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ORIGINAL ARTICLE

Outpatient follow-up of people living with HIV-1/Aids in the state of Piauí in the context of the Covid-19 pandemic

Acompanhamento ambulatorial de pessoas vivendo com HIV-1/Aids no estado do Piauí no contexto da pandemia de Covid-19

Seguimiento ambulatorio de personas que viven con el VIH-1/Sida en el estado de Piauí en el contexto de la pandemia de Covid-19

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ABSTRACT

Justification and Objectives: The Covid-19 pandemic has posed significant challenges to public health, especially for vulnerable groups such as people living with HIV-1/Aids (PLWHA). This study aimed to analyze the impact of the pandemic on sociodemographic aspects, clinical outcomes and opportunistic infections of PLWHA in outpatient care in Piauí. **Methods**: An observational epidemiologic study was conducted using retrospective data from medical records of PLWHA receiving outpatient care at the Natan Portella Institute of Tropical Diseases (IDTNP) in Teresina, Piauí. The sample consisted of 334 medical records of patients receiving antiretroviral therapy for at least six months. **Results**: Antiretroviral therapy (ART) showed significant efficacy before the pandemic, with a decrease in viral load between follow-up visits. During the pandemic, patients showed a decrease in viral load between follow-up visits, but the lack of complete data prevented a comprehensive analysis. CD4+ T-cell counts increased both before and during the pandemic, reflecting ART adherence. There was no significant difference in CD8+ T cell counts. The CD4+/CD8+ T cell ratio showed significant differences, indicating immunologic improvement. The most common opportunistic infections were syphilis, tuberculosis and neurotoxoplasmosis. **Conclusion**: The Covid-19 pandemic had a negative impact on ART adherence and increased the prevalence of co-infections among PLWHA in Piauí. Adaptive strategies, such as multi-month ART dispensing and the use of telemedicine, were crucial to ensure treatment continuity. This study highlights the need for adaptive public policies to ensure continuity of patient care during public health crises.

Keywords: *HIV-1. Covid-19. Health profile.*

RESUMO

Justificativa e Objetivos: A pandemia de Covid-19 tem representado desafios significativos para a saúde pública, especialmente para grupos vulneráveis como as pessoas vivendo com HIV-1/Aids (PVHA). Este estudo teve como objetivo analisar o impacto da pandemia nos aspectos sociodemográficos, desfechos clínicos e infecções oportunistas de PVHA em atendimento ambulatorial no Piauí. **Métodos**: Foi realizado um estudo epidemiológico observacional com dados retrospectivos de prontuários de PVHA atendidas em ambulatório do Instituto de Doenças Tropicais Natan Portella (IDTNP) em Teresina, Piauí. A amostra foi composta por 334 prontuários de pacientes que receberam terapia antirretroviral por pelo menos seis meses. **Resultados**: A terapia antirretroviral (TARV) apresentou eficácia significativa antes da pandemia, com diminuição da carga viral entre as consultas de acompanhamento. Durante a pandemia, os doentes apresentaram uma diminuição da carga viral entre as visitas de acompanhamento, mas a falta de dados completos impediu uma análise exaustiva. As contagens de células T CD4+ aumentaram tanto antes como durante a pandemia, refletindo a adesão à TAR. Não se registou qualquer diferença significativa nas contagens de células T CD8+. A razão de células T CD4+/CD8+ apresentou diferenças significativas, indicando uma melhoria imunológica. As infecções oportunistas mais comuns foram a sífilis, a tuberculose e a neurotoxoplasmose. **Conclusões**: A pandemia de Covid-19 teve um impacto negativo na adesão ao TARV e aumentou a prevalência de co-infecções entre as PVHA no Piauí. Estratégias adaptativas, como a dispensação multi-mensal de TARV e o uso da telemedicina, foram cruciais para garantir a continuidade do tratamento. Este estudo destaca a necessidade de políticas públicas adaptativas para garantir a continuidade do atendimento aos pacientes durante crises de saúde pública.

Descritores: *HIV-1. Covid-19. Perfil de saúde.*

RESUMEN

Justificación y Objetivos: La pandemia del Covid-19 trajo desafíos importantes a la salud pública, especialmente a los grupos vulnerables, entre ellos, los que portadores de VIH-1/SIDA (PVVS). Este estudio tuvo como objetivo analizar el impacto de la pandemia en los aspectos sociodemográficos, resultados clínicos e infecciones oportunistas de PVVS en seguimiento ambulatorio en el estado de Piauí. **Métodos**: Se realizó un estudio epidemiológico observacional, en el que se utilizaron datos retrospectivos de historiales médicos de PVVS en tratamiento ambulatorio en el Instituto de Dolencias Tropicales Natan Portella (IDTNP), de Teresina, Piauí. La muestra estuvo constituida por 334 historias clínicas de pacientes bajo tratamiento antirretroviral de aproximadamente seis meses. **Resultados**: Antes de la pandemia, la terapia antirretroviral (TARV) mostró una eficacia significativa, con reducción de la carga viral entre las visitas de seguimiento. Durante la pandemia, la carga viral de los pacientes también disminuyó entre las visitas de seguimiento, pero la falta de datos minuciosos ha obstaculizado un análisis más exhaustivo. Los recuentos de células T CD4+ aumentaron antes y durante la pandemia, lo que refleja la adherencia al TARV. No hubo gran diferencia en los recuentos de células T CD8+. Sin embargo, la relación TCD4+/TCD8+ mostró diferencias significativas, apuntando hacia una mejoría inmunológica. Las infecciones oportunistas más prevalentes fueron la sífilis, la tuberculosis y la neurotoxoplasmosis. **Conclusión**: la pandemia del Covid-19 impactó negativamente en la adhesión al TARV y aumentó la prevalencia de coinfecciones en PVVS en Piauí. Las estrategias adaptativas, como la dispensación del TARV por varios meses y la telemedicina, fueron cruciales para

