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ORIGINAL ARTICLE

Gender and race inequalities in adolescent and young adult homicide mortality rates: a multilevel ecological analysis of Brazilian municipalities

Iniquidades de gênero e raça na mortalidade de adolescentes e adultos jovens por homicídio: uma análise ecológica multinível dos municípios brasileiros

Kezauyn de Miranda Aiquoc[I], Ana Mayara Gomes de Souza[I], Talita Araujo de Souza[II], Arthur de Almeida Medeiros[I,III], Isabelle Ribeiro Barbosa[I]

[I]Universidade Federal do Rio Grande do Norte, Postgraduate Program in Public Health – Natal (RN), Brazil.
[II]Universidade Federal do Rio Grande do Norte, Postgraduate Program in Health Sciences – Natal (RN), Brazil.
[III]Universidade Federal do Mato Grosso do Sul, Integrated Health Institute – Campo Grande (MS), Brazil.

ABSTRACT

Objective: The aim of this study was to analyze the relationship between adolescent and young adult homicide mortality rates in Brazilian municipalities according to gender, race, and contextual characteristics at the municipal and federation unit levels. **Methods:** This is an ecological study that used secondary data available from the death records of the Mortality Information System and socioeconomic data from the Brazilian Census. The dependent variables were homicide mortality rates among people aged 15–29 years by sex and race from 2015 to 2017. The contextual variables were related to education, income, schooling, and vulnerability. Multilevel linear regression was applied in an ecological model to verify the first- and second-level variables' effect. Each variable's effect was estimated using β and its respective confidence intervals (95%CI) and statistical significance. **Results:** There was a direct and significant relationship between the adolescent and young adult mortality rates and the homicide mortality rates among adults, regardless of sex and race/skin color. However, this relationship was more pronounced among black adolescents and young adults. At the federative unit level, the human development index was significantly related to the mortality rates of black men, white men, and white women. **Conclusion:** There is racial inequality in adolescent and young adult mortality from violence in Brazil; the rates are related to municipal characteristics, such as violence in the adult population and inequalities in education and social protection.

Keywords: Violence. Homicide. Racism. Socioeconomic factors. Multilevel analysis.

CORRESPONDING AUTHOR: Isabelle Ribeiro Barbosa. Rua Princesa Leopoldina, 3.466, Candelária, CEP: 59065-100, Natal (RN), Brazil. E-mail: isabelle.ribeiro@ufrn.br

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INTRODUCTION

According to the World Health Organization, violence is characterized as the intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment, or deprivation[1]. Currently, the global rate of violent death has been decreasing, but there is evidence of critical regional inequalities. While Europe and Asia have rates below the global average (6.2 deaths per 100,000 people), the Americas and Africa report mortality rates as high as 17.2 and 13.0 deaths per 100,000 people, respectively[2].

With almost 60,000 murders per year, Brazil alone accounts for 11% of homicides in the world[3,4] and is one of the seven countries with the highest number of homicides in the Americas, where mortality from violence stands out and represents a cause of concern in the political and social spheres, not only due to the physical and psychological damage caused but also due to the number of deaths[5].

While the magnitude of homicides in the population can be considered very high, young people have a socially endemic character. The violent death of young people in Brazil, especially in large urban centers, has been a growing problem since the 1980s, a tragedy with implications for the country's health and demographic dynamics and economic and social development process[5,6].

Violence unequally affects the population, generating different risks depending on sex, race/color, age, and social space. The factors related to death include socioeconomic status, family constitution, domestic environment, age and personality traits, sex of the victim, the victim's ethnicity, use of alcoholic beverages and chemicals, biological factors, and multicausal factors[7]. As for demographic factors, black adolescents and young people have often been identified as the main victims of the various types of violence, indicating that age and race/skin color are closely related to the external causes of mortality[8].

