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Effect of the Brazilian cash transfer programme on suicide rates: a longitudinal analysis of the Brazilian municipalities

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Abstract

Purpose There is a growing awareness of the economic and contextual factors that may play a role in the aetiology of suicide. The Programa Bolsa Família (PBF) the Brazilian conditional cash transfer programme, established in 2004, aims to attenuate the effects of poverty of Brazilians. Our study aims to evaluate the effect of Bolsa Família Programme (BFP) coverage on suicide rates in Brazilian municipalities.

Methods We conducted an ecological study using 2004–2012 panel data for 5507 Brazilian municipalities. We calculated age-standardized suicide rates for each municipality and year. BFP coverage was categorized according to three levels ($< 30\%$, $\geq 30\%$ and $< 70\%$ and $\geq 70\%$) and duration (coverage $\leq 70\%$ for all years, $\geq 70\%$ for 1 year, $\geq 70\%$ for 2 years, $\geq 70\%$ for 3 or more years). We used negative binomial regression models with fixed effects, adjusting for socio-economic, demographic and social welfare co-variables.

Results An increase in BFP coverage was associated with a reduction in suicide rates. The strongest effect was observed when in addition to greater municipal coverage (RR 0.942, 95% CI 0.936–0.947), the duration of the high coverage was maintained for 3 years or more (RR 0.952 95% CI 0.950–0.954).

Conclusions The results provide evidence that the conditional cash transfer programme may reduce suicide in Brazilian municipalities, mitigating the effect of poverty on suicide incidence.

Keywords Conditional cash transfer programme · Suicide · Attempted suicide · Impact evaluation

Introduction

Worldwide suicide is a public health problem causing almost one million deaths every year [1]. Among countries, Brazil ranks eighth in the incidence of suicide, with an age-standardized rate of 5.8 per 100,000 inhabitants, in 2012 [1].

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Inside Brazil, variations may be observed between regions, with higher rates in the Southern region (9.8/100,000 in 2012), followed by the Centre-West (7.6/100,000 in 2012) [2]. Incidence is approximately three times higher amongst men than women, and there is a higher rate amongst old people (8.0/100,000 in 2012) [2].

The association between suicide and socio-economic factors has been well-documented in the literature [3, 4]. A recent review assessed the effects of poverty on the entire spectrum of suicidal ideation and behaviour in low and middle-income countries and found that 62% of studies reported an association of suicide with worst economic conditions, income shocks and unemployment [5]. At the aggregate level, studies have found an inverse association between public spending on social policies and suicide mortality in Europe [6] and the United States [7]. In Brazil, a positive association has been seen between the suicide rate and the income inequality, where every 10-point decrease in the Gini Index results in a 5.5% reduction in the suicide rate. An inverse association of municipal suicide rates and average

per capita income was also reported [2]. It is known that suicide is associated with mental health, in particular, mood disorders, such as depressive conditions [8]. As poverty is associated with mental health [9], this could be a possible mechanism to explain the link between suicide and poverty.

It seems that poverty and income inequality may have some important impact on suicide rates [2, 10, 11] and therefore, actions focused on decrease poverty such as cash transfer programmes can impact on suicide [12]. In Brazil, the conditional cash transfer programme (CCT), branded as Programa Bolsa Família (PBF), established in 2004, is an important socio-economic intervention that aims to attenuate the effects of absolute poverty through a minimum cash transfer for beneficiary families, and to break the intergenerational cycle of poverty through investment in education and health conditionalities [13].

The effects of the PBF on population health in Brazilian municipalities have been investigated, and the PBF has been associated with the improvement of nutritional status [14], and health outcomes such a as infant mortality [15] and leprosy [16]. However, no studies have yet been conducted to evaluate its effects on suicide. It is important to investigate whether a conditional cash transfer programme, such as the PBF, helps to attenuate the incidence of suicide to support the adoption of poverty reduction strategies, enabling potential changes and improvements to the programme, such as encouraging the inclusion of mental health

care in its conditionalities. This study, therefore, aims to assess the effect of PBF coverage on suicide rates in Brazil. The mechanisms linking BFP to suicide are conceptualized in Fig. 1.

