Analysis of combined prevention measures on HIV/AIDS incidence in Brazil (1980-2020)

Análise de medidas de prevenção combinadas sobre a incidência de HIV/AIDS no Brasil (1980–2020)

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ABSTRACT

Introduction: The Human Immunodeficiency Virus (HIV) attacks the immune system, with acquired immunodeficiency syndrome (AIDS) being the most advanced clinical manifestation. Prevention strategies have evolved over time in response to scientific advancements. From an institutional perspective, the Unified Health System (SUS) provides tools for Combined Prevention to the entire Brazilian population, universally and free of charge. However, despite therapeutic advances, HIV/AIDS remains a significant public health problem. **Objective:** To analyze the impact of Combined Prevention measures on the incidence of HIV/AIDS in Brazil from 1980 to 2020. **Methods:** Quantitative, observational, longitudinal, and retrospective study. Descriptive and multivariate analyses were conducted, specifically employing linear regression techniques. The variables of interest included case incidence and the distribution of: tests for sexually transmitted infections (STIs), condoms, post-exposure prophylaxis for HIV (PEP), and pre-exposure prophylaxis for HIV (PrEP). Publicly available data were sourced from governmental repositories. **Results:** The country has accumulated 1,037,878 infection cases, with an average of 25,947 new cases per year. Regarding prophylaxis inputs, five out of six variables demonstrated a negative correlation with the incidence rate, with only the distribution of male condoms showing a positive correlation. The analysis of the effect of PrEP was not statistically significant. **Conclusion:** Brazil has reduced the incidence of the disease as Combined Prevention measures have advanced. More time is needed to assess the impact of PrEP on the incidence of new cases.

Keywords: HIV. Acquired immunodeficiency syndrome. HIV testing. Condoms. Pre-exposure prophylaxis.

RESUMO

Introdução: O vírus da imunodeficiência humana (HIV) ataca o sistema imunológico. A síndrome da imunodeficiência adquirida (AIDS) é a manifestação clínica mais avançada. As estratégias de prevenção evoluíram ao longo do tempo conforme os avanços científicos. Do ponto de vista institucional, o Sistema Único de Saúde (SUS) disponibiliza ferramentas de prevenção combinada a toda a população brasileira de forma gratuita e universal. Contudo, apesar de todos os avanços terapêuticos, o HIV/AIDS continua sendo um grave problema de saúde pública. **Objetivo:** Analisar as medidas de prevenção combinada sobre a incidência de HIV/AIDS no Brasil no período entre 1980 e 2020. **Métodos:** Quantitativo, observacional, longitudinal e retrospectivo. Estatisticamente, foram realizadas análises descritiva e multivariada, mais especificamente a técnica de correção linear. As variáveis de interesse foram a incidência de caso e as distribuições de: testes para infecções sexualmente transmissíveis (IST), preservativos, profilaxia pós-exposição sexual ao HIV (PEP) e a profilaxia pré-exposição ao HIV (PrEP). Os dados utilizados são de caráter público e obtidos em repositórios governamentais. **Resultados:** O país acumula 1.037.878 casos de infecção, com média de 25.947 novos casos por ano. Quanto aos insumos de profilaxia, cinco das seis variáveis demonstraram correlação negativa com a taxa de incidência. Apenas a distribuição de preservativos masculinos teve correlação positiva. A análise do efeito da PrEP não foi estatisticamente significativa. **Conclusão:** O Brasil tem reduzido a incidência da doença à medida que avançam as medidas de prevenção combinada. É necessário mais tempo para analisar o impacto da PrEP na incidência de novos casos.

Palavras-chave: HIV. Síndrome de imunodeficiência adquirida. Teste de HIV. Preservativos. Profilaxia pré-exposição.

INTRODUCTION

HIV/AIDS has an aggressive pathophysiology within the individual's body, and an associated social impact. Despite being distinct clinical entities, the primary health guidelines address strategies for both diagnoses within the same health policies[1,2]. Prejudice, discrimination, and stigma are significant factors in the course of the disease that significantly interfere with the patient's quality of life[3].

