The Outcome of HIV Patients on ART during the War and Siege in a Tertiary Hospital, Northern Ethiopia, a Cross-Sectional Study

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Abstract

Introduction: HIV remains a serious global health pandemic, especially in developing countries where conflicts and political instabilities have persisted for decades. Although Tigray once had one of Ethiopia's best health systems, it has now completely collapsed due to the devastating two-year war and siege. Not only the lack of food but also the lack of medication has led to a loss of life and increased complications. Therefore, the aim of this study was to assess the outcomes of people living with HIV infection in Tigray.

Method: Health facility-based independent repeated cross-sectional study designs were used to assess the outcome of HIV/AIDS patients during the war and siege in Ayder Comprehensive Specialized Hospital from October 2022 to November 2022. Descriptive statistics and logistic regression were applied. The results are presented with tables and figures.

Results: A total of 440 participants were enrolled in prewar and during the war and siege periods with equal distribution to each. The mean ages were 39 and 41.2 years before and during the war. In this study, 63 (28.6%) in prewar, and 120 (54.5%) during the war and siege period had poor outcome status (p=0.000).

Following the eruption of the war, 68.8% of ART drugs were not available for more than 12 months, and only 10.6% (23/218) and 30.7% (67/218) of the participants took IPT and CPT, respectively. During the crisis, services such as CD4 and viral load determinations were significantly affected (p=000); there were also frequent ART switches and an increased number of missed appointments (p=000).

In prewar, severe malnutrition AOR 3.98 (95% CI-1.04-15.22), viral load determination AOR 0.07 (95% CI-0.03-0.18), and viral load >1000 copies AOR 6.68 (95% CI-2.91-15.32) were found to be associated factors with HIV outcome. During the crisis, AOR 2.56 (95% CI-1.14-5.74), CD4 count above 200 cells/ml AOR 0.27 (95% CI-0.08-0.97), patients on CPT 0.43 (95% CI-0.22-0.85), and frequent ART switches AOR 0.12 (95% CI-0.05-0.28) were the independent factors identified.

Conclusion: The war and siege have led to significantly poor outcome status of HIV patients and disruption of services in HIV care.

Introduction

HIV/AIDS is a global public health problem with cases reported virtually from every corner of the world, with the majority being inhabitants of the sub-Saharan Africa region, accounting for 22.5 million patients (1, 2). As of 2021, there was a report of 612,925 and 50,703 people living with HIV in Ethiopia and Tigray, respectively. In Tigray, approximately 43,000 HIV patients were accessing ART drugs in the 141 ART clinic facilities (1, 3, and 4).

HIV patients’ lives have been improving over time due to the introduction of highly active antiretroviral treatment (HAART). However, man-made problems such as conflict have adversely affected the mortality
and morbidity of HIV/AIDS patients. For example, the risk of HIV transmission increases during and after conflict due to complex social factors with armed conflicts due to increased gender-based violence, especially in the case of rape as a “weapon of war”, displacement leading to the disintegration of families and communities and so forth leading to increased vulnerability to HIV (2, 4, 5).

In conflict-affected areas, access to prevention services and HAART is significantly limited because of health system disruption. However, the literature also shows that continuing ART in different conflict areas is feasible. One of the best experiences of access to ART medication in three severely war-affected areas was the experience of MSF on the effective provision of ART in Yemen and the Central Republic of Africa (CRA), where run-away bags containing 3-4 months of ART medications and health cards including helpline to call in case they faced drug shortages in sudden violent eruptions were applied (2, 6). The other was a case study in Haiti in which the ART supply chain was not disrupted (2, 6, and 7).

The ongoing war in the Tigrai region of Ethiopia that started in early November 2020 displaced 2.5 million internally, and nearly 70,000 fled to Sudan. This was followed by the siege imposed by the Ethiopian government and its allies after the Tigrayan defense forces liberated most parts of Tigrai, including the capital city, Mekelle, at the end of June 2021. This has brought enormous damage to the health system, ranging from complete destruction, looting, and displacement of professionals, including health workers, to the de facto blockade of food, medicine, and fuel, as well as interruption of banking services, communication, and other essential services (8, 9). According to an MSF report, prior to the war, Tigray had one of the best health systems in Ethiopia, with relatively well-equipped and well-functioning hospitals as well as referral systems throughout the region. As a result of the war, Tigrai’s health system completely collapsed due to widespread looting, vandalization, and total destruction of health facilities by Eritrean and Ethiopian troops (10, 11). However, from a study conducted in Tigrai from November 2020 to June 2021 during the active war within the region, only 30% of hospitals, 17% of health centers, 11.5% of ambulances, and none of the 712 health posts were functional (9). According to the UN and USAID reports, Tigray was deliberately blocked by the Ethiopian government and allies from accessing aid, including medications (8, 9). The media outlets describe many deaths related to chronic illness because of a lack of medication, including ART. This signposts there was a significant disruption of HIV care service delivery during the war and siege. As a result, there is a fear of increasing HIV transmission in the community, death due to opportunistic infections, and the risk of drug resistance.