Method

We conducted an ecological longitudinal study, which combines an analysis of multiple observation units with a temporal trend design. We used panel data for the 5507 Brazilian municipalities which existed at the time of analysis. All the municipalities were examined through repeated observations over the 9 years from 2004 to 2012.

All data came from the Health Informatics Department of the Brazilian Ministry of Health [17], including the mortality data for each municipality that was collected from the Mortality Information System (Sistema de Informação sobre Mortalidade: SIM). Socio-economic and demographic variables were obtained from the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística: IBGE) [18] and the Primary Care Information System (Sistema de Informação da Atenção Básica: SIAB) [17]. PBF coverage was obtained from the Ministry of Social Development's database [19].

Suicide, the outcome variable, was defined as the cause of death recorded as "intentional self-harm" according to the
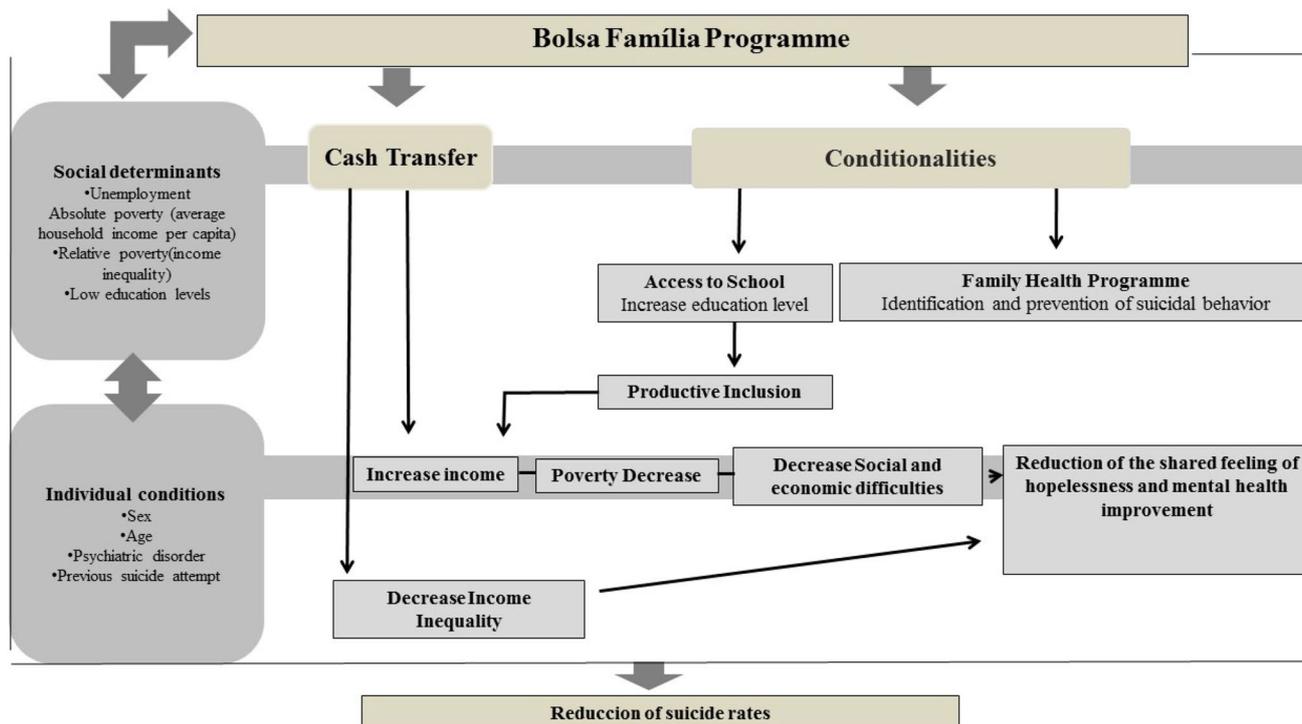

Fig. 1 Mechanisms linking the Bolsa Familia Programme to suicide

10th Edition of the International Classification of Diseases (ICD-10), codes X60-X84. The suicide rate was calculated at the municipal level and standardized for age in 5-year intervals using the direct method and taking the World Health Organization (WHO) population as a reference. For each municipality and year of analysis, we calculated a general and gender-stratified suicide rates. Suicide rates were calculated for individuals aged 10 years or above since this event is infrequent before this age.

