence for women living in municipalities with greater inequality. In this model, 6.7% of the violent acts were attributed to municipalities. The inclusion of the random effect was significant in all models (Table 2).

Figure 2 shows that two municipalities (Dourados and Tacuru) have a negative random effect, decreasing the chance of Indigenous women experiencing physical IPV, while two municipalities have a positive random effect, increasing the chance of Indigenous women experiencing physical IPV (Caarapó and Antônio João).

Table 2. Distribution of odds ratios (OR) at the multilevel model, for physical violence by an intimate partner among Indigenous women in the Dourados macro-region, 2009 to 2020.

	Null Model ¹		Model 1 ²		Model 2 ³		Model 3 ⁴		Model 4 ⁵	
Variables level 1	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Age										
10 to 19	1		1						1	
20 to 29	2.03	1.39; 2.97	1.58	1.06; 2.36					1.59	1.07; 2.37
30 to 39	2.43	1.61; 3.66	1.75	1.13; 2.71					1.75	1.13; 2.70
40 to 49	2.85	1.69; 4.80	2.00	1.16; 3.45					1.98	1.15; 3.42
≥ 50	2.40	1.38; 4.17	1.63	0.91; 2.92					1.64	0.91; 2.94
Pregnant										
No	1		1						1	
Yes	0.42	0.29; 0.60	0.57	0.38; 0.84					0.56	0.38; 0.83
Marital Status										
No partner	1									
With partner	0.81	0.53; 1.24								
Alcohol intake										
No	1		1						1	
Yes	2.75	1.90; 3.97	2.07	1.39; 3.08					2.08	1.40; 3.09
Repeated violence										
No	1									
Yes	0.75	0.56; 1.09								
Place of occurrence										
At home	1.18	0.73; 1.91								
Other location	1									
Level 2 variables										
HDI	1.28	0.90; 1.81								
Male homicide rates	1.02	0.80; 1.29								
Gini Index	0.7	0.54; 0.96					0.72	0.54; 0.96	0.699	0.53; 0.92
Illiteracy Rate	0.80	0.56; 1.15								
Unemployment rate	1.02	0.82; 1.28								
Average per capita income	1.12	0.76; 1.65								
Proportion of people with 1/2 salaries	0.78	0.55; 1.11								
Random effect										
Variance	0.4028*				0.4035*		0.2827*		0.2396*	
ICC	0.1090				0.1092		0.0791		0.067	

^a Null multilevel model with random effects; ^b simple multilevel model for level 1 and 2 variables; ^c multiple multilevel model with level 1 variables; ^d level 2 multilevel model; ^e multiple multilevel model with level 1 and 2 variables. * p < 0.001.

Source: Authors.

Discussion

The historical process of rights violations and violence to which Indigenous peoples have been subjected over the years is influenced by contact with non-Indigenous populations, the loss of territory, and the exploitation of labor. This entire process of social, economic, and cultural change has influenced gender relations, making them conflictual and contributing to gender-based violence within communities¹⁵.

The percentage of physical violence in this study corroborates the results of other studies that analyzed reports of IPV from SINAN. In a study that analyzed IPV reports between 2011 and 2017 in Brazil, the percentage of physical violence was 86.6%¹⁶.

At the individual level, Indigenous women, aged 20 to 29, 30 to 39, and 40 to 49 years, were more likely to experience physical IPV compared to women aged 10 to 19. In a study that analyzed the trend of physical IPV in the state of

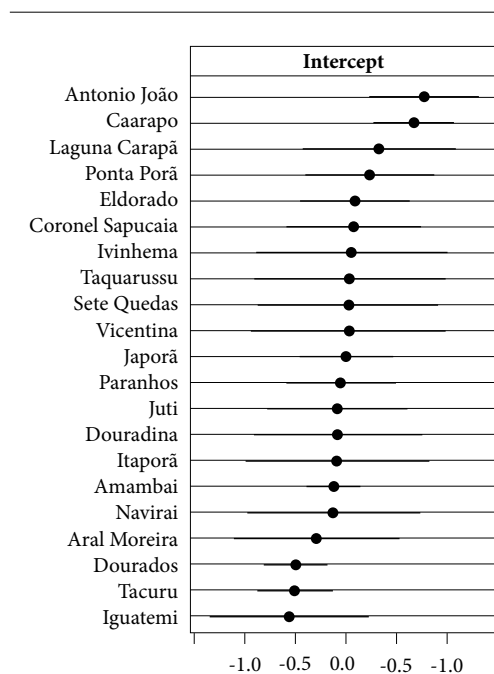


Figure 2. Random effects related to the municipalities where acts of physical violence by an intimate partner occurred and their respective confidence intervals. Dourados Macroregion, 2009 to 2020.