In Tigrai, there was a single study that assessed HIV service provision in rural health facilities during the first 8 months of the war (12); however, there is a scarcity of data on the impact of the continuing war and the complete siege applied by the federal government on individual patients as well as further damage to service provision. Therefore, the objective of this study is to assess the effect of the war and siege on the outcome of HIV patients who were followed up for two years before and during the war. This study can provide insight into the current state of HIV/AIDS in the Tigray region and help guide resource allocation efforts during the resumption of services and rehabilitation period in the region.

**Methodology**
Study Area

This study was conducted in Ayder Comprehensive Specialized Hospital (ACSH) from October 20 to November 20, 2022. ACSH is located in Mekelle, the capital city of Tigray. Mekelle is located in northern Ethiopia, 783 km from the capital city of Addis Ababa. Tigray is surrounded by Eritrea to the north, the Amhara region to the south, Sudan to the west, and the Afar region to the east. The estimated area of the region is 50,079 km$^2$ with a total population of 7,070,260 at a density of 140/km$^2$ (13). The ACSH serves more than nine million people from Tigray, the northern part of Amhara, Afar. Although the hospital has ART clinics, following the eruption of the war in November 2020, HIV tests and ART services were interrupted.

Study design and period

Health facility-based independent repeated cross-sectional study designs were used to assess the effect of the war and siege on HIV/AIDS patients enrolled in the ART clinic of ACSH before and during the war and siege of Tigray. Data regarding ART and HIV/AIDS-related characteristics were collected from 2018 to 2022.

Data source

ART drug-related data were collected before the war and during the siege on the availability of drug options from ART pharmacies. Regarding individual patient status, the last measurement data were collected from the patient chart and registration before the eruption of the war and during the war and siege.

Source Population

All patients enrolled in the ART clinic of ACSH

Study population

All patients enrolled in the ACSH ART clinic who had follow-up data since 2018

Study Unit

ART patients enrolled in the ACSH ART clinic were selected by the sampling technique and fulfilled the inclusion criteria.

Eligibility criteria
All HIV/AIDS patients enrolled in the ART clinic of ACSH who had follow-up data since 2018 were included in this study, but patients with incomplete chart information and those who lost their charts were excluded.

**Variables**

Dependent variable: Patient outcome status

Independent variables: Sociodemographic variables, clinical and service condition-related variables, laboratory service-related variables, and pharmacy-related variables.

**Sample size and sampling technique**

Based on the work of Johnston and his coworkers, sample size determination is required when planning chart reviews and other retrospective studies that aim to describe disease patterns. HIV/AIDS-related reports since 2018 were used to assess the trend of the disease and its characteristics. In addition, based on the assessed literature, the minimum sample size for the study was estimated using a single proportion formula with the following assumptions (14). The assumptions were as follows: the proportion of people with HIV/AIDS who lost ART was 15.07%, 95% confidence interval, and a 5% margin of error. The minimum sample size including a 10% nonresponse rate was 217, but 220 samples before and during the war and siege period were used to assess the outcome status of participants under ART. Simple random sampling techniques were applied to select patients from ART registers in both periods (before the war and during the war and siege).

Data collection tools and techniques

A structured data abstraction tool was prepared based on the availability of data from the registration and chart of the patients enrolled in the ART clinic, which is related to the topic. The tool has sociodemographic and clinical characteristics and risk factors associated with the outcome of the patients. Regarding data before and during the war and siege, the last measurements from their chart and registration of the patients were collected. Data were collected using ODK software from ART registration and patient charts selected by the sampling technique.