Estimates indicate that, from 1980 to June 2021, 1,045,355 cases of AIDS were identified in Brazil, with an annual average of 36,800 new cases in the last five years[4]. In the early years of the epidemic, the main, and practically the only, prevention strategy was the use of condoms during sexual intercourse[5]. Starting in 1990, Brazil established free access to diagnosis and treatment for HIV/AIDS through the Unified Health System (SUS), and, since 1996, the country has provided antiretroviral treatment (ART) through the public healthcare system[5,6].

Only from 2006, the Ministry of Health introduced rapid testing as a diagnostic method for HIV infection. Medicinal options such as Post-Exposure Prophylaxis for HIV (PEP) and Pre-Exposure Prophylaxis (PrEP) were incorporated into SUS only in 2012 and 2017, respectively[7].

Currently, action strategies are guided by Combined Prevention, which includes biomedical, behavioral, and structural intervention strategies[8]. These cover PEP, PrEP, condom distribution, testing for sexually transmitted infections (STIs), and educational and awareness campaigns[4,5]. Its importance is focused on continuous healthcare attention, aiming to prevent infection at different stages of the process[9].

Despite scientific advancements and the expansion of disease combat policies, HIV infection remains a global public health problem, even after nearly five decades since the reporting of the first cases[5]. The Brazilian population's awareness of these prophylactic measures is still low[5]. Studies demonstrate that the high degree of protection offered by prevention depends on good adherence[10]. However, individual behavior change depends on both the available alternatives and the perspectives offered to them[11].

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In this context, a better understanding of the impacts of HIV/AIDS prevention strategies can contribute to adherence to HIV prevention methods, leading to paradigm shifts with the improved implementation of combined interventions, aiming to achieve significant results in virus prevention.

OBJECTIVE

In light of the aforementioned, what is the impact of HIV/AIDS prevention measures on the incidence of cases in Brazil? The objective of this study is to assess the combined measures in controlling the disease in the country. To achieve this, information pertaining to the period from 1980 to 2020 will be analyzed, based on data made available by the Ministry of Health.

METHODS

This study is of a quantitative, observational, longitudinal, and retrospective nature, conducted through the analysis of secondary data. The information used was obtained from the databases of the Ministry of Health and the Department of Informatics of the Unified Health System (DATASUS, in Portuguese).

The data regarding the epidemiology of HIV/AIDS included the incidence of diagnosed cases of the disease from 1980 to 2020 throughout Brazil, categorized by the year of diagnosis, and were extracted from Ministry of Health databases. This information is provided by the Department of Chronic Conditions and Sexually Transmitted Infections (DCCI, in Portuguese).

Data on Combined Prevention included variables such as the distribution of male and female condoms, diagnostic tests, lubricating gel, and the provision of PrEP and PEP from 1996 to 2020. These data were also obtained from the HIV PrEP and PEP Monitoring Report of 2021, and the Logistics Information Notebook for Strategic Inputs for IST, HIV/AIDS, and Viral Hepatitis of 2023 (129th Edition).

Methodologically, descriptive and multivariate statistics were used to assess the numbers of HIV/AIDS cases and the relevant Combined Prevention measures. In particular, the linear correlation technique was employed to measure the degree of correlation between the variables examined over the specified period.

The data were analyzed with a 95% confidence interval and a p-value of 0.05. The information was initially tabulated using Microsoft Excel 2018®. Subsequently, statistical analyses and reports were generated using R Statistical 4.2.2.

Resolution 466/12, item IV.8, from the National Health Council, provides for the waiver of informed consent in situations where it is impossible to obtain. Given that the research will be conducted through the study and analysis of secondary data provided by Ministry of Health databases, without any form of individual identification, there is no need or possibility to obtain any informed consent.