garantizar la continuidad del tratamiento. Este estudio destaca la necesidad de políticas públicas adaptativas para asegurar la continuidad de la atención al paciente durante las crisis de salud pública.

Palabras Clave: *VIH-1. Covid-19. Perfil de salud.*

INTRODUCTION

Covid-19 (coronavirus disease-2019), a respiratory disease caused by the SARS-CoV-2 virus, emerged in December 2019 in the city of Wuhan, Hubei Province, China.[1] The first cases of the disease were associated with pneumonia of unknown origin. Due to its high transmissibility, the disease spread rapidly around the world, and on March 11, 2020, the World Health Organization (WHO) declared the new coronavirus a pandemic.[2] Covid-19 can manifest in a variety of ways, from asymptomatic cases to severe cases requiring intensive care, such as mechanical ventilation in intensive care units (ICUs). The most common symptoms are fever, cough, sore throat and dyspnea. Severe cases may progress to acute respiratory failure (ARI).[3,4]

The health crisis caused by Covid-19 has posed a significant global public health challenge, particularly in terms of high hospitalization rates, morbidity and mortality, and transmissibility. Specific population groups, such as the older adult, those with co-morbidities (systemic arterial hypertension and diabetes mellitus), those in vulnerable situations (incarceration or living in favelas/slums) and immunosuppressed individuals (undergoing cancer therapy or living with HIV-1/Aids), have been identified as more susceptible and therefore more likely to experience severe complications of the disease.[2,5]

In the scenario of people living with HIV/Aids (PLWHA), the Covid-19 pandemic has posed additional challenges to the clinical management of these conditions. Outpatient care for these people has become more complex due to restrictions on mobility and access to health services.[6] Adherence to antiretroviral therapy (ART) and regular monitoring of viral load and T-lymphocyte counts (CD4+ and CD8+) are critical for treatment efficacy and prevention of serious complications, including opportunistic infections.[3,5] PLWHA are particularly vulnerable to co-infection and opportunistic infections.

PLWHA are particularly vulnerable to co-infections and opportunistic infections due to the immunosuppression caused by HIV-1. During the pandemic, the possibility of co-infection with SARS-CoV-2 posed a significant challenge, as it not only exacerbated pre-existing health conditions, but also increased the need for rigorous clinical follow-up adapted to the new realities imposed by Covid-19.[2,5-7]

The pandemic has brought unprecedented challenges to the follow-up of PLWHA, highlighting the importance of studies that assess the impact of the pandemic on outpatient care practices. Understanding how clinical variables and the prevalence of opportunistic infections were affected during this period is crucial to identify deficiencies in the health system and develop more effective strategies for future health crises. By addressing the obstacles faced by PLWHA, it is possible to enrich the existing literature and provide a solid foundation for the continuous improvement of public health policies, ensuring a more resilient response tailored to the needs of these patients.[5-7 Stroke]

In view of this scenario, this study aimed to analyze the impact of the Covid-19 pandemic on sociodemographic aspects, viral and immunological markers, and opportunistic infections in PLWHA under outpatient follow-up in Piauí.

METHODS

Type of study

An observational and analytical study of an epidemiologic nature was conducted using a mixed-methods approach. The study was based on retrospective data extracted from clinical records of PLWHA receiving outpatient care at the Natan Portella Institute of Tropical Diseases (IDTNP).

Study location

The study was conducted at the IDTNP Outpatient Clinic in Teresina, Piauí. This center is known for its excellence in the treatment and prevention of tropical and infectious diseases and serves patients from various regions, including neighboring states such as Maranhão.

Instrument and data collection

Microsoft Excel® 2010 was used for tabulation and preliminary analysis of the data. Data were collected between December 2022 and October 2023 through medical records and administrative records available at the Medical Archive and Statistics Service (MASS) of the IDTNP Outpatient Clinic.

Sample population

The sample consisted of 372 medical records of PLWHA receiving outpatient care at IDTNP. Before the pandemic, follow-up visits occurred at a normal interval (six months), but during the pandemic, visits usually occurred over a longer period.

