

ORIGINAL ARTICLE

Why Brazilian women suffer more from depression and suicidal ideation: a mediation analysis of the role of violence

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Objective: We aimed to investigate the mediating effect of violence by a family member or acquaintance on biological sex, depression and suicidal ideation.

Methods: We used data from the 2013 Brazilian National Health Survey, a cross-sectional nationwide survey. Major depressive episode and suicidal ideation were evaluated with the Patient Health Questionnaire. Violence victimization and other sociodemographic variables were self-reported. We used logistic regression to estimate the OR, 95%CI and G-computation to calculate the natural direct and indirect effects.

Results: A total of 60,202 individuals were evaluated. Women had higher prevalences of major depressive episode (OR = 2.36; 95%CI 2.03-2.74), suicidal ideation (OR = 2.02; 95%CI 1.73-2.36) and violence victimization (OR = 1.73; 95%CI 1.45-2.06). The mediation analysis showed that 10.6% of the association between sex and major depressive episode and 8.0% of the association between sex and suicidal ideation is explained by violence.

Conclusions: Women in Brazil have an increased risk of major depressive episode and suicidal ideation, and this association is mediated, in part, by the fact that they suffer more violence from family members or acquaintances.

Keywords: Depression; suicide; violence; sex; population-based study

Introduction

Depression and suicidal ideation are about two to three times higher in women than men.¹⁻⁷ Theories explaining this higher risk focus on biological issues, despite the evident impact of social variables and inequities. Although scientists have reported this gap for many decades, empirical evidence explaining this difference is scarce.⁸⁻¹⁰

Violence is a global public health problem and women are at a higher risk of victimization, especially from family members or acquaintances.¹¹⁻¹⁵ According to the United Nations' Sustainable Development Goals Report 2019, from 2005 to 2017, 18% of women between 15 and 49 years of age had experienced physical and/or sexual violence by an intimate partner in the previous 12 months. The majority (64%) of victims of intimate partner/family-related homicides in 2017 were also women.¹⁶

Violence may lead to death in the most extreme cases, and when it does not, it could have important consequences for the victim's mental health and quality of life, independently of the type of violence (physical, sexual, economic or psychological).¹⁷ Many studies have

demonstrated the association between violence and mental illness, and that certain kinds of violence, such as that by intimate partners or acquaintances, are more prevalent in women. Other studies have shown that violence might play different roles in depressive disorder in men and women in adulthood.^{12,13} Gender inequality and exposure to severe adversity, especially violence, might explain the higher prevalence of certain mental disorders in women.^{10,12,13}

Nevertheless, little is known about the role of violence in the causal pathway of mental disorders in both sexes, and none have explored it using a counterfactual framework. Therefore, the aim of this study was to investigate the mediating effect of violence in the association between biological sex and depression or suicidal ideation in adult respondents to a nationwide Brazilian survey.

Methods

This study used data from the 2013 National Health Survey (Pesquisa Nacional de Saúde), a cross-sectional population-based survey. The National Health Survey

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covered the entire territory of Brazil based on tracts used in the 2010 census. Areas with special characteristics or small populations were excluded.

The sampling process was carried out in three stages: census tracts (or set of sectors) were the primary sampling units, households were the second-stage units and residents aged 18 years or over were the third-stage units. The original study selected 69,954 households and involved 13.9% losses and refusals. Through a simple randomization process, one individual per household was selected and invited to participate in the face-to-face survey. Trained interviewers applied the survey using personal digital assistants. Written informed consent was obtained from all participants.

Based on the probability of sample participation, weighting was used to ensure national, regional, and state representativeness. Further details on the methodology, sampling and weighting factors can be found in the National Health Survey technical report.¹⁸

The outcomes considered in the present study were major depressive episode (MDE), determined through the Patient Health Questionnaire (PHQ-9), which identifies cases according to DSM-IV criteria, and suicidal ideation, which was determined with the final question of the PHQ-9: "In the last two weeks, how many days did you think about hurting yourself in any way or think that it would be better to be dead?" Possible answers to the question were: None, Less than one week, One week or more, and Almost every day. If the respondent's answer was anything other than "none", he/she was considered positive for suicidal ideation. The PHQ-9 has been validated for adults in the general population of Brazil.¹⁹

We investigated whether respondents were victims of family violence (mediator/effect modifier) with the question: "In the last 12 months, did you experience any violence or aggression from an acquaintance (such as father, mother, child, spouse, partner, boyfriend, friend, neighbor)?" The variable biological sex (male and female) was our main exposure variable.

