Unsuppressed Viral Load and Associated Factors among Adult ART Users at Public Health Facilities of Jimma Town, Ethiopia

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ABSTRACT

Background: Unsuppressed viral load in patients on antiretroviral therapy (ART) occurs when treatment fails to suppress a person's viral load and is associated with decreased survival and increased human immunodeficiency virus transmission. To our knowledge, studies on the incidence and risk factors of virologic failure in Ethiopia are scant.

Objective: To assess unsuppressed viral load (Viral Load >1000 copies/ml) and associated factors among patients taking first line anti-retroviral treatment at public health facilities found in Jimma town 2019.

Methods: A retrospective review of data was performed for 669 patients on first-line ART (at least for six months) in public health facilities in Jimma Town. Socio-demographic, treatment, clinical, immunological and viral load data were extracted from medical records, entered into Epidata version 3.1 and analyzed by SPSS version 20. Multivariate logistic regression analysis was performed to identify factors independently associated with viral non-suppression, considering a 95%CI with p-value <0.05 statistical significance level.

Result: In this study, prevalence of unsuppressed viral load was 20.3%. The risk of unsuppressed viral loads was 91% lower among ART patients who had been taking ART for <2 years (AOR=0.09, 95% CI: (0.01, 0.83) compared to those taking for >2 years. Having a baseline BMI between 16 and 18.5 kg/m^2 (AOR=2.89, 95% CI: (1.76, 4.79) versus BMI > 18.5 kg/m^2, baseline BMI <16 kg/m^2 (AOR=4.44, 95% CI: (1.56, 12.64) compared with those BMI >18.5 kg/m^2, baseline CD4 >100-250 cells/mm^3 (AOR=2.07, 95% CI: (1.28, 3.34) versus CD4>250 cells/mm^3, baseline CD4 $\leq$100 cells/mm^3 (AOR=2.76, 95% CI: (1.45, 5.29) compared to those with CD4>250 cells/mm^3, poor Adherence to ART medication (AOR=3.19, 95% CI: 1.29, 7.89) versus good adherence and immunologic failure (AOR=4.26, 95% CI: 2.56, 7.09) compared to those with no immunological failure significantly increased the risk of virological failure.

Conclusion: This study revealed that high level of viroligic failure among adult HIV-patients. Patients initiated on ART for less than two years, lower baseline BMI, low baseline CD4, poor adherence and immunologic failure were independent predictors of unsuppressed viral load. These results indicated the need to develop and close follow up strategies of targeted interventions for patients in care who are at high risk of unsuppressed viral load.

Keyword: HIV, antiretroviral therapy, adherence to treatment, viral load suppression, Jimma town

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Table of Contents

ABSTRACT iii
Acknowledgements iv
Table of Contents v
List of abbreviations and Acronyms vii
CHAPTER-ONE: INTRODUCTION 1
1.1. Background 1
1.2. Statement of the problem 3
Conceptual framework 5
1.3. Significance of the study 6
CHAPTER-TWO: LITERATURE REVIEW 7
CHAPTER-THREE: OBJECTIVES 11
3.1. General Objective 11
3.2. Specific objectives 11
CHAPTER-FOUR: METHODS 12
4.1. Study area and period 12
4.2. Study design 12
4.3. Population 12
4.3.1. Source population 12
4.3.2. Study population 13
4.3.3. Eligibility Criteria 13
4.3.3.1. Inclusion criteria 13
4.3.3.2. Exclusion criteria 13
4.4. Sample size and Sampling technique /Sampling procedures 14
4.4.1 Sample size 14
4.4.2. Sampling technique 15
4.5. Data collection procedures 16
4.6. Study Variables 17
4.6.1. Dependent (Outcome) variable 17
4.6.2. Independent (exposure) variable 17
4.7. Operational Definitions 17
4.8. Data quality management 18

4.9. Data processing 18
4.10. Data analysis 19
4.11. Ethical considerations 19
4.12. Dissemination plan 19
CHAPTER-FIVE: RESULTS 20
5.1 Scio-demographic Characteristics of Study Participants 20
5.2. Clinical Characteristics of Study Participants 21
5.3. Treatment Characteristics of Study Participants 22
5.4. Status of Viral Load suppression among ART-taking HIV-patients 23
5.5. Factors Associated to Unsuppressed Viral load among adult ART users in Jimma town 26
CHAPTER-SIX: DISCUSSION 32
Limitations 34
CHAPTER SEVEN: CONCLUSION AND RECCOMENDATIONS 35
7.1. Conclusion 35
7.2. Recommendations 35
References 36
Annexes 40
Data Collection tool 40

List of abbreviations and Acronyms

AIDS	Acquired Immunodeficiency Syndrome
ART	Antiretroviral Treatment
EDHS	Ethiopian Demographic and Health Survey
FMOH	Federal Ministry of Health
HAAR	Highly Active Antiretroviral Therapy
HIV	Human Immunodeficiency Virus
HO	Health Office
HC	Health Center
HGB	Hemoglobin
JMUC	Jimma University Medical Center
ORHB	Oromia Regional Health Bureau
PHFs	Public Health Facilities
PLWHIV	People living with HIV
SGH	Shenen Gibe Hospital
RNA	Ribonucleic Acid
RHO	Regional Health Office
UNAIDS	United Nations AIDS
VL	Viral load
WHO	World Health Organization

CHAPTER-ONE: INTRODUCTION

1.1. Background

Human Immunodeficiency Virus (HIV) continues to be a major global public health burden. The global AIDS response is at a precarious point-partial success in saving lives and stopping new HIV infections. New infections are still continued due to, prevention services are not being provided on an adequate scale and with sufficient intensity and not reaching the people who need them the most (1).

According to 2018 global report, in 2017, there are approximately 36.9 million PLWHIV, among these 27.7 million (75%) were knew their HIV positive status and 21.7 million people living with HIV (59%) were accessing ART. The African Region is the most affected region and accounts for over two thirds of the global total of new HIV infections. In Sub-Saharan Africa countries estimated 22.7 million people living with HIV, among these 17.9 million (79%) were knew their HIV status and of these, 11.7 million people (66%) were on ART. In Ethiopia, in 2017, 722,248 Ethiopians are living with HIV, among these, 527.700 (73%) were knew their HIV positive status and 420,000 (71%) people were on antiretroviral treatment(2). The national HIV prevalence is 1.16%, (3). This report also indicated that viral suppression is sub-optimal compared to UNAIDS 90-90-90 targets. The global suppression rate was 47%, Sub-Saharan Africa countries 52% and Ethiopia achieved only 32% (2).

HIV treatment outcomes among people living with HIV (PLHIV) are dependent on monitoring of the response to antiretroviral therapy (ART). WHO clinical staging, immunological (CD4 T-cell count) and monitoring of routine viral load suppression are methods used to monitor treatment outcomes. Immunological and clinical monitoring has poor sensitivity and lower positive predictive value for identifying treatment failure compared to viral suppression. The main rationale for recommending viral load monitoring as the preferred approach compared to immunological and clinical monitoring is to provide an early and more accurate indication of treatment failure and switch to second-line drugs, which in turn reduces the accumulation of drug-resistance mutations and improve clinical outcomes(4). More importantly, at the individual patient

level, sustained viral suppression can prevent the emergence of drug resistance mutations and decrease the risk of clinical therapeutic failure. Patients who achieve early virologic suppression remain on first-line antiretroviral regimens longer have a lower risk of developing opportunistic infections, and face lower mortality rate(5). Therefore, the use of routine viral load testing to monitor treatment response is the gold standard, and has been recommended by WHO in its treatment guidelines since 2013(4).

WHO defines viral load suppression as having a HIV-1 RNA $\leq$1000 copies/mL and unsuppressed viral load as a viral load >1000 copies/mL at least six months after initiation of ART, which indicates that viral replication is not well controlled (6). WHO also recommends routine VL monitoring should be done after six months of ART initiation and then every 12 months thereafter(7).

In developed countries viral load monitoring is done routinely and the rate of suppression is known. However, in resource limited countries, it is not regularly conducted and the rate of suppression was not known. Hence, there are limited data available on HIV viral suppression. In line with UNAIDS' the 90-90-90 strategic plan, Ethiopian has adopted and updated national HIV treatment guidelines and launched routine viral load test for all PLHIV on ART in 2015 and has been started implementing the 3rd 90, VL testing service since 2016 in selected ART hospitals of the country at achieving the UNAIDS' the 90-90-90 goal leading to HIV epidemic control by 2020(8).