It is noteworthy that the ethnic-racial aspect represents an important factor of exposure to violence. Black and indigenous populations in Brazil have, among other aspects, worse levels of education and employment in addition to less access to goods and services as a result of the influence of health determinants and issues related to racial belonging[9,10]. It is the invisible or original violence encoded into visible violence and a complex, multifaceted phenomenon resulting from multiple determinations, closely linked to social processes based, in the last instance, on an unequal and unjust social structure[11].

The relationship of young people with violence in general and specifically in homicides is ambivalent. Sometimes they are victims, and sometimes they are the authors of these events. This complex relationship raises the need to understand the dynamics of the homicide phenomenon in this specific group[1]. The process of vulnerability to violence starts in childhood. Therefore, young people tend to trigger the perpetuation of harmful practices experienced in childhood and adolescence[12].

The association between violence, poverty, and citizenship, passing through the territorial dimension, has interrupted the lives of a generation of young people in the country. Studies on homicidal violence, from the perspective of race/skin color and age, have proved to be a particularly fruitful source of discoveries for analyzing factors that affect the production and reproduction of homicidal violence in Brazil.

Thus, this study aimed to analyze the relationship between adolescent and young adult homicide mortality rates in Brazilian municipalities according to gender, race/skin color, and contextual characteristics at the municipal and federation unit level in multilevel modeling.

METHODS

This is a population-based ecological study that used secondary data available from the death records of the Mortality Information System of the Ministry of Health of Brazil and socioeconomic data from the Brazilian Census.

This study analyzed the relationship between a dependent variable that expresses adolescent and young adult mortality from violence (homicides) and independent contextual variables by fitting a multilevel linear regression model where the first level corresponded to municipal variables and the second level to contextual variables concerning the federation unit.

The study's dependent variable was the average homicide mortality rate per Brazilian municipality of residence according to gender and race/skin color from 2015 to 2017. This rate was obtained by dividing the number of homicide deaths of people aged 15–29 years by the number of people in the same age group, gender, and race/skin color, living in the municipality. Results are presented in terms of deaths per 100,000 inhabitants. The categories of race/skin color used in this study were white and black, where the latter included black and brown people. All information about the deaths was taken from the website of the Department of Informatics of the SUS (datasus.saude.gov.br).

For the dependent variable, we analyzed the registered deaths in codes X85 to Y09 of the *International Classification of Diseases* and health-related problems in its 10th review (*ICD-10*), which occurred in the period from 2015 to 2017 in 5,570 Brazilian municipalities. The results of 3 years were included to reduce the influence of annual random variability, an important issue for small municipalities.

Among the first ecological level (municipality), the quantitative independent variables were per capita income, schooling, and child poverty. Per capita income was used to assess gross income, which is the ratio between the sum

of the income of all individuals living in permanent private households and the total number of these individuals.

The effect of schooling on the levels of violence was tested. The variable used was the proportion of individuals aged 18 years or over with at least primary education, called "schooling." The "schooling" is the ratio between the population aged 18 years or over who completed primary school and the total population.

A variable expressing child poverty was included to analyze the social vulnerability, namely, the "proportion of individuals up to 14 years of age who had a per capita household income of up to R$ 140.00 monthly (August 2010)"[13]. The "Average homicide mortality rate in the population aged 30 to 59 years for the 2015-2017 period" was included to test whether the mortality of an adolescent and a young adult follows the same pattern as that of the adult population. The socioeconomic information for each Brazilian municipality was extracted from the United Nations Development Program based on data from Brazil's Human Development Atlas[13]. Population data were obtained from the 2010 Brazilian Census, informed by the Brazilian Institute of Geography and Statistics[14].

Brazil is a decentralized country, and each municipality must guarantee health, education, drinking water, and basic sanitation services through national economic resources transferred to the municipalities and the federation units. With the hypothesis that adolescent and young adult homicide rates can be affected by regional factors, each of the 26 states in Brazil and the federal district were included as the second level of the model. Among the second ecological level variables, the study considered the average values in *Reais* (R$) for 2012–2014, adjusted per capita, which the government sent to each state to finance education/culture and public security. In addition to these variables, the "Human Development Index of the state" was included. This information was obtained from the Institute of Applied Economic Research[15], based on the Ministry of Finance – National Treasury Secretariat data.