Sociodemographic data, collected through the general questionnaire, were used as covariables: age in complete years (18 to 24; 25 to 34; 35 to 44; 45 to 54; 55 to 64; 65 or more); self-reported skin color (white, black, brown, yellow or indigenous); education (none or incomplete elementary school; complete elementary school or incomplete secondary school; complete secondary school or incomplete higher education; complete higher education); and wealth index quintiles (WIQ). For WIQ classification, the respondents were asked about residential characteristics and household belongings, such as: house or apartment, number of bedrooms, having a domestic worker, and the number and type of home appliances (such as televisions). The five quintiles ranged from the poorest (1st) to the richest (5th).

Data analysis was performed in Stata version 14.0 (Stata Corp, College Station, Texas, USA), and the clustering effect was considered using the "survey" command. We calculated total and stratified prevalence of the variables and used chi-square tests for heterogeneity. Odds ratios (OR) and 95% confidence intervals (95%CI) were estimated with logistic regression to estimate the association

between sex, MDE, and suicidal ideation. The analysis was stratified according to violence, and a multiplicative interaction term between both sexes and violence was included in the regression models to determine if there was a modifier effect. We also calculated the relative excess risk due to interaction, a measure similar to additive interaction that uses risk ratios or odds ratios rather than risks.²⁰

To estimate the potential mediating effect of violence, we used the G-formula, a parametric computation that uses Monte Carlo simulations. The G-formula offers greater flexibility than traditional mediation methods, including modelling non-linearities and allowing for mediator-outcome confounding and exposure-mediator interaction. We calculated the total effect, the natural direct effect (NDE), the natural indirect effect (NIE), and the controlled direct effect (CDE).²¹ The NDE represents the effect of exposure (being a woman) on the outcomes (MDE or suicidal ideation) that is not explained by the mediator (violence), while the NIE estimates the effect that is explained by it. The sum of the NDE and NIE represents the total effect, and the quotient of the NIE divided by the total effect represents the percentage of the effect explained by the mediator. On the other hand, the CDE represents the direct effect of exposure on the outcome if the mediator is controlled (maintaining it constant at one level independently of exposure). In our case we investigated what would happen if no one was exposed to violence, regardless of gender. We created and tested two different models, one for MDE and one for suicidal ideation, adjusting for age, skin color, education and WIQ (Figure 1). Education was included in the model as an intermediate confounder.

Ethics statement

All procedures in this study complied with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration. All procedures involving human participants were approved by the Brazilian Ministry of Health's National Commission of Ethics in Research for Human Beings (number 328.159).

Results

Of the 60,202 interviewed individuals, 52.9% were female, 21.6% were between 25 and 34 years of age, most self-reported their skin color as white (47.5%), completed secondary school or had incomplete higher education (38.1%), and belonged to the poorest quintile (20.3%). Overall, 4.1% presented MDE (5.6% in women vs. 2.5% in men) and 3.8% presented suicidal ideation (4.9% in women vs. 2.5% in men) and 2.5% had suffered family violence in the last 12 months (3.1% in women vs. 1.8% in men).

Older men and women with less education and a lower WIQ had a higher prevalence of MDE and suicidal ideation. Violence victimization was more frequent in poor young black women with low education (Table 1).

Table 2 shows that women's odds of MDE and suicidal ideation were 2.36 and 2.02 times higher than men, respectively. When the analysis was stratified according to violence victimization, female victims had a higher risk