1.2. Statement of the problem

Routine VL monitoring for HIV patients on ART is a standard practice in developed countries to monitor the rate of suppression and optimal treatment outcomes of patients on antiretroviral therapy (ART). Many studies have demonstrated that lower HIV viral suppression appears with a wide range of factors in different settings, however, the level and the cause of the problem differ from countries to countries, for example, the non-suppression rate of VL in South Africa 15%, in Swaziland 16%, in Uganda 29%, in Cambodia 23.2%, in Zimbabwe 14% and in Los Angeles county 27%. In these studies factors including socio-demographic and psychological conditions, previous treatment failure, low baseline CD4, ARV regimens and long periods on ART, drug resistance, poor adherence to treatment, poor absorption of ARVs, co-morbidities, drug toxicity, substance abuse and weak social support networks, sexually transmitted infections (STI) and lack of knowledge or awareness about the benefits of viral suppression were associated with viral load non suppression (4,9,10,11,12,13).

Other studies revealed that people with non-nucleoside reverse-transcriptase inhibitor (NNRTI) drugs (Efavirenz or Nevirapine (EFV/NVP), resistance among people retained on ART ranged from 4% to 28%, while among people with unsuppressed viral load on first-line NNRTI regimens; it ranged from 47% to 90%. Therefore, People with NNRTI resistance were less likely to achieve viral suppression(14). This could result in the emergence and accumulation of drug resistance (DR) mutations or patients being prescribed more toxic and expensive regimens, further limiting drug options for the patients and increasing overall ART program cost(15).

Viral load suppression below the 90% target suggesting that there are gaps in quality of HIV treatment service delivery, inadequate identification and switching of people failing first-line ART which was resulted in both human and financial consequences. In 2017 WHO tackling HIV drug resistance report, the mathematical modeling predicts that if NNRTIs continue to be included in first-line ART regimens, and the level of pretreatment HIV drug resistance (PDR) to NNRTIs reaches above 10% in sub-Saharan

Africa, the global targets to end AIDS as a public health threat by 2030 will not be attained (14), moreover between 2016-2020 it is predicted that there will be 105 000 new HIV infections, 135 000 AIDS deaths, and 650 million USD additional costs needed for ARV drug (16). In addition from the HIV prevention and public health significance, sustained virological failure at the community level can substantially increase new drug resistance HIV transmission and increase new HIV infections. VL monitoring is therefore, critical for early detection of treatment failure and to maintain the long-term sustainability of ART (17).

In Ethiopia before 2016, according to the World Health Organization (WHO) criteria, treatment outcome of HIV patients were monitored clinically and immunologically (CD4 T-cell count) and this approaches are poor predictors of treatment failure and lead to delayed recognition of virological non-suppression and unnecessary switching to second line regimens(18). The 2018 national HIV care and treatment guideline of Ethiopia recommending routine and targeted viral load (VL) to monitor ART patients' treatment outcome and to standardize the quality of HIV service. Based on this, the implementation of VL testing service had been applying since 2016(19). However, there were few studies done on the predictors of non-viral suppression to determine ART outcomes among patients on first-line antiretroviral therapy. Hence, there is limited data available on the proportion of viral suppression and associated factors. In addition there was no study conducted in the study area in particular. Therefore, the purpose of this study was to assess the extent of viral suppression and factors independently related to unsuppressed viral load among adult patients initiated on first line ART at public health facilities of Jimma town, Southwest Ethiopia.

Conceptual framework

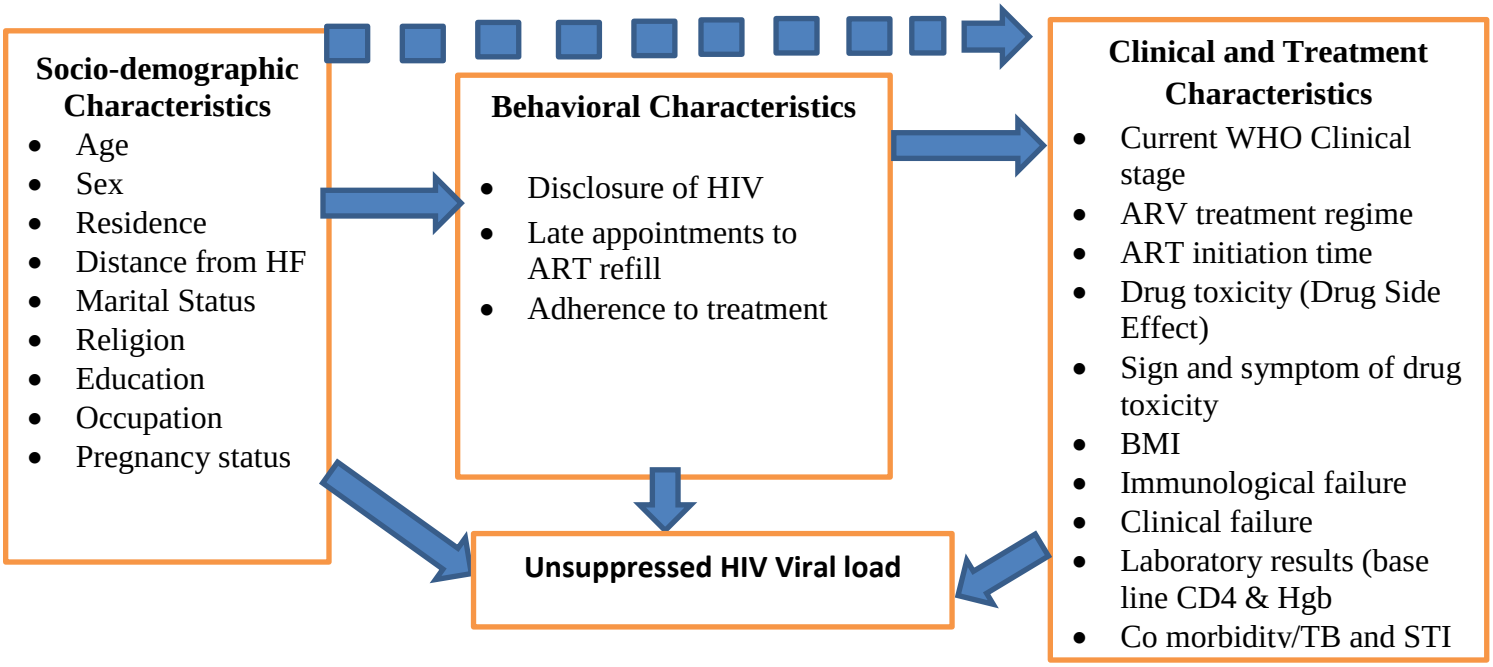

Fig.1. Conceptual frame work for studying unsuppressed viral load and associated factors among HIV patients on ART(20).

1.3. Significance of the study

These findings are of important to health care workers of HFs in anticipating unsuppressed viral load among ART patients and assist at promoting future management of People living with HIV with unsuppressed viral load. In addition, the findings would also use FMOH in policy making and review guidelines of HIV management that would avert possible virologic failure. ORHB, Jimma town HO, Non-governmental organizations (NGOs), stakeholders and other partners working in HIV care and treatment found in Jimma town would benefits from findings of this study.

CHAPTER-TWO: LITERATURE REVIEW

World health organization (WHO) defines viral suppression as having a HIV-1 RNA $\leq$ 1000 copies/mL after at least 6 months of initiation of ART with adherence support. Clinical failure defined as among adults and adolescents as new or recurrent clinical conditions indicating severe immunodeficiency (WHO clinical stage 4 conditions) after 6 months of effective treatment (4).

Immunological failure is defined as CD4 fall to or below 10% or CD4 levels persistently <100cells/mm3 for children while on ART and CD4 levels below <250cells/mm^3 or Persistent CD4 level <100 cells/mm^3 adults and adolescents after treatment for at least 12 months of effective ART. Viral non suppression is defined as viral load > 1000 copies/ml (19)

Viral non-suppression may occur due to various risk factors including socio-demographic and psychological conditions, previous treatment failure, drug resistance, poor adherence to treatment, poor absorption of ARVs, co-morbidities, drug toxicity, drug interactions and substance abuse leading to poor adherence, sexually transmitted infections (STI) and lack of knowledge or awareness about the benefits of viral suppression(9,21–25). There are however other factors including age, gender, advanced HIV disease, low baseline CD4, ARV regimens and long periods on ART that are associated with treatment failure as indicated by several studies(23).

