# Impact of a conditional cash transfer on AIDS incidence, hospitalizations and mortality in Brazil: a nationwide longitudinal study

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**SUMMARY**

**Background.** Brazil has long been recognized for its strong response to the AIDS epidemic. However, one of the biggest challenges of this response has been reaching the poorest people. The country implemented one of the world's largest Conditional Cash Transfer programmes, the Bolsa Familia Programme (BFP), which targeted poor individuals and contributed to the improvement of their socioeconomic conditions. This study aims to evaluate the impact of BFP coverage on AIDS incidence, hospitalizations and mortality in Brazil.

**Methods.** This study uses panel data from 5,507 Brazilian municipalities over the period 2004 to 2018 and fixed effects multivariable negative binomial regressions to estimate the effect of BFP coverage - classified as low (0% to 29%), intermediate (30% to 69%), and high (≥70%) - on the main AIDS outcomes (i.e., incidence, hospitalizations and mortality rates) adjusting for all relevant demographic, socioeconomic and healthcare covariates.

**Findings.** A high BFP coverage was associated with the reduction of AIDS incidence (Rate Ratio – RR:0.94; 95%CI:0.90-0.99), AIDS-related hospitalizations (RR:0.85; 95%CI:0.79-0.91) and AIDS mortality rates (RR:0.88; 95%CI:0.81-0.94). The effect on incidence was more pronounced in municipalities with higher AIDS endemicity levels (RR:0.86; 95%CI:0.80-0.94), among adult women (RR:0.85; 95%CI:0.77-0.93) and in children under 14 years old (RR:0.75; 95%CI:0.57-0.99).

**Interpretation.** This is the first study to comprehensively evaluate the impact of a Conditional Cash Transfer on AIDS in a LMIC over a 15-year period. The effect of BFP coverage on incidence, hospitalizations and mortality rates from AIDS in Brazil could be explained by the reduction of households' poverty and by BFP health-related conditionalities. During the current dramatic rise in global poverty due to the COVID-19 pandemic, the protection of the most vulnerable populations through conditional cash transfers could avert potential changes in the trends of AIDS in LMIC.

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## RESEARCH IN CONTEXT

### Evidence before this study

Conditional Cash Transfer (CCT) programmes are essential components of government actions to increase social protection with the aim of providing social security to the most economically vulnerable individuals, allowing people to afford basic needs such as food, education, and medical care. Recent studies suggest that conditional cash transfer programmes may be effective in reducing the number of cases of HIV infection in some populations. To investigate studies that evaluated possible associations between receipt of cash transfer programmes and outcomes related to HIV/AIDS infection we searched Embase and Medline databases with no restriction on publication date or language until November 19th, 2021, using the following search strategy: ('cash transfer program'/syn OR 'cash transfer'/syn) AND ('acquired immune deficiency syndrome'/syn OR 'human immunodeficiency virus'/syn) AND ('acquired immune deficiency syndrome'/dm OR 'human immunodeficiency virus infection'/dm) AND ('case control study'/de OR 'cohort analysis'/de OR 'cross sectional study'/de OR 'longitudinal study'/de OR 'multicenter study'/de OR 'observational study'/de OR 'prospective study'/de OR 'quasi experimental study'/de OR 'randomized controlled trial'/de). Thirty-nine studies were found, among which 11 evaluated the impact of different conditional cash transfers on outcomes involving HIV infection. It is possible to summarize that the individuals receiving the benefit test more often for HIV and for other sexually transmitted infections; have a lower number of sexual partners, are less affected by domestic violence, have lower prevalence of HIV infection and better adherence to antiretroviral therapy - when infection is present. However, no evidences have been found on the effects of cash transfers on morbidity and mortality from AIDS.