RESULTS

Since the introduction of the disease in Brazil in 1980, the country accumulated 1,037,878 people living with HIV (PLHIV) up to the year 2020, with an annual average of 25,947 new cases. The year with the highest number of registrations was 2013, with a total of 43,850 diagnoses. **Table 1** describes the findings.

Throughout this period, the annual rate of cases per 100,000 inhabitants varied significantly, ranging from 0.00 to 22.56. Until the year 1998, there was a progressive increase in the incidence rate. The first decline in the rate is observed only from the year 1999, but is not sustained, alternating between highs and lows until 2011.

Regarding the Combined Prevention measures, the annual distribution of male condoms, female condoms, HIV screening and diagnostic tests, lubricating gels, post-exposure prophylaxis (PEP), and pre-exposure prophylaxis (PrEP) were analyzed. These policies were widely implemented in the Unified Health System (SUS) in 1996, 2000, 2005, 2006, 2011, and 2018, respectively. **Figure 1** illustrates the findings.

It is noted that the country went through 16 years without a public health policy for HIV infection prevention since the introduction of the disease in Brazilian territory. This fact is in line with the progressive increase in the number of cases during the same period. During the analyzed period, a total of 7,158,804,272 male condoms, 105,805,953 female condoms, 87,050,341 screening and diagnostic tests, 290,808,564 lubricating gels, 699,506 PEPs, and 29,718 PrEPs were distributed.

As shown in **Table 1**, the distribution of male condoms ranged from 13,494,464 to 625,500,000 (mean=286,352,170), female condoms from 0 to 22,310,800 (mean=5,290,297), tests from 509,180 to 13,923,858 (mean=5,440,646), lubricating gel from 276,200 to 45,356,800 (mean=19,387,237), PEP from 21,157 to 140,492 (mean=69,950), and PrEP from 6,197 to 12,859 (mean=9,906). In general, the trend was an increase in the availability of preventive measures over the years, with higher records from 2013. Only the distribution of female condoms was not carried out during the year 2011.

When analyzing the correlations between the distribution of inputs and the case rate, a negative correlation is observed in five of the six variables of interest. These variables are: female condom ($r=-0.48$; $p<0.05$), screening and diagnostic tests ($r=-0.59$; $p<0.05$), lubricating gel ($r=-0.61$; $p<0.05$), PEP ($r=-0.88$; $p<0.001$), and PrEP ($r=-0.79$; $p>0.05$). The findings demonstrate an association with a reduction in the case rate as the distribution of these inputs increases.

However, a positive correlation is observed when examining the variable "male condoms" ($r=0.36$; $p<0.05$). Some questions may arise from this result. It is necessary to consider the discrepancy in the quantity of male condoms distributed compared to the other measures. This is because the total quantity of male condoms is 2,461% higher than the second most widely distributed input, which is lubricating gel. When compared to more recent measures such as PEP and PrEP, this value reaches 1,023,408% and 24,089,118%, respectively. For this reason, this finding suggests a spurious correlation.

The only variable that did not show statistical significance was PrEP. It is believed that this is due to the short implementation time of this measure compared to the absolute period analyzed. **Figure 2** summarizes the described results.

DISCUSSION

Studies indicate that the expansion of early diagnosis and treatment of people with HIV can provide control of the epidemic[12]. The World Health Organization (WHO) emphasizes the importance of early diagnosis to achieve satisfactory results[13]. Since the 1990s, Brazil has established early HIV diagnosis as a guideline[1].

Table 1. Distribution of HIV/AIDS cases and case rates, prophylaxis inputs per year during the period 1980-2020.

