

Effect of War on Health Institutions of Eastern Tigray, Ethiopia

Dr Fikre Tekulu,

Submitted to: JMIR Formative Research
on: March 27, 2025

Disclaimer: © The authors. All rights reserved. This is a privileged document currently under peer-review/community review. Authors have provided JMIR Publications with an exclusive license to publish this preprint on its website for review purposes only. While the final peer-reviewed paper may be licensed under a CC BY license on publication, at this stage authors and publisher expressly prohibit redistribution of this draft paper other than for review purposes.

Table of Contents

Original Manuscript.....	4
---------------------------------	----------

Preprint
JMIR Publications

Effect of War on Health Institutions of Eastern Tigray, Ethiopia

Dr Fikre Tekulu,

Corresponding Author:

Dr Fikre Tekulu,

Abstract

Background: The war in Tigray has caused significant damage to the region's healthcare facilities.

Objective: This study aimed to assess the extent of the war's impact on healthcare facilities in the Eastern Tigray Zone.

Methods: A mixed research strategy was used, with both quantitative and qualitative approaches. Primary data were collected through questionnaires, interviews, focus group discussions, and observations, while secondary data were obtained from published and unpublished documents. Participants were selected using a simple random sampling method. The collected data were analyzed using a linear regression model to determine the statistical significance of the findings.

Results: The study found that the impact of the war on healthcare facilities was high to very high, with 97.9 percent of the damage attributed to the war. Of the 177 healthcare facilities in the Eastern Tigray Zone, 29 (16.4 percent) were severely affected, and 118 (66.66 percent) were totally damaged. This indicates that 83 percent of the health system in the region was damaged. The linear regression model showed that the war explained 55.8 percent of the observed health facility damage.

Conclusions: The damage to health facilities in the Eastern Tigray Zone has led to the complete collapse of the health system at the zone level. The urgent need for reconstruction and restoration of health facilities is highlighted to provide essential health services to the affected population. The government and concerned individuals must take immediate action to address this critical situation and help mitigate the negative impact of the war on the health of the people in Tigray.

(JMIR Preprints 27/03/2025:75073)

DOI: <https://doi.org/10.2196/preprints.75073>

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

✓ **Please make my preprint PDF available to anyone at any time (recommended).**

Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.

Only make the preprint title and abstract visible.

No, I do not wish to publish my submitted manuscript as a preprint.

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**

Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain visible to all users.

Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in a JMIR journal, my title and abstract will remain visible to all users.

No. Please do not make my accepted manuscript PDF available to anyone.

Original Manuscript

Effect of War on Health Institutions of Eastern Tigray, Ethiopia

Fikre Belay Tekulu(Ph.D.)¹ Haftom Teshale Gebre(MA)²

¹Adigrat University, College of Social Science and Humanities , Department of Geography and Environmental Studies, Adigrat, Ethiopia, fikrebelay23@gmail.com,

¹Adigrat University, College of Social Science and Humanities , Department of Geography and Environmental Studies, Adigrat, Ethiopia haftomteshale1@gmail.com.

ABSTRACT

Background

The war in Tigray has caused significant damage to the region's healthcare facilities. This study aimed to assess the extent of the war's impact on healthcare facilities in the Eastern Tigray Zone.

Methods

A mixed research strategy was used, with both quantitative and qualitative approaches. Primary data were collected through questionnaires, interviews, focus group discussions, and observations, while secondary data were obtained from published and unpublished documents. Participants were selected using a simple random sampling method. The collected data were analyzed using a linear regression model to determine the statistical significance of the findings.

Results

The study found that the impact of the war on healthcare facilities was high to very high, with 97.9 percent of the damage attributed to the war. Of the 177 healthcare facilities in the Eastern Tigray Zone, 29 (16.4 percent) were severely affected, and 118 (66.66 percent) were totally damaged. This indicates that 83 percent of the health system in the region was damaged. The linear regression model showed that the war explained 55.8 percent of the observed health facility damage.

Conclusions

The damage to health facilities in the Eastern Tigray Zone has led to the complete collapse of the health system at the zone level. The urgent need for reconstruction and restoration of health facilities is highlighted to provide essential health services to the affected population. The government and concerned individuals must take immediate action to address this critical situation and help mitigate the negative impact of the war on the health of the people in Tigray.

Keywords: War, Health Institutions, Health Services, Effect, Eastern Tigray

1. INTRODUCTION

War is a situation of armed conflict between two states or nations, often openly proclaimed and hostile. While war rule normally applies and the state of war is the legal, state established and ended by an official declaration independent of actual military hostilities (Merriam-Webster, 2021)

According Bista, (2015) either political or socioeconomic reasons are at the root of the war. In some African countries, there were problems with social groups. The struggle in Iraq

was between Kurds and Iraqis who are Muslims who are Sunnis and those who are not. The Taliban in Afghanistan had a strong political interest in the ongoing civil war.

Wars destroy human life and economic infrastructure such as schools, hospitals, health centers generally create a great burden on social service delivery (Imai, et al., 2000)

Wars are manufactured disasters with known detrimental effects on general and mental health. The daily struggles of life in a time of regular disruptions to essential utilities make up the war. Electricity and water supplies were completely cut off for several months due to the war in Lebanon (Farhood, et al, 1993).

The right to health is protected by human rights agreements. For example, Article 12 of the International Covenant on Economic, Social, and Cultural Rights (ICESCR) states that nationality may not be a basis for discrimination in access to health care and other covenant rights, and that "health facilities, goods, and services shall be made available to all, including the most vulnerable or excluded part of the population, in law and in fact, without discrimination." (Farhood, et al, 1993). 89 percent of fathers and mothers agreed the Lebanese war resulted in Health-related problems (WHO, 1990).

The study provides in Syria evidence that conflict incidents were associated negatively with the utilization of routine health services, such as outpatient consultations and antenatal care (Ekzayez, A, 2021).

Armed conflict negatively affects and disrupts normal civilian activities such as employment, health care, and education Garry & Checchi, 2019).

Armed conflicts damage established health systems, typically resulting in a resurgence of preventable infectious diseases. While 70 percent of deaths worldwide are now non-communicable; in low-income countries. The burden of these infectious diseases has been exacerbated by armed conflicts, leading to dramatic long-term consequences (Khorram-et al., 2021)

Prior to the crisis escalation in 2013, there was little coverage of the delivery of health services in Yemen for prenatal care, institutional delivery, and children vaccinations. Based on the available data, this coverage persisted until 2017 (Sami, 2020). Wars raise mortality, accounting for 29.4 million deaths among civilians. All age groups and genders showed increases in overall and cause-specific death linked to war, while children 0–5 years old had the greatest relative increases in mortality (Jawad, et al, 2020).