Age of the patient on treatment has been shown to affect viral suppression among patients initiated on ART by several studies though different age categories were considered. Studies conducted in Haiti and Zimbabwe have shown that the older age group 41 years and $\geq$50 years is associated with better viral load suppression among patients on ART compared to those aged 22 years and $\leq$ 40 years (5,10), also in study conducted in Uganda the odds of HIV viral non-suppression decreased with increasing age, with children aged 0–4 years and young adolescents registering the highest odds(26). Other studies done in Peru and California in United States of America also younger age associated with viral non suppression (27,28). In other study conducted in Nigeria using a viral load cut off of 400 copies/ml and study in Mexico using a viral

load cut off of 50 copies/ml showed that patients younger than 30 years of age were more likely to have viral non suppression (29).

Gender of the patients with immunologic and/or clinical failure has been shown not to be associated with unsuppressed viral load. A study done in Haiti and Zimbabwe showed that Male gender was associated with non-viral suppression compared to women (5,10). A study done in Swaziland and others showed that male children and adolescents were more likely to have detectable (>1000 copies/ml) viral loads (12). In contrast in study done in Mexico female gender was marginally associated with non-viral suppression (30). A study conducted in Los Angeles showed females had higher odds of unsuppressed VL than males (13). However, in other study conducted in Kenya showed gender was not associated with non-viral suppression(31).

The level of CD4 cell count at baseline has been associated with viral suppression as shown by several studies. Different CD4 cell count cut offs were applied by different studies in determining non-viral suppression. In studies done in South Africa and Kenya patients with a CD4 cell count below 50 were more likely to have non-viral suppression (9,31). In similar studies done in Haiti and Brazil those with decreased CD4 counts had lower odds of non-viral suppression compared to those with CD4 counts of 500 cells/mm^3 or greater for 200 cells/ mm^3 or fewer; for 201-500 cells/mm^3)(5,32). In other study done in Vietnam unsuppressed HIV VL was independently associated with lower CD4 cell count (33). In other study in Hanoi, Vietnam a lower baseline CD4 count (<200 cells/mm3) was associated with a higher risk of non-viral suppression (34).

In studies conducted in Swaziland and Thailand those with CD4 count <350 cells/ml were more likely to show non-viral suppression (12,35). Contrasting in a study done in Brazil no difference was observed between patients with CD4+ counts 350–499 and 500+ cells per micro liter (32).

Adherence to treatment is vital in ensuring viral suppression among patients on ART. Non-adherence associated with non-viral suppression in several studies. A study done in Thailand, Vietnam, United States, Haiti and Rwanda showed that poor adherence period, multiple late appointments in past year and missed doses on a daily basis were more likely associated to have non-viral suppression (5,33,35–38). Study of Kenya

showed patients who had missed ARV drug had non-viral suppression compared to those who had not missed. In other study conducted in Brazil lower adherence among women which was associated non-viral suppression compared to men (12,31,32).

In treatment of HIV, the use of triple ARVs is highly recommended to achieve the goal of treatment. The prevalence of unsuppressed viral load and antiretroviral drug resistance increased with time on ART(24). Compared to patients on ZDV-3TC-EFV, those on ZDV-3TC-NVP and PI-based regimens were significantly less likely to achieve viral suppression. Patients with those having been on ART for 24 to 35 months were all significantly less likely to achieve viral suppression. Patients Receiving ZDV-3TC-NVP regimens or PI-based regimens were significantly associated with a plasma HIV-1 RNA $\geq$1000 copies/mL compared to ZDV-3TC-EFV; TDF-3TC-EFV regimens, TDF-3TC-NVP regimens and other regimens did not differ significantly from ZDV-3TC-EFV regimens(5). In other study done in Brazil viral load suppression did not differ among those on 2NRTI+1NNRTI, 2NRTI+1PI/r, and 1NRTI+1PI/r but higher pill burden and dosing frequency increased the odds of viral non-suppression (32).

A study conducted in Kenya, South Africa and Haiti showed that the risk of non-viral suppression was associated with length of time that patients have been on ART that is as the time of patients on ART increases, viral suppression decrease. HIV patients those on first line ART had non-viral suppression compared to patients on second line(5,9,31). But, in study done in Zimbabwe there were no significant associations among the 1st line ART patients with viral load non-suppression (10).

Other factors associated with non-viral suppression include opportunistic infections during ART (WHO clinical stage 3 and 4) (6). In study done in Haiti patients with a WHO clinical stage II compared to those with stage I, WHO stage II presentation was associated with the odds of non-viral suppression compared to those presenting with WHO Stage I; there was no significant difference for those patients with WHO stages III or IV when compared to stage I. Those with TB co-infection had decreased odds of viral suppression(5). In study done Swaziland, patients those with WHO stages 3 or 4 disease or advanced immune-suppression (CD4<350 cells/ml) were more likely to have non-viral suppression (12).

A study of South Africa and Zimbabwe showed that patients on TB treatment had increased odds of not achieving viral suppression (9,10).

In study done in Peru, previous exposure to ARVs before initiation of ART and baseline hemoglobin level less than 10g/dl associated to non-viral suppression (28). In contrast, other studies conducted in Nigeria marital and employment status, disclosure of HIV status, history of Tuberculosis (TB), socioeconomic status/class, history of smoking at time of viral load testing, herbal medicine use at the time of viral load testing were associated factors(29).

In other study done in Vietnam unsuppressed HIV VL was independently associated with social isolation, high stigma, alcohol and injection drug use has associations with unsuppressed viral load (33). Also in other study done in Vietnam there was no difference between viral load suppression and alcohol consumption or active drug use (39). In study conducted in United States daily alcohol use had an almost four-fold rise in the odds of detectable HIV viral load as compared to patients on ART who did not use alcohol (22).

CHAPTER-THREE: OBJECTIVES

3.1. General Objective

To assess unsuppressed viral load level and associated factors among adult HIV patients taking first line anti-retroviral treatment in public health facilities found in Jimma town 2019.

3.2. Specific objectives

1. To describe the socio-demographic and clinical characteristics of adults on antiretroviral therapy with unsuppressed viral load.
2. To determine the proportion of unsuppressed viral load among HIV patients on first line antiretroviral treatment.
3. To identify factors that is associated with unsuppressed viral load among HIV patients on first line antiretroviral therapy in Jimma town.

CHAPTER-FOUR: METHODS

4.1. Study area and period

This study was conducted in Jimma town which is found in Oromia regional state, located 353 KM south west of Addis Ababa. According to 2017 Population projection the total population of Jimma town is 194,139. There are six public HFs of which four of them are providing chronic HIV/AIDS care and treatment services. This study was carried out in Jimma Medical Center (JMC), Shenen Gibe Hospital (SGH), Jimma HC (JHC) and Higher-2 HC from March 1-20, 2019 in Jimma town.

Jimma Medical Center (formerly known as Jimma University Specialized Hospital) is the only teaching and referral hospital overseen by Federal Ministry of Education of Ethiopia and provide medical service for more than 15 million people of the south-west regions of the country. It is viral load testing facility of south-west regions and has been providing viral load testing services for all catchment ART service providing HFs found under regions through referral system since March, 2016.

Shenen Gibe Hospital, Jimma HC and Higher-2 HC are administered by Oromia Regional Health Bureau and providing HIV/ART services in Jimma town. They refer viral load sample to JMC for test.

4.2. Study design

A health facility based cross sectional study design was employed.

4.3. Population

4.3.1. Source population

Source population was adult human immune deficiency virus (HIV) infected patients on antiretroviral therapy (ART) at public health facilities found in Jimma town.

4.3.2. Study population

Selected adult HIV positive patients on first line ART at public health facilities found in Jimma town.

4.3.3. Eligibility Criteria

4.3.3.1. Inclusion criteria

ART patient's record that fulfilled the following criteria was included in this study.

- Adult HIV positive whose age was $\geq$ 15
- Patients who were on first line ART for at least six months
- Patients for whom 1st viral load test was done between the period from March, 2016 to February, 2019.

4.3.3.2. Exclusion criteria

- ART clients transferred out to other health facilities
- Lost to follow up (LTFU) patients from ART treatment restarted their medication.
- ART patients whose data was incomplete on patient's medical records were excluded from the study.

4.4. Sample size and Sampling technique /Sampling procedures

4.4.1 Sample size

To determine the sample size, Cochran's sample size calculation formula was applied.