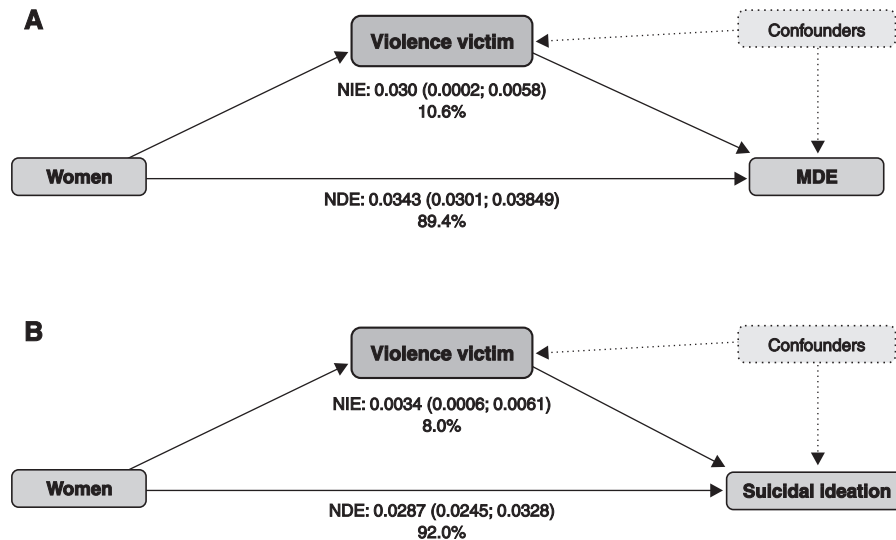


Figure 1 The mediating effect of violence in the association of being a woman and: (A) major depressive episode, (B) suicidal ideation. The main exposure was being a woman, with men as the reference group. As a mediator, violence was categorized as victimization vs. not having a major depressive episode vs. not having suicidal ideation. The natural direct and indirect effects were calculated with G-computation. Confounders included age, skin color, wealth index, and education (intermediate confounder). The percentages are based on the natural direct and indirect effects and represent the proportion of the association explained by each pathway. MDE = major depressive episode; NIE = natural indirect effect; NDE = natural direct effect.

of MDE (OR = 3.31; 95%CI 2.54-4.32) and suicidal ideation (OR = 3.85; 95%CI 2.83-5.25). However, confidence intervals from multiplicative interaction terms included the reference, suggesting that these differences could be due to chance (MDE interaction term: 1.37; 95%CI 0.86-2.19; suicidal ideation interaction term: 1.65; 95%CI 1.00-2.71).

When the additive interactions were calculated using the OR from our regression models, we found that the relative excess risk due to interaction for depression was 5.97 (95%CI 3.10-8.84) and that of suicidal ideation was 6.20 (95%CI 3.37-9.02). Since both were > 1, this implies a positive additive interaction between sex and violence in both outcomes.

G-computation estimates of the NIE, NDE and CDE for suicidal ideation (NIE: $\beta = 0.0034$; 95%CI 0.0006-0.0061; NDE: $\beta = 0.0287$; 95%CI 0.0245; 0.0328; CDE: $\beta = 0.0281$; 95%CI 0.0239-0.0322) and MDE (NIE: $\beta = 0.030$; 95%CI 0.0002-0.0058; NDE: $\beta = 0.0343$; 95%CI 0.0301-0.03849; CDE: $\beta = 0.0339$; 95%CI 0.0298-0.0381) were similar. Figure 1 shows that, in the mediation analysis, the NIE corresponded to 10.6% of the total effect of sex on MDE and 8.0% of the effect on suicidal ideation.

Discussion

We found that women are at higher risk of MDE and suicidal ideation than men, and that this association is mediated by suffering violence from a family member or acquaintance in the last 12 months. The NIE should be interpreted as the proportion of the association between sex and MDE (10.6%) and between sex and suicidal ideation (8.0%) that is mediated by violence. In other words, approximately 1/10 of the higher risk that women

have of these mental conditions is due to their increased risk of violence victimization.

Since there was no multiplicative interaction between exposure and the mediator, it was expected that the NDE would be equal to the CDE. Thus, we could also interpret the same result in terms of the mediator. If no violence had occurred in this population, 10% of the association between sex, MDE and suicidal ideation would have been prevented. However, we should point out that there was a positive additive interaction, which suggests that female violence victims would benefit more from interventions to reduce the risk of depression and suicidal ideation.

Our finding that there is a higher prevalence of MDE and suicidal ideation in women is similar to other results in the literature.^{1-4,7} Although biological theories of depression involve hormonal function and the performance of neurotransmitters and neuromodulators,²² social adversity, including maltreatment, gender roles, and violence, is higher in women, and its psychological impact can be very significant for both depressive disorders and suicidal ideation.^{7,9,10,23}

Even when social impairment is discussed in the literature as a possible explanation for the mental health gap between men and women, most of the discussion about likely associations has focused on the fact that sex differences in depression and negative mood may be associated with biopsychosocial factors such as hormonal differences, family environment, childhood stressors and social and cultural factors.^{4,5,7,9,10,23}