The relationship between the homicide mortality of an adolescent and a young adult and contextual variables was tested and fitted in a multilevel linear regression model. The effect was estimated through β and its respective confidence intervals (95%CI) and statistical significance. Variables with significant relationships in the bivariate analyses ($p<0.20$) were included in the multivariate model. In the first stage, the contextual effect was assessed based on a null model using the likelihood ratio test to verify significance. Subsequently, two models were tested: model 1, only with municipal-level variables; and model 2, with municipal-level and federation unit-level variables. Collinearity between explanatory variables was verified by calculating the variance inflation factor. Data analysis was performed using the statistical software STATA 13 and SPSS 25.0.

RESULTS

From 2015 to 2017, 182,725 deaths from aggression occurred in Brazil, and of these, 93,541 (51.19%) occurred in the population aged 15–29 years. Of these, 94.28% of cases affected the male population. Brazil recorded a mortality rate of 168.31 deaths per 100,000 black men and 50.94 deaths per 100,000 white men. In the same period, there was a mortality rate of 9.53 deaths per 100,000 black women and 4.16 deaths per 100,000 white women.

In the results of the bivariate analysis, for mortality rates among young blacks (both sexes), most municipal- and federal-level variables showed a significant relationship with these results (Table 1).

Tables 2 and 3 show a contextual effect at the federation unit level for the four outcomes since the likelihood ratio value was significant for all, showing the sample's adequacy for the analysis.

For male mortality rates (Table 2), model 1 revealed that the mortality rates of young black men had a significant and direct relationship with the variables "schooling" and "homicide rate among adults" and had a significant inverse relationship with the variable "child poverty." The model 2 was composed of three municipal variables and the variable "human development index" at the federation unit level.

For the mortality of young white men, in model 2, the variables "schooling" and "homicide rate among adults" maintained a direct and significant relationship, while the variables "per capita income," "child poverty," and "security investment" maintained an inverse and significant relationship (Table 2).

For the mortality rate among black women, the only variable that showed a significant relationship with the outcome in both models was the "homicide rate among adults." Variables at the level of the federation units lost significance in model 2.

For the mortality rate among white women, in model 2, only the variables "homicide rate among adults" and "human development index" remain significant (Table 3). The variable "homicide rate among adults" had a direct and significant relationship with the mortality rate among adolescents and young adults, and the most significant relationships were observed between black men and black women.

DISCUSSION

The main findings of this study demonstrate that there is racial and gender inequality in the mortality of adolescents and young adults due to violence in Brazil. Corroborating the findings of this study, the results of the Global Burden of Disease 2019 revealed inequalities in the violent mortality of adolescents and young adults according to sex, causes, regions, and Brazilian-federated units[9,16].

Table 1. Bivariate analysis between the mortality outcomes of young people aged 15–29 years and variables of the municipal and state context. Brazil, 2015–2017.