Attacks against medical personnel and facilities have been widely reported in the continuing conflicts in Yemen and Syria. Hospital bombings in Syria and Yemen appear to be significantly more common than those recorded in other conflicts, according to tabulated data, however it's unclear if this is a reporting artifact (Briody et al, 2018).

Access to health care in the affected areas of Syria was limited during the study period. The study shows that incidents of conflict were negatively associated with the use of routine health services such as outpatient consultations and prenatal care. While conflict incidents have been positively associated with emergencies, childbirth, and cesarean sections (Manesh, 2021). The population's health is negatively impacted by war in a number of ways, including a shortage of medical supplies, equipment, and health professionals, as well as damage to medical facilities or systemic collapses, which exacerbate the serious health issue of maternal and newborn mortality (Levy & Sidel, 2016).

Yemen's conflict has quickly caused a widespread humanitarian crisis and severely damaged the country's already precarious healthcare sector. However, there are still significant areas of ambiguity, such as the amount of health workers leaving the country and the degree to which substitute providers have filled in the growing service shortages as the conflict has intensified (Qirbi & Ismail,

2017).

In addition to the apparent deaths and injuries on the battlefield, the conflict has adverse health effects due to population displacement, the disintegration of health and social services, and increased risk of disease transmission (Murray, et al, 2002). Conflicts and wars, commonplace in today's world, have plunged populations into abject poverty, displaced people from their homes, denied them access to basic services, and left people vulnerable to various diseases (Deepti N, 2019).

The health consequences of the ongoing US-led war on terror and civil armed conflicts in the Arab world are much more than the collateral damage inflicted on civilians, infrastructure, environment, and health systems. Protracted war and armed conflicts have displaced populations and led to lasting transformations in health and health care (Dewachi, et al., 2014).

Significant disparities existed in the availability and accessibility of services between urban and rural areas, which was partially reflected in the poor indicator performance for immunization and access to reproductive health services when compared to nearby regions. In addition to causing fatalities and injuries, the Russia-Ukraine War of 2022 also had an adverse effect on the lives and safety of Ukrainians by destroying medical facilities and interfering with the supply of medical equipment (Haque, et al., 2022).

In general, there were differences in the way health services were accessed in Cameroon before and after the conflict. In particular, health service utilization indicators showed an improvement from 2016 to 2017 and then a decline in 2018. DPT3 vaccination coverage fell from 90 percent in 2017 to 55 percent in 2018, births attended by trained staff, decreased from 46 percent in 2017 to 26 percent in 2018, and the total number of people who had been tested for HIV decreased from 20,3987 in 2017 to 18 and 3,654 in 2018 (Haddison et al. , 20202).

According to Bista (2015), either political or socioeconomic reasons are at the root of most wars. In some African countries, inter-group tensions—particularly those based on ethnic, tribal, or religious identities—have contributed significantly to armed conflicts. For instance, the Rwandan genocide (1994) was primarily driven by ethnic tensions between the Hutu and Tutsi groups (Uvin, 1998), while civil wars in Sudan and South Sudan were fueled by a combination of ethnic, regional, and religious divisions (Johnson, 2011).

Similarly, the Iraq conflict involved complex social and political divisions. The post-2003 war in Iraq led to intensified violence between ethnic Kurds and Arab populations, as well as sectarian violence between Sunni and Shia Muslims, which escalated into large-scale civil unrest and insurgencies (Dodge, 2012; Haddad, 2011).

Even many years later, experiences of war and their impact on mental health are associated with higher healthcare expenditures, especially for those who remained in the conflict zone. For numerous reasons, including economic ones, it is crucial to focus on the impact of conflict on mental health (Sabes-Figuera, et al., 2012).

The terrible conflict in Ethiopia's Tigray area has left the region's health system on the verge of collapse, created a severe humanitarian catastrophe, made it difficult for people to acquire humanitarian food, and is estimated to have displaced 2.1 million people(Mulugeta & Gebregziabher,2022).

The war affected 106 health facilities between mid-December 2020 and March 2021, finding only 13 percent functional with nearly 70 percent looted and 30 percent damaged. In many cases, MSF identified the damage as deliberate. From November 2020 through June 2021, the interim Tigrayans administration and foreign non-governmental groups collated damage data from a variety of sources. Data from the prewar calendar year were compared. Only 30 percent of hospitals, 17 percent of health centers, 11.5 percent of ambulances, and none of the 712 health posts were operational six

months into the war (Gesese, et al., 2021).

Only 3.6 percent of all health facilities (n=1007), 13.5 percent of all hospitals and health centers (n=266), and none of the health stations (n=741) are operational. Destruction varies by geographic location; only 3.3 percent in Western, 3.3 percent in South Eastern, 6.5 percent in North Western, 8 percent in Central, 14.6 percent in Southern, 16 percent in Eastern, and 78.6 percent in Mekelle are fully operational. Only 9.7 percent of health centers, 43.8 percent of general hospitals, and 21.7 percent of primary hospitals are operational (Gebregziabher, et al., 2022).

The conflict in the Tigray region caused households without access to needed health services to increase by 35 percent and medicines by 8 percent. It has also increased the proportion of households unable to buy basic groceries by 26 percent. The proportion of households without access to water has not increased, although the percentage able to buy soap has fallen by 17 percent (Abay et al., 2022). The war in Tigray has resulted in critical health care service disruption and high loss to follow-up for patients with chronic disease, likely leading to increased morbidity and mortality. Local, national, and global policymakers must understand the extent and impact of the service disruption and urge their efforts toward restoration of those services (Geberehiwot et al., 2023).

The study's focus is on how the war in Tigray affected health services, including the provision of medical care and its trends both before and after the conflict. Therefore, researchers were motivated to study the impact of the war on healthcare facilities and its aftermath. Finally, this study serves as a baseline or input for the damages and burden that the war has caused to eastern Tigray's healthcare facilities.

Thus, to find out the extent and magnitude of destruction resulted from the war in Tigray, the present study set out to answer the following research questions.

1. What is the extent of health institution damage caused by war activities in the study area?
2. How has the destruction of health institution affected health service delivery for the residents in the study areas?

2. Materials and Methods

2.1 Study Area

2.1.1. Location

The Eastern Tigray Zone is located in the northern part of Ethiopia and consists of 18 woredas with a total area of 6,256 km². It is located between 133259 N to 144056 N latitude and between 391139 E to 395943 E longitude. In general, this zone borders with Eritrea, in the north with the Central Zone in the west, in the southeast with the Afar regional state in the east (Figure 1).