One of the most discussed (and probably the most widely accepted) hypotheses is that women's hormone levels change more throughout life due to menarche, pregnancy, menopause and contraceptive use, and this could contribute significantly to the research gap. These

Table 1 Sample description, major depressive episodes, suicidal ideations and family violence in Brazilian adults according to sociodemographic variables, 2013 National Health Survey (n=60,202)

Variables	Total n=60,202	Men n=25,920	Women n=34,282	Major depressive episode		Suicidal ideations		Violence victim	
				Men	Women	Men	Women	Men	Women
Age				p < 0.001	p < 0.001	p = 0.001	p = 0.022	p = 0.020	p < 0.001
18-24	15.9	16.7	15.3	1.5	3.7	2.6	3.8	2.3	3.8
25-34	21.6	22.3	21.0	1.2	4.9	1.4	4.3	2.2	4.4
35-44	19.2	18.9	19.5	2.3	5.6	2.4	5.1	2.2	3.1
45-54	17.5	17.5	17.5	3.6	6.6	3.5	5.8	1.6	3.3
55-64	13.5	13.1	13.8	2.7	6.9	2.2	5.8	1.3	2.1
65 or more	12.3	11.4	13.1	4.5	6.1	3.4	4.6	0.9	1.2
Skin color				p = 0.979	p = 0.606	p = 0.937	p = 0.072	p = 0.067	p = 0.001
White	47.5	46.8	48.1	2.4	5.4	2.4	4.5	1.5	2.6
Black	9.2	9.2	9.2	2.4	5.7	2.4	4.9	2.2	3.9
Brown	42.0	42.8	41.2	2.5	5.9	2.5	5.4	2.1	3.7
Yellow or indigenous	1.4	1.2	1.5	2.5	5.3	3.3	3.6	0.8	2.0
Education				p < 0.001	p < 0.001	p < 0.001	p < 0.001	p = 0.841	p < 0.001
No education or incomplete elementary school	21.8	21.1	22.4	4.1	8.2	3.9	6.6	1.7	2.2
Complete elementary school or incomplete secondary school	27.3	29.6	25.3	3.0	6.4	2.9	6.6	2.0	4.1
Complete secondary school or incomplete higher education	38.1	37.9	38.4	1.3	4.3	1.8	3.5	1.8	3.1
Complete higher education	12.7	11.4	13.9	1.7	3.6	0.9	2.8	1.6	3.2
Wealth index quintiles				p = 0.055	p < 0.001	p < 0.001	p < 0.001	p < 0.001	p < 0.001
1 (poorest)	20.3	21.0	19.7	3.2	7.0	3.4	6.8	3.0	4.6
2	19.8	19.8	19.8	2.6	6.5	2.9	5.9	1.7	3.7
3	20.2	19.9	20.4	2.7	5.8	2.9	4.8	1.9	2.9
4	20.0	19.6	20.3	2.2	4.9	1.9	4.4	1.2	2.7
5 (wealthiest)	19.8	19.7	19.8	1.5	3.8	1.1	2.6	1.3	1.9

Data presented as percentages.

Table 2 Association between sex, major depressive episode, and suicidal ideation for the overall sample, stratified by violence, 2013 National Health Survey (n=60,202)

Variables	Major depressive episode*	Suicidal ideation [†]
Overall sample	2.36 (2.03; 2.74)	2.02 (1.73; 2.36)
Non-victims	2.24 (1.91; 2.62)	1.88 (1.59; 2.22)
Violence victims	3.31 (2.54; 4.32)	3.85 (2.83; 5.25)

Data presented as odds ratio (comparing females vs. males) and 95% confidence interval. p-values for interaction term in a logistic regression: * p = 0.183; [†] p = 0.050.

changes could be directly related to mood and negative/positive affect, and could interact with gendered intra- and interpersonal factors, such as stress. In addition, women might have a blunted cortisol response.¹⁰ Nevertheless, some research has proposed that this gap might be related to greater exposure to severe adversity, especially violence, and to structural gender inequality at macro- and microlevels, despite the present lack of empirical evidence.^{5,9,10}

In a context where suicidality is more likely a consequence of depression, these theories might be relevant, although some of the burden of suicidality is not necessarily due to depression or depressive-like symptoms. Therefore, other important predictors and mediators should be explored.²⁴ However, in general, the reasons women

are more affected than men by depression and/or suicidality remain unresolved in the literature, and biological factors do not seem to fully explain it.