	Mortality rates black men				Mortality rates white men			
	R^2	β	95%CI	p-value	R^2	β	95%CI	p-value
Municipal level								
Per capita income	0.016	-0.06	-0.07; -0.04	<0.001	0.004	0.01	0.009; 0.02	<0.001
Schooling	0.001	0.30	0.01; 0.60	0.041	0.019	0.81	0.66; 0.87	<0.001
Child poverty	0.024	0.83	0.69; 0.97	<0.001	0.008	-0.25	-0.32; -0.18	<0.001
Homicide rate among adults	0.261	2.15	2.06; 2.25	<0.001	0.069	0.58	0.52; 0.63	<0.001
Federation unit level								
HDI	0.083	-727.28	-790.87; -663.69	<0.001	0.001	36.77	2.16; 71.38	0.037
Security investment	0.012	0.02	0.01; 0.02	<0.001	0.0001	-0.00006	-0.003; 0.002	0.960
Education investment	0.013	0.008	0.006; 0.01	<0.001	0.000008	-0.0004	-0.001; 0.000	0.328
	Mortality rates black women				Mortality rates white women			
	R^2	β	95%CI	p-value	R^2	β	95%CI	p-value
Municipal level								
Per capita income	0.001	-0.004	-0.007; -0.001	0.003	0.002	0.004	0.002; 0.006	0.001
Schooling	-0.00001	-0.013	-0.07; 0.05	0.709	0.001	0.06	0.02; 0.11	0.004
Child poverty	0.001	0.03	0.006; 0.06	0.021	0.004	-0.05	-0.08; -0.03	<0.001
Homicide rate among adults	0.017	0.12	0.09; 0.14	<0.001	0.002	0.03	0.01; 0.04	0.001
Federation unit level								
HDI	0.002	-28.24	-43.09; -13.39	<0.001	0.004	24.68	14.16; 35.19	<0.001
Security investment	0.001	0.001	0.00; 0.002	0.018	-0.0001	0.0001	-0.001; 0.001	0.659
Education investment	0.0003	0.0003	-0.00005; 0.001	0.085	-0.0001	-0.00008	-0.0003; 0.0002	0.585

R^2: coefficient of determination in a regression model; β: regression beta coefficients; CI: confidence interval; HDI: Human Development Index.

Table 2. Multilevel linear regression analysis of young males' mortality rates according to race/skin color and municipal and federation unit contextual variables.

Race/skin color: black								
	Null model (n=5,565)		Model 1 (n=5,565)			Model 2 (n=5,565)		
	β	95%CI	β	95%CI	p-value	β	95%CI	p-value
Constant	110.23	87.73; 132.73	-20.23	-51.23;10.76	0.201	584.47	333.78; 835.17	<0.001
Schooling			2.34	1.96; 2.71	<0.001	2.33	1.95; 2.70	<0.001
Child poverty			-0.56	-0.83; -0.30	<0.001	-0.63	-0.90; -0.36	<0.001
Homicide rate among adults			1.66	1.56; 1.76	<0.001	1.65	1.55; 1.75	<0.001
HDI						-858.12	-1209.61; -506.63	<0.001
Random effects								
Variance (95%CI)	3,321.58 (1,909.68; 5,777.35)		2,826.57 (1,609.71; 4,963.29)			1477.94 (834.90; 2616.22)		
LR test (p-value)	1,255.81 (p<0.001)		739.87 (p<0.001)			506.31 (p<0.001)		
Race/skin color: white								
	Null model (n=5,565)		Model 1 (n=5,565)			Model 2 (n=5,565)		
	β	95%CI	β	95%CI	p-value	β	95%CI	p-value
Constant	34.48	27.81; 41.15	-3.70	-19.46; 12.04	0.645	-1.22	-16.93; 14.48	0.879
Per capita income			-0.02	-0.04; -0.01	<0.001	-0.02	-0.04; -0.01	<0.001
Schooling			1.06	0.81; 1.32	<0.001	1.07	0.82; 1.33	<0.001
Child poverty			-0.30	-0.48; -0.13	0.001	-0.30	-0.48; -0.12	0.001
Homicide rate among adults			0.60	0.54; 0.66	<0.001	0.60	0.54; 0.66	<0.001
Security investment						-0.005	-0.01; -0.001	0.027
Random effects								
Variance (95%CI)	263.93 (142.81; 487.79)		172.66 (87.79; 339.58)			152.44 (79.11; 293.75)		
LR test (p-value)	323.13 (<0.001)		220.53 (p<0.001)			218.12 (p<0.001)		

β: regression beta coefficients; CI: confidence interval; HDI: Human Development Index; LR: likelihood ratio.

Table 3. Multilevel linear regression analysis of young women's mortality rates according to race/skin color and municipal and federation unit contextual variables.