Year	Cases	Ratio	Male condom	Female condom	Tests	Gel	PEP	PrEP
1980-1995	104,648	4.67	0	0	0	0	0	0
1996	23,695	15.09	20,193,312	0	0	0	0	0
1997	25,958	16.26	13,494,464	0	0	0	0	0
1998	28,869	17.84	38,368,201	0	0	0	0	0
1999	26,488	16.16	39,456,646	0	0	0	0	0
2000	36,590	21.55	78,427,455	1,407,500	0	0	0	0
2001	34,996	20.30	125,664,194	517,000	0	0	0	0
2002	39,404	22.56	146,200,000	1,967,000	0	0	0	0
2003	38,334	21.67	257,000,000	2,524,000	0	0	0	0
2004	38,576	21.54	153,000,000	1,541,500	0	0	0	0
2005	38,360	20.83	251,300,000	39,000	509,180	0	0	0
2006	37,814	20.25	252,000,000	1,042,000	579,640	276,200	0	0
2007	38,897	20.54	1228,00,000	1,569,000	1,372,175	1,874,200	0	0
2008	41,591	21.93	410,100,000	2,962,500	1,847,935	1,851,500	0	0
2009	41,608	21.73	461,600,000	2,050,800	2,543,280	2,170,400	0	0
2010	41,226	21.61	333,200,000	379,700	1,759,040	5,768,200	0	0
2011	43,225	22.47	495,300,000	0	2,368,915	10,483,900	21,157	0
2012	43,004	22.17	337,600,000	11,609,500	3,778,080	12,416,860	25,465	0
2013	43,850	21.81	625,500,000	6,313,500	4,729,485	13,967,000	28,865	0
2014	42,623	21.02	443,800,000	2,074,000	6,492,105	18,879,997	35,820	0
2015	41,519	20.30	552,400,000	22,310,800	8,533,270	35,270,600	52,053	0
2016	39,916	19.37	385,300,000	10,004,180	7,383,260	37,222,975	73,082	0
2017	39,095	18.83	456,500,000	9,627,283	11,828,080	44,884,832	87,288	0
2018	38,627	18.53	333,700,000	1,623,715	13,923,858	45,356,800	109,138	6,197
2019	38,327	18.24	468,200,000	10,705,475	11,983,758	31,053,600	140,492	10,662
2020	30,638	14.36	357,700,000	15,537,500	7,418,280	29,331,500	126,146	12,859

PEP: post-exposure prophylaxis for HIV; PrEP: pre-exposure prophylaxis for HIV.

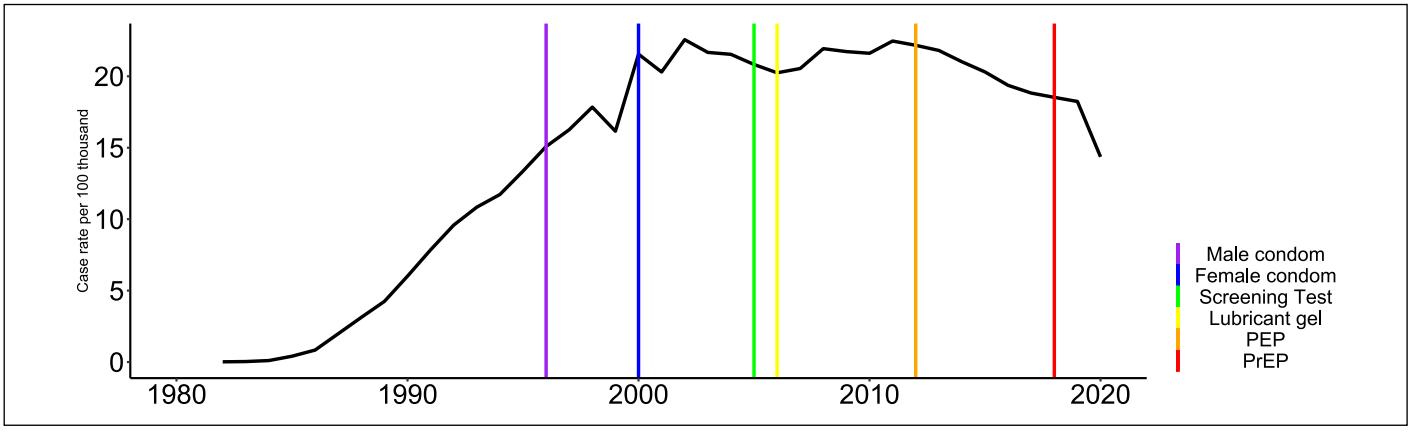

Figure 1. Variation in HIV/AIDS case rates from 1980–2020 with emphasis on the temporal milestones of prophylaxis input introduction.