An error of 5 % and 95% confidence level was preferred(40). The desired sample size (n) was arrived at as indicated in the formula below:

$$no = \frac{Z^2\, p\, q}{d^2} \quad = \quad no = \frac{(z_{\alpha/2})^2 p(1-p)}{d^2}$$

The 2017, Global UNAIDS the 90-90-90 report of Ethiopia used for calculation, the 3rd 90 achievement was 32% viral suppression as a baseline to calculate sample size that could represent our study population (2).

$$n = \frac{(z_{\alpha/2})^2 pq}{d^2} \quad = \quad n = \frac{(z_{\alpha/2})^2 p(1-p)}{d^2} \quad = \quad n = \frac{(1.96)^2\ 32\%(100\%-32\%)}{0.05^2}$$

$$n = \frac{(1.96^{2)}\ x\ (32\%)\ (68\%)}{0.05^2} \quad = \quad \frac{1.96^2\ x\ (0.32)\ (0.68)}{0.05^2} \quad = \quad \frac{3.8416\ x\ 0.2176}{0.0025} = \quad 334.4$$

The sample size required was 334.4. However, to improve the power of study the sample size was multiplied by two and the total sample size for data collection was 669 records.

Where, n is the sample size, Z^2 is the abscissa of the normal curve that cuts off an area α at the tails (1 - α equals the desired confidence level, 95%), d is the desired level of precision, p is the estimated proportion of an attribute that is present in the population, and q is 1-p (40).

4.4.2. Sampling technique

Patients' medical records contained ID number attending ART clinic at PHFs was used. Patient's medical records that meet the inclusion criterion using simple random sampling method were selected for study sample. The records that were finally included in the analysis were selected randomly using a Microsoft Excel randomizer. The records in excel sheet were assigned serial numbers which guided selection of records once random numbers are generated. The selected records were assessed for completeness. If a record was incomplete and missing information cannot be corrected, it was replaced with the next randomly selected record until the desired sample size was achieved.

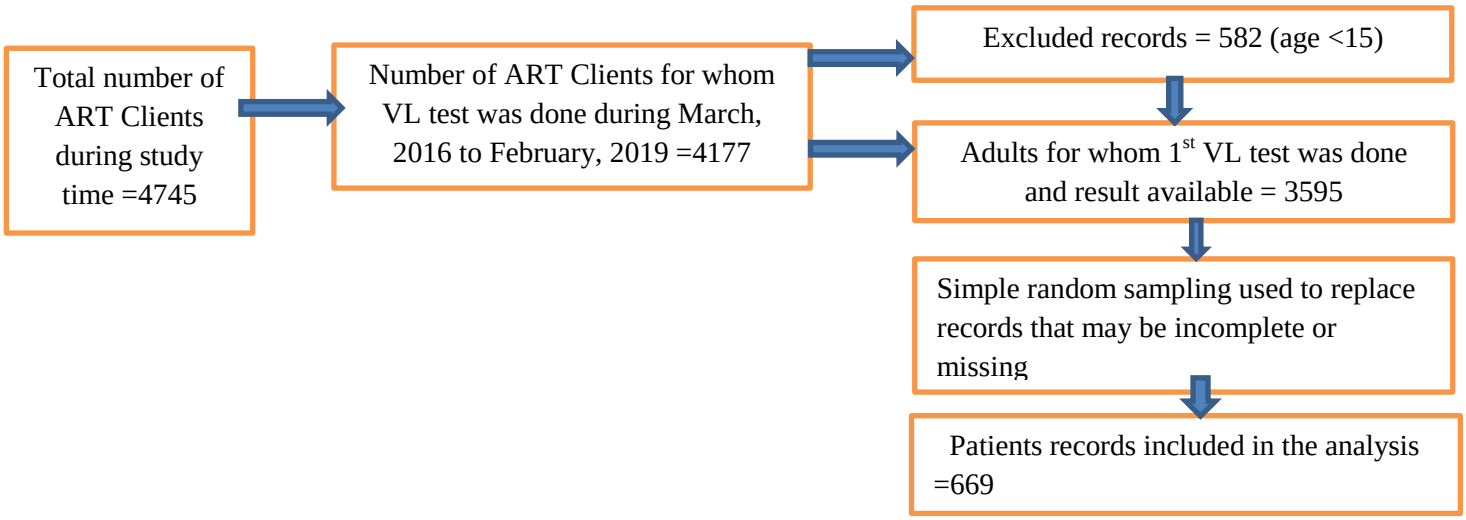

Fig 2: Flow chart showing the records included in the sampling frame

To allocate number of sample size of each HF, the performance of VL test during March, 2016 to Feb, 2019 of each HF was reviewed. Then, the total sample sizes were determined and the proportion of sample size of each health facilities was shared according to the number VL test was done. Finally, 462 for Jimma university medical center, 64 for Shenen Gibe hospital, 134 for Jimma HC and 9 for Higher-2 HC sample size was allocated and simple random selection was applied using excel sheet which contained serial numbers that guided the selection of allocated sample.

Study Sample size determination					
HF	Clients on ART during research period	Patients for whom VL test Done between March, 2016 to Feb, 2019	Calculation to determine Sample size	Study Sample proportion	Sample X 2
JUMC	3225	2888	334.4/4177 x 2888	231	462
SGH	495	400	334.4/4177 x 400	32	64
JHC	892	834	334.4/4177 x 834	67	134
H-2 HC	133	55	334.4/4177 x 55	4.4	9
Total	4745	4177	334.4	334.4	669

Table.1. Study Sample size determination

4.5. Data collection procedures

Data for this study was collected using structured data abstraction tool which was prepared in English adapted from FMOH of Ethiopia ART patient intake forms, follow up chart and registers that could address the objectives of the study. A retrospective review of routinely collected HIV information and viral load test data of patients from March 1-20, 2019 were done. Data was collected by four ART trained nurses working at ART clinics. Four card room runners were assigned for bringing cards from the card room. The principal investigator and four supervisors were closely monitored the whole data collection process on a daily basis.

Data collection tool includes basic patients' information such as:

- Socio-demographic characteristics of ART patients

- Clinical and treatment characteristics
- Laboratory results information
- Comorbidities: STI, TB infection and
- Medically diagnosed non communicable diseases

4.6. Study Variables

4.6.1. Dependent (Outcome) variable

- Unsuppressed viral load.

4.6.2. Independent (exposure) variable

- Independent variables: were Socio-demographic characteristics of ART patients: age, sex, resident and distance from HFs, marital status, Pregnancy status, religion, education status, and occupational status.
- Clinical and treatment characteristics were: disclosure of HIV, ART Initiation time, ARV treatment regimen, Side Effect of ART Drug (Toxicity), Sign and symptom of ART side effect observed, Baseline Body Mass Index (BMI), current WHO clinical staging, adherence to treatment, Multiple late appointments in the last year, Clinical failure in the past years before VL test and Immunological failure in the past years before VL test.
- Laboratory results information (Baseline CD4, viral load, Baseline Hgb)
- Comorbidities: STI, TB infection and medically diagnosed non communicable diseases.

4.7. Operational Definitions

Adherence to medication: adherence to long-term therapy is defined as the extent to which a person's behavior (taking medication, following a diet and/or executing lifestyle changes) corresponds with agreed upon recommendations from a health care provider (41). Adherence to medication can be categorizes as Good (equal to or greater than 95% or ≤ 3 doses missed per month), Fair (85-94% or 4-8 doses missed per month), or Poor (less than 85% or ≥ 9 doses missed per month) (41).

Clinical failure: new or recurrent clinical event indicating severe immunodeficiency (WHO clinical stage 4 conditions) after 6 months of effective treatment (23).

Immunological failure: CD4 count at or below 250 cells/mm^3 following clinical failure or persistent CD4 levels below 100 cells/mm^3 (6).

Viral load (VL): the amount of HIV in a sample of blood. Viral load (VL) is reported as the number of HIV RNA copies per milliliter of blood. An important goal of antiretroviral therapy (ART) is to suppress a person's VL to an undetectable level—a level too low for the virus to be detected by a VL test (6).

Viral suppression: when antiretroviral therapy (ART) reduces a person's viral load (HIV RNA) to $\leq$1000 copies/mL (6) .

Unsuppressed viral load defined as plasma viral load above 1000 copies/mL after 6 months of ART initiation(6).

4.8. Data quality management

Before data collection, data collectors and supervisors were got a one-day orientation on the objectives of the study, contents of tools and how to collect the data by principal investigator. The data collectors were hospitals and health centers data clerks and the supervisors were ART providers of hospitals and health centers. The completeness, consistence, missing and outliers of collected data were checked. A regular supervision to data collectors and supervisors was conducted by principal investigator to maintain the data quality.