### Added value of this study

To the best of our knowledge, there are no studies that evaluated - over an extended period of time - the nationwide impact of a conditional cash transfer on a comprehensive range of AIDS-related outcomes, i.e., incidence, hospitalizations and mortality rates. Using a panel of all 5,507 Brazilian municipalities followed for 15 years (2004-2018), we performed multivariable regressions adjusted for all the relevant demographic and socioeconomic characteristics to evaluate the impact of one of the world's largest CCT, *Bolsa Familia Programme* (BFP) on AIDS. Our results show a strong effect of BFP on the reduction of the incidence, hospitalizations and mortality rates. Also, a strong effect on the incidence of woman over 14 years old and children under 14 was found. Our results demonstrate the potential of using linked health and socioeconomic administrative datasets to study the impact of nationwide policies on health outcomes.

### Implications of all the available evidence

Our results, together with the other evidences from the literature and theoretical considerations, demonstrate the importance of conditional cash transfers for the attainment of the AIDS-related Sustainable Development Goal (SDG), especially during the current increases of poverty and inequalities due to the Covid-19 pandemic.

## INTRODUCTION

The association between HIV/AIDS and poverty is complex. Several studies have suggested that new cases of HIV/AIDS can be linked to poverty, while wealth may also drive HIV transmission among some populations.[1] Nevertheless, populations with socioeconomic and other vulnerabilities may be at increased risk not only for contracting HIV, but also to face barriers in receiving appropriate, timely, and continuous care and treatment.[2] In this sense, there is a consensus that, in order to reduce AIDS-related morbidity and mortality, it is necessary to plan interventions that act not only on healthcare but also on the social determinants of health (SDH).[2] The disease of HIV/AIDS reinforces the cycle of perpetuation of poverty, being related to a high level of stigma, which can further increase poverty among populations that already live in situations of high social vulnerability.[3,4]

Conditional Cash Transfer programmes (CCT) have been widely adopted in many low- and middle-income countries (LMIC) as a means to improve the socioeconomic conditions of the poorest families. While the evidences are far from conclusive, existing studies suggest that CCTs are effective in the reduction of mother-to-child HIV transmission[5] and may reduce HIV/AIDS incidence among some populations.[6–8] Since CCTs reduce household poverty, it may reduce unprotected, age-disparate and transactional sex,[8,9] and enhance adherence to antiretroviral therapy (ART).[10] Furthermore, CCTs may improve living conditions among people living with HIV through improved housing, nutritional status, and by reducing barriers to education and healthcare services access.[11]

The Brazilian response to HIV/AIDS had many successful outcomes.[12,13] Indeed, the incidence of AIDS has decreased by 2.3% between 2003 and 2012, and by 14% between 2013 and 2019,[14] mainly due to the early universal access to antiretroviral policy.[15] However, the AIDS incidence is still high for a middle income country, with a current rate of 17.8 cases per 100 thousand inhabitants,[14] and higher rates among the more developed areas of the country.[16] The largest burden of AIDS cases in Brazil is among individuals aged 25 to 39 years, and the incidence is higher among men who have sex with men (MSM),[17] transgender woman,[18] female sex workers,[19] and drug users in general (DU).[14] Furthermore, since 2009, AIDS cases are more prevalent in black women, while among men this trend has been observed since 2012.[14]

Brazil had made considerable progress in reducing poverty until 2014, mainly due to the success of one of the world's largest CCT programmes, the *Bolsa Familia Programme* (BFP).[20] Launched in 2003, its coverage has reached all Brazilian municipalities and 14.2 million families were enrolled by 2018. This programme is based on direct cash transfers from governments to poor households (i.e., families earning between US$18–36 per person per month). The monthly cash benefits range from US$17 to a maximum of US$41 (depending on household size and composition) and payments are credited directly to a beneficiary debit card. The conditionalities for continuing to receive the benefit are that parents comply with health care and education requirements for their children (e.g., pregnant women must be present at prenatal and postnatal consultations, children must be up-to-date with nutrition monitoring and vaccinations, and school-aged children must attend school). While a large focus of BFP is on families with children, individuals living in poverty, but with no children, may also qualify for and receive the benefit.[20]

Figure 1 shows how structural determinants and CCTs could affect HIV/AIDS incidence, continuum of care, hospitalizations and mortality.