Inclusion and exclusion criteria

Patients of both sexes, aged 18 years or older, with a confirmed diagnosis of HIV-1 and in outpatient treatment for at least six months were included. Medical records with incomplete data, patients who did not adhere to the established minimum treatment regimen, patients who died during the study period, and patients who did not receive outpatient follow-up during the pandemic were excluded.[8-11]

Study variables

The variables studied included: sociodemographic aspects (gender, age group, municipality of residence), viral markers (plasma HIV-1 viral load), immunologic markers (quantification of lymphocytes TCD4+, TCD8+, and TCD4+/TCD8+ ratio), and record of opportunistic infections in PLWHA.[8-11]

Time frame

The study employed a detailed temporal analysis, defining the interval through December 2019 as the pre-pandemic period and January 2020 through January 2022 as the pandemic period.

Data analysis and interpretation

The sample consisted of 372 medical records for sociodemographics and opportunistic infections, and 334 medical records for viral and immunologic markers due to lack of follow-up during the pandemic. In the statistical analysis, the Wilcoxon test was used for paired data comparing the medians of viral load, MCT4+, CD8+, and MCT4+/MCT8+ ratio before and during the Covid-19 pandemic, with values of $p \leq 0.05$ considered significant. Bioestat 5.0 software (Instituto Mamirauá, Brazil) was used to generate the graphs. Descriptive analysis was applied to socio-demographic aspects and opportunistic infections, presented in tables with absolute and relative frequencies.

Ethical and legal aspects

This study was approved by the Research Ethics Committee of the Federal University of Piauí, under CAAE number 62729722.6.0000.5214, approval opinion No. 6.750.383 and approval date April 8, 2024.

RESULTS

Sociodemographic Variables of PLWHA from the IDTNP

Of the 372 patients, most are male, representing 70.2% of the sample, while females represent 29.8%. The distribution by age group shows that most patients are in the age group 40 to 49 years (30.1%), followed by the group 30 to 39 years (22.6%) and 50 to 59 years (22.0%). Patients aged 60 years and older represent 14.5% of the sample,

while the lowest proportion is in the 18-29 age group (10.8%). Regarding the municipality of residence, most patients live in the capital city of Teresina (63.98%), while 31.72% come from other cities in the interior of Piauí and 4.30% from the state of Maranhão (Table 1).

Table 1. Distribution of absolute and relative frequencies of sociodemographic variables of PLWHA who undergo outpatient follow-up at IDTNP, Teresina – Piauí, 2024. (n=372)

Sociodemographic Variables	Absolute and relative frequency N (%)
Sex	
Male	261 (70.20)
Female	111 (29.80)
Age group	
18 to 29 years old	40 (10.80)
30 to 39 years old	84 (22.60)
40 to 49 years old	112 (30.10)
50 to 59 years old	82 (22.00)
60 years or older	54 (14.50)
Municipality of residence	
Capital	238 (63.98)
Other cities in the interior of Piauí	118 (31.72)
Maranhao	16 (4.30)

Viral markers - HIV-1 plasma viral load of PLWHA before and during the Covid-19 pandemic

At the first follow-up visit prior to the pandemic, patients had a high plasma HIV-1 viral load. However, starting at the second visit, a significant reduction in viral load was observed, as evidenced by the consistent decline in plasma HIV-1 RNA levels at subsequent visits. This progressive and significant decline, indicated by the statistical significance markers (**** and **), suggests that ART was effective in reducing viral load in patients followed prior to the pandemic (Figure 1A).

At the first follow-up visit during the pandemic, plasma HIV-1 RNA levels are similar to those observed before the pandemic, and patients have high viral loads. A significant decrease in viral load was observed during the pandemic, particularly between visits 1 and 2 (p=0.0008). However, a comprehensive comparison between all visits was not possible due to the lack of viral load data from patients at visits 3 and 4. Many data, such as plasma viral load and TCD4+ lymphocytes, were missing from some patients'

medical records. Analyses were then performed using the data that was available from the patients. Therefore, in visits 2, 3, and 4 (during the pandemic), the number of patients in the analysis decreases because these data were not in the medical records and these tests were probably not performed during the pandemic. Despite the challenges posed by the pandemic, ART was effective in controlling patients' viral loads during this period (Figure 1B).

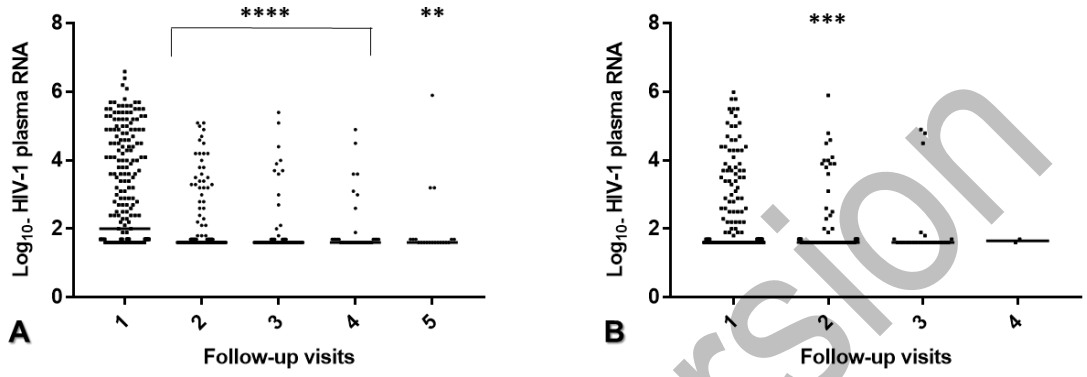

Figure 1. Plasma HIV-1 viral load of PLWHA before (A) and during (B) the Covid-19 pandemic at follow-up visits. (N=334). Horizontal lines represent median values and each point represents a different patient at each visit. * $p<0.05$ - Wilcoxon U test.