The Programa Bolsa Família (PBF)—the main exposure—is a conditional cash transfer programme, established in 2004. In 2012, cash transfers were made through a basic benefit of 70 Brazilian Reals (R$), aimed at extremely poor families, that is families with a monthly family income of up to R$ 70.00. Furthermore, there was a variable benefit of 32 Brazilian Reals granted to families with children, adolescents, pregnant and breastfeeding women, who had a per capita household income of up to R$ 140.00 [13]. Health conditionalities include the monitoring of vaccinations and nutritional surveillance of children under 7 years old, as well as pre-natal care for pregnant and postpartum women. In education, these include 85% school attendance for children and adolescents aged 6–15 years old and 75% attendance for young people aged 16 and 17 years [13]. In our study, we used the PBF coverage of the target population, calculated by dividing the number of families who receive PBF by the total number of eligible families, transformed into percentages and multiplied by 100 [18]. The coverage was then categorized according to three levels (< 30%; ≥ 30% and < 70%; and ≥ 70%). Then we analysed whether the persistence in the time of high coverage would have an effect on the rates of suicide and hospitalization for suicide attempts. Thus, the duration of high PBF coverage of 70% or more was categorized into 3 time periods (coverage ≤ 70% for all years; ≥ 70% for 1 year; ≥ 70% for 2 years; ≥ 70% for 3 or more years).

We included socio-demographic, economic and social welfare variables as controls: percentage of employed population—percentage of the employed population aged 16 years or above; rate of urbanization—percentage of people living in cities; percentage of people with low education levels—percentage of people with incomplete primary education (up to 8 years of schooling); percentage of people on a low income—percentage of population resident with a monthly per capita household income of up to R$ 140.00; percentage of separated people—percentage of people who declared themselves divorced; percentage of households with one resident—percentage of private households occupied by only one resident; percentage of individuals who declared themselves to be Pentecostal. We also included a health care variable as control: Family Health Programme (Programa Saúde da Família: PSF) coverage—the ratio between the total number of people registered on the programme divided by the municipal population. The selection of all these variables was based on evidence of their association with suicide, as seen in the literature [4, 8, 9].

Statistical analysis

We used models of negative binomial regression to assess the association between PBF coverage and suicide rates. The time variable was introduced into the models to control for the effect of time on political changes and secular trends which might affect all the municipalities [20]. The estimated regression was $(Y_{it}) = \alpha_i + \beta_1 BF_{it} + \beta X_{nit} + \gamma_t + u_{it}$, where, Y_{it} refers to the number of suicides divided by the population residing in municipality i in year t; α_i was the fixed effect for municipality i which captures all the unobserved time-invariant factors; BF_{it} was Bolsa Família Programme coverage for municipality i in year t; X_{nit} the value for each co-variable in the model, including all the socio-economic, demographic and social welfare determinants, in municipality i in year t; γ_t was the specific effect of time; and u_{it} the error. To assess whether municipality size might influence the results, we conducted stratified analysis by municipalities with a population lower than or equal to 10,000 inhabitants, between 10,000 and 50,000, and greater than or equal to 50,000 inhabitants.

The Hausman specification test was conducted to analyse the robustness of results in relation to the regression model selected for the panel data. We used the Akaike (AIC) and Bayesian Information Criteria (BIC) to establish the model that best fitted the data was produced by Poisson or negative binomial regressions [20]. All the statistical analyses were conducted using Stata (version 12).