4.9. Data processing

Data were checked for completeness, coded and, finally it was entered into Epi Data version 3.1, cleaned and analyzed by using SPSS version 20. Descriptive statistics, including frequencies, mean and percentages were used to describe demographic, clinical, and treatment-related characteristics of patients. Binary logistic regression analysis was carried out for independent variables with an outcome variable to select candidate variables for multivariable analysis. Variables with a p-value < 0.25 in bivariate analysis were included into a multivariable logistic regression analysis using backward likelihood ratio method to identify the independent factors of non-viral

suppression. The final model was assessed for goodness-of-fit using Hosmer–Lemeshow test. No evidence indicating lack of fit was found (p-value = 0.298). Finally, variables that had significant associations with unsuppressed viral load were identified based on the adjusted odd ratio (AOR) with a 95% CI and p-value < 0.05.

4.10. Data analysis

Data was analyzed using SPSS 20. ART patient's medical and VL test records were used for analysis. A bivariate analysis was performed to determine proportion of unsuppressed viral load (>1000 copies/ml) and describe the association of each independent factor with viral non-viral suppression. Candidate variables with cut off p-value of <0.25 were chosen from the bivariate analysis and then entered to multivariate logistic regression analysis to estimate association of covariates to non-viral suppression with P-value less than 0.05 at 95% CI as cut of point. Crude and adjusted odds ratios (AOR) were computed to determine the strength of association between independent predictors and unsuppressed viral load.

4.11. Ethical considerations

Institutional ethical clearance and formal permission letters were obtained from Jimma university institutional review board to conduct this study and communicated with local administrative relevant bodies and research conducting public health facilities.

4.12. Dissemination plan

The findings of this study will be presented to Jimma University, faculty of public health, department of epidemiology, town health office, public health facilities and other stakeholders for effectiveness of treatment program among patients retained in HIV care and informing future clinical quality improvement interventions. In addition the result of this study would be reviewed by peer reviewer and published in scientific journals for international communities.

CHAPTER-FIVE: RESULTS

5.1 Scio-demographic Characteristics of Study Participants

A total of 669 ART patients chart was abstracted. Among the study patients 258 (38.6%) were found in age group 25-34. The median age of the study participants was 35 years. Females accounted for 68.2% of participants. Majority 560 (93.7%) of study participants were urban dwellers. More than half 389(58%) of study participants were married. One-hundred seventy one (25.6%) of study participants were house wives by their occupation and 128 (19.1%) of study ART clients were unemployed. Among study participants, 295 (44.1%) attended primary education followed by secondary level of education 204 (30.5%) as shown in table 2 below.

Table 2: Baseline socio-demographic characteristics of first line ART study participants in four public health facilities of Jimma town, 2019

Patient Characteristic	Variables	Frequency (N=669)	Percentage %
Sex	Female	456	68.2%
	Male	213	31.8%
Age Group	15-24	65	9.7%
	25-34	258	38.6%
	35-44	250	37.4%
	45 and above	96	14.3%
Residential place	Urban	560	93.7
	Rural	109	6.3
Distance from HF	1-10 KM	527	78.5%
	11-20 KM	27	4%
	21-40 KM	24	3.6%
	41-100 KM	58	8.7%
	>100 KM	35	5.2%
Marital status	Married	389	58.1%
	Single	105	15.7%
	Divorced	117	17.5%
	Widowed	58	8.7%
Religion	Muslim	215	32.1%
	Orthodox	371	55.5%
	Protestant	83	12.4%
Level of education	Uneducated (0 Grade)	120	17.9
	Primary (1-8 Grade)	295	44.1
	Secondary (9–12 grade)	204	30.5%
	Diploma and above	50	7.4%
Occupational status	Gov't Employee	85	12.7%
	Private employee	94	14.1%

	House wife	171	25.6%
	Daily laborer	114	17%
	Merchant	36	5.4%
	Student	25	3.7%
	Unemployed	128	19.1%
Pregnancy status	Pregnant	31	6.8%
	Not Pregnant	401	87.9%
	Breast Feeding	24	5.3%

5.2. Clinical Characteristics of Study Participants

Among study participants 660 (98.7%) were with current WHO clinical stage I and those with clinical stage II and above were 9(1.3%). Majority, 544 (81.3%) of ART patients were with BMI >18.5kg/m^2, those with moderate malnutrition (BMI 16-18.5kg/m^2) were 61 (9.1%) and those with severe malnutrition (BMI <16 kg/m^2) were 19 (2.8%) at baseline.

In this study most of ART patients 439 (65.6%) were with CD4 >250 cells/mm^3, while those with CD4 >100-250 cells/mm^3 were 165 (24.7%) and those with CD4 ≤100 cells/mm^3 were 65 (9.7%) at baseline. Among study clients 525(78.5%) were with Hgb >10 gm/dl while those with ≤10 gm/dl were 144(21.5%) at baseline. In this study 102 (15.2%) of patients had history of immunological failure in the past years before VL test conducted. Likewise 40 (6%) of ART clients were developed STI and 35 (5.2%) of study clients were developed TB infection after initiation of ART as shown in table 3 below.

Table 3: Clinical Characteristics of adult HIV-positive patients on first line ART four public health facilities of Jimma town, 2019

Patient Characteristic	Description	Frequency(N=669)	Percentage %
Baseline Body Mass Index (BMI)	>18.5kg/m^2 = No Malnutrition	544	81.3%
	16-18.5kg/m^2 = Moderate malnutrition	106	15.8%
	< 16 kg/m^2 = Severe malnutrition	19	2.8%
Current WHO	WHO Clinical stage I	660	98.7%

clinical staging	WHO Clinical stage II and above	9	1.3%
Clinical failure in the past years before VL test	Yes, WHO stage III or IV	50	7.5%
	No, WHO stage I	619	92.5%
Immunological failure in the past years before VL test	Yes, CD4<250 cells/mm^3	102	15.2%
	No, CD4 >250 cell/mm^3	567	84.8%
STI After initiation of ART	Yes	40	6%
	No	629	94%
TB infection After initiation of ART	Yes	35	5.2%
	No	634	94.8%
Medically diagnosed non communicable diseases			
Hypertension	Yes	6	0.9%
	No	663	99.1%

5.3. Treatment Characteristics of Study Participants

In this study more than half of study populations 358 (53.5%) have been taking first line 1e regimen ARV drugs (Tenofovir/Lamivudine/Efaverienz (TDF-3TC-EFV)), ART clients those on first line 1c regimen (Zidovudine/Lamivudine/Nevirapine (AZT-3TC-NVP) were 171 (25.6%), those on first line 1f regimen (Tenofovir/Lamivudine/ Nevirapine (TDF-3TC-NVP)) were 82 (12.2%) while on first line on 1d regimen (Zidovudine/Lamivudine/ Efaverienz (ZDV/3TC/EFV)) were 58 (8.7%).

The result of this study indicated that more than half 359(53.2%) of the patients had been taking ART for 6-10 years, clients those who have been taking ART for 3-5 years were 145 (21.7%), those who were taking for more than 11 years were 132 (19.7%) and those who have been taking for less than two years were 36 (5.4%), and the median time of clients on ARV treatment was 3 years.

Among study participants 174 (26%) were not disclosed their HIV status. Majority of ART clients 643 (96.1%) were with good adherence to their medication while; patients with poor adherence were 26(3.9%). Most, 456 (68.2%) of ART clients refill their drug on scheduled date of appointment whereas, 213 (31.8%) refill with multiple late appointments as shown in table 4 below.

Table 4: Treatment Characteristics of adult HIV-positive patients on first line ART in four public health facilities of Jimma town, 2019

Patient Characteristic	Description	Frequency(N=669)	Percentage %
Disclosure of HIV status	Yes	495	74%
	No	174	26%
ART Initiation time	Less than two years	36	5.4%
	3-5 years	145	21.7%
	6-10 years	359	53.2
	>11 years	132	19.7%
ART Regimen	1c (AZT-3TC-NVP)	171	25.6%
	1d (AZT-3TC-EFV)	58	8.7%
	1e (TDF-3TC-NVP)	358	53.5%
	1f (TDF-3TC-NVP)	82	12.2%
Side Effect of ART Drug (Drug Toxicity)	No Side Effect	669	100%
	Yes, side effect Present	0	0%
Adherence to ARV drug treatment	Good	643	96.1%
	Poor	26	3.9%
Multiple late appointments in the last years	Yes	213	31.8%
	No	456	68.2%

5.4. Status of Viral Load suppression among ART-taking HIV-patients

This study has shown that, out of 669 study participants, over two-thirds 533(79.7%) of study patients had achieved VL suppression (viral load $\leq$1000 copies/ml). However, the proportion of ART patients with unsuppressed viral load (viral load >1000 copies/ml) after six or more months initiation of ART were 136 (20.3%).