Immunological markers – Quantification of TCD4+ and TCD8+ lymphocytes of PLWHA before and during the Covid-19 pandemic

During PLWHA follow-up visits, a gradual and significant increase in TCD4+ lymphocyte counts was observed prior to the pandemic (Figure 2A). At the first pre-pandemic visit, many patients were observed to have relatively low levels of TCD4+ cells. From the second visit, a significant increase in TCD4+ lymphocyte count was observed (1x2 visit: $p<0.0001$; 1x3 visit: $p=0.0004$; 1x4 visit: $p=0.0002$; 1x5 visit: $p=0.0004$). These results suggest a positive response to ART, which is also reflected in the decrease in viral load (Figure 1A).

During the pandemic, a significant increase in TCD4+ lymphocyte count was also observed between follow-up visits. Visit 1 compared to visit 2 resulted in a $p=0.01$ value, and visit 1 compared to visit 3 resulted in a $p=0.04$ value. However, it was not possible to make a complete comparison between all visits during the pandemic due to the lack of TCD4+ lymphocyte data from patients, especially at visit 4. This may be related to the difficulty in accessing health services and the suspension of several laboratory tests during the pandemic. However, it is noteworthy that the adherence of these patients to ART was reflected in the increase in TCD4+ cells observed in the present study (Figure 2B).

There was no significant difference in TCD8+ lymphocyte counts during the follow-up visits of the patients studied before the pandemic (Figure 2C) (1x2 visit: p=0.189; 1x3 visit: p=0.425; 1x4 visit: p=0.973; 1x5 visit: p=0.433). Similarly, no significant difference in TCD8+ cell counts was observed between follow-up visits during the pandemic (Figure 2D) (1x2 visit: p=0.84; 1x3 visit: p=0.85). However, a full comparison between all visits during the pandemic was not possible due to the lack of data on patients' TCD8+ cell counts, especially at visit 4. Similarly, the lack of data is closely related to the access of these patients to health services during this period and the suspension of many laboratory tests that should have been performed for the follow-up of PLWHA.

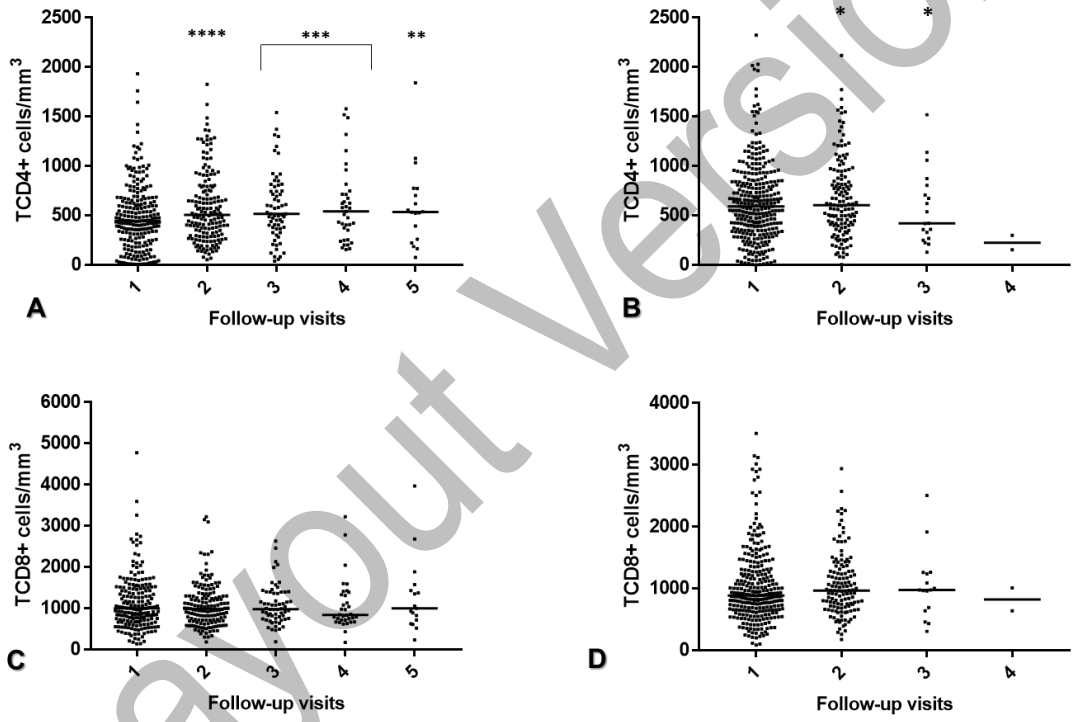

Figure 2. Absolute counts of TCD4+ lymphocytes (A and B) and TCD8+ lymphocytes (C and D) in PLWHA before (A and C) and during (B and D) the Covid-19 pandemic at follow-up visits. (n=334) Horizontal lines represent median values, and each point represents a different patient at each visit. * p<0.05 - Wilcoxon U test.