2.1.2. Topography of the study area

The general topography of the influence area ranges from its lowest 148 meters above sea level up to 3,298 meters above sea level. Its mean elevation above sea level equals 2,225 meters. It is characterized by the local climate primarily 'degua', 'weyna degua' and 'kola'.

2.1.3. Climate of the study area

The climate is commonly defined as the weather average over a long period mostly used for 35 years. Climate includes the statistics of temperature, humidity, atmospheric pressure, wind, and precipitation. However, the data is limited to temperature and rainfall. These two climatic elements of the course are the most important for both agriculture and hydrology. In Eastern Tigray, as in other parts of the country, the climate is determined by latitudinal and altitudinal factors. Annual rainfall of the zone ranges from its minimum in Erob about 140 mm up to the highest in Saesie-Tsaeda-Emba

about 672mm. Similarly, about to temperature, the lowest temperature is experienced in Ganta Afeshum including Adigrat about 6° C up to the maximum of about 30° C in Erob (Adigrat University, 2018).

2.2. Methodology

2.2.1. Sampling Techniques and Designs

The study employed both quantitative and qualitative approaches.

- For the quantitative component, simple random sampling was used to select 335 households from the Eastern Tigray Zone.
- For the qualitative component, purposive sampling was applied to select participants for interviews and focus group discussions, ensuring the inclusion of elders, women, religious leaders, and officials with local knowledge. This combination allowed for a comprehensive understanding of the impact of war on health facilities from both statistical and community-based perspectives.

Probability particularly simple random sample for households. 335 households were selected from the entire target population of the Eastern Tigray zone using a simple random sampling procedure.

To determine the appropriate sample size for household surveys, we used the formula developed by Kothari (2004):

$$\frac{N z^2 P Q}{E^2 (N - 1) + z^2 P Q}$$

Where:

- n = sample size
- N = estimated total household population of the Eastern Tigray Zone (based on the 2018 data from the Tigray Statistics Agency)
- z = z-value corresponding to the desired confidence level (1.96 for 95%)
- p = estimated proportion of an attribute that is present in the population (assumed as 0.5 to maximize variability)
- q = 1 – p
- e = acceptable margin of error (set at 5% or 0.05)

The 95% confidence level was chosen as a standard for social science research, providing a high degree of certainty while maintaining statistical efficiency. The 5% margin of error was selected to balance precision and feasibility given field constraints.

Using this formula, a sample size of 335 households was calculated to ensure representativeness and statistical reliability for the quantitative portion of the study.

Linear Regression Model

A multiple linear regression model was used to examine the relationship between the intensity of war activities and the damage to health institutions in Eastern Tigray.

- The dependent variable is the severity of damage to health institutions, measured by a composite index based on three main indicators:
 1. Structural damage to buildings (partial or total destruction)
 2. Functional disruption (closure or loss of medical services)
 3. Availability of staff and medical equipment
 This index was constructed using field observation data, survey responses, and institutional reports.

- The independent variable, War Frequency, refers to the number of conflict-related events occurring in each woreda during the conflict period (2020–2022). These events include airstrikes, armed confrontations, looting, and deliberate destruction of infrastructure. Data on war frequency were obtained from verified sources such as government reports, local administration records, and NGO documentation.

The model is presented as follows eq.:

$$\text{Damage Index} = a + b(\text{War frequency}) + \varepsilon$$

Where:

- a = intercept
- b = regression coefficient
- ε = error term

2.2.2. Participant Description and Setting for Field Observation

The participants for the interviews and focus group discussions in this study were carefully selected to ensure a diverse representation of individuals with different backgrounds and perspectives. The study conducted focus group discussions comprising elders, women, religious leaders, and officers from the study area.

The participants in the study comprised individuals from a diverse range of age groups, ensuring a comprehensive exploration of the research topic from various generational perspectives. The age spectrum of participants ranged from young students, representing the youth demographic, to working-age adults and older individuals, including elders who brought wisdom and extensive life experiences to the discussions.

The Field observation randomly selected seven districts located in the Eastern Tigray Zone, namely Adigrat, Hawzen, Kilteawelaelo, Edaghamus, Atsbi, Gantafeshum, and Wukuro. These districts were selected as representative locations within the study area to provide a comprehensive understanding of the research topic within the context of the Eastern Tigray Zone.

By observing and analyzing the setting and context of these towns, the study aimed to capture the unique characteristics, socio-cultural nuances, and local dynamics that may influence the research findings as shown in Table 1,

The age groups presented in Table 1 refer to the household respondents who completed the questionnaire survey, not interview or FGD participants.

Table 1: Demographic Characteristics of Household Respondents (Survey Data)

Demographic Characteristic	n	%
Age Group		
18-30 years	90	26.55
31-45 years	101	29.9
46-60 years	80	23.60
61 years and above	64	18.67
Household Size		
1-3 members	75	22.12
4-6 members	105	31.4

7-9 members	96	28.02
10 members and above	59	17.41

Source: Field survey, 2022

2.2.3. Type of Data Collected during Field Observation:

Both primary and secondary data were collected.

The research instruments used to collect data in this study included:

1. Field survey questionnaire
2. Interview and focus group discussion
3. Observation checklist
4. Document review

Questionnaire

Design

The structured questionnaire used in the household survey was organized into four sections to improve clarity and flow:

1. Section A: Demographic Characteristics
 - o Age, gender, education level, household size, and occupation.
2. Section B: Physical Damage to Health Institutions
 - o Perceptions of damage to health centers, hospitals, and availability of medical equipment due to the war.
3. Section C: Health Service Delivery Impact
 - o Changes in maternal and child care, medicine shortages, staff availability, and healthcare access before and after the conflict.

Likert

Scale

Definition:

Responses were recorded using a 5-point Likert scale, defined as follows:

- 1 = Very Low
- 2 = Low
- 3 = Moderate
- 4 = High
- 5 = Very High

This design allowed respondents to express the intensity of their perceptions regarding different impacts of the war, while the structured sections helped ensure clarity during analysis.

Focus group discussions (FGDs)

To complement the survey data, qualitative data were gathered through in-depth interviews and focus group discussions (FGDs). Purposive sampling was used to select participants who were knowledgeable about the local context and had lived experience of the conflict. These included:

- Local elders
- Women
- Religious leaders
- Health professionals
- Local administrative officers

A total of **7 focus group discussions** (one per district) and **15 key informant interviews** were conducted. Participants were recruited based on their role in the community, direct involvement in healthcare or governance, and their ability to provide insight into war-related healthcare challenges.