**Data quality control**

A one-day intensive training was provided to the five data collectors on how to fill data to ODK software and on methods of sampling. The tool was pretested in 20 charts of patients under ART in Mekelle General Hospital. Each day-filled device was checked for completeness and validity. The collected data using ODK were cross-checked by principal investigators.
Data Management and Analysis

Data were cleaned and coded and then exported to SPSS 22 for analysis. Descriptive analysis was applied for categorical variables and mean and standard deviation (SD) for continuous variables. Chi-squared and p-values were used to compare variables and reports before the war and during the war and siege. Binary logistic regression was performed to assess the relationship between outcome and independent variables. Variables with a p-value of <0.25 in the bivariate analysis were exported to multivariable analysis. In multivariable logistic regression, a P value <0.05 with AOR (95% CI) was used to assess the level of statistical significance. Multicollinearity was assessed to check confounding variables. Model fitness was checked using the Hosmer and Lemishow test (0.786 and 0.268 for both pre- and during the war, respectively).

Operational definition

Stable outcome: if a patient enrolled in the ART clinic for ACSH has a good prognosis from the disease.

Poor outcome: if patients enrolled in the ART clinic of ACSH have any of the following conditions (treatment failure, dropout, loss to follow-up, and missed appointments) or die from the disease

Results

Sociodemographic characteristics

In this study, a total of 440 participants were enrolled in prewar and during the war and siege periods with a 100% response rate. The mean age and standard deviation before and during the war were 39 (±12.6) and 41.2 (±12.9) years, respectively. The majority of the participants coming from Mekelle had a statistically significant difference before and during the war and siege for the outcome status of PLWHIV (p=0.003) compared with those who came from outside Mekelle. Similarly, the mean duration of ART was 6.8 (±4.4) and 8.7 (±4.4) years, respectively.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Categories</th>
<th>Prewar (No/%)</th>
<th>During war and siege (No/%)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years</td>
<td>&lt;15</td>
<td>15 (6.8)</td>
<td>15 (6.8)</td>
<td>0.904</td>
</tr>
<tr>
<td></td>
<td>≥15</td>
<td>205 (93.2)</td>
<td>205 (93.2)</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>93 (42.3)</td>
<td>87 (39.5)</td>
<td>0.561</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>127 (47.7)</td>
<td>133 (60.5)</td>
<td></td>
</tr>
<tr>
<td>Address</td>
<td>Mekelle</td>
<td>152 (69.1)</td>
<td>179 (81.4)</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>Out of Mekelle</td>
<td>68 (30.9)</td>
<td>41 (18.6)</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Sociodemographic characteristics of participants in ACSH 2023
Clinical and service condition of participants

CD4 count and viral load determination had significant differences during the war compared with the prewar period (p=0.000). ART regiments were changed more than one time in the last two years during the war and siege compared with the prewar period (p=0.000). Similarly, most of the participants discontinued their ART regimens during the war and siege compared to the prewar period (p=0.000).

Table 2: Clinical and service conditions of the participants under ART in ACSH, Tigray 2023

<table>
<thead>
<tr>
<th>Variables</th>
<th>Categories</th>
<th>Pre-war (No/%)</th>
<th>During war and siege (No/%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD4 Count determined</td>
<td>Yes</td>
<td>170 (72.3)</td>
<td>84 (38.9)</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>50 (37.7)</td>
<td>132 (61.1)</td>
<td></td>
</tr>
<tr>
<td>CD4 Count cell/mm</td>
<td>&lt;200</td>
<td>43 (25.3)</td>
<td>18 (21.5)</td>
<td>0.497</td>
</tr>
<tr>
<td></td>
<td>≥200</td>
<td>127 (74.7)</td>
<td>66 (78.5)</td>
<td></td>
</tr>
<tr>
<td>Viral load determined</td>
<td>Yes</td>
<td>188 (85.5)</td>
<td>98 (45.2)</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>32 (14.5)</td>
<td>119 (54.8)</td>
<td></td>
</tr>
<tr>
<td>Viral load count in copies</td>
<td>&lt;1000</td>
<td>157 (83.5)</td>
<td>92 (93.9)</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>≥1000</td>
<td>31 (16.5)</td>
<td>6 (6.1)</td>
<td></td>
</tr>
<tr>
<td>Frequent ART Switch in the last 2 years</td>
<td>Yes</td>
<td>3 (3.5)</td>
<td>43 (33.1)</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>82 (96.5)</td>
<td>87 (66.9)</td>
<td></td>
</tr>
<tr>
<td>Drug discontinuation</td>
<td>Yes</td>
<td>22 (10)</td>
<td>131 (60.4)</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>197 (90)</td>
<td>86 (39.6)</td>
<td></td>
</tr>
<tr>
<td>Anthropometry</td>
<td>Normal</td>
<td>162 (77.1)</td>
<td>148 (70.5)</td>
<td>0.246</td>
</tr>
<tr>
<td></td>
<td>MM</td>
<td>33 (15.7)</td>
<td>46 (21.9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SM</td>
<td>15 (7.2)</td>
<td>16 (7.6)</td>
<td></td>
</tr>
<tr>
<td>Taking nutritional supplementation</td>
<td>Yes</td>
<td>11 (5)</td>
<td>0 (0)</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>209 (95)</td>
<td>218 (100)</td>
<td></td>
</tr>
</tbody>
</table>