Source: Authors.

Paraná, between 2009 and 2012, the highest percentage of physical violence was among women, aged between 30 and 39 years, while between 2013 and 2016 it was among women, aged 20 to 29 years¹⁷.

In Guarani and Kaiowá communities, changes in social relations can influence the occurrence of gender-based violence, including IPV. In these ethnic groups, social relations are based on the unit called “home fire,” controlled by women, who play an important role in maintaining traditional culture. However, there has been a reallocation of gender activities within the home fire, observed when women leave their territories to engage in paid work or when they consume excessive amounts of alcohol. Among men, this reallocation process is observed when they also seek urban environments for paid work due to the difficulty in carrying out traditional subsistence activities¹⁸. This change in social relations, experienced by women, who are of childbearing age and economically active,

can contribute to the weakening of gender relations and an increase in the occurrence of IPV, including physical violence.

In this study, pregnant Indigenous women were less likely to experience physical IPV, when compared to non-pregnant women. During pregnancy, women become increasingly concerned about their bodies and the management of the pregnancy, reducing their physical and emotional availability, which can lead to gender conflict¹⁹. In a cohort study of pregnant women in Recife in 2011, 40.7% of women experienced some type of IPV. In the state of Maranhão, in the city of São Luís, a study of 971 pregnant women showed that 50.2% experienced some type of violence (physical, sexual, and/or psychological) perpetrated by their intimate partners²⁰, with psychological violence being the most prevalent, at 49.2%²¹. In a study conducted in Rio de Janeiro with 526 postpartum women, physical violence during pregnancy occurred primarily among women with less education, who did not work outside the home, and who had fewer prenatal appointments²². Factors that may possibly contribute to the protective factor of pregnancy against physical IPV are: greater sensitivity of the woman during pregnancy, the risk of miscarriage, and the possibility of identification of physical violence by the health professional during the prenatal consultation.

Alcohol is heavily consumed by men, potentially causing mood swings and increased aggression, leading to gender-based violence and being associated with the occurrence of IPV²³. A study conducted with 12,300 women in Canada highlighted the association between alcohol and IPV. Canadian women were five-fold more likely to experience violence when their partner consumed alcohol²⁴. In an analysis of IPV and alcohol consumption in Brazil, 44.6% of men consumed alcohol during the violent episode²⁵.

For the Brazilian Indigenous population, alcohol consumption on Indigenous lands is a problem, exacerbated by the vulnerability of these people²⁶. Consumption in Indigenous territories and reservations is associated with the ease with which alcohol enters the land, making it an accessible consumer good. A study conducted with indigenous people of the Karitiana ethnic group, located in the state of Rondônia, indicates that contact with the non-indigenous population in this ethnic group has favored an increase in alcohol consumption in the community, especially during festivities²⁷. Alcoholism has weakened the organizational structure of indigenous communities, increasing the preva-

lence of mental disorders, physical aggression, and gender-based violence²⁸.

In the bivariate multilevel model with variables relating to the municipalities' contextual characteristics, there was no association with the occurrence of physical intimate partner violence, except for the Gini coefficient variable. Violence is related to the socioeconomic characteristics of municipalities, as the increase in urban violence is associated with social inequality, unemployment, urban segregation, a culture of masculinity, drug trafficking, alcohol and other drug use, and the availability of firearms²⁹. The Dourados macroregion has municipalities on the border with Paraguay with high crime rates and high homicide rates, primarily associated with drug trafficking³⁰. The result was similar to that of a study conducted in the municipality of São Paulo, in which, through multilevel analysis, IPV was not associated with the male homicide rate in the neighborhood where the woman lives³¹.

Social inequalities are responsible for the feedback loop of structural violence, the increase in alcohol and illicit drug use, and the increase in violence against women³². The Gini coefficient is an indicator that analyzes inequality and is associated with the occurrence of violence against women, as rates of violence tend to be higher in more unequal societies, with higher levels of poverty and fragile social relations³³. In the present study, women living in municipalities with lower inequality rates are more likely to experience IPV, which disagrees with the findings of other studies. In a study that analyzed the temporal trend of femicide by assault between 2002 and 2012 in Brazil, it was observed that mortality by assault was higher in states with greater inequality³⁴. The likely explanation for the association of the Gini coefficient with the occurrence of physical IPV found in this study may lie in the historical context of the creation and location of Indigenous Reservations in the southern region of Mato Grosso do Sul. However, further studies are needed to investigate this hypothesis.