2.2.4. Data Analysis:

The qualitative data collected through interviews, focus group discussions, and field observations were analyzed using SPSS. 20 and STATA software. The analysis involved several systematic steps:

Transcription: Audio recordings were transcribed verbatim.

Initial Coding: Transcripts were reviewed line-by-line and coded based on emerging patterns and keywords.

Thematic Categorization: Codes were grouped into broader themes and sub-themes relevant to the research objectives (e.g., healthcare disruption, maternal care challenges, infrastructure damage).

Inter-Coder Reliability: To ensure coding consistency, two independent researchers conducted coding separately. Their results were compared, and discrepancies were resolved through discussion and consensus, ensuring high inter-coder agreement.

Interpretation: Final themes were interpreted in the context of the study area and research questions.

In addition to the linear regression model, which quantified the overall impact of war frequency on the severity of health institution damage, inferential statistical tests — including Independent Sample T-tests and One-Way ANOVA — were applied to explore group-level differences in perception.

- The T-test was used to determine whether there was a statistically significant difference in responses between male and female participants regarding the perceived destruction of health facilities.
- The One-Way ANOVA was used to evaluate whether perceptions of war-related health service disruption varied significantly by age group and educational level.

These tests were crucial in addressing the study's second research question: *“How has the destruction of health institutions affected health service delivery for the residents in the study areas?”*

They provided insights into how different demographic groups experienced and interpreted the impacts of the conflict on healthcare access and infrastructure.

3. Results and Discussion

3.1. Destruction of Health Services

A total of 335 household respondents participated in the structured questionnaire assessing the impact of war on health services (Table 2). The majority reported severe disruptions:

- Over 98% indicated high to very high levels of burden on health institutions and damage to health facilities.
- Infant and maternal mortality were perceived as significantly increased by 100% of respondents.
- Institutional delivery sharply declined, with 90.7% reporting a very high reduction.
- Shortages of medicine and supplies were also widely reported, with nearly 99% perceiving high or very high impact.

A Chi-square goodness-of-fit test confirmed that the distribution of responses on health facility damage was statistically significant (χ^2 (3, N = 335) = 369.85, $p < .001$), validating the findings.

Table 2: Perceptions of War Impact on Health Services (n = 335)

Impact Area	Response	Frequency	Percent
1. Burden on Health Institutions	Very low	2	0.6%
	Low	2	0.6%
	High	120	35.8%
	Very high	201	62.9%
2. Infant & Maternal Mortality	High	130	38.8%
	Very high	205	61.2%
3. Mothers' Institutional Delivery	Very low	4	1.2%
	Low	6	1.8%
	Medium	4	1.2%
	High	17	5.0%
	Very high	304	90.7%
4. Shortage of Medicines	Low	4	11.9%
	High	125	37.3%
	Very high	206	61.5%
5. Health Facility Damage	Very low	2	0.6%
	Low	2	0.6%
	High	130	38.8%
	Very high	201	60.0%

3.2. Health Standards Before and After the War

The analysis reveals a substantial decline in healthcare access, particularly in rural areas, following the conflict. The population-to-health centre ratio worsened from:

- 1:64,378 to 1:112,662 in urban areas, and
- 1:26,956 to 1:52,327 in rural areas.

This disparity reflects the greater destruction of rural facilities, caused by their proximity to conflict zones, limited security, and inaccessibility for emergency repairs.

The post-conflict ratios significantly exceed national and international standards:

- Ethiopian MoH Standard: 1 Health Centre per 25,000 people
- WHO Emergency Benchmark: 1 Health Unit per 10,000–15,000 people

With a post-war ratio of 1:52,327 in rural areas and 1:112,662 in urban areas, access to health services in Eastern Tigray has reached emergency levels, signalling an urgent need for reconstruction and intervention.

Table 3: Health Facility Access Ratios Before and After the War in Eastern Tigray

Area/Indicator	Population	Health Center s Before War	Ratio Before War	Health Center s After War	Ratio After War	95% Confidence Interval
Urban Areas	4,50,649	7	1:64,378	4	1:112,662	(N/A)
Rural Areas	8,89,561	33	1:26,956	17	1:52,327	(33,602 – 40,854) *
Population per Primary Hospital	—	—	—	—	1:268,042	(251,382 – 284,702)

Population Health Center	per	—	—	—	—	1:33,505.25	(31,153 – 35,857)	–
Population Health Post	per	—	—	—	—	1:10,309.31	(8,447 – 12,171)	–

Source: TSA (2019), MUDC (2020), ADCS & Eastern Zone Administration (2021)

*Confidence interval for rural burden is estimated from the post-war population-health post ratio. Other CI estimates apply to general post-war access burdens.

3.3. Linear Regression Analysis

A linear regression model. The result depicts that the percentage shared variance in the dependent variable, i.e. Health institutions damage being explained by the changes in the independent variable, war explains 55.8% ($R^2 = 0.558$, $p < .001$) of the observed change in Health institutions damage. Shown in table 4.

Table 4. Regression of School damage with war activities as a predictor

Model	B (Unstandardized)	SE	β (standardized)	T
(Constant)	.640	.193		3.321
War	.853	.042	.747***	20.523
R	.747			
adj. R^2	.556			
R^2	.558			

* $p < .05$; ** $p < .01$; *** $p < .001$

As shown in table 5, An Independent-Sample T-test was conducted to compare the effect of war on health institutions for Males and Females. There was no significant difference between Male ($M = 4.56$, $SD = 0.624$) and Female ($M = 4.58$, $SD = 0.543$) conditions; $t(332) = 0.305$, $p > 0.05$. This implies that both Males and Females have similar perceptions of the effect of war on health institutions.

Table 5. Independent Samples Test

Test	F	Sig. (Levene's Test)	t	df	Sig. (2- tailed)	Mean Difference (MD)	Std. Error (SE)	95% Confidence Interval
Equal variances assumed	0.572	0.45	-0.305	332	0.761	-0.021	0.068	[-0.154, 0.113]
Equal variances not assumed	—	—	-0.305	281.59	0.752	-0.021	0.065	[-0.149, 0.108]

Variable: Perceived destruction of health centers and hospitals
MD = Mean Difference; SE = Standard Error
Source: Field Survey, 2022

Table 6 shows the mean scores of different age groups on the perceived impact of war on health institutions. Respondents aged 20–30 reported the highest agreement ($M = 4.88$), followed by those aged ≥ 51 ($M = 4.79$), indicating stronger perceptions of war-related damage. The 41–50 group had the lowest mean ($M = 4.42$), though all groups scored above 4.4, reflecting consistently high

concern. Younger and older adults appeared most affected, possibly due to greater exposure or reliance on health services. A Tukey HSD test confirmed significant differences among age groups.