Immunological markers – Ratio of TCD4+/TCD8+ lymphocytes of PLWHA before and during the Covid-19 pandemic

A significant difference in the ratio of TCD4+/TCD8+ cells was observed at all follow-up visits before the pandemic (Figure 3A) (1x2 visit: p<0.0001; 1x3 visit: p<0.0001; 1x4 visit: p=0.0001; 1x5 visit: p=0.0006). These results showed a significant increase in the ratio of TCD4+/TCD8+ cells over the visits and a positive response to ART before the pandemic. During the pandemic, an increase in the ratio of

TCD4+/TCD8+ cells between follow-up visits was also observed (Figure 3B) (1x2 visit: p=0.002; 1x3 visit: p=0.01). However, it was not possible to perform an analysis between all follow-up visits during the pandemic due to the lack of data on patients' TCD4+/TCD8+ lymphocyte counts, especially at visit 4. These results suggest that despite the difficulties posed by the pandemic, there was adherence to ART by PLWHA and significant immune recovery, as reflected by the increase in the ratio of TCD4+/TCD8+ lymphocytes.

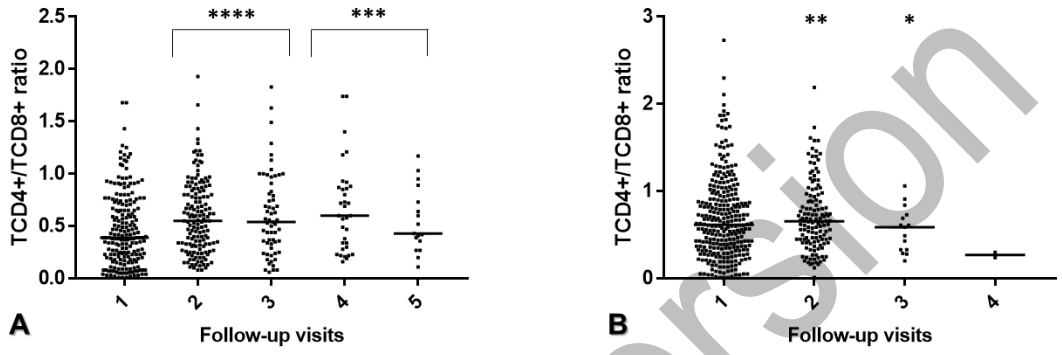

Figure 3. Number of TCD4+/TCD8+ lymphocytes in PLWHA before (A) and during (B) the Covid-19 pandemic at follow-up visits. (N=334). Horizontal lines represent median values and each point represents a different patient at each visit. * p<0.05 - Wilcoxon U test.

Opportunistic infections associated with PLWHA before and during the Covid-19 pandemic

Among the opportunistic infections recorded, syphilis, tuberculosis, and neurotoxoplasmosis were the most common, accounting for 17.2%, 8.3% and 6.2% of the total sample (n=372). Other opportunistic infections such as herpes zoster (1.9%), leishmaniasis (1.6%), hepatitis B (1.3%), and pneumonia (1.1%) presented significant values (Table 2). It is noteworthy that the "no record" category has the highest number and percentage, indicating that many cases have no documented opportunistic infection. This is probably related to the decrease in plasma HIV-1 viral load and the increase in TCD4+ lymphocytes (before and during the pandemic) observed in our study (Figure 1 and Figure 2).

Table 2. Distribution of absolute and relative frequencies of the main opportunistic infections presented by PLWHA undergoing outpatient treatment at IDTNP, Teresina – Piauí, 2024.

Opportunistic infections	Absolute and relative frequency (%)
No registration	223 (59.9)
Syphilis	64 (17.2)
Tuberculosis	31 (8.3)
Neurotoxoplasmosis	23 (6.2)
Herpes zoster	7 (1.9)
Leishmaniasis	6 (1.6)
Hepatitis B	5 (1.3)

Pneumonia	4 (1.1)
Moniliasis	2 (0.5)
Toxoplasmosis	2 (0.5)
Leprosy	2 (0.5)
Candidiasis	1 (0.3)
Meningitis	1 (0.3)
Cryptococcosis	1 (0.3)

DISCUSSION

The present study shows the predominance of men (70.2%) and the age group 40-49 years (30.1%) among the PLWHA followed up, confirming the findings of previous studies in Piauí.[8-11] This prevalence may be attributed to behavioral factors, such as risky sexual practices, and to the lower use of preventive health services by men. The predominant age group may reflect a longer history of infection prior to diagnosis, as suggested by studies indicating late diagnosis in adults in this age group.[8.9]