Despite the success of CCTs in improving socioeconomic and living conditions, as well as improving some health outcomes,[21,22] little is known about the effects of CCTs on morbidity and mortality from AIDS. To address this gap, the present study aims to estimate the nationwide impact of BFP expansion and AIDS-related incidence, hospitalizations and mortality rates over the period 2004-2018.

## METHODS

### Study Design

This study has a longitudinal ecological design, using a panel data for all 5,507 municipalities in Brazil during the period 2004-2018. To evaluate the heterogeneity effect of AIDS endemicity levels, analyses were also stratified by average AIDS incidence rates in the municipalities over the study period.

BFP coverage of the target population was calculated as the ratio between the number of families enrolled in the BFP within a municipality and the number of eligible families according to the BFP criteria in the same municipality. Following previous studies,[21] the BFP coverage indicator of the target population was categorized as follow: low (from 0% to 29%), intermediate (from 30% to 69%), and high (≥ 70%).

We selected three main sets of covariates at the municipal level that are essential for making the unit of analysis comparable and that might additionally confound the relationship between BFP and AIDS-related outcomes. These included: *i)* health services: coverage of community-based primary health care, known as the Family Health Programme (FHP), which was calculated as the ratio of the total number of individuals registered in the FHP programme and the total population in the municipality, and was categorized as low (from 0% to 29%), intermediate (from 30% to 69%), high (≥ 70%),[23] and the number of physicians, nurses, hospital beds, and specialized clinics per 1000 inhabitants; *ii)* household characteristics: average number of residents in the household, proportion of garbage collected, proportion of households with piped water, and proportion of households with inadequate sewage; and *iii)* municipal socio-economic data: average fertility rate, average *per capita* income, proportion of low-income population (earning up to 1/4 of the minimum wage, i.e., extremely poor), illiteracy rate, and unemployment rate. As in previous studies,[20,22] the annual values for socioeconomic variables in the period 2001-09 were estimated by linear interpolation, and for the period 2011-18 by extrapolation methods weighted by yearly household surveys values (WebAppendix, pages 4-6).

All municipal-level covariates were dichotomized into higher (versus lower) values as compared to the median value of their respective Federative Unit (e.g. state). A fixed-effects time dummy variable was also included to adjust for national yearly fluctuations in the AIDS epidemic and for the introduction of new therapeutics and diagnostics. In the models we used categorized variables because, while continuous variables allow the estimation of the average strength of an association along the entire range of its values, the use of different categories of intervention coverage allows the verification of the existence of a gradient of effect, related to different degrees of implementation of the interventions, and a more policy-oriented interpretation of the findings[20]. Moreover, categorized variables have been widely used in aggregate-level policy evaluations because are usually more robust to unintended fluctuations and measurement errors in coverage estimations and non-linear extrapolations.[21,22] For the evaluation of the impact of BFP on AIDS mortality rates, we selected the municipalities based on the quality of vital information, as done in a previous study.[20]

**Data Sources**

Different information systems were used to collect the data: *i)* Ministry of Social Development databases to calculate BFP coverage; *ii)* Primary healthcare system from the Ministry of Health (MoH) for data on municipal coverage of the FHP; *iii*) Notifiable Diseases Information System (in Portuguese: *Sistema de Informações de Agravos de Notificação – SINAN*) to obtain the AIDS incidence; *iv*) Mortality Information System (in Portuguese: *Sistemas de Informações Sobre Mortalidade - SIM*) to obtain AIDS mortality data; *v)* Hospital Information System (in Portuguese: *Sistemas de Informações Hospitalares – SIH-SUS*) to obtain hospitalizations from AIDS; and *vi)* demographic censuses (in Portuguese: *Instituto Brasileiro de Geografia e Estatística* – IBGE) of 2000 and 2010 for socioeconomic and geographic variables at municipal level. The cases of AIDS considered in our analysis were those individuals notified to SINAN who met some of the diagnostic criteria: adapted CDC criteria, Rio de Janeiro/Caracas criteria and Death criteria.[24] Mortality from AIDS was defined by deaths with the ICD-10 codes B20-24 as basic cause in the SIM registries.