Similar study conducted in Croatia shows that, war affects self-perceived health, physical ability, and emotional and mental health of the entire population affected by war, especially younger age groups, those with lower education, and lower income (Babić-Banaszak, 2002).

Table 6. Mean Score on Different Age group

Age Group	N	Mean $\pm$ SD	Standard Error (SE)
20–30 years	58	4.88 $\pm$ 0.564	0.074
31–40 years	125	4.54 $\pm$ 0.500	0.045
41–50 years	128	4.42 $\pm$ 0.621	0.055
≥ 51 years	24	4.79 $\pm$ 0.658	0.134
Total	335	4.57 $\pm$ 0.594	0.032

Variable: Perceived destruction of health institutions
Scale: 1 (Very Low) to 5 (Very High)
Source: Field Survey, 2022

Table 7 presents ANOVA results indicate a statistically significant difference in perceptions of war-related damage to health institutions among different age groups ($F = 9.962$, $p < .001$). This suggests that respondents' views on the impact of the war vary significantly based on their age group.

Table 7. Results on the Age Group and Effect on Health Institutions

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9.769	3	3.256	9.962	.000
Within Groups	108.517	332	.327		
Total	118.286	335			

The table 8 shows that respondents with a college diploma reported the highest mean score ($M = 4.95$) regarding the impact of war on health institutions, indicating stronger agreement. Those who can read and write had the lowest mean ($M = 4.42$). Overall, perceptions were consistently high across all education levels, but agreement tended to increase with higher educational attainment up to the diploma level.

Table 8. Mean Score on Different Educational Status

Educational Status	N	Mean $\pm$ SD	Standard Error (SE)
Read and write	33	4.42 $\pm$ 0.663	0.115
Primary school	34	4.68 $\pm$ 0.653	0.117
Secondary school	65	4.54 $\pm$ 0.502	0.062
College/Diploma	39	4.95 $\pm$ 0.223	0.036
Degree and above	164	4.50 $\pm$ 0.631	0.049
Total	335	4.57 $\pm$ 0.596	0.033

Variable: Perceived destruction of health institutions
Scale: 1 (Very Low) to 5 (Very High)
Source: Field Survey, 2022

The ANOVA results in table 9 show a statistically significant difference in perceptions of war-related damage to health institutions across different educational levels ($F = 5.595$, $p < .001$). This indicates that respondents' views on the impact of the war varied notably depending on their educational background.

Table 9. Educational Status and Effect on Health Institutions

Destruction of health centers and hospitals

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7.5	4	1.880	5.595	.000
Within Groups	109.8	327	.336		
Total	117.4	331			

4. Discussion

The findings of this study indicate that the Tigray War had a significant impact on the destruction of health facilities in the Eastern Tigray Zone. According to the assessment found that of 177 healthcare facilities, 29 (16.4 percent) and 118 (66.66 percent) were severely and completely damaged, respectively. This suggests that 83 percent of the Eastern Zone's healthcare systems were damaged. The damage to healthcare facilities has severely affected the healthcare system at the zone level. These findings are concerning as the destruction of health facilities can have far-reaching consequences on the health system and the population's health. The damaged health facilities may be unable to provide essential services such as emergency care, maternal and child health services, and routine healthcare services. This may lead to a deterioration in the population's health, increased morbidity, and mortality. Moreover, the destruction of health facilities may have a long-term impact on the health system's capacity to provide healthcare services. Rebuilding health facilities requires resources, including financial, human, and material resources. It may take a long time to rebuild the health facilities, and in the meantime, the population may continue to face challenges accessing healthcare services. The findings of this study highlight the urgent need to rebuild and restore health facilities in the Eastern Tigray Zone. The government and affected people should prioritize the reconstruction of health facilities and ensure that the necessary resources are allocated to this effort. This is crucial to ensure that the population can access essential healthcare services and to prevent further deterioration in the population's health.

The findings of this study, which highlight the severe destruction of health infrastructure in Eastern Tigray, closely align with patterns observed in other conflict-affected regions, such as Syria and Yemen. In Syria, hospital bombings and deliberate targeting of medical facilities led to long-term system collapse, requiring years of externally supported rehabilitation (Briody et al., 2018). Similarly, in Yemen, the health system's recovery was severely hampered by the outflow of health workers, widespread infrastructure destruction, and blockade-related supply shortages (Qirbi & Ismail, 2017).

This means that the burden of service delivery by the health centers increased after the war. Study conducted by Gesesew, et al. (2021) indicated every aspect of a nation's current health system is impacted by conflict, including research, planning, policy, and funding, as well as health and health-related infrastructure.

The burden of service delivery by the health centers increased after the war. Assume that if health services continue as usual, the population will increase at an annual growth rate of 2.75 and the total population will increase from 1,340,210 to 1,769,077 in 2032. This population growth will put a strain on health services. The health service burden at the health center and health post will increase from the current 1:63819 and 1:37228 to 1:84,241 and 1:49141, respectively, in 2032. This means that at the zone level in 2032, health facilities such as primary hospitals, health centers and health

posts 17, 50, and 314 will be needed respectively. Before the war, there were 1,637 health professionals in the zone, but that number dropped to 1,314. This means that almost 20% of healthcare professionals are off duty. The reduction in the number of healthcare professionals could lead to a decline in the quality of healthcare services, as there are fewer experts available to provide care for patients illustrated in table 4, (ECC-ADCS,2021), (Tigray Statistics Agency,2018) and (Ministry of Urban Development &Construction, 2020). In line with this the study conducted by (Al-ghzawi, et al., 2014) shows Arab populations exposed to war and conflict need to have agencies with a rich supply of professionals, funding and equipment to provide basic needs, social supports good screening, and rehabilitation programs.

The shortage of skilled workers is particularly problematic in times of war when there is a higher demand for healthcare services due to injuries sustained during combat. An estimated 782 medical workers have died over this time due to the fighting in Syria and intentional targeting of healthcare facilities; doctors have accounted for 32% of all deaths over the course of the five years, leaving services destroyed. Additionally, a number of facilities are only functioning at 1% or less (Omar, A., 2020). Similar study conducted in Ukraine shows that, the recent military invasion of Ukraine by Russia necessitates a global reaction in public health. For all of the Ukrainian refugees, the international community needs to give humanitarian help, healthcare, social security, food security, and education (Jankowski, & Gujski, 2022). A similar appeal also required the worldwide community to reconstruct the Tigray region's destroyed health facilities and supply medication and equipment.