A progressive decrease in the rate is only observed from the year 2012, with an average reduction of 4.49% per year. These results are in line with other studies that also observed a decrease in the AIDS detection rate during the same period[14]. The reduction may be related to the new recommendation of the Ministry of Health (MS) at the time. Starting in 2013, the MS began recommending treatment for all diagnosed patients, regardless of CD4 T-cell levels. This measure positions Brazil as a pioneer in HIV/AIDS management, as the WHO updated its HIV care protocol to recommend immediate antiretroviral therapy (ART) initiation only two years after the change by the Brazilian Ministry[15].

Since 2014, global guidelines have advocated for "Treatment as Prevention" (TasP) as a strategy to achieve AIDS eradication goals by 2030[13]. Brazil has been at the forefront of combating the HIV/AIDS epidemic. The first actions began in the mid-1980s, coinciding with the introduction of the disease into the Brazilian territory and the creation of the SUS. The first program dedicated to disease control as a strategy was established in 1984 in São Paulo by the State Department of Health, while the national-level program, the National Program for Sexually Transmitted Diseases and AIDS, followed two years later[16].

Alongside the expansion of combined antiretroviral therapy (cART) distribution, public policies included early diagnosis and transmission

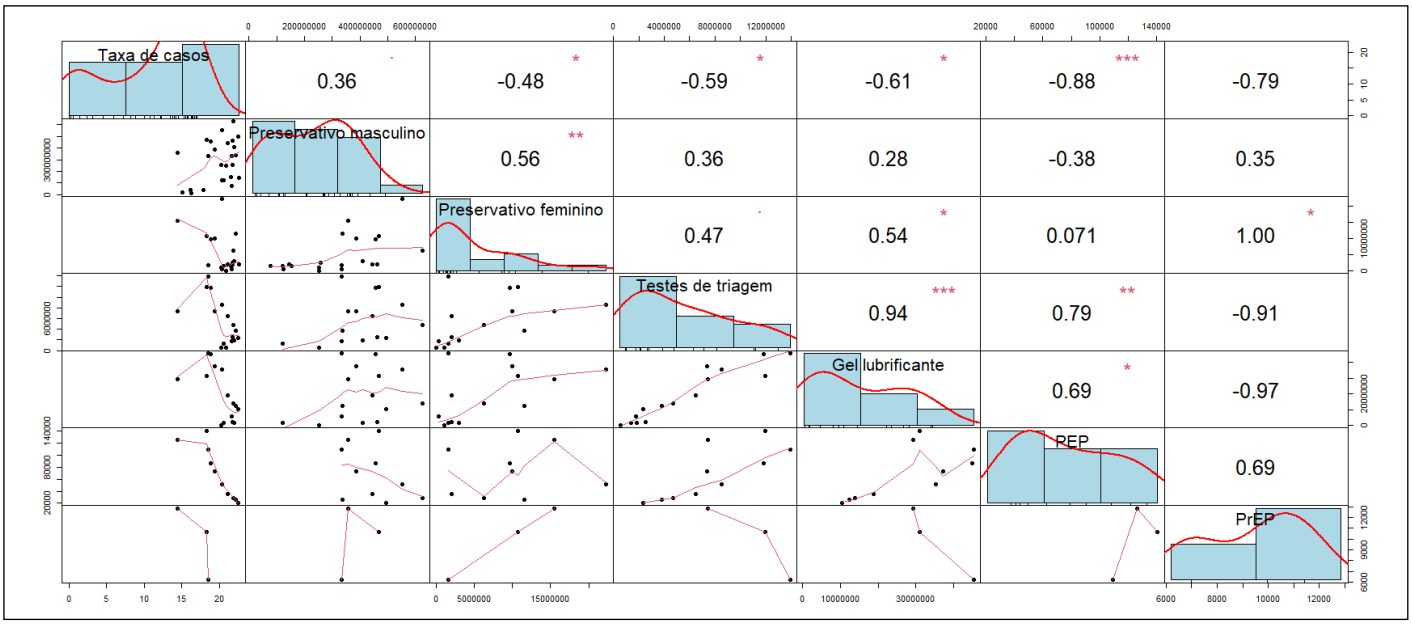

Figure 2. Linear correlation between case rate per 100,000 inhabitants and distribution of prophylaxis inputs.