**Statistical Analyses**

To evaluate the association between BFP coverage and AIDS-related incidence, hospitalizations and mortality, negative binomial regression models for panel data were performed. These models are indicated when the outcome is count data, and the assumption of the Poisson regression model that the mean is equal to the variance is not fulfilled due to the overdispersion of the data.[25]

Initially the associations between BFP and AIDS outcomes (i.e., incidence, hospitalizations and mortality rates) were evaluated considering the whole sample of municipalities. Since the AIDS epidemic in Brazil is very heterogeneous in terms of incidence rates across the country, an average municipal incidence rate of AIDS over the study period – expressed as average incident cases per 100.000 inhabitants-year – was measured and classified into >10, >20 and >30 cases (per 100.000). All analyses were performed for all municipalities and stratified according to these incidence rates. Finally, the effect of BFP on AIDS incidence for both adult women and men over 14 years old, and for children under 14 years old, were investigated.

The models were estimated accounting for both fixed and random effects, and fixed effects models were chosen based on the Hausman specification test. The fixed effects model includes a second term in the regression equation to account for characteristics of the unit of analysis that are constant over the period, and have not been included in the model as confounding variables, e.g., geographic, sociocultural and historical aspects of each municipality.[25] This allow to control for unobserved variables related to the implementation of the intervention, and for such reason fixed effects are considered more robust in impact evaluation of interventions when using panel data.[25] Goodness of fit tests with Akaike information criterion (AIC) and Bayesian information criterion (BIC) estimates were also performed. The usage of different levels of BFP coverage of the target population allows to evaluate the existence of a dose-response effect, i.e., increasing degrees of effectiveness according to increasing intervention coverage.[20] The lowest coverage of BFP was considered as the reference category.

Several sensitivity analyses were performed to verify the robustness of the results: first, Poisson models were estimated and the results compared to negative binomial models to evaluate if the effects of BFP hold

similar. Second, we estimated the BFP coverage effect as a categorized variable, instead of a dummy variable that estimates the coefficients referred to a unique baseline category. Third, the results between fixed effect and random effects models for panel data was performed and compared, and finally, the estimates of BFP on AIDS mortality rates were also tested for all Brazilian municipalities instead of the ones selected for quality of vital information. The whole sensitivity analyses estimates are displayed in the WebAppendix, pages 8 to 13, tables S3, S4, S5 and S6.

**Role of the Funding Source**

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

**RESULTS**

Descriptive statistics show a decrease in the average municipal AIDS incidence, hospitalization and mortality rates between 2004 and 2018 (-12.9%, -30.6%, and -10.5%, respectively) (Table 1). The BFP coverage of the target population (TP) increased by 39.88%, achieving an average coverage of 86.94% in 2018. This trend was observed also in the FHP coverage. Socioeconomic variables changed over time, with reductions in the proportion of extremely poor population, illiteracy rate, unemployment rate and *per capita* income, and increases in the proportion of garbage collected and households with piped water. Furthermore, the number of physicians, nurses and specialized clinics (per 1,000 inhabitants) increased over the period, while numbers of hospital beds (per 1,000 inhabitants) decreased.

Table 2 shows both non-adjusted and adjusted effects of the BFP on the incidence, hospitalizations and mortality rate from AIDS. All the specifications show a negative association between BFP and the outcomes. In multivariable analyses, a dose response effect of the BFP was shown, with a reduction of 5.1% on the incidence, 14.9% on the hospitalization and 12% on the mortality rates when a high coverage of the target population (≥70%) is achieved, compared to a low coverage (≤ 29%). Moreover, the intermediate coverage (from 30% to 69%) also shows a reduction of 4.9%, 14.7% and 9.5% on the incidence, hospitalizations and mortality rates, respectively.