This study used exclusively secondary data from the public domain, therefore; approval from a Research Ethics Committee was not a requirement.

Sensitivity analysis

We checked the robustness of our results performing several sensitivity analyses. First, we tested using several alternative model specifications with random and fixed effects and Poisson models (S1 Appendix, Table A). Second, models specifications with sequential addition of covariates were tested (S2 Appendix, Table B). Third, we repeated the best-fit model including only municipalities with accurate vital information [21] (S3 Appendix, Table C). Fourth, we tested different classifications of PBF coverage (S4 Appendix, Table D). Fifth, because of the potential for misclassification of external causes and suicide, we tested the effect of BF Programme over suicide rates adjusted to ill-defined causes of death (S5 Appendix, Table E). Sixth, we conducted analyses on hospitalizations for attempted suicide to verify common data trends between mortality and suicide attempted,

given that the literature suggests that suicide and suicide attempts have similar phenomenological characteristics [8] and may have common contextual determinants (S6 Appendix, Table F). Seventh, we have also performed sensitive analyses including "hospitalizations rates due to psychiatry problems" as a controlling variable (S7 Appendix, Table G).

Results

From 2004 to 2012, there was a 4% increase in suicide rates. The PBF coverage increased by 46.64%, accompanied by improvements in socio-economic conditions, with the percentage of people on low incomes falling by 26.76%, the employment rate rising by 7.26% and those with low education levels falling by 21.83%. About the socio-demographic data, the average urbanization grew over this period (7.02%), as did the proportion of divorced people (59.75%). About healthcare, the average Family Health Programme coverage in the municipalities rose from 60% in 2004 to 77.23% in 2012 (Table 1).

Table 2 shows the crude and adjusted associations between levels of municipal PBF coverage and suicide rates, presenting a statistically significant dose–response relationship, even after the adjustment for the socio-economic, demographic and social welfare co-variables. Suicide rates were significantly lower in municipalities with coverage between 30 and 70% (RRcrude 0.966; CI 95% 0.960–0.972) and over 70% (RRcrude 0.942; CI 95% 0.936–0.947) compared with low coverage municipalities (less than 30%).

An increase in the percentage of the population with low incomes, with low educational levels, separated, in families with one resident was associated with an increase in suicide rates. The percentage of people employed, declared to

be Pentecostal and urbanization rate by municipality were negatively associated with suicide rates. Similar results were obtained when the analysis was repeated stratifying by the size of municipal population (less than 10,000; between 10,000 and 50,000; and over 50,000), maintaining the magnitude and direction of association found between suicide rates and PBF coverage. There was no statistically significant association between suicide rates and Family Health Programme coverage (Table 2).

When we assessed the association between the duration of high PBF coverage of 70% and suicide rates, the results demonstrated that an increase in the duration of high PBF coverage of 70% or more was associated with a fall in suicide rates. The effect increased as the number of years with the persistent high coverage increased (Table 3).

In relation to gender, an increase in PBF coverage duration of 70% or more was associated with a fall in suicide rates amongst women (Table 3).

Sensitivity analyses

Sensitivity analyses demonstrate that our findings are robust as none of these sensitivity analyses changed our main findings. Alternative model specifications (S1 Appendix, Table A) demonstrate the stability of the results. We found that controlling for different factors, such as fixed or random effects and different covariates, did not change our results (S1 and S2 Appendix, Table A and B). Different classifications of PBF were tested, and our results were the same for all classifications (S4 Appendix, Table D). Evaluating proportion ill-defined cause adjusted in the model to control by mistakes in the classification of suicide, demonstrated that an increase in PBF coverage is associated with a reduction in suicide rates in Brazilian municipalities, even following

Table 1 Selected variables—average and standard deviations for the Brazilian municipalities (*n* 5507)