In this study, out of 136 ART clients identified with unsuppressed viral load, the proportion of males were 36% and female clients' accounts for 64%. The proportion of clients taking first line 1e regimen were 41.2%, those patients taking 1c were 30%, those on 1f were 19.8% and those who have taking 1d regimen were 8.8%. The result had also showed that, the proportion of unsuppressed VL among patients with Current WHO clinical stag one were 97%(out of total 136 clients with high viral load), proportion of patients who have taking first line ART for 3-5 years were 22.8%, those who were taking 6-10 years was 50% and those who have been taking for more than 11 years was 26.5%, clients with BMI >18.5 kg/m^2 were 61.7%, those with BMI 16-18.5

kg/m^2 were 30.9% and participants with BMI <16 kg/m^2 at baseline were 7.4% as shown in table 5 below.

Table 5: Status of Viral load suppression among first line ART-taking HIV-patients in four public health facilities of Jimma town, 2019

Variables		Frequency (N=669)	Viral Load Test Result	
			Number & % did not achieved viral suppression (Unsuppressed VL) (>1000 cop/ml) (N=136)	Achieved viral suppression (≤1000 cop/ml)
Age	15-24	65	19(14%)	46
	25-34	258	51(37.5%)	207
	35-44	250	51(37.5%)	199
	45 and above	96	15(11%)	81
Sex	Male	213	49(36%)	164
	Female	456	87(64%)	369
Residential place	Urban	560	115(84.6%)	445
	Rural	109	21(15.4%)	88
Distance from HF	1-10 KM	525	108(79.4%)	417
	11-40 KM	51	8(5.8%)	43
	41-100 KM	58	11(8%)	47
	>100 KM	35	9(6.6%)	26
Marital status	Married	389	78(57.3%)	311
	Single	105	27(19.8%)	78
	Divorced	117	19(14%)	98
	Widowed	58	12(8.8%)	46
Religion	Muslim	215	43(31.6%)	172
	Orthodox	371	72(53%)	299
	Protestant	83	21(15.4%)	62
Level of education	Uneducated (0 Grade)	120	20(14.7%)	100
	Primary (1-8 Grade)	295	68(50%)	227
	Secondary (9–12 grade)	204	43(31.6%)	161
	Diploma and Above	50	5(3.7%)	45
Occupational status	Gov't Employee	85	18(13.2%)	67
	Private employee	110	22(16%)	88
	House wife	171	35(25.7%)	136
	Daily laborer	114	22(16%)	92
	Merchant	36	5(3.7%)	31
	Student	25	9(6.6%)	16
	Unemployed	128	25(18.3%)	103
Disclosure of HIV status	Yes	495	107(78.7%)	388
	No	174	29(21.3%)	145
ART Initiation	Less than two	36	1(0.7%)	35

time	years			
	3-5 years	145	31(22.8%)	114
	6-10 years	356	68(50%)	288
	>11 years	132	36(26.5%)	96
ART regimen	1c (AZT-3TC-NVP)	171	41(30%)	130
	1d (AZT-3TC-EFV)	58	12(8.8%)	46
	1e (TDF-3TC-NVP)	358	56(41.2%)	302
	1f (TDF-3TC-NVP)	82	27(19.8%)	55
Side Effect of ART Drug (toxicity)	No Side Effect	669	136(100%)	533
	Yes side effect Present	0	0(0%)	0
Baseline Body Mass Index (BMI)	>18.5kg/m^2 = No Malnutrition	544	84(61.7%)	460
	16-18.5kg/m^2 = Moderate malnutrition	106	42(30.8%)	64
	< 16 kg/m^2 = Severe malnutrition	19	10(7.3%)	9
Current WHO clinical staging	WHO Clinical stage I	660	132(97%)	528
	WHO Clinical stage II and above	9	4(3%)	5
Adherence to ARV drug treatment	Good	643	120(88.2%)	523
	Poor	26	16(11.8%)	10
Multiple late appointments in the last years	Yes	213	59(43.4%)	154
	No	456	77(56.6%)	379
Clinical failure in the past years before VL test	No, WHO stage I	619	112(82.4%)	507
	Yes, WHO stage III or IV	50	24(17.6%)	26
Immunological failure in the past years before VL test	No, CD4 >250cell/mm^3	567	87(63.9%)	480
	Yes, CD4<250 cells/mm^3	102	49(36.1%)	53
Pregnancy status	Pregnant	31	0(0%)	31
	Not Pregnant	387	86(63.2%)	305
	Breast Feeding	24	1(0.7%)	23
Base line CD4 test	CD4 >250 cells/mm^3	439	62(45.6%)	377
	CD4 >100-250cells/mm^3	165	49(36%)	116
	CD4 $\leq$100 cells/mm^3	65	25(18.3%)	40
Base line Hgb test	>10 gm/dl	525	90(66.2%)	435
	$\leq$10 gm/dl	144	46(33.8%)	98
STI After initiation of	Yes	40	10(7.3%)	30
	No	629	126(92.7%)	503

ART				
TB infection After initiation of ART	Yes	35	11(8%)	24
	No	634	125(92%)	509
Medically diagnosed non communicable diseases				
Hypertension	Yes	6	0(0%)	6
	No	663	136(100%)	527
Total Viral load test Result		669	136(20.3%)	533(79.7%)

5.5. Factors Associated to Unsuppressed Viral load among adult ART users in Jimma town

Bivariate logistic regression analysis was performed to see the association between independent variables and viral load suppression status. Based on the analysis, about seven variables, namely: Residential place, Religion, Distance from HF, Pregnancy status, STI, Side effect of ART Drug (toxicity), and Medically diagnosed non communicable diseases (hypertension) had no association with unsuppressed viral load at p-value <0.25 at 95% CI.

However, factors such as ART patients' age, sex, marital status, level of education, occupation, disclosure of HIV status, ART initiation time, ART regimen, baseline body mass index (BMI), Current WHO clinical staging, adherence to ARV treatment, multiple late appointment, clinical and immunological failure in the past years before VL test, baseline CD4 and Hgb, and TB infection status were identified having association with unsuppressed vial load at P-value of < 0.25 at 95% CI, hence, all were included in multivariable logistic regression analysis as shown in table 6 below.

Table 6: Association between Unsuppressed viral load status and socio-demographic, clinical and treatment characteristics of adult HIV-patients who were on first line ART in four public health facilities of Jimma town, 2019. n=669

Variables	Frequency	Viral Load Test Result		COR (95%CI)	p-value
		Did not Achieved viral suppression (Unsuppressed VL)	Achieved viral suppression (≤1000 cop/ml)		

			(>1000 cop/ml)			
Age	15-24	65	19	46	2.23(1.04,4.81)	0.04
	25-34	258	51	207	1.33(0.71,2.49)	0.38
	35-44	250	51	199	1.38(0.74,2.60)	0.31
	45 and above	96	15	81	1	
Sex	Male	213	49	164	0.79(0.53, 1.17)	0.24
	Female	456	87	369	1	
Residential place	Urban	560	115	445	1.08 (0.65, 1.82)	0.76
	Rural	109	21	88	1	
Distance from HF	1-10 KM	525	108	417	1	
	11-40 KM	51	8	43	0.72(0.33, 1.58)	0.40
	41-100 KM	58	11	47	0.90(0.45, 1.80)	0.77
	>100 KM	35	9	26	1.34(0.61, 2.93)	0.47
Marital status	Married	389	78	311	1	
	Single	105	27	78	1.38(0.84, 2.28)	0.20
	Divorced	117	19	98	0.77(0.45, 1.34)	0.35
	Widowed	58	12	46	1.04(0.52, 2.05)	0.91
Religion	Muslim	215	43	172		
	Orthodox	371	72	299		
	Protestant	83	21	62		
Level of education	Uneducated (0 Grade)	120	20	100	1.80(0.64, 5.10)	0.27
	Primary (1-8 Grade)	295	68	227	2.70(1.03, 7.10)	0.04
	Secondary (9–12 grade)	204	43	161	2.40(0.89, 6.43)	0.08
	Diploma and Above	50	5	45	1	
Occupational status	Gov't Employee	85	18	67	1.11(0.56, 2.18)	0.77
	Private employee	110	22	88	1.03(0.54, 1.95)	0.93
	House wife	171	35	136	1.06 (0.59, 1.88)	0.84
	Daily laborer	114	22	92	0.99(0.52, 1.87)	0.96
	Merchant	36	5	31	0.66(0.24, 1.89)	0.44
	Student	25	9	16	2.34(0.92, 5.85)	0.08
	Unemployed	128	25	103	1	
Disclosure of HIV status	Yes	495	107	388	0.73(0.46, 1.14)	0.16
	No	174	29	145	1	
ART Initiation time	Less than two years	36	1	35	0.08 (0.01, 0.58)	0.013
	3-5 years	145	31	114	0.73 (0.42,	0.25