In Table 3 are presented BFP effects for different strata of average municipal AIDS incidence rate over-period, showing a positive and progressive BFP impact on AIDS incidence: municipalities with high BFP coverage show reductions of 4.4%, 8.8% and 13.1% on the AIDS incidence for average incidence rate greater than 10, 20 and 30 per 100,000 inhabitants respectively. The effect of high BFP coverage on the other AIDS-related outcomes, taking into account AIDS incidence rate over-period, was also estimated, showing reductions of 16.5%, 19.9% and 22.6% for AIDS-related hospitalization rate for different average municipal AIDS incidence rates (greater than 10, 20, and 30 per 100,000 inhabitants respectively). Moreover, a high coverage of the BFP show AIDS mortality reductions of 12.6%, 15.4% and 14.8% when considering the increasing average municipal AIDS incidence rates. The full results for hospitalizations and mortality rates in different strata of average municipal AIDS incidence rate are displayed in the WebAppendix, Tables S1 and S2, page 7.

Finally, in municipalities with average municipal AIDS incidence rate over 30 per 100,000 inhabitants, a high coverage of BFP was showing a reduction effect on AIDS incidence rates of 14.8%, 10.8% and 24.5%

in adult women, adult men and children under-14, respectively (Table 4). The intermediate coverage also shows reductions on AIDS incidence by 12.5% for adult woman, 7.1% for adult men, and 23.6% for children (Table 4).

**DISCUSSION**

The results of our study show that high levels of BFP coverage were able to reduce AIDS incidence, hospitalizations and mortality rates during the past two decades in Brazil, with a stronger impact in municipalities with higher AIDS endemicity, and larger effects on adult women and children under-14.

The positive impact of Cash Transfer Programmes on health outcomes has been already shown, including in Brazil, with reductions on tuberculosis incidence,[21] leprosy,[26] child [20] and maternal mortality.[22] Studies conducted in other LMIC, such as Malawi, showed a reduction of more than 60% in HIV prevalence among adolescents who received financial aid, regardless of the programme's conditionalities.[7] Other interventions and economic incentives based on the "contingency management" theory (short-term gratification that can influence behaviors immediately) have also demonstrated their effectiveness. A study in Tanzania showed a 25% reduction in sexually transmitted diseases – also used as a proxy for HIV – when the achievement of being free from these diseases was associated with a small economic reward.[27] In Malawi, economic incentives have increased the number of people taking HIV tests.[28] Several studies have shown that conditional cash transfer programmes can contribute to reduce HIV-related morbidity and mortality through several mechanisms.[8,10] For instance, i) improving the socioeconomic conditions of families, especially in contexts of extreme poverty, ii) decreasing the possibility that women practice commercial sex work (or transactional sex) on an occasional basis to obtain income or essential goods,[8] in part explained by the greater empowerment of women beneficiaries of the CCT, and iii) avoiding risky sexual behavior that prevents new cases of infection.[19] CCTs could also delay or inhibit the conversion from HIV infection to AIDS, and to AIDS-related hospitalization and mortality, because could reduce the economic and geographic barriers for access to HIV/AIDS specialized services. An increased access to healthcare services can contribute to the autonomy of care for these individuals and to a higher adherence to antiretroviral treatment.

Another mechanism applicable to our findings refers to the improvement on the nutritional status coming from the income increments, allowing investment in adequate and healthy food as an attenuating factor for the worsening of the immune system and possible transition between HIV infection and AIDS, thus reflecting in lower incidence, hospitalization and mortality rates by the disease.[29]

Through the conditionalities of prenatal care for pregnant women once they must be tested for HIV (among other diseases), it is possible to understand the effects of the health service in the increased information on the serological status through testing in the referenced service; monitoring of women and children by the health team and social assistance, mitigation of comorbidities acting in the final stage of the disease, access to adequate health information on adherence to treatment, reduction of vertical transmission, and prevention of transmission to others partners.[30]