	2004		2012		Percentage
	Average	SD	Average	SD	Change
Variables					
Suicide rate*	7.85	14.71	8.16	13.68	3.99
Suicide rate—men*	12.65	25.65	12.95	23.39	2.37
Suicide rate—women*	2.99	1.26	3.38	1.26	13.22
PBF coverage of the eligible population	62.16	22.36	91.15	16.29	46.64
Low income (%)	56.55	20.95	41.42	22.80	− 26.76
Low education levels	75.63	8.11	59.12	10.56	− 21.83
Employment rate	58.43	16.54	62.67	14.72	7.26
Urbanization rate	60.89	22.55	65.17	21.79	7.02
Divorced (%)	2.86	1.60	3.88	1.98	35.71
Pentecostals (%)	9.32	5.76	11.54	6.78	23.80
Family Health Programme coverage	60.00	37.61	77.23	29.20	28.72

SD standard deviation

*Standardized rate

Table 2 Regression models for fixed effects between the level of PBF coverage and suicide rates, overall and stratified by population size for the Brazilian municipalities (2004–2012)

Variables	Total				Population ≤ 10,000		Population between 10,000 and 50,000		Population ≥ 50,000	
	Crude		Adjusted		Adjusted		Adjusted		Adjusted	
	RR	CI (95%)	RR	CI (95%)	RR	CI (95%)	RR	CI (95%)	RR	CI (95%)
PBF coverage <30%	1.000	–	1.000	–	1.000	–	1.000	–	1.000	–
PBF coverage ≥30% and <70%	0.966	(0.960–0.972)	0.968	(0.963–0.974)	0.956	(0.944–0.968)	0.962	(0.953–0.972)	0.981	(0.972–0.991)
PBF coverage ≥70%	0.942	(0.936–0.947)	0.939	(0.933–0.945)	0.921	(0.909–0.933)	0.932	(0.923–0.942)	0.956	(0.947–0.966)
Low income (%)	–	–	1.003	(1.003–1.004)	1.004	(1.004–1.004)	1.003	(1.003–1.004)	1.003	(1.002–1.003)
Employed (%)	–	–	0.997	(0.997–0.997)	0.999	(0.998–0.999)	0.998	(0.998–0.999)	0.995	(0.994–0.997)
Low education level	–	–	1.009	(1.008–1.009)	1.005	(1.003–1.006)	1.006	(1.005–1.007)	1.007	(1.006–1.009)
Separated (%)	–	–	1.008	(1.004–1.012)	1.009	(1.002–1.015)	1.008	(1.003–1.013)	1.010	(1.002–1.019)
Self-declared Pentecostals (%)	–	–	0.982	(0.980–0.983)	0.988	(0.986–0.990)	0.987	(0.986–0.989)	0.984	(0.982–0.986)
Urbanization rate	–	–	0.998	(0.997–0.998)	1.003	(1.002–1.004)	1.004	(1.004–1.005)	0.998	(0.997–0.999)
Households with one resident (%)	–	–	1.046	(1.044–1.049)	1.014	(1.010–1.018)	1.052	(1.048–1.055)	1.014	(1.009–1.019)
Family Health Programme Coverage	–	–	1.001	(1.000–1.001)	1.001	(1.000–1.001)	1.000	(1.000–1.000)	1.000	(1.000–1.000)
Time	–	–	1.000	(0.998–1.001)	0.998	(0.994–1.001)	0.988	(0.986–0.990)	1.008	(1.004–1.011)
Number of observations	46,134		46,134		23,456		18,030		4277	
Number of municipalities	5126		5126		2719		2156		506	

Table 3 Regression model for fixed effects between the duration of high PBF coverage and suicide rates, total and stratified by gender for the Brazilian municipalities (2004–2012)