Violence against women can take many forms, such as physical, sexual and emotional/psychological, and these forms can coexist.^{14,25,26} Several studies have shown female violence victims are at an increased risk of mental disorders.²⁵⁻²⁹ Furthermore, women who have experienced repeated domestic violence and abuse, other forms of violent victimization, or direct expressions of rage or aggression have a strong tendency to suppress their emotions.⁵ This could be related to other behaviors, such as substance use and other psychological consequences of violence, including suicidal ideation.^{26,27,29,30} When combined with the submissive nature of some women,

continuous exposure to stressful events, such as violence, could lead to extreme vulnerability, fear and feelings of inability or powerlessness, which could cause or contribute to mental health problems.^{5,26,27,29}

Sociocultural factors, such as the stress associated with traditional female roles, can affect women's mental health.^{5,7,8,10} In this study we found important associations between sociodemographic characteristics and depression and suicidal ideation in women, a relationship that has been demonstrated in other studies.^{1,4,31} For the men in our sample, no associations were found between skin color and either outcome, between education and violence victimization, or between WIQ and MDE. In Brazil, skin color, education and WIQ are markers of social vulnerability, which can be associated with mental health conditions.^{32,33} The fact that important social determinants were associated with outcomes for Brazilian women but not for men could indicate that these determinants are among the sociocultural markers that affect women's mental health. We also found that women are more likely than men to suffer violence by a family member or acquaintance, which has also been reported in previous studies.^{11,12,15} However, these findings also indicate the importance of investigating these mental health conditions and their greater occurrence among women from a social determinants of health perspective.

It is important to consider some limitations of our study. First, since we did not have access to all the necessary information on losses and refusals, we could not assess their impact on our measures of association. However, the losses were relatively small, and they do not seem related to exposure, since the prevalence of females and depression/suicide were similar to that reported in other studies.² The PHQ-9 uses an algorithm to assess depression that reproduces DSM-IV diagnostic criteria. Nevertheless, as with any screening test, classification errors could have occurred, since a clinical interview was not conducted for diagnostic confirmation. Similarly, suicidal ideation and violence were self-reported and evaluated with a single question. Thus, underreporting could have also been an issue in this study. However, we considered that if there was a classification error for any of these cases it would be non-differential, thus the measures of association reported in this study could be underestimated. Such underestimation could influence our findings, leading to underestimation of the mediating effect of violence, for example. In addition, although longitudinal measures would be preferable for assessing the mediating effect of violence, we find it more plausible to think that depression and suicidal ideation are a consequence of violence, at least in this case, and not the other way around, and there is evidence of such a longitudinal association in the literature.^{12,13} In addition, respondents reported the occurrence of violence in the last 12 months, but depression and suicidal ideation in the last two weeks.

We only studied violence from family members or acquaintances, which might have limited our capacity to determine which kind of violence would be more important in the explored mediators. However, the available data was inappropriate for answering this specific question, since the type of violence was self-reported and the

occurrence of violence was likely underestimated. Thus, the answer to this question should be explored in other studies with higher specificity.

On the other hand, we used a representative sample of the entire Brazilian population that included more than 60,000 individuals. We also assessed mediation with a novel method, using a counterfactual framework that avoided overadjustment and extracted measures that could be considered confounders. Since violence and mental health outcomes could both be consequences of sociodemographic characteristics, to correctly calculate NDE and NIE, we had to adjust our models for those variables, and given that adjusting for sociodemographic characteristics in a regular regression model would have been inadequate (leading to overadjustment), they had to be treated as post-confounders. Thus, estimating from G-computation is more adequate for evaluating the mediating effect of violence while adjusting for sociodemographic variables.²¹

Finally, our study has shown evidence that violence is a mediator in the causal pathway between sex, and depression and suicidal ideation. Avoiding any kind of violence is already considered an important objective worldwide, and it should be pursued independently of any association with mental health. However, we find it relevant to highlight the importance of psychosocial issues, especially violence from family members or acquaintances, in the etiology of mental health conditions, since they partially explain why women are more affected than men. Our results indicate that one likely reason women have a higher burden of depression and suicidality is the violence they suffer, i.e., vulnerability to these mental health problems is not as much an inherent condition as a consequence of external psychosocial factors. Therefore, it is important to consider these issues in the planning and implementation of public mental health policies, as well as in more specific clinical approaches, especially those regarding women's mental health.

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Disclosure

The authors report no conflicts of interest.

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