Our study has limitations. While the evaluation has been extremely comprehensive in terms of health outcomes analyzed, stratifications and broad range of adjusting variables, due to limitation in the data sources it was not able to adjust for risky sexual behavior of the individuals. However, as explained above,

these risk factors should be considered effect mediators of BFP and of the social determinants included in the models, and not confounding factors. Moreover, because cultural and behavioral factors are considered approximately constant over the study period, the municipal fixed-effects terms should adjust for their effects in the multivariable regression. Another limitation is the use of the BFP coverage of the target population instead of municipal coverage as used in some previous studies.[21,22] While BFP municipal coverage allows to partially capture the effects of BFP externalities, using BFP coverage of the poor eligible population is more efficient in the identification of the effect on the most vulnerable subpopulation, where a reduction of poverty levels could have a stronger effect on AIDS morbidity and mortality. It is important to note that the effects found of the BFP coverage on the incidence, hospitalization and mortality rates is related to the population with AIDS as a whole, i.e., being beneficiary or non-beneficiary of the BFP, showing a positive externality of the programme to this specific population. Despite this, the effects were maintained even after the adjustment for all demographic, socioeconomic and healthcare variables, and was robust to a wide range of sensitivity analyses.

The results of our study provide evidence that cash transfer programmes can significantly reduce HIV/AIDS morbidity and mortality in a large LMIC such as Brazil, and they could represent important interventions for the achievement of the HIV/AIDS-related Sustainable Development Goal (SDG) 3.3, also considering their potential mitigation effect of the dramatic poverty increases during the Covid-19 pandemic.

**Declaration of interests**

These analyses rely on de-identified, aggregated data and were therefore considered exempt from human subjects' review. The authors declare no competing interests.

**Contributors**

RD, and MGAS developed the study concept. MGAS, SAF and OJA collected the data. RD and MGAS designed the study and investigation. RD, MGAS, GNS, SAF did the data analysis and wrote the first draft of the manuscript. RD, ML, DI, SLE and MJ contributed to data interpretation, and reviewed and edited the manuscript. DR supervised the study process.

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**Data sharing**

All data used in the analyses are available from public websites hosted by Brazilian government agencies. Municipal-level datasets were extracted and downloaded. Socioeconomic variables were obtained from https://www.ibge.gov.br/estatisticas/sociais/populacao/22827-censo-2020-censo4.html?=&t=downloads. Bolsa Familia Programme coverage can be obtained from https://aplicacoes.mds.gov.br/sagirmps/bolsafamilia/. Family Health Programme coverage can be obtained

from https://egestorab.saude.gov.br/paginas/acessoPublico/relatorios/relHistoricoCoberturaAB.xhtml. Health services data were obtained from https://datasus.saude.gov.br/

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**Table 1. Descriptive statistics of incidence, hospitalization and mortality rates by AIDS, *Bolsa Familia Programme* and Family Health Programme coverage, and socioeconomic variables, Brazil, 2004-2018.**

| Variables | 2004 | 2018 | % Change 2004-18 |
|---|---|---|---|
| AIDS incidence (per 100,000 inhabitants) | 20.95 | 18.24 | -12.93% |
| AIDS hospitalizations (per 100,000 inhabitants) | 21.53 | 14.93 | -30.65% |
| AIDS mortality (per 100,000 inhabitants) | 5.98 | 5.35 | -10.53% |
| BFP coverage of the target population (%) | 62.15 (22.35) | 86.94 (18.92) | 39.88% |
| FHP coverage of the municipal population (%) | 62.30 (38.28) | 88.45 (22.03) | 41.98% |
| Fertility rate | 3.83 (0.71) | 3.03 (0.51) | -20.85% |
| Household density | 3.71 (0.47) | 2.98 (0.41) | -19.67% |
| Per capita income (R$) | 982.67 (526.47) | 616.55 (320.07) | -37.26% |
| Extremely poor (%) | 16.98 (14.75) | 6.69 (9.36) | -60.59% |
| Piped Water (%) | 61.82 (21.85) | 75.06 (20.09) | 21.41% |
| Garbage collection (%) | 59.28 (24.78) | 79.22 (20.11) | 33.64% |
| Inadequate Sewage (%) | 21.35 (18.99) | 8.90 (13.75) | -58.31% |
| Illiteracy rate (%) | 17.85 (10.49) | 11.24 (7.37) | -37.03% |
| Unemployment rate (%) | 9.35 (4.71) | 4.74 (4.83) | -49.30% |
| Physicians (per 1000 inhabitants) | 0.59 (0.51) | 0.80 (0.76) | 33.93% |
| Nurses (per 1000 inhabitants) | 0.34 (0.23) | 0.88 (0.44) | 158.47% |
| Hospital beds (per 1000 inhabitants) | 2.14 (2.46) | 1.75 (2.01) | -18.22% |
| Specialized clinics (per 1000 inhabitants) | 0.02 (0.07) | 0.11 (0.16) | 285.48% |