Race/skin color: black								
	Null model (n=5,565)		Model 1 (n=5,565)			Model 2 (n=5,565)		
	β	95%CI	β	95%CI	p-value	β	95%CI	p-value
Constant	8.23	6.91; 9.56	4.09	2.76; 5.41	<0.001	4.09	2.76; 5.41	<0.001
Homicide rate among adults			0.11	0.09; 0.14	<0.001	0.11	0.090; 0.14	<0.001
Random effects								
Variance (95%CI)	6.73 (2.88; 15.74)		2.38 (0.59; 9.55)			2.38 (0.59; 9.55)		
LR test (p-value)	27.71 (<0.001)		4.61 (0.015)			4.61 (0.015)		
Race/skin color: white								
	Null model (n=5,565)		Model 1 (n=5,565)			Model 2 (n=5,565)		
	β	95%CI	β	95%CI	p-value	β	95%CI	p-value
Constant	3.72	2.77; 4.67	4.56	3.20; 5.92	<0.001	-25.03	-36.94; -13.12	<0.001
Child poverty			-0.06	-0.08; -0.03	<0.001			
Homicide rate among adults			0.04	0.02; 0.06	<0.001	0.048	0.03; 0.06	<0.001
HDI						38.49	21.88; 55.10	<0.001
Random effects								
Variance (95%CI)	3.50 (1.50; 8.16)		1.37 (0.34; 5.42)			1.60 (0.54; 4.67)		
LR test (p-value)	27.07 (<0.001)		6.25 (0.006)			11.58 (0.0003)		

β: regression beta coefficients; CI: confidence interval; HDI: Human Development Index; LR: likelihood ratio.

Differentials in the risk of death of young people in the country are also explained by the household conditions and the living conditions in the municipalities and states; in Brazil, those poor young people living in more developed areas are more at risk of dying[16].

This study found a direct and significant relationship between adolescent and young adult mortality rates and homicide mortality rates among adults, which was more pronounced among black males. In capitals and large cities, homicides are concentrated in areas occupied by low-income populations and the lowest provision of services, with precarious urban infrastructure and low levels of human development. Several indicators of deficiency superimposed in the same place increase the chances of people being targets of the problems in question[17].

The racism that structures the Brazilian society results, for the black population, in poverty, marginalization, precarious work, and low schooling, as well as belonging to places with high rates of violence due to environmental and housing segregation[18]. In the United States, while young blacks witnessed and suffered more community violence than those of other ethnicities, the white population suffered the least because of living in safer places than minorities[19].

Widespread violence in the population, expressed in homicide mortality among adults, was also related to young women's mortality. However, this relationship was more pronounced among black women. In the Brazilian cultural scenario, consolidated on the pillars of patriarchy, the black woman is subject not only to gender violence but also to racism[20]. Besides the damage to physical and mental health, domestic violence, sexualization, and poverty are the main factors related to this population's victimization[21].

In this study, it was identified that child poverty was related to mortality by violence. Childhood and adolescence are considered to be stages of development where everything that happens in their environment, especially in their families and in the place where they live, returns directly to the most vulnerable children[22]. The cultural opportunities and relational skills provided by families in poverty are necessarily less extensive and diversified, which results in less favorable conditions for the development and well-being of poor children. The situation is further exacerbated when, due to the poverty of families, other specific social conditions are associated, such as belonging to ethnic groups or minorities[23].

The relationship between high schooling areas and violence against white and black men was also identified. In a meeting defined by the prevailing socioeconomic organization and by the individualistic cultural formation of low solidarity and patriarchal values, the culture of force, machismo, and consumption is exacerbated, which deepens prejudices. In addition to this, the lack of respect for diversity and intolerance toward the poor, blacks, women, and other minorities are the factors of conflicts and deaths.

The fragile governance of a State that does not look after everyone, serving dominant interests, increases inequities and violence[24].