MM=Moderate malnutrition, SM= Sever malnutrition

Outcome status of the participants
In this study, 63 (28.6%) and 120 (54.5%) of the participants in the prewar period and during the war and siege period had poor outcome status (p=0.000), respectively.

Similarly, the annual report of the hospital showed that the number of individuals who dropped out were lost to follow-up and died was higher during the war and siege period.

**Medication and laboratory service-related factors**

Before the eruption of the war, laboratory services such as CD4 count/percentage, viral load, and PCR (DBS) service were available in the hospital for twelve months compared to less than three months during the war and siege. Similarly, HIV counseling and testing were reduced from 9925 tests in 2018 and 9611 in 2019 to 3870 in 2021 and zero in 2022.

Regarding the availability of ART and other supportive medications in the hospital, before the war, six of the ART drugs, including the second line, were out of stock for six months, and three items, including first-line drugs, were also out of stock for three months, but the majority (85%) of the drugs were available throughout the year. Following the eruption of the war, the majority of the items 15 (68.8%), including second-line ART drugs, were not available for more than 12 months, but first-line drugs such as 1E (TDF,3TC, EFV) and 1J (TDF,3TC, DTG) were also out of stock from three to nine months.

Before the war started, 24.1% (53/220) and 52.7% (116/220) of participants used IPT and CPT, respectively. Following the war, only 23 (10.6%) and 67 (30.7%) of the participants took IPT and CPT, respectively. IPT and CPT utilization during the war and siege had significantly decreased compared with the prewar period (p=0.000) due to the unavailability of the drug in the hospital. Regarding ART regiments, most of the adult participants used 1E and 1J regiments, whereas children used 4C.

**Associated risk factors for the poor outcome status of ART**

In this study, anthropometry measurements, level of CD4, viral load determination, level of viral load, and taking CPT were variables associated with ART outcome status in the prewar period. Similarly, age, address, CD4 level, frequent ART regimen change in the last two years, and taking CPT were variables associated with the outcome status of ART patients during the war and siege period.

During the prewar period, participants who had severe malnutrition had a four times higher risk for poor outcome status of ART patients compared with normal nutritional status. In addition, participants whose viral load was determined were 93% less likely to have poor outcome status and those whose viral load was greater than 1000 viral copies had a 6.7 times higher risk of having poor outcome status. During the war and siege period, participants coming from out of Mekelle were at 2.56 times higher risk for poor outcome status compared with individuals coming from Mekelle city. In addition, participants with a CD4 count of greater than 200 cells per mm were 73% less likely to have poor outcome status compared with those who had less than 200 cells per mm. Furthermore, individuals who frequently switched their ART
regimens within the last two years of the data collection period were 88% less likely to develop poor outcomes. Individuals who took CPT were 57% less likely to develop poor outcome status.

Table 3: Factors associated with a poor status of ART patients in ACSH Tigray, 2023