prevention as main objectives[12,14]. Another strategy in the Ministry of Health's protocol is the use of accessible and welcoming language by healthcare professionals, as well as expanding actions to the general population rather than targeting specific groups[17].

Moreover, despite peaks in the distribution of inputs, they did not necessarily result in a reduced incidence of new cases of the disease. Several questions can be raised about this result, one of which is the inequality and access to public health policies. This perspective highlights the complexity of formulating and implementing health policies in a country with a continental magnitude[16].

This approach allowed people to approach and incorporate HIV/AIDS prevention into their healthcare, regardless of their sexual orientation[13,14]. This was the case in 2002, with the creation of the "Nascer-Maternidade" Project, which made it mandatory to conduct rapid HIV tests during prenatal and labor, as well as pre- and post-test counseling and follow-up based on the results[18].

In addition to the decrease in the incidence of newly diagnosed cases, studies also indicate an increase in patients with undetectable or reduced viral loads. This is significant because, besides the individual sphere with improved quality of life for people living with HIV (PLHIV), there is also a collective impact on society, as individuals with undetectable viral loads do not transmit the virus[12].

Given the impact of HIV/AIDS on public health due to its chronic and incurable nature, the country seeks to keep up with new discoveries to advance in controlling the epidemic. The latest approach is to diversify prevention methods. It is in this context that pre-exposure and post-exposure prophylaxes (PrEP and PEP) emerge[19].

Despite the limited time for a more comprehensive analysis of the new measures, the findings from other studies have demonstrated the feasibility of PEP and PrEP as effective public strategies, with good acceptance among the population[19,20]. Furthermore, PrEP is classified as having a good safety profile and is not correlated with an increase in the diagnosis of sexually transmitted infections (STIs) during the analyzed period[21].

Strengths

The main contribution of this work lies in addressing a variable that is often overlooked in studies involving the effectiveness of actions to combat sexually transmitted infections (STIs): prophylactic inputs. Despite variations in the acquisition of new prophylaxis items, it can be affirmed that the policies have remained in place throughout the period since their implementation. Five out of six variables showed negative correlations with the infection rate. In other words, during periods of greater distribution, there was a lower record of cases.

Limitations

Among the limitations of this study, the use of secondary data and a high percentage of missing information stand out, such as the absence of records of the acquisition of female condoms in the year 2011, for example. On the other hand, the coverage of HIV/AIDS case records increased with improved notification quality over time, along with the enhancement and creation of new specific databases. Despite these limitations, all registered cases of HIV/AIDS and purchases of inputs recorded by the Ministry of Health were analyzed, allowing for comprehensive coverage from the introduction of the disease to the current decade.

CONCLUSION

More than just the numerical values, it is possible to perceive the achievements and advancements in public policies over time, as well as the complex and lengthy path toward controlling the epidemic of a disease that still has no cure. In this scenario, there is a recognition of the need for social commitments that embrace the complexity surrounding people living with HIV (PLHIV) beyond their diagnosis.

Participation of each author

GMCA: conceptualization, data curation, formal analysis, methodology, writing – original draft, writing – review & editing. LEOS: data curation, formal analysis, software, writing – review & editing. SSL: conceptualization, formal analysis, writing – review & editing.

Funding

Fundação de Amparo à Pesquisa do Estado de Alagoas (FAPEAL).

Conflict of interest

The authors declare no conflicts of interest.

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Received on: 09.18.2023
Approved on: 09.26.2023