Variables	Total				Women		Men	
	Crude		Adjusted		Adjusted		Adjusted	
	RR	CI (95%)	RR	CI (95%)	RR	CI (95%)	RR	CI (95%)
PBF coverage < 70<% for all years	1.000	_	1.000	_	1.000	_	1.000	_
PBF coverage ≥ 70% for 1 year only	0.985	(0.983–0.988)	0.975	(0.973–0.978)	0.976	(0.918–1.039)	1.003	(0.970–1.037)
PBF coverage ≥ 70% for 2 years	0.972	(0.970–0.975)	0.962	(0.960–0.965)	0.912	(0.854–0.973)	0.992	(0.958–1.028)
PBF coverage ≥ 70% for 3 or more years	0.952	(0.950–0.954)	0.958	(0.956–0.961)	0.908	(0.851–0.969)	0.986	(0.953–1.022)
Low income (%)	_	_	1.003	(1.003–1.003)	1.003	(0.999–1.007)	1.005	(1.003–1.007)
Employed (%)	_	_	0.997	(0.997–0.998)	0.999	(0.988–1.010)	1.005	(1.000-1.011)
Low education levels	_	_	1.008	(1.008–1.009)	1.011	(0.995–1.028)	1.013	(1.005–1.022)
Separated (%)	_	_	1.008	(1.004–1.012)	0.969	(0.884–1.063)	0.972	(0.928–1.019)
Self-declared Pentecostals (%)	_	_	0.982	(0.981–0.983)	0.967	(0.942–0.992)	0.990	(0.976–1.003)
Urbanization rate	_	_	0.998	(0.997–0.998)	0.993	(0.981–1.006)	0.996	(0.990–1.002)
Households with one resident (%)	_	_	1.045	(1.043–1.048)	1.041	(0.982–1.105)	0.989	(0.960–1.019)
Family Health Programme Coverage	_	_	1.001	(1.001–1.001)	1.001	(1.000–1.002)	1.001	(1.000–1.002)
Time	_	_	1.001	(1.000-1.003)	1.053	(1.008–1.099)	1.056	(1.033–1.079)
Number of observations	46,134		46,134		30,762		44,937	
Number of municipalities	5126		5126		3418		4993	

adjustment for this variable (S5 Appendix, Table E). Repeating the analyses only including municipalities considered to have accurate vital information the results remained similar to the analyses including all the Brazilian municipalities (S3 Appendix, Table C). Evaluating the effect of PBF coverage on hospitalizations for attempted suicide rates in Brazil, demonstrated that an increase in PBF coverage is also associated with a reduction in hospitalizations for attempted suicide rates in Brazilian municipalities (S6 Appendix, Table F). We have added in the model the hospitalizations due to psychiatry problems rates, and our results remained similar (S7 Appendix, Table G).

Discussion

The results of our study demonstrate that an increase in PBF coverage was associated with a reduction in suicide rates in Brazilian municipalities, even following adjustment for socio-economic, demographic and social welfare factors. The effect of the PBF increased when, alongside high coverage (equal to or greater than 70%), this level of coverage was maintained for several years. We also conducted robustness sensitivity testing, and the main results were maintained in both suicide and hospitalizations for attempted suicide rates. Furthermore, this effect was also maintained following stratification for municipal population size. In relation to gender, PBF had an effect on reducing suicide rates in women, but not in men. These findings support the hypothesis that a well established and with high coverage CCT

programme have an effect on reducing deaths from intentional self-harm. Our study main finding, that high PBF coverage is associated with lower suicide rates, is in line with a previous finding, suggesting that a cash transfer programme in Indonesia reported a reduction of approximately 10% in suicide incidence in the sub-districts that implemented the programme [12].

Cash transfer may attenuate the effects of poverty, by improving better mental health and consequently reducing suicide [22]. Several studies have suggested that poverty may influence the incidence of suicide [2, 10], with one study undertaken in Brazil reporting that both absolute poverty, measured by average per capita household income, and income inequality, measured by the Gini Index, are related to an increased suicide rates in Brazilian municipalities [2]. Greater investment in public welfare is associated with reduced suicide rates [6, 7], and the population's confidence in social welfare policies exercise a protective effect on suicidal behaviour [6]. Cash transfer programmes not only reduce poverty, but has also been associated with other factors that influence suicide, such as a reduction in depression symptoms [22] and common mental health disorders [23], and in perceived hope and optimism [22] among beneficiaries.