Most patients (63.98%) live in Teresina, the state capital, indicating better access to health services in the capital. This highlights the need to extend services to less supported regions, where a lack of infrastructure and resources can lead to delays in diagnosis and treatment.[8,10,11] Targeted strategies are needed to expand coverage and access to health services in peripheral and rural areas of the country. It is important to consider that the stigma associated with HIV-1 may lead people from rural areas to seek treatment in larger cities for greater anonymity.[8-11]

The present study shows a significant reduction in viral load after initiation of ART, confirming the findings of other studies demonstrating the efficacy of ART in suppressing HIV-1 viral replication.[12,14] This low viral load is essential as it indicates reduced viral replication, which significantly reduces the risk of disease progression and transmission of HIV-1. Patient adherence to ART is a critical factor in achieving these positive outcomes, underscoring the importance of health policies that encourage and support adherence.[13.15]

Despite the lack of data on some visits during the pandemic, the results suggest that patients adhered well to ART, that ART continued to be effective for most patients, and that many had access to treatment even during the pandemic. This is consistent with other studies indicating the relative resilience of PLWHA in maintaining regular use of ART.[16,17] The ability to keep viral load under control during a global health crisis underscores the importance of public health strategies that ensure treatment continuity even in adverse situations.[14.18]

Factors such as adherence to ART, the presence of comorbidities, and the severity of disease caused by HIV-1 are critical to understanding the trajectory of viral load during the pandemic.[16,19] Treatment adherence is particularly important to ensure continuity of viral suppression. In addition, continuous viral load monitoring is essential to assess the effectiveness of ART and to detect potential treatment failures, especially in times of crisis such as the Covid-19 pandemic.[20.21]

The gradual and significant increase in TCD4+ lymphocyte count after ART initiation is consistent with the existing literature.[13,14] Previous studies have shown that ART is highly effective in reconstituting the immune system, resulting in a substantial increase in TCD4+ lymphocyte count.[20,22] This immune recovery is critical, as it is associated with reduced susceptibility to opportunistic infections and significantly improves the quality of life of PLWHA. The increase in TCD4+ lymphocyte count prior to the pandemic underscores the effectiveness of ART in providing a robust immune recovery, which is critical in preventing complications associated with HIV-1.[21-23]

During the Covid-19 pandemic, increases in TCD4+ lymphocyte counts were observed, even with incomplete data at some visits, suggesting that ART maintained its efficacy in most patients and that PLWHA had good adherence to treatment. Studies suggest that continuity of antiretroviral treatment was essential to maintain the immune response, even in the face of the difficulties posed by the pandemic.[21,22] The importance of rigorous clinical follow-up of PLWHA, especially in times of crisis, is emphasized. Social distance and fear of Covid-19 infection made regular testing difficult, but adaptive strategies such as multi-month drug delivery and the use of telemedicine were essential to maintain treatment adherence and immune recovery in patients.[13,14,16,23]

However, regarding TCD8+ lymphocytes, this study found no significant difference in the number of these lymphocytes between the follow-up visits before and during the Covid-19 pandemic. However, they remained relatively stable, suggesting a consistent response to treatment even during the pandemic. This behavior is consistent with the literature indicating stability or minimal changes in TCD8+ lymphocyte counts in patients under effective treatment.[21,23] Although TCD8+ lymphocytes control the virus during acute HIV-1 infection, their cytotoxic potential declines dramatically as the disease progresses and they are no longer able to mount an adequate antiviral response. These lymphocytes undergo changes in their numbers, differentiation, and activation profile, and undergo immune exhaustion and progressive dysfunction.[19,21,23]

The ratio of TCD4+/TCD8+ lymphocytes is an important marker to assess immune recovery in PLWHA. In this study, a significant increase in the ratio of TCD4+/TCD8+ lymphocytes was observed at all follow-up visits, both before and during the pandemic. This increase is indicative of continued immune recovery and reflects the efficacy of ART in promoting recovery of TCD4+ lymphocytes and stabilization of TCD8+ lymphocytes. The literature highlights that an increasing ratio of TCD4+/TCD8+ lymphocytes is associated with a better immune response and a more favorable prognosis for PLWHA. The maintenance of this ratio during the pandemic suggests that despite the challenges posed by Covid-19, patients were able to maintain a robust immune response due to the continuity of antiretroviral treatment.[20-22]

The prevalence of opportunistic infections is a critical issue in the management of PLWHA. This study found a low incidence of opportunistic infections (40.1%) such as syphilis, tuberculosis and neurotoxoplasmosis among patients, which can be attributed to the efficacy of ART and sustained immune recovery. The significant reduction in viral load and increase in TCD4+ lymphocyte count play a critical role in preventing these infections, as a low viral load and increased TCD4+ lymphocyte count are indicators of a strengthened immune system that is less susceptible to opportunistic infections.[18,19,23,24]

During the Covid-19 pandemic, despite difficulties in maintaining regular follow-up, continuation of ART helped to maintain the immunological benefits and reduce the incidence of opportunistic infections. However, the pandemic may have affected the detection and registration of opportunistic infections due to limited access to health services.[22.-25]