					1.26)	
	6-10 years	356	68	288	0.63(0.36, 1.00)	0.05
	>11 years	132	36	96	1	
ART regimen	1c (AZT-3TC NVP)	171	41	130	1	
	1d (AZT-3TC-EFV)	58	12	46	0.82(0.40, 1.71)	0.60
	1e (TDF-3TC-NVP)	358	56	302	0.58 (0.37, 0.92)	0.02
	1f (TDF-3TC-NVP)	82	27	55	1.55(0.87, 2.77)	0.13
Side Effect of ART Drug (Toxicity)	No Side Effect	669	136	533		
	Yes side effect Present	0	0	0		
Baseline Body Mass Index (BMI)	>18.5kg/m^2 = No Malnutrition	544	84	460	1	
	16-18.5kg/m^2 = Moderate malnutrition	106	42	64	3.59(2.28, 5.65)	0.001
	< 16 kg/m^2 = Severe malnutrition	19	10	9	6.08(2.40, 15.42)	0.001
Current WHO clinical staging	WHO Clinical stage I	660	132	528	0.31(0.08, 1.18)	0.09
	WHO Clinical stage II and above	9	4	5	1	
Adherence to ARV drug treatment	Good	643	120	523	1	
	Poor	26	16	10	6.97(3.08, 15.7)	0.001
Multiple late appointments in the last years	Yes	213	59	154	0.53(0.34, 0.78)	0.001
	No	456	77	379	1	
Clinical failure in the past years	No, WHO stage I	619	112	507	1	
	Yes, WHO	50	24	26	0.24(0.13, 0.43)	0.001

before VL test	stage III or IV					
Immunological failure in the past years before VL test	No, CD4 >250cell/ mm^3	567	87	480	1	
	Yes, CD4<250 cells/mm^3	102	49	53	0.21(0.13, 0.31)	0.001
Pregnancy status	Pregnant	31	0	31		
	Not Pregnant	387	82	305		
	Breast Feeding	24	1	23		
Base line CD4 test	CD4 >250 cells/mm^3	439	62	377	1	
	CD4 >100-250cells/ mm^3	165	49	116	2.56(1.67, 3.94)	0.001
	CD4 ≤100 cells/mm^3	65	25	40	3.80(2.15, 6.70)	0.001
Base line Hgb test	>10 gm/dl	525	90	435	1	
	≤10 gm/dl	144	46	98	2.26(1.49, 3.44)	0.001
STI After initiation of ART	Yes	40	10	30	0.75(0.36, 1.58)	0.45
	No	629	126	503	1	
TB infection After initiation of ART	Yes	35	11	24	0.54(0.26, 1.12)	0.01
	No	634	125	509	1	
Medically diagnosed non communicable diseases						
Hypertension	Yes	6	0	6		
	No	663	136	527		

5.6. Independent Predictors of Unsuppressed Viral load among adult ART patients attending four public health facilities in Jimma town

Multiple logistic regression analysis was carried out to describe the effect of the explanatory variables on the HIV-viral load non-suppression. Variables that had association with unsuppressed viral load in bivariate logistic regression analysis at P-value < 0.25 were included in multivariate logistic regression model using stepwise backward likelihood ratio method. This study had found that, variable such as ART

Initiation time, BMI, Baseline CD4, Adherence to ARV medications and Immunologic failure had statistically significant and remained as independent factors that had association with unsuppressed viral load after adjusting other variables entered for multiple regression analysis.

In this study the odds of unsuppressed viral load was 91% less likely (AOR=0.09, 95% CI: (0.01, 0.83) among those who had initiated and taking ART for less than two years compared to those initiated for more than three years, the odds of unsuppressed viral load was 2.9 times more (AOR=2.90, 95% CI: (1.76, 4.79) among ART patients those who had moderate malnutrition (BMI 16-18.5kg/m^2), likewise the odds of viral load non suppression was 4.4 times more (AOR=4.44, 95% CI: (1.56, 12.64) among those who had severe malnutrition (BMI <16kg/m^2) at baseline compared to those with BMI of > 18.5 kg/m2, the odds of unsuppressed viral load was 2.7 times more (AOR=2.76, 95% CI: (1.45, 5.29) among those with baseline CD4 ≤100 cells/mm^3, likewise the odds of viral load non suppression was 2 times more (AOR=2.07, 95% CI: (1.28, 3.34) among those who had baseline CD4 >100-250 cells/mm^3 compared to those with baseline CD4 >250 cells/mm^3, the odds of unsuppressed viral load was 3.2 times more (AOR=3.19, 95% CI: 1.29, 7.89) among those with poor adherence to their medication compared to those with good adherence and the odds of unsuppressed viral load was 4.2 times more (AOR=4.26, 95% CI: 2.56, 7.09) among ART patients those who had immunological failure in the past years compared to those with no immunological failure as displayed in table 7 below.

Table: 7 Independent Predictors of unsuppressed viral loads among Adult HIV-patients receiving first line ART in four public health facilities of Jimma town, 2019. n=669

Variables	Frequency	Viral Load Test Result		AOR (95%CI)	p-value
		Did not Achieved viral suppression (Unsuppressed VL) (>1000 cop/ml)	Achieved viral suppression (≤1000 cop/ml)		

Disclosure of HIV status	Yes	495	107	388	0.60(0.35, 1.03)	0.06
	No	174	29	145	1	
ART Initiation time	< 2yrs	36	1	35	0.09(0.01, 0.83)	0.03
	3-5yrs	145	31	114	0.88 (0.47, 1.65)	0.69
	6-10yrs	356	68	288	0.62(0.36, 1.05)	0.77
	>11yrs	132	36	96	1	
Baseline Body Mass Index (BMI)	>18.5kg /m^2= No Malnutrition	544	84	460	1	
	16-18.5kg/ m^2 = Moderate malnutrition	106	42	64	2.89(1.76, 4.79)	0.001
	< 16 kg/m^2 = Severe malnutrition	19	10	9	4.44(1.56,12.64)	0.01
Current WHO clinical staging	stage I	660	132	528	0.22(0.04, 1.14)	0.07
	stage II and above	9	4	5	1	
Adherence to ARV drug treatment	Good	643	120	523	1	
	Poor	26	16	10	3.19 (1.29, 7.89)	0.02
Multiple late appointments in the last years	No	456	77	379	1	
	Yes	213	59	154	0.66(0.42, 1.04)	0.07
Immunological failure in the past years before VL test	No,CD4 >250 c/mm^3	567	87	480	1	
	Yes,CD4 <250 c/mm^3	102	49	53	4.26 (2.56, 7.09)	0.001
Base line CD4 test (Cells/mm^3)	>250 c/mm^3	439	62	377	1	
	100 - 250 c/mm^3	165	49	116	2.07(1.28, 3.34)	0.03
	≤100 c/mm^3	65	25	40	2.76(1.45, 5.29)	0.002

CHAPTER-SIX: DISCUSSION

This is the first study conducted on unsuppressed viral load and associated factors among adult HIV patients on first line ART attending four public health facilities in Jimma town, Southwest, Ethiopia.

In this study we found that 20.3% of patients on first line ART had a viral load >1000 copies/ mL , that means do not achieved viral suppression after six or more month's initiation of ART. This finding is comparable to the studies conducted in Haiti 15%, Zimbabwe 18%, Cameroon 23.6% and in Peru 24% where their finding ranges from 15-24% unsuppressed viral load (5,10,24,28). When compared to the national HIV-prevention and control target, this figure is higher than that required to reach the 90-90-90 treatment targets. This was possibly linked to patients' duration on ART, lower baseline BMI & CD4, poor adherence to medication and low immunological failure that increased odds of unsuppressed viral load.