In the Dourados macro-region, the Indigenous struggle for traditional territories has generated conflicts between farmers, Indigenous people, and police forces. These conflicts are most intense in the region's largest municipalities, which have lower levels of inequality and the largest Indigenous populations confined to reservations³⁵.

A common characteristic of these municipalities is the creation of reservations for the

confinement of Indigenous people³⁶. Understandably, Indigenous people in the region face an organizational dilemma, generating social unrest, especially in the most populated villages, with high rates of violence, delinquency, and other social problems¹⁸. Therefore, this scenario of territorial conflict, coupled with high population density and marginalization, especially in the largest municipalities of the Dourados macro-region, contributes to the modification of gender relations among Indigenous people and the increase in physical IPV.

In the analysis of the random effect of municipalities on the occurrence of physical violence by an intimate partner, Dourados and Tacuru showed a negative random effect, with a smaller variation in physical IPV, while Caarapó and Antônio João showed a positive random effect. In these municipalities, the Indigenous population lives confined to reservations, Indigenous lands, and reclaimed areas, the latter of which is not recognized by the state. Despite these inequities, due to the social determinants in which the municipality's Indigenous population lives, the municipality of Dourados offers specialized health services, which serve as a reference for the macro-region, and a support network in cases of violence. The Dourados Indigenous Reservation has two Social Assistance Reference Centers (CRAS). The Military Police and the Civil Police, through the Women's Assistance Police Station (DEAM), carry out actions with women and leaders to prevent IPV on the Dourados Indigenous Reservation. The municipality also provides booklets on the Maria da Penha Law in the region's native Indigenous language to raise awareness about violence against women³⁷.

Therefore, although the Indigenous population is living in high population density and marginalized conditions in some territories, the presence of the state, implementing actions tailored to the specificities of each territory, is important in order to prevent and reduce the occurrence of violence against Indigenous women. However, caution is needed in this analysis, as difficulties in notifications and reporting violence due to logistical and intercultural issues, such as the lack of translators in reporting units, can lead to underreporting and the perception of a low percentage of physical violence in some municipalities.

This study had some limitations. By using SINAN data, only women notified by health services were analyzed. Because these are secondary data, important variables for determin-

ing the association with IPV were not analyzed due to incompleteness. Furthermore, it was also not possible to analyze disparities between ethnicities. The number of reports was also a limiting factor. Due to underreporting and incorrect reporting of the race/color variable, the number of cases may have been higher, which directly influenced the multilevel analysis. Due to the ethnic diversity of Indigenous peoples, the results of this study cannot be applied to people from other regions.

Another limitation of the study was the comparison group used, as women victims of physical violence were compared with women who experienced other types of violence. This comparison was made due to the use of a secondary database composed solely of cases of violence, and the high percentage of physical IPV. However, other studies that also used secondary data have compared two groups exposed to different types and natures of violence³⁸.

This study is relevant to public health, as it identified the profile of women victims of physical IPV reported by health services and the association of this violence with contextual factors. Furthermore, it can also serve as a basis for studies in other populations.

Conclusion

IPV among Indigenous people is a complex phenomenon that requires consideration of historical, cultural, social, and economic aspects. Changes in traditional relationships and intense contact with non-Indigenous people have contributed to the occurrence of violent acts within Indigenous lands and reservations. This study demonstrated that, in the Dourados macro-region, physical IPV against Indigenous women occurs at different levels within the Indigenous society of the region.

Therefore, public policies are needed to raise awareness and reduce IPV within and outside Indigenous territories, in addition to establishing a support network for victims of violence, taking into account the cultural characteristics of the Indigenous population. Actions that reaffirm traditional culture and legalize traditional lands are also needed, which can contribute to improving social relations and reducing IPV among this population.

Collaborations

GA Freitas contributed to the study conception and design, data acquisition, analysis, and interpretation, and drafting, critically reviewing, and writing preliminary versions of the article. CMPF Silva contributed to the study conception and design, data analysis and interpretation, and critically reviewing important intellectual content. JR Welch and GEB Marcon contributed critical review. All authors approved the final version and are responsible for all aspects of the work, ensuring that questions related to the accuracy and integrity of any part of this work are properly investigated and resolved.

Data availability statement

The data sources used in the research are indicated in the body of the article.

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