Lessons from these countries suggest that long-term recovery models must address not only the physical rebuilding of health facilities but also the retraining and reintegration of healthcare workers, re-establishment of supply chains, and the restoration of essential services through both government and NGO coordination. Community-led health reconstruction models, as used in post-conflict northern Uganda and South Sudan, have also proven effective in restoring trust and access to care in fragile settings.

For Eastern Tigray, a phased recovery model is recommended, beginning with rapid rehabilitation of primary care services, followed by the rebuilding of referral hospitals, training of displaced or returning health professionals, and mental health service integration. Strong collaboration between national authorities, international donors, and local communities is essential to ensure the health system is not only restored but also made more resilient to future shocks.

These findings of health care before and after the war suggest that the Tigray War had a severe impact on the healthcare system, resulting in a significant decrease in healthcare services. The destruction of healthcare facilities and hospitals, particularly primary hospitals, has severely impacted the population's access to healthcare services. Moreover, the shortage of healthcare facilities and hospitals before the war indicates that the healthcare system was already struggling to provide essential services. The impact of the war has further worsened the situation, making it imperative to rebuild and restore the damaged healthcare facilities and hospitals. The findings of this study highlight the urgent need to allocate resources toward rebuilding and restoring healthcare facilities and hospitals in the Tigray region. This is crucial to ensure that the population can access essential healthcare services, particularly in light of the ongoing conflict and the resulting humanitarian crisis.

One of the consequences of conflict is a shortage of health experts and professionals. This shortage can result from various factors, such as casualties among healthcare workers, migration of professionals to safer areas, or a decrease in the number of medical students due to the disruption of education. In this discussion, we will explore the effects of the war on the shortage of skilled workers in healthcare facilities. The shortage of healthcare professionals also impacts the delivery of healthcare services in areas affected by the war. In areas where healthcare facilities are already

inadequate, the shortage of healthcare workers may lead to long waiting times for patients and an inability to respond to medical emergencies adequately. Moreover, the scarcity of healthcare professionals may lead to an increase in the workload for those who remain, leading to burnout and decreased job satisfaction, which could result in further migration or reduced productivity. The shortage of healthcare professionals has other consequences, including reduced access to care for vulnerable populations. In conflict zones, civilians, particularly women, and children, are at increased risk of injuries and illnesses that require specialized care. If healthcare facilities are understaffed, they may be unable to provide the necessary care, leaving patients without the assistance they need.

While this study provides important insights into the effects of war on health institutions in Eastern Tigray, several limitations should be acknowledged:

- **Sample Selection Bias:** Although simple random sampling was used for household selection, the conflict context limited access to certain woredas. As a result, the selected sample may not fully represent the entire population of the Eastern Tigray Zone.
- **Non-Response Bias:** A small proportion of targeted participants declined to respond due to fear, trauma, or displacement. This may have slightly skewed responses toward those willing and available to participate.
- **Access and Security Constraints:** Ongoing insecurity restricted the research team's ability to visit some of the most severely affected or remote areas. Some data had to be collected through intermediaries or local informants, which may affect precision.
- **Reliance on Self-Reported Data:** Much of the data, especially perceptions of damage and healthcare disruption, relied on respondent recall and opinion, which are subject to memory bias and emotional influence, particularly in post-conflict settings.
- **Limited Mental Health Assessment:** While mental health impacts were considered in the revised questionnaire, the study did not employ standardized psychological instruments, limiting the depth of mental health analysis.

Despite these limitations, the findings offer a robust representation of the healthcare impacts of war in the accessible zones and serve as a critical baseline for future assessments and recovery planning.

Conclusion

The results of the study clearly show that the Tigray War had a severe impact on the health system in East Tigray Zone, resulting in the destruction of a large number of health facilities and hospitals. The damage to these facilities has severely affected the population's access to essential health services, which is worrying as it could lead to deterioration in their health and increased morbidity and mortality. The shortage of healthcare professionals and skilled workers in affected areas is also exacerbating the situation, leading to long wait times for patients, reduced productivity, and limited access to care for vulnerable populations. Therefore, urgent action is required to rebuild and restore the damaged health facilities and hospitals in the Tigray region and to address the shortage of medical professionals to ensure the population has access to essential health services. The government and affected people should prioritize providing the necessary resources for these efforts to prevent further deterioration in the health of the population.

Many studies indicating restoration and rehabilitation of health services some of the studies are: In line with WHO Investing in primary health care improves health outcomes, health care performance, accountability of health systems, and equity and access worldwide (WHO,2023). Community participation is a fundamental element of an equitable and rights-based approach to health that is proven effective in optimizing health interventions for positive public health impact (Haldane et al.,

2019). The study conducted in Croatia indicates opposite to the finding there were no significant differences between the war-affected and non-affected areas regarding sex, age, and educational level of respondents. The study conducted in Gaza shows that significant associations between low health related quality of life in Gaza reports and selected conventional factors such as age, sex, educational levels and residence of participants due to the war (Abu-Rmeileh, 2012).

Delivery of health care, including infrastructure and equipment for rehabilitation and service maintenance. Development of human resources with an emphasis on educating and paying government health personnel a living wage. Institutional development, which includes information system development, managerial capacity strengthening, and decentralization (Waters, H et al., 2007). Traumatic injuries necessitate a variety of medical and surgical procedures, and fast and efficient care and referral, together with suitable rehabilitation services and post-treatment follow-up, are crucial to their successful treatment (Barth, et al., 2021).

Young age for traumatic and non-traumatic amputations indicates the devastating impact of war and fragile health systems on a society. Improved collaboration between primary healthcare, surgical and rehabilitation services, a prioritization of rehabilitation and increased resource provision are recommended to ensure adequate access to comprehensive rehabilitation care (Jain et al., 2020). Restoring and rebuilding health service delivery requires restocking medical equipment, drugs, vaccine and other medical supplies that have been destroyed or stocked out since the start of the war. Such effort should also include immediate restoration of basic infrastructures (Tesema, & Kinfu, 2021). The following suggestions are made in light of global experiences.