<table>
<thead>
<tr>
<th>Variables</th>
<th>Categories</th>
<th>Pre-War</th>
<th>During War and Siege</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>COR (95% CI)</td>
<td>AOR (95% CI)</td>
</tr>
<tr>
<td>Age In years</td>
<td>&lt;15</td>
<td></td>
<td>1.92 (0.66-5.6)</td>
</tr>
<tr>
<td></td>
<td>≥15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address</td>
<td>Mekelle</td>
<td></td>
<td>2.0 (0.97-4.09)</td>
</tr>
<tr>
<td></td>
<td>Out of Mekelle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anthropometry measurement</td>
<td>Normal</td>
<td>000</td>
<td>0.95 (0.36-2.55)</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td>1.52 (0.66-3.5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>9.2 (2.77-30.66)</td>
<td></td>
</tr>
<tr>
<td>Level of CD4 cell/mm</td>
<td>&lt;200</td>
<td>000</td>
<td>0.44 (0.19-1.06)</td>
</tr>
<tr>
<td></td>
<td>≥200</td>
<td>0.24 (0.12-0.51)</td>
<td></td>
</tr>
<tr>
<td>Viral load determined</td>
<td>Yes</td>
<td>0.12 (0.05-0.27)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>0000</td>
<td>0.07 (0.03-0.18)**</td>
</tr>
<tr>
<td>Level of viral load copies</td>
<td>&lt;1000</td>
<td>6.68 (2.91-15.32)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥1000</td>
<td>6.68 (2.91-15.32)**</td>
<td></td>
</tr>
<tr>
<td>Frequent ART switched</td>
<td>Yes</td>
<td></td>
<td>0.15 (0.07-0.35)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Took CPT</td>
<td>Yes</td>
<td>2.31 (1.25-4.25)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>0000</td>
<td>0.94 (0.43-2.1)</td>
</tr>
</tbody>
</table>

*p value <0.01, **p-value <0.001

Discussion

In this study, the poor outcome status of participants had a significant difference whereby 63 (28.6%) had a poor outcome before the war compared to the 120 (54.5%) who had a poor outcome during the war and siege. Regarding medication and laboratory services, more than 85% of services in the prewar period were available, less than 15% were out of stock for more than six months, and over 68% of ART drugs and laboratory services were unavailable for a year during the crisis. Factors such as nutritional status, viral load copies, and their determination were associated with poor outcomes before the war, while address, CD4 count, use of CPT, and frequent ART change in the last two years were associated with poor outcomes.

This study showed that 54.5% of participants had poor outcome status during the war and siege, which is almost double compared to the prewar period, and it is also supported by the yearly report of the hospital (15). This figure is higher than the studies done in other conflict settings (6, 16, and 17). Although all people living with HIV/AIDS, including those in conflict areas, are strongly recommended to
start ART and continue their follow-up (18), more than half of the participants in this study had poor outcomes. This result is higher than from the studies conducted during the postelection crisis in Kenya, in the study conducted by MSF in Sub-Saharan African countries, from the assessment conducted in the Central Africa Republic and Yemen by MSF, and Tanzania (6, 16, 17, and 19). A possible explanation for the high number of poor outcome statuses in this study could be 1) During the first round of war (November 2020 to June 2021), there was no security guarantee for safe transportation amid the active war, where several pieces of evidence have shown that civilians were targeted (20, 21); 2) starting from the end of June 2021, no ART and laboratory supplies were received due to the war and defacto blockade (22); and 3) there was no coordinated effort of the Federal/Regional Ministry of Health and nongovernmental agencies to support the provision of drug regimens in the region. On the other hand, during the conflict and crisis in CAR and Yemen, and other sub-Saharan African countries, MSF provided ART medications using different modalities (6, 16), unlike in Tigray, where MSF and NRC were banned from delivering health services during the complete siege, including communication, transportation, banking, and extra (23).

The war and siege significantly hampered ART and OI prophylactic medication supplies and laboratory services such as viral load, CD4 testing, and voluntary counseling and testing (VCT). This result is similar to the studies done in conflict areas such as Liberia, Cotidiviore, and instability in Haiti, where there was a significant shortage of basic HIV service supplies (7, 24, 25). This was despite increasing global and local determinations aiming at improving access to antiretroviral treatment in sub-Saharan Africa and promoted that the lack of essential medicines in conflict settings, including ART, is a violation of human rights (26, 27). However, in Tigray, during the two-year-long crisis, there was a complete collapse of the health system, and the majority of health facilities were either destroyed, looted, and/or minimally functioning (9, 10).

In other conflict-affected settings, it is uncommon to see reports of significant disruption of ART provision. The MSF experience in Bukavu can be a lesson, where they reported sufficient medication supplies in the health facilities during the conflict, and those who were displaced to neighboring Rwanda were able to collect their ARVs in Rwanda (28).

Participants with severe undernutrition before the war and siege were at four times higher risk of poor outcome status compared with their counterparts. This result is similar to the findings of a study performed in Metema Ethiopia and Tanzania, where low BMI was associated with a risk of death among ART users (19, 29). In addition, participants whose viral load was determined and viral load above 1000 copies had a poor outcome status. This was also supported by the study done in Metema Ethiopia (29), where viral loads above 1000 copies have a higher risk of death.