In England, it was found that a 1-year increase in the average schooling levels of men reduced the rates of conviction for violent crimes by approximately one-third to fifty percent[25]. The application of public resources in cultural investments and educational improvement directly influences individuals' lower involvement with violent acts[26]. Therefore, it is essential to invest in quality education in order to promote the reduction of violence.

For white men, the inverse relationship between investment in public security and homicide rates was also identified. Nóbrega Jr, analyzing the effects of public security expenditures in the Northeast, concluded that there is a significant and negative relationship between public security expenditures and homicides[27].

Creating new public security policies, increasing the number of police officers, vehicles to meet demands more quickly, and installing more sophisticated means of detecting illicit acts, such as surveillance cameras on the streets, should reduce crime rates[28].

Several economic, education, and public safety, and social welfare policies were implemented in Brazil to minimize violence: the *Peace in Schools Program* that trained teachers with an emphasis on Ethics and Citizenship; Maria da Penha Law, of 2006, to combat all forms of violence against women; and ordinance number 737 of 2001, establishing the National Policy for Reducing Morbidity and Mortality from Accidents and Violence[29]. Another initiative to combat the violent mortality of black youth was the creation of the Living Youth Plan, intending to structure actions to defend the lives of this specific group of people, especially those in situations of greater social and economic vulnerability[30].

This study's limitations are related to the use of secondary data, which is subject to underreporting, although the records on mortality in Brazil have improved considerably in terms of quality in recent decades. Another limitation refers to the study's design; the possibility of ecological bias is always considered a limitation for the use of ecological correlations.

Despite the limitations, the data made it possible to understand the relationship between mortality from violence and the Brazilian municipalities' socioeconomic context. The contributions of this study, in turn, are the subsidies generated for public policies with an emphasis on preventive actions, which can be used as a criterion for more equitable distribution of public resources, prioritizing the most vulnerable population groups.

The scenario of racial and gender inequality in adolescent and young adult homicide in Brazil was significantly evident. Living conditions in the municipalities are influenced by contextual factors of the federation units, and being a black man or a black woman was identified as determinants for the vulnerability of this population to violence. Thus, the still alarming scenario of homicides among the black population and its determinants reinforces the importance of debating the tools to fight this problem. It is essential to promote the social deconstruction of the stigma that associates black people with criminality and, at the same time, to implement policies to reduce racial inequalities.

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RESUMO

Objetivo: Analisar a relação entre as taxas de mortalidade por homicídios de adolescentes e adultos jovens em municípios brasileiros segundo sexo, raça e características contextuais nos níveis municipal e das unidades da federação. **Métodos:** Estudo ecológico que utilizou dados secundários disponíveis nos registros de óbitos do Sistema de Informação sobre Mortalidade e dados socioeconômicos do Censo Brasileiro. As variáveis dependentes foram as taxas de mortalidade por homicídio entre pessoas de 15 a 29 anos, por sexo e raça, de 2015 a 2017. As variáveis contextuais foram relacionadas a escolaridade, renda, escolaridade e vulnerabilidade. A Regressão Linear Multinível foi aplicada em um modelo ecológico para verificar o efeito das variáveis de primeiro e segundo nível. O efeito de cada variável foi estimado por meio de β e seus respectivos intervalos de confiança (IC95%) e significância estatística. **Resultados:** Houve relação direta e significativa entre a taxa de mortalidade de adolescentes e adultos jovens e as taxas de mortalidade por homicídio entre adultos, independentemente de sexo e raça/cor da pele. No entanto, essa relação foi mais acentuada entre os jovens negros. No nível das unidades federativas, o Índice de Desenvolvimento Humano foi significativamente relacionado às taxas de mortalidade de homens negros, homens brancos e mulheres brancas. **Conclusão:** Há desigualdade racial na mortalidade de adolescentes e adultos jovens por violência no Brasil; os índices estão relacionados a características municipais, como violência na população adulta e desigualdades na educação e na proteção social.

Palavras-chave: Violência. Homicídio. Racismo. Fatores socioeconômicos. Análise multinível.

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