5. Recommendations

5.1. Recommendations and Policy Implications

The government should adopt policies that prioritize restoring health services as soon as possible. Here are some policy recommendations:

1. Temporary arrangements: The government should facilitate the setup of temporary health centers in safe locations, such as community centers or tents, to ensure residents receive basic health services, especially in rural areas.
2. Provision of materials: The government, in cooperation with NGOs and interest groups, should provide health equipment and medicines to ensure health care for the residents of the war-affected areas.
3. Funding for Reconstruction: The federal government, regional entities, collaboration with private donors, and international aid agencies, should allocate funds to rebuild damaged health centers or build new health centers in war-affected areas.
4. Training and support: The government should facilitate training and support for health workers to enable them to provide health care in challenging situations.
5. Psychosocial support: The government should facilitate psychosocial support to health workers and parents who have experienced Trauma and stress due to war and the damage caused by war.

Declarations

- 1) Compliance with Ethical Standards: We confirm that this manuscript has no ethical issues.
- 2) Funding: The authors did not receive support from any organization for the submitted work. All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.
- 3) Conflict of Interest: We wish to confirm that there are no conflicts of interest associated with this

4) **Ethical Approval:** The researchers declare that this work follows the standards of a genuine research study.

6. Ethical approval for this study was obtained from the Quality control and ethics committee of college of social science and humanities, reference number: **010.04.2023**, and all methods were performed in accordance with ethical standards as outlined in the Declaration of Helsinki and its later amendments. Written informed consent was obtained from all participants.

“Not applicable” in this section

Appendix

[illegible]

References

- Abay et al., “Access to health services, food, and water during an active conflict”: Evidence from Ethiopia. *PLOS Global Public Health*, volume 2 no 11, 2022, <https://doi.org/10.1371/journal.pgph.0001015>.
- Abu-Rmeileh, N. M., Hammoudeh, W., Mataria, A., Husseini, A., Khawaja, M., Shannon, H. S., & Giacaman, R. (2012). Health-related quality of life of Gaza Palestinians in the aftermath of the winter 2008–09 Israeli attack on the Strip. *The European Journal of Public Health*, 22(5), 732–737:<https://doi.org/10.1093/eurpub/ckr131>
- Adigrat University, “Adigrat City Structural Plan Preparation”, 2018, unpublished material.
- Al-ghzawi, et al. (2014). “The impact of wars and conflicts on mental health of Arab

population'. *International Journal of Humanities and Social Science*, volume 4 no 6, pp.237-242, 2014, <https://www.researchgate.net/>

Arage, et al. "Exploring the health consequences of armed conflict: the perspective of Northeast Ethiopia", 2022: a qualitative study. *BMC public health*, Volume 23 no1, p.1, <https://link.springer.com/article/10.1186/>

Babić-Banaszak, A., Kovačić, L., Kovačević, L., Vuletić, G., Mujkić, A., & Ebling, Z. (2002). Impact of war on health related quality of life in Croatia: population study. *Croatian Medical Journal*, 43(4), 396-402.

Barth, C. A., Wladis, A., Blake, C., Bhandarkar, P., Perone, S. A., & O'Sullivan, C. (2021). Retrospective observational study of characteristics of persons with amputations accessing International Committee of the Red Cross (ICRC) rehabilitation centres in five conflict and post conflict countries. *BMJ open*, 11(12), e049533.

Bista, "Conflict and Internal Displacement in Nepal" Socio-Economic Query. *Journal of South Asian Studies*, volume 3 no 3, pp, 307-314, 2015, <http://www.escijournals.net/JSAS/> (Accessed, Jan.22, 24).

Bista, M. B. (2015). War and its causes in modern society. Kathmandu: Himalaya Publishing House.

Briody et al., "Review of attacks on health care facilities in six conflicts of the past three decades". *Conflict and health*, volume 12, pp.1-7, 2018, [https://link.springer.com/article/10.1186/\(accessed, Jan. 23, 2024\)](https://link.springer.com/article/10.1186/(accessed, Jan. 23, 2024)).

Briody, C., Rubenstein, L. S., Roberts, L., Penney, E., Keenan, W., & Horbar, J. D. (2018).

Brolin Ribacke, K. J., van Duinen, A. J., Nordenstedt, H., Höijer, J., Molnes, R., Eriksson, A., ... & von Schreeb, J. (2016). Conflict and health: A literature review of the health impacts of war and conflict in low-resource settings. *Global Health Action*, 9(1), 32747. <https://doi.org/10.3402/gha.v9.32747>

Debarre, A., "Hard to reach: providing healthcare in armed conflict". International Peace Institute, 2018, <https://www.ipinst.org/wp-content/uploads/2018/12/1812>

Deepti N, "Effect of Human war and Conflict on Public healthcare", *International Journal of Science, Environment and Technology*, volume 8, no 6, pp. 1114-1119, 2019, <https://www.researchgate.net/publication/346625356>.

Dewachi, et al., "Changing therapeutic geographies of the Iraqi and Syrian wars". *The Lancet*, volume 383 no 9915, pp.449-457, 2014, [http://dx.doi.org/10.1016/S0140-6736\(13\)62299-0](http://dx.doi.org/10.1016/S0140-6736(13)62299-0).

Dodge, T. (2012). Iraq: From war to a new authoritarianism. International Institute for Strategic Studies.

ECC-ADCS, "Assess emergency projects response work and humanitarian need assessment in the ground to prepare better for the future response to the war crisis in Tigray", pp.1-41, 2021 unpublished material.

Ekzayez, A., Alhaj Ahmad, Y., Alhaleb, H., & Checchi, F. (2021). The impact of armed conflict on utilization of health services in north-west Syria: an observational study. *Conflict and health*, 15(1), 1-10. <https://conflictandhealth.biomedcentral.com/>

Farhood, et al, "The impact of war on the physical and mental health of the family": The Lebanese experience. *Social Science & Medicine*, volume 36 no 12, pp.1555-156, 1993, [https://doi.org/10.1016/0277-9536\(93\)90344-4](https://doi.org/10.1016/0277-9536(93)90344-4).

Garry & Checchi, "Armed conflict and public health: into the 21st century". *Journal of Public Health*, Volume 42 no 3, p.1, 2019, | doi:10.1093/pubmed/fdz095.