In Brazil, the PBF may influence suicide rate by fulfilling its main objectives of immediate poverty alleviation through the transfer of benefits to poor and extremely poor families and via investment in human capital through education and health conditionalities. Transferring money may provide greater financial stability, which helps to reduce the stress

related to economics [24] and increased well-being [23, 24]. Regular income transfers may also support a reduction in those factors that may precipitate the occurrence of suicide, such as alcohol consumption and diagnosis of other mental health disorders [23–25]. Education-related conditionalities may act in a prospective manner, supporting increased schooling, increasing social empowerment and inclusion in the job market. There is evidence that low educational levels and unemployment are associated with increased risk of suicide [4]. In this way, programmes aimed at mitigating these factors, such as the PBF, may also contribute to reducing suicide rates. Furthermore, health conditionalities lead to increased access to health services (Fig. 1).

Another important finding was that the observed reduction of suicide rates increased with the duration of high PBF coverage at the municipality level, indicating the importance of the continuity of social interventions to strengthen its effect [11]. Regarding gender, duration of PBF coverage at municipality level only reduced suicide rates among women, but not among men. Women are the principal beneficiaries of many social protection programmes, underpinned by the notion of the greater vulnerability of women in economic crises, and the fact that studies demonstrate that cash received by women tends to be invested in resources that promote family well-being [26]. In Brazil, PBF is preferentially awarded to women [13]. Benefits received by women may influence the family dynamic, strengthening female self-esteem and decision-making power [25]. In Brazil, qualitative evidence has shown that PBF may contribute to female empowerment, promoting greater autonomy and visibility for women in the community [27, 28] as legitimated representatives and family spokespeople [27]. An association between cash transfer programmes and reduced intimate partner violence suffered by women have also been reported [25, 29]. Cash transfer programmes have an impact on increased overall well-being and in the self-reported happiness of women [29].

In our study, socio-economic factors—percentage of people with low levels of education and percentage on a low income—were associated with higher suicide rates in the Brazilian municipalities, supporting the findings that suicide rates may be reduced by anti-poverty polices, such as PBF, given that this aims to increase family income and to break the poverty cycle. Furthermore, higher employment rates had a protective relationship with suicide rates.

As we used municipal level data, we evaluated the effect of social policy at an aggregate level and our inferences cannot be extrapolated to the individuals, under the risk of committing an ecological fallacy. However, we are aware of the possible spillover effects of BFP. Besides the effect on the target population receiving BF, the economic improvement in the municipalities given a high percentage of inhabitants receiving the benefit, possibly affect the overall economic situation of these municipalities [30]. The quality of SIM data is one possible limitation, due to potential under-recording of suicide data. However, a previous study showed that SIM data is of good quality for about 80% of Brazilian municipalities [31]. We also tested the robustness of the PBF effect on suicide rate restricting our analysis for municipalities with accurate vital information, and we found similar results.

One strong feature of the study was its use of longitudinal, panel data analysis, than traditional cross-sectional data analysis, which enabled us to explore the influence of the PBF and the social and economic contextual characteristics in the same municipalities over time, strengthening the evidence for the relationship we found [20]. We also realized sensitivity analysis done gave much the same effect estimates, suggesting that our findings are robust. Suicide contributes to increasing the burden of mortality from causes that have been gaining prominence in Brazil's mortality hierarchy and our findings also have the potential to produce robust evidence on the impact of poverty and social interventions on suicide rates, not limited to health care. Our results suggest that economic circumstances may be associated with suicide incidence in Brazil and that the implementation of conditional cash transfer programmes has the potential to decrease self-inflicted deaths, particularly in programmes which use conditionalities to break the poverty cycle. However, as our results cannot be extrapolated for the individual level, we suggest that new researches at the individual level test the association between cash transfer and suicide rates, to strengthen the evidence of the potential role of PBF in reducing suicide.

Compliance with ethical standards

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