IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 20, Issue 6 Ser.5 (June. 2021), PP 36-45
www.iosrjournals.org

Viral load suppression rates among people living with HIV started on ART before and after implementation of "Test and Start" policy in Kilifi, Kwale and Mombasa counties of Coastal Kenya.

Isaac Chome Mwamuye[1], Simon Karanja[1], Joseph Baya Msanzu[2], Aggrey Adem[2], Mary Kerich[1]
[1]*Jomo Kenyatta University of Agriculture and Technology, Kenya*
[2] *Technical University of Mombasa, Kenya*

Abstract
Background: *Advancement in ART have prolonged and improved the lives of people living with HIV globally. With the implementation of universal ART in Kenya since 2016, there are no studies that have evaluated the success of the program especially in coast of Kenya using viral load suppression as the indicator of success. This study aims to determine the viral load suppression rates for 24 months among cohorts of people living with HIV started on anti- retroviral therapy before and after implementation of "Test and Start" program in 18 facilities in Coastal Kenya.*
Materials and Methods: *This is was an observational retrospective cohort study which enrolled people living with HIV aged >15 years started on ART in the periods of April to August 2016 and April to August 2017 and follow up data censored after 24 months. Summary estimates for viral load suppression were determined and categorized as before "Test and Start" and after "Test and Start" values. Two sample t-test was used to compare the outcomes between the two cohorts.*
Results: *786 patients (470 before test and start, 316 after test and start cohort) were enrolled. The proportion of viral load unsuppression was 9.9% and 9.8% among the before and after test and start cohorts respectively at 6 months (P=0.95) with similar findings observed at 12 and 24 months. PLHIV who are young, live in informal settlements and with low levels of education had a higher risk of being virally unpressed.*
Conclusion: *The viral load suppression rates for the "test and start" cohort was comparable to those who started ART before test and start.*

Date of Submission: 30-05-2021 Date of Acceptance: 13-06-2021

I. Introduction

Rapid scale up of ART uptake has been successful in the last decade in Eastern and Southern Africa which account for 53 % of the global HIV burden (19.6 million out of 36.9 million)[1].In Kenya, more than 1.1 million of the 1.5 million PLHIV are on treatment according to the Ministry of Health. This is largely due to the guidelines of universal ART for all PLHIV released by WHO in 2015[2] and adopted in Kenya in 2016[3].

The universal ART program for all PLHIV, famously referred to as "test and start" was recommended after evidence from various studies found that provision of ART to all PLHIV prolonged and improved the quality of life among PLHIV, as well as reduced transmission of HIV from those infected to their HIV negative partners. In the U.S.A and Canada, a study done between 2000 and 2007 among 22,937 PLHIV aged above 20 years on ART, contributing to 82,022 person years and 1622 deaths, reached a conclusion that "a 20-year-old HIV-positive adult on ART is expected to live into their early 70s, a life expectancy approaching that of the general population [4]. Based on scientific evidence that was available then, a mathematical model by Granich *et al.* [5] on universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission, showed that immediate ART for those identified as HIV positive would reduce HIV associated mortality to less than 1 case per 1000 and reduce HIV prevalence to less than 1% from the high of almost 5% in most Sub-Saharan Africa countries in 2009. A prospective cohort study with 3,381 African sero-discordant couples followed up for a period of 24 months, showed a 92% reduction in transmission rates in the group who were on ART compared to those who were not on ART with transmission rates of 0·37 per 100 person-years and 2·24 per 100 person-years respectively[6]. In Uganda,zero HIV transmission occurred among 32 sero-discordant couples in which the HIV-1 index partners started ART followed up for 53.6 person-years[7].

With the adoption of the "Test and Start" program, new evidence is thus needed on its implementation successes, challenges and the individual factors that are associated with viral load suppression.Programs, especially those supported by the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) have used viral suppression, retention and attrition to measure the extent to which clients on ART continue treatment as some of the main indicators of the success of HIV programs [8,9]. There are very few studies on the success of the "test and start" programs using viral load suppression rates as the indicator of measurement[10,11] moreso when it comes to the Kenyan context and in the Coast of Kenya to be more specific. This study evaluated the effectiveness of the "test and start" program by comparing the viral load suppression rates among cohorts of PLHIV started on ART in the period before universal ART and those after.

According to WHO, a key goal of HIV treatment is to suppress plasma HIV RNA to <1000 copies/ml [10]which is termed as "*viral suppression*". Typically, viral load suppression is achieved within 3-4 months with good adherence after initiation of HAART. While viral load suppression is a measure of the success of ART treatment for the individual as outlined above, cohort level viral suppression rates are used to measure the success of HIV programs as outlined above([8,9]. Viral suppression rates for cohorts can be measured in two ways; having the number of individuals achieving viral suppression divided by all the HIV positive clients started on ART in the cohort period known as Intention to treat population, or by the clients alive and on ART from the cohort known as On treatment population [11]. Using data from the Kenya AIDS Indicator Survey of 2012[12], population level viral suppression was described as the total number of HIV infected people in an area used as the denominator and those achieving viral suppression as the numerator[13]. While this is in line with the definition of the 3rd 90 of the UNAIDS 2020 goals [14] which uses population level denominators, it is difficult to measure unless during a survey or census which are expensive to carry out. According to the Ministry of Health in Kenya, the viral load suppression rates across all regions in Kenya range from 80% to 96%[15].

Even though adherence to ART and drug efficacy are known to be the main predictors for viral suppression, there are other factors that directly or indirectly contribute to viral load suppression. Being a child or adolescent, male gender, low BMI, low CD4 count, previous viral load between 1000 and 50,000 copies/ml and not having a formal employmenthave been cited as predictors of viral load unsuppression[15,16,17].

While the above studies provide insight on the individual level factors associated with viral load suppression generally, none of them provided information whether the same factors hold during the "test and start' period. This study provides updated information on individual level factors associated with viral load suppression in addition to providing data for decision making and improving HIV programs in the Coast of Kenya whose HIV program has been least studied.

II. Materials and Methods

Study setting: This study was conducted in the coastal region of Kenya covering 18 health facilities from theurban county of Mombasa and rural counties of Kilifi and Kwale. The 6 facilities with the highest number of PLHIVinitiated on anti-retroviral therapy in the April to August 2017 period in each of the counties were selected.The total population for the three counties is slightly above 3million and the HIV prevalence of Mombasa is 4.1% and that of Kilifi and Kwale is 3.8% [18] with poverty levels being more than 50%.

Study design: This was a retrospective observational cohort study which collected, analyzed and comparedviral load data for two cohorts of PLHIV from the study facilities. The first cohort comprised of PLHIV who initiated ART between April and August 2016 before Kenya implemented the WHO recommendations of universally treating all HIV positive people with ART ("delayed treatment group"). The second cohort was made up of PLHIV who initiated ART between Apriland August 2017 after the "Test and Start" guidelines were adopted in Kenya ("Test and start group"). The period between was assumed to be contaminated since PLHIV who had not initiated ART in compliance with the old guidelines were being transitioned to the new "Test and Start" guidelines of universal ART for all PLHIV.

Study population: The study population consisted of all PLHIV in the 18 health facilities who started ART in the two periods under study i.e. April-August 2016 andApril-August 2017 and documented in the ART registers. The sampling frame for the study was 1,623 and 1,496 for the delayed treatment and test and start cohorts respectively.

Sample size determination: The estimation of sample size was done based on having statistical power to show significantly higher hazard of loss to follow up among the test and start patients compared to the delayed treatmentgroup as was shown in a South African Cohort with aHR of 1.58[19]. Among PLHIV on ART, the