During the war and siege period, participants who traveled a long distance to access HIV care had a two times higher risk of having a poor outcome status. During that period, services such as transportation, telecommunication, banking, and most health facilities were closed. For these reasons, participants who were coming from outside of Mekelle had a greater risk of having poor outcome status. This result was
supported by a qualitative study performed in Ethiopia, where lack of transportation was found to be among the barriers to ART follow-up (30). Participants with a CD4 count above 200 cells/mm were 73% less likely to develop poor outcome status. This result is similar to a study performed in South Africa where participants with a high CD4 count were less likely to be lost to follow-up (31, 32). Despite the fact that CD4 determination is crucial in HIV follow-up, only 38.9% of patients received CD4 determination during the war period due to a shortage of supplies, which is approximately half compared to those during the prewar time.

Having frequent ART switches had a positive relationship with ART follow-up status. In this study, participants who switched ART regimens in the last two years were 88% less likely to have a poor outcome status than those who interrupted. In peacetime, ART regimen change is done due to the change in guidelines and the emergence of new and efficient drug combinations (18, 33), but in this situation, the frequent change was due to the unavailability of ART drugs, and patients were forced to switch to ART available in stocks. Even though frequent changing might carry the potential risk of HIV resistance, in crisis time, it is better to provide medications that are available in the facility than leave patients without any form of therapy. This might have an advantage to some extent in reducing the infectivity rate, for example in the case of mother-to-child transmission.

Individuals who have taken CPT during the war and siege period had a positive outcome status. This result is similar to the study conducted in the Sheka zone and northwestern Ethiopia, where patients not on CPT were at higher risk of death and loss from follow-up (34, 35). This is because taking CPT has a positive impact on their functional and health status, but during the war and siege, there was a CPT shortage, and most of the participants were not taken.

**Strengths and limitations of the study**

The study showed the impact of war and siege on the outcome and service disruption in the study area. The retrospective nature of the study, where important information might be missing, is one drawback. The other limitation of this study is that it did not look in detail into treatment failure, as there was an erratic CD4 determination and a complete absence of viral load determination during the data collection time. Due to the lack of communication, the number of deaths might be overlooked because an increasing number of dropouts and lost follow-ups were seen on whom the deceased ones might be.

**Conclusions**

In this study, almost double the participants had poor outcome status during war and siege than in the prewar period. The majority of the participants were lost to follow-up, and there were also dropouts. HIV service provision was significantly disrupted; 68% of ART drugs were unavailable for a year. In addition, there were erratic CD4 and viral load determinations due to the lack of supplies for 16 months in the hospital. Before the war, factors such as nutritional status, viral load copies, and viral load determination
were associated with poor outcomes, while address, CD4 count, use of CPT, and frequent ART changes during the war and siege were independent risk factors for poor outcomes. The war has adversely affected the lives of HIV patients. It is crucial for responsible sectors in collaboration to initiate a coordinated effort toward giving priority to the allocation of resources and complete resumption of services.

Abbreviations

ACSH- Ayder Comprehensive Specialized Hospital, ART- antiretroviral treatment, CPT- Cotrimoxazole preventive therapy, IPT- INH preventive therapy, DBS-dried blood test, 1J-Tenofovir, Lamivudine and Daltgravir, 1E- Tenofovir, Lamivudine, and Efavirenz, 4C- Tenofovir, Lamivudine, and Lopinavir boosted with ritonavir.

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from the institutional review board of the College of Health Science, Mekelle University (MU-IRB 2018/2022). A permission letter was also received from the ACSH medical director to proceed with the study. Confidentiality was kept using anonymity.

Consent for publication

Not applicable

Data availability

The dataset of this study is available from the corresponding author upon request.

Conflicts of Interest

The authors have declared that there are no conflicts of interest with respect to the authorship and/or publication of this study.

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Authors’ contribution

MGW contributed to the conception and design. ATN and TG performed the data analysis and result writing. MGW, ATN, TG, HH, TG, NT, BT, EK, and AG contributed to the research design and data collection of the study. MGW, ATN, and TG underwrote the discussion section. MGW, ATN, SK, RT, BT, TG, and BY contributed to the interpretation and revision of the draft manuscript. All the authors have read and approved the final manuscript.

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Figures
Figure 1

Outcome indicators of patients on ART in ACSH, Tigray 2023

Figure 2

Patient on ART outcome indicators among HIV/AIDS patients in ACSH from 2018 to 2022, Tigray