In this study, the odds of unsuppressed viral load was 91% less likely (AOR=0.09, 95% CI: (0.01, 0.83) among those who had initiated and taking ART for less than two years compared to those initiated for more than two years. The finding was comparable to the study conducted in Haiti, patients those having been on ART for 2 to 3 years were all significantly less likely to achieve viral suppression(5). In other similar study conducted in South Africa, Kenya and Cameroon, the risk of non-viral suppression was associated with length of time that patients have been on ART that is as the time of patients on ART increases, viral suppression decrease which may be the opposite explanation to our study (5,9,24,31).

In our study, the odds of unsuppressed viral load was 2.9 times more (AOR=2.90, 95% CI: (1.76, 4.79) among ART patients those who had moderate malnutrition (BMI 16-18.5kg/m^2), likewise the odds of non-suppression was 4.4 times more (AOR=4.44, 95% CI: (1.56, 12.64) among those who had severe malnutrition (BMI <16kg/m^2) at baseline compared to those with BMI > 18.5 kg/m^2. This finding was supported by similar studies conducted in Uganda, The occurrence of unsuppressed viral load was higher among HIV-infected adults with baseline lower BMI, BMI$\leq$16-18.5kg/ m^2 compared to

those with BMI > 18.5 kg/m^2 (21). In other study done in Tanzania, HIV patients with baseline lower BMI when they started ART were at a significantly higher risk of having high viral and early mortality compared to patients with a baseline BMI between18.5 and 22.9 kg/m2(42).

This study has demonstrated that the odds of unsuppressed viral load was 2.7 times more (AOR=2.76, 95% CI: (1.45, 5.29) among those with baseline CD4 ≤100 cells/mm^3, likewise the odds of non-suppression was 2 times more (AOR=2.07, 95% CI: (1.28, 3.34) among those who had baseline CD4 >100-250 cells/mm^3 compared to those with baseline CD4 >250 cells/mm^3. This finding was comparable with studies done in Haiti, Swaziland, Vietnam and Thailand, HIV patients on ART those with decreased baseline CD4 counts had higher odds of non-viral suppression compared to those with CD4 counts of 500 cells/mm^3 or greater (14,20,24,26). In contrast in study conducted in Brazil no difference was observed between patients with baseline CD4 counts 350–499 and 500 and above cells per micro liter (32).

In our study the odds of unsuppressed viral load was 3.2 times more (AOR=3.19, 95% CI: 1.29, 7.89) among those with poor adherence to their medication compared to those with good adherence. This result was supported by studies done in South Africa, Haiti, Zimbabwe, Vietnam, Brazil, Rwanda, Cameroon and Tigray in Ethiopia, poor adherence period to ARV medication and missed doses on a daily basis were more likely associated to have non-viral suppression compared to those with good adherence (10,14,15,25,27,29,30,43). Non-adherence associated with non-viral suppression as seen in several studies, adherence to treatment is vital in ensuring viral suppression among patients on ART.

Furthermore, in this study the odds of unsuppressed viral load was 4.2 times more (AOR=4.26, 95% CI: 2.56, 7.09) among ART patients those who had immunological failure in the past years compared to those with no immunological failure. This finding was comparable with studies conducted in Haiti, Kenya, Brazil and Tigray in Ethiopia, Immunological failure in HIV patients with a CD4 cell count below 100 cells/mm^3 were more likely to have non-viral suppression compared to those with CD4 >250 cells/mm^3 (5,31,32,43).

The results of this study can help health care workers of HFs in identification of factors that can affect viral suppression among patients on first-line ART and support the expansion of improved VL monitoring interventions. Further, identifying patients at risk of virologic failure and allow early targeted adherence interventions and help shift to second- or third-line therapy. In addition, the findings would also be important to FMOH in policy making and review guidelines of HIV management that would avert possible virologic failure. ORHB, Jimma town HO, Non-governmental organizations (NGOs), stakeholders and other partners working in HIV care and treatment especially in Jimma town would benefits from findings of this study.

Limitations

Limitations encountered during this study, we were being reviewed records of patients who had a VL test result, which may underestimate the true proportion of patients on ART with unsuppressed viral load. In addition the medical records did not include any adherence measures such as pill counts or on-time drug pickups and other factors that could affect adherence such as alcohol and khat consumption, mental health status and psycho social factors (depression and stigma). So, we were restricted to evaluate the impact of those subjective measures of patients on VL suppression.

CHAPTER SEVEN: CONCLUSION AND RECCOMENDATIONS

7.1. Conclusion

The present study revealed that, low viral suppression (79.7%) compared to UNAIDS target 90%, the key independent factors for viral un-suppression were time of patients initiated on ART (less than two years), lower BMI, low baseline CD4, poor adherence to ARV medications and immunologic failure. Therefore, these results reinforce the need to develop and close follow up of targeted interventions for ART patients in care who are at high risk of unsuppressed viral load.

7.2. Recommendations

This study confirmed that there were a significantly higher proportion of ART patients with unsuppressed viral load in Jimma town public HFs. Therefore we recommend town health office, all stake holders, hospital and health center managers and ART service providers the need to develop strategies to maximize adherence support, improve clinical management of patients with high viral load, nutritional assessment and support and more commitment and effort on these predictors so as to sustain the treatment outcome and prevent drug resistance HIV.

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Annexes

Data Collection tool

Mark “X” in the Boxes if necessary

Name of HF_____ Name of Data collector_____ Date _____

UAN_____ Mark “X” in the Boxes if necessary

Part One : Socio demographic Data		
	Back ground information	Response
1.	Age in years	
2.	Sex	1. Male 2. Female
3.	Residential place	1. Urban 2. Rural
4.	Distance from HF	1. --------KM
5.	Marital status	1. Married 2. Never married 3. Divorced 4. Widowed
6.	Religion	1. Muslim 2. Orthodox 3. Protestant 4. Catholic 5. Other specify
7.	Level of education	1. Uneducated (0 Grade) 2. Primary (1-8 Grade) 3. Secondary (9–12 grade) 4. Diploma & above 5. Others specify----------
8.	Occupational status	1. Employed 2. Private employee 3. House wife 4. Daily laborer 5. Farm worker 6. Merchant 7. Student 8. Unemployed
9.	Pregnancy status	1. Pregnant 2. Not Pregnant 3. Breast feeding 4. Not Applicable
Part Two : Behavioral and Psychosocial Characteristics		

10.	Disclosure of HIV status	1. Yes 2. No
Part Three : Clinical and treatment characteristics		
11.	ART Initiation time	1. 6 months-1 year 2. 1-2 years 3. 3-5 years 4. 6-10 years 5. >11 years
12.	ARV treatment regimen	1. 1b 2. 1c 3. 1d 4. 1e 5. 1f 6. Other specify----------
13.	Side Effect of ART Drug (Drug Toxicity)	1. No Side Effect 2. Present
14.	Sign and symptom of ART side effect observed	1. Nausea, Diarrhea, Fatigue & Headache, 2. Numbness, 3. Rash, 4. Anemia, 5. Abdominal pain, 6. Jaundice, Fat change, 7. Dizzy, Anxiety, 8. Other, 9. Not Applicable
15.	Baseline Body Mass Index (BMI)	1. >18.5kg/m2 = No Malnutrition 2. 16-18.5kg/m2 = Moderate malnutrition 3. < 16 kg/m2 = Severe malnutrition
16.	Current WHO clinical staging	1. WHO Clinical stage I 2. WHO Clinical stage II 3. WHO Clinical stage III 4. WHO Clinical stage IV
17.	Adherence to ARV drug treatment:	1. Good 2. Fair 3. Poor
18.	Multiple late appointments in the last year	1. Yes 2. No
19.	Clinical failure in the past 12 months	1. WHO stage III or IV 2. WHO stage I
20.	Immunological failure in the past 12	1. CD4>250 cells/mm^3 2. CD4 100-250 cell/mm^3

	months	3. CD4 <100 cell/mm^3
Part Four: Laboratory tests		
21.	Viral load test (First Viral load test Result)	1^{st} Viral load test date: _____ Result: 1. <1000 copies/ml 2. >1000 copies/ml
22.	Base line CD4 test	Result: 1. CD4 >250 cells/mm^3 2. CD4 >100-250 cells/mm^3 3. CD4 ≤100 Cells/mm^3
23.	Base line Hgb test	Result: 1. >10 gm/dl 2. ≤10 gm/dl
Part Five: Opportunistic infections		
24.	STI	1. Before initiation of ART 2. After initiation of ART
25.	TB infection status	1. Before initiation of ART 2. After initiation of ART
Part Six: Chronic Non communicable diseases		
26.	Medically diagnosed non communicable diseases	1. Hypertension 2. Diabetics 3. Cancer 4. Heart Disease 5. Other 6. Not Applicable