The Covid-19 pandemic posed significant challenges to the clinical follow-up of PLWHA, resulting in a reduction in face-to-face consultations and monitoring visits.[13] This posed a significant risk to the health of patients, compromising the continuous evaluation of treatment efficacy and the implementation of therapeutic adjustments when necessary. Studies carried out in Latin America, including Brazil and Venezuela, confirm these findings and demonstrate the negative impact of the pandemic on the follow-up of these consultations and examinations.[14-16]

In the face of this global health crisis, significant innovations in outpatient care were needed. At this point, adaptive interventions such as multi-month antiretroviral drug regimens in a single visit and telemedicine emerged as critical solutions. These strategies proved effective in maintaining treatment continuity and patient adherence.[13-16, 25 months]

In Piauí, at the IDTNP, the measure adopted during the pandemic to ensure treatment continuity and minimize patients' exposure to the risk of infection by the new coronavirus was to provide antiretroviral drugs for several months in a single visit. This approach is supported by the literature and has been shown to be an effective strategy for maintaining treatment continuity and patient adherence.[14.15]

The literature highlights the importance of telemedicine, which, although not used in the IDTNP context, is described as an essential solution in many contexts. Telemedicine enabled remote and continuous monitoring of patients, minimizing the need for face-to-face consultations and helping to prevent the spread of the SARS-CoV-2 virus.[16]

This study was also affected by the pandemic, resulting in incomplete data collection on viral and immunologic markers. This reduction has made it difficult to obtain accurate information on the health status of PLWHA, limiting the ability to conduct a comprehensive analysis of the impact of COVID-19 on this population.

In addition, the observational nature of the study prevents the inference of causality between variables, and it is necessary that future studies with experimental or quasi-experimental designs provide more robust evidence of cause and effect relationships.

This study, conducted on 372 PLWHA patients treated at the IDTNP in Teresina, Piauí, showed that most patients are male and that the predominant age group is between 40 and 49 years. Most patients reside in the capital city of Teresina, while a significant proportion come from other cities in the interior and the state of Maranhão.

In terms of viral markers, a significant reduction in HIV-1 plasma viral load was observed before and during the Covid-19 pandemic, despite interruptions in health care services. Immunologic markers, particularly TCD4+ lymphocyte counts, showed a significant increase both before and during the pandemic, indicating a positive response to antiretroviral treatment. However, TCD8+ lymphocyte counts remained relatively stable. The TCD4+/TCD8+ ratio also showed a significant increase, suggesting continued immune recovery.

In terms of opportunistic infections, about 60% were unrecorded, of which syphilis, tuberculosis and neurotoxoplasmosis were the most common in the patients studied.

Although this study has made a valuable contribution to understanding the experience of PLWHA in Piauí during the Covid-19 pandemic, it is important to note

some limitations. The sample of 372 PLWHA, although significant, may not be fully representative of the total population of PLWHA in Piauí, and the generalization of the results to other regions or socioeconomic contexts should be done with caution.

In short, the study highlights the importance of adaptive and innovative measures to ensure continuity of care for PLWHA, especially in times of public health crises such as the Covid-19 pandemic. The strategy implemented in IDTNP, the provision of antiretroviral drugs over several months, proved effective in maintaining treatment and the health of patients.

REFERENCES

1. Cavalcante JR, Cardoso-dos-Santos AC, Bremm JM et al. Covid-19 in Brazil: evolution of the epidemic until epidemiological week 20 of 2020. Epidemiol Serv Saude 2020;29. https://doi.org/10.5123/s1679-49742020000400010.

2. Schaurich D, Munhoz OL, Ramos Junior A et al. Clinical progression of Covid-19 co-infection in people living with human immunodeficiency virus: a scoping review. Rev Bras Enferm 2022;75. https://doi.org/10.1590/0034-7167-2020-1380 .

3. Merad M, Blish CA, Sallusto F et al. The immunology and immunopathology of Covid-19. Science 2022; 375:1122–7. https://doi.org/10.1126/science.abm8108.

4. Albuquerque ACB, Albuquerque JB, Gomes VMDO et al. The cytokine storm in Covid-19: a narrative review. REMS 2021; 2(2):23. https://doi.org/10.51161/rems/964.

5. Jones DL, Morgan KE, Martinez PC et al. Covid-19 burden and risk among people with HIV. J Acquir Immune Defic Syndr 2021; 87:869–74. https://doi.org/10.1097/qai.0000000000002656.

6. Pereira TMV, Gir E, Santos AST. People living with HIV and changes in daily routine resulting from the Covid-19 pandemic. Esc Anna Nery 2021;25. https://doi.org/10.1590/2177-9465-ean-2021-0176.

7. Gatechompol S, Avihingsanon A, Putcharoen O et al. Covid-19 and HIV infection co-pandemics and their impact: a review of the literature. Aids Res Ther 2021;18. https://doi.org/10.1186/s12981-021-00335-1.

8. Silva JFT, Oliveira LGF, Sousa EO et al. Overview of HIV/Aids cases reported in the state of Piauí between 2000 and 2021. Collective Health (Barueri) 2023; 13:12536–51. https://doi.org/10.36489/saudecoletiva.2023v13i85p12536-12551.