Note: Standard Deviations in ( ); FHP – Family Health Programme; BFP – *Bolsa Familia Programme*

**Table 2. Fixed-effect negative binomial models of the association between AIDS incidence, hospitalizations and mortality rates and BFP: Brazil, 2004-2018.**

| | AIDS incidence | | | | AIDS hospitalizations | | | | AIDS mortality | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IRR unadjusted | 95% CI | IRR Adjusted | 95% CI | IRR Unadjusted | 95% CI | IRR Adjusted | 95% CI | IRR Unadjusted | 95% CI | IRR Adjusted | CI95% |
| **BFP Target Population Coverage** | | | | | | | | | | | | |
| Low (0%-29%) | 1.00 | | 1.00 | | 1.00 | | 1.00 | | 1.00 | | 1.00 | |
| Intermediate (30%-69%) | 0.971 | [0.931-1.012] | 0.951* | [0.911-0.992] | 0.756*** | [0.707-0.808] | 0.853*** | [0.794-0.917] | 0.964 | [0.900-1.032] | 0.905** | [0.841-0.974] |
| High (70% +) | 0.967 | [0.928-1.008] | 0.949* | [0.909-0.991] | 0.708*** | [0.663-0.756] | 0.851*** | [0.791-0.916] | 0.900** | [0.842-0.962] | 0.880*** | [0.816-0.949] |
| **Health Services** | | | | | | | | | | | | |
| FHP Municipal Coverage | | | | | | | | | | | | |
| Low (0%-29%) | | | 1.00 | | | | 1.00 | | | | 1.00 | |
| Intermediate (30%-69%) | | | 0.952*** | [0.939-0.966] | | | 0.905*** | [0.881-0.928] | | | 0.921*** | [0.896-0.947] |
| High (70% +) | | | 1.057*** | [1.034-1.081] | | | 1.204*** | [1.162-1.247] | | | 1.005 | [0.952-1.060] |
| Physicians (per 1000 pop.) | | | 1.016 | [0.998-1.035] | | | 0.930*** | [0.905-0.957] | | | 0.982 | [0.937-1.029] |
| Nurses (per 1000 pop.) | | | 1.014* | [1.001-1.028] | | | 0.919*** | [0.897-0.941] | | | 1.017 | [0.982-1.053] |
| Hospital beds (per 1000 pop.) | | | 0.927*** | [0.909-0.946] | | | 0.876*** | [0.848-0.904] | | | 0.950 | [0.897-1.007] |
| Specialized clinics (per 1000 pop.) | | | 0.998 | [0.980-1.016] | | | 0.867*** | [0.842-0.893] | | | 1.058** | [1.020-1.098] |
| **Household Characteristics** | | | | | | | | | | | | |
| Household density (mean) | | | 0.996 | [0.982-1.009] | | | 0.979 | [0.955-1.003] | | | 1.067*** | [1.035-1.100] |
| Piped Water (%) | | | 1.036** | [1.011-1.062] | | | 0.927*** | [0.893-0.963] | | | 1.074* | [1.003-1.150] |
| Garbage collection (%) | | | 1.016 | [0.991-1.041] | | | 0.944** | [0.909-0.981] | | | 1.054 | [0.993-1.119] |
| Inadequate Sewage (%) | | | 0.991 | [0.973-1.009] | | | 0.957** | [0.930-0.986] | | | 1.021 | [0.977-1.067] |
| **Municipal Socio-Economic Status** | | | | | | | | | | | | |
| Fertility (mean) | | | 0.970** | [0.950-0.990] | | | 0.949** | [0.918-0.981] | | | 0.964 | [0.917-1.012] |
| Per capita income (R$) | | | 1.086*** | [1.069-1.103] | | | 1.042** | [1.015-1.070] | | | 1.043* | [1.002-1.087] |
| Extremely poor (%) | | | 1.107*** | [1.090-1.123] | | | 1.070*** | [1.042-1.098] | | | 1.185*** | [1.146-1.226] |
| Illiteracy rate (%) | | | 0.947*** | [0.925-0.970] | | | 1.085*** | [1.047-1.126] | | | 0.970 | [0.917-1.026] |
| Unemployment rate (%) | | | 1.115*** | [1.101-1.130] | | | 1.168*** | [1.140-1.196] | | | 1.087*** | [1.053-1.123] |
| Years (dummies) | No | | Yes | | No | | Yes | | No | | Yes | |
| Observations | 79020 | | 78001 | | 66090 | | 65479 | | 22425 | | 22392 | |
| AIC | 202395.3 | | 199687.1 | | 160831.4 | | 158136.0 | | 43249.2 | | 42753.7 | |
| BIC | 202423.1 | | 199983.6 | | 160858.7 | | 158426.9 | | 43273.3 | | 43010.2 | |