- Gebregziabher, et al. (2022). "Geographical distribution of the health crisis of war in the Tigray region of Ethiopia." *BMJ global health*, volume 7 no 4, 2022, <https://doi.org/10.1136/bmjgh-2022-008475>
- Gebrehiwet et al., "War and Health Care Services Utilization for Chronic Diseases in Rural and Semi urban Areas of Tigray, Ethiopia. *JAMA network open*, volume 6 no 8, 2023, and doi:10.1001/jamanetworkopen.2023.31745.
- Gesesew, et al., "The impact of war on the health system of the Tigray region in Ethiopia: an assessment. *BMJ Global Health*, volume 6 no 1, 2021, doi: 10.1136/bmjgh-2021-007328
- Haddad, F. (2011). *Sectarianism in Iraq: Antagonistic visions of unity*. Oxford University Press.
- Haddison, Julius, & Kagina," Health services utilization before and during an armed conflict"; Experiences from the Southwest region of Cameroon. *The Open Public Health Journal*, volume 13 no 1 p.1, 2020, DOI: 10.2174/1874944502013010547
- Haldane, V., Chuah, F. L., Srivastava, A., Singh, S. R., Koh, G. C., Seng, C. K., & Legido-Quigley, H. (2019). Community participation in health services development, implementation, and evaluation: A systematic review of empowerment, health, community, and process outcomes. *PloS one*, 14(5), e0216112.
- Haque, et al., "The human toll and humanitarian crisis of the Russia-Ukraine war": the first 162 days. *BMJ global health*, volume 7 no 9, p 1, 2022, <https://gh.bmj.com/content/7/9/e009550>. (Accessed Jan.22, 2024).
- Imai, Kosuke, and Jeremy M. Weinstein. "Measuring the Economic Impact of Civil War." CID Working Paper Series 2000.51, Harvard University, Cambridge, MA, June 2000, <http://nrs.harvard.edu/urn-3:HUL.InstRepos:39547794>
- Ismail, S. A., McCoy, D., & Patel, P. (2017). The impact of conflict on maternal and child health service delivery: A country case study of Yemen. *Conflict and Health*, 11(1), 1–7.
- Jain, R. P., Meteke, S., Gaffey, M. F., Kamali, M., Munyuzangabo, M., Als, D., & Bhutta, Z. A. (2020). Delivering trauma and rehabilitation interventions to women and children in conflict settings: a systematic review. *BMJ global health*, 5(Suppl 1), e001980.
- Jankowski, & Gujski, (2022). "The public health implications for the refugee population, particularly in Poland, due to the war in Ukraine". *Medical Science Monitor: International Me*
- Jawad, et al., "Estimating indirect mortality impacts of armed conflict in civilian populations": panel regression analyses of 193 countries, 1990–2017. *BMC medicine*, volume 18 no 1, pp. 1-11, 2020, <https://bmcmmedicine.biomedcentral.com/>
- Johnson, D. H. (2011). *The root causes of Sudan's civil wars: Peace or truce*. James Currey.
- Khorram-et al., "Estimating the number of civilian casualties in modern armed conflicts—a systematic review". *Frontiers in public health*, Volume 9, no 1, p.1, Oct. 2021, <https://doi.org/10.3389/fpubh.2021.765261>.
- Kothari," Sample size determination. *Research Methodology*". *New Age International Publications*, volume I p.174, 2004
- Leaning, J., & Guha-Sapir, D. (2013). *Natural disasters, armed conflict, and public health*.
- Levy & Sidel, "Documenting the effects of armed conflict on population health". *Annual review of public health*, Volume 37, pp. 205-218, 2016, <https://doi.org/10.1146/annurey-publhealth-032315-021913>.

- Manesh, “The influence of war and conflict on infectious disease”: a rapid review of historical lessons we have yet to learn. *Sustainability*, volume 13 no 19, pp. 2-10, 2021, <https://doi.org/10.3390/su131910783>. (Accessed, Jan.2024).
- Merriam-Webster, “The definition of war”, Merriam-Webster Inc, USA, 2021.
- Ministry of Urban Development &Construction, (2020)“Revised Standards for Structure Plan Preparation and Implementation”, Addis Ababa, pp.14, 2020, unpublished material.
- Mulugeta & Gebregziabher, “Saving children from man-made acute malnutrition in Tigray, Ethiopia”: a call to action. *The Lancet Global Health*, volume 10 no 4, 2022, DOI: [https://doi.org/10.1016/S2214-109X\(22\)00023-7](https://doi.org/10.1016/S2214-109X(22)00023-7).
- Murray, et al, (2002). “Armed conflict as a public health problem”. *Bmj*, volume 324 no7333, pp.346-349, 2002, doi: 10.1136/bmj.324.7333.346.
- New England Journal of Medicine, 369(19), 1836–1842.<https://doi.org/10.1056/NEJMra1109877>
- Omar, A. (2020). Understanding and preventing attacks on health facilities during armed conflict in Syria. *Risk management and healthcare policy*, 191-203 10.2147/RMHP.S237256
- Qirbi & Ismail, Health system functionality in a low-income country in the midst of conflict: the case of Yemen. *Health policy and planning*, volume 32 no 6, pp. 911-922, 2017, <https://doi.org/10.1093/heapol/czx031>.
- Qirbi, N., & Ismail, S. A. (2017).Health system functionality in a low-income country in the midst of conflict: The case of Yemen. *Health Policy and Planning*, 32(6), 911–922.
- Reviewing attacks on health care in Syria: Reported violations, contextual factors, and the use of data in advancing accountability. *BMJ Global Health*, 3(2), e000658. <https://doi.org/10.1136/bmjgh-2017-000658>
- Sabes-Figuera, et al., “Long-term impact of war on healthcare costs”: An eight-country study. *PloS one*, volume 7 no1, 2012, <https://doi.org/10.1371/journal.pone.0029603>.
- Sami, S., Mayai, A., Sheehy, G., Lightman, N., Boerma, T., Wild, H., ... & Spiegel, P. (2020). Maternal and child health service delivery in conflict-affected settings: a case study example from Upper Nile and Unity states, South Sudan. *Conflict and health*, 14, 1-12. <https://link.springer.com/article/10.1186/>
- Tesema, A. G., & Kinfu, Y. (2021). Reorienting and rebuilding the health system in war-torn Tigray, Ethiopia. *BMJ global health*, 6(8).
- Tigray Statistics Agency, “Annual Statistical Abstract, unpublished material”, pp. 1-293, 2018, unpublished material.
- Uvin, P. (1998). Aiding violence: The development enterprise in Rwanda. Kumarian Press.
- Waters, H., Garrett, B., & Burnham, G. (2007). Rehabilitating Health Systems in Post-Conflict Situations (Research Paper 2007/06). Tokyo: United Nations University World Institute for Development Economics Research. Available online at <http://www>.
- WHO,(2023) Primary Health Care: <https://www.who.int/news-room>
- WHO,” International *migration, health and human rights*. International Organization for Migration” Migr-H&HR-01.3-Qd-Uk_90 (who.int).
- World Health Organization (WHO). (2015). Health system recovery in post-conflict settings: A framework for analysis and action. Geneva: WHO Press.