9. Costa Junior IG, Ribeiro SJS, Ferreira do Nascimento JM et al. HIV/Aids epidemiological profile in the state of Piauí in 2019. Rev. Ciênc. Plural 2021; 8:e25682. https://doi.org/10.21680/2446-7286.2022v8n1id25682.

10. Dias FICR, Diniz CLM, Sambuichi R et al. Epidemiological survey of HIV/Aids in the municipality of Parnaíba-PI, Brazil, 1990-2018. Rev. Ciênc. Plural 2020; 6:16–34. https://doi.org/10.21680/2446-7286.2020v6n3id20338.

11. Amorim PJDF, Abreu IM, Mendes PM et al. Sociodemographic profile and clinical evolution of patients with human immunodeficiency syndrome. Rev Enferm UFPE On Line 2019;13. https://doi.org/10.5205/1981-8963.2019.241310.

12. Woldegeorgis BZ, Zekarias Z, Adem BG et al. Prevalence and determinants of opportunistic infections among HIV-infected adults receiving antiretroviral therapy in Ethiopia: A systematic review and meta-analysis. Front Med (Lausanne) 2023;10. https://doi.org/10.3389/fmed.2023.1087086.

13. Härter G, Spinner CD, Roider J et al. Covid-19 in people living with human immunodeficiency virus: a case series of 33 patients. Infection 2020; 48:681–6. https://doi.org/10.1007/s15010-020-01438-z.

14. Fusco FM, Sangiovanni V, Tiberio C et al. Persons living with HIV may be reluctant to access to Covid-19 testing services: data from 'D. Cotugno' Hospital, Naples, Southern Italy. Aids 2020; 34:2151–2. https://doi.org/10.1097/qad.0000000000002678.

15. Prabhu S, Poongulali S, Kumarasamy N. Impact of Covid-19 on people living with HIV: A review. J Virus Erad 2020; 6:100019. https://doi.org/10.1016/j.jve.2020.100019.

16. Pierone G, Fusco JS, Brunet L et al. 886. The impact of the Covid-19 pandemic on clinical follow-up, monitoring and regimen discontinuation for people living with HIV in the US. Open Forum Infect Dis 2021; 8: S534–5. https://doi.org/10.1093/ofid/ofab466.1081.

17. Ho H-E, Peluso MJ, Margus C et al. Clinical outcomes and immunologic characteristics of Coronavirus disease 2019 in people with human immunodeficiency virus. J Infect Dis 2021; 223:403–8. https://doi.org/10.1093/infdis/jiaa380.

18. Vizcarra P, Pérez-Elías MJ, Quereda C et al. Description of Covid-19 in HIV-infected individuals: a single-centre, prospective cohort. Lancet HIV 2020; 7:e554–64. https://doi.org/10.1016/s2352-3018(20)30164-8.

19. Perdomo-Celis F, Taborda NA, Rugeles MT. CD8+ T-cell response to HIV infection in the era of antiretroviral therapy. Front Immunol 2019;10. https://doi.org/10.3389/fimmu.2019.01896.

20. Wang F, Hou H, Luo Y et al. The laboratory tests and host immunity of Covid-19 patients with different severity of illness. JCI Insight 2020;5. https://doi.org/10.1172/jci.insight.137799.

21. Rosendo INGM, Ribeiro Júnior JLC, da Silva MCS et al. Impacts of immunosuppression on the gravity of Covid-19 in individuals co-infected with the human immunodeficiency virus (HIV). AJMI 2021, 6:9. https://doi.org/10.28933/ajmi-2021-06-1806.

22. Diao B, Wang C, Tan Y et al. Reduction and functional exhaustion of T cells in patients with Coronavirus disease 2019 (Covid-19). Front Immunol 2020;11. https://doi.org/10.3389/fimmu.2020.00827.

23. Wang F, Nie J, Wang H et al. Characteristics of peripheral lymphocyte subset alteration in Covid-19 pneumonia. J Infect Dis 2020; 221:1762–9. https://doi.org/10.1093/infdis/jiaa150.

24. Beserra DR, Alberca RW, Branco ACCC et al. Upregulation of PD-1 expression and high sPD-L1 levels associated with Covid-19 severity. J Immunol Res 2022; 2022:1–9. https://doi.org/10.1155/2022/9764002.

25. Fonetenele GS, Carvalho ACN, Albuquerque NM et al. Prevalence of opportunistic diseases in HIV patients in a hospital in the Far North of the country. Braz J Infect Dis 2023; 27:103046. https://doi.org/10.1016/j.bjid.2023.103046.

AUTHORS' CONTRIBUTIONS

Francisco Rafael de Carvalho designed the project, analyzed and interpreted the data, and wrote the article. **Wellinton Costa Araújo** and **Lucas Dario Ferreira Santos** contributed to the relevant critical review of the intellectual content. **Érika de Araújo Abi-chacra** project design, analysis, interpretation of data and final approval of the version to be published.

All authors approved the final version to be published and are responsible for all aspects of the work, ensuring its accuracy and completeness.