Notes: Incidence Rate Ratios (IRR) at 95% confidence intervals (95%CI). * p<0.05, ** p<0.01, *** p<0.001; BPF – *Bolsa Familia Programme*; FHP – Family Health Strategy
AIC - Akaike information criterion; BIC - Bayesian information criterion;

**Table 3. Adjusted fixed-effect negative binomial models for the effect between BFP and AIDS incidence according to municipal AIDS average incident cases per 100.000 inhabitants over the study period (AIDS incidence levels): Brazil, 2004-2018.**

| | AIDS incidence levels | | | |
|---|---|---|---|---|
| | Total Sample | >10 | >20 | >30 |
| **BFP Target Population Coverage** | | | | |
| Low (0%-29%) | 1.00 | 1.00 | 1.00 | 1.00 |
| Intermediate (30%-69%) | 0.951* [0.911-0.992] | 0.955* [0.913-0.999] | 0.914*** [0.866-0.964] | 0.899** [0.832-0.971] |
| High (70% +) | 0.949* [0.909-0.991] | 0.956* [0.913-1.000] | 0.912*** [0.863-0.962] | 0.869*** [0.803-0.941] |

Source: Research results. Note: Incidence Rate Ratios (IRR) at 95% intervals confidence. * p<0.05, ** p<0.01, *** p<0.001; BFP – *Bolsa Familia Programme*

**Table 4. Adjusted models between BFP coverage and AIDS incidence according to gender and age in municipalities with average incident cases >30 per 100.000 inhabitants: Brazil, 2004-2018.**

| | Adult Woman | Adult Men | Children (Under14) |
|---|---|---|---|
| **BFP Target Population Coverage** | | | |
| Low (0%-29%) | 1.00 | 1.00 | 1.00 |
| Intermediate (30%-69%) | 0.875** [0.796-0.961] | 0.929 [0.853-1.011] | 0.764* [0.587-0.994] |
| High (70% +) | 0.852** [0.773-0.939] | 0.897* [0.822-0.979] | 0.755* [0.573-0.994] |

Note: Incidence Rate Ratios (IRR) at 95% intervals confidence. * p<0.05, ** p<0.01, *** p<0.001; BFP – *Bolsa Familia Programme*

**Figure 1. Conceptual framework of selected structural determinants of AIDS incidence, hospitalizations and mortality, and of the hypothesized effects of the cash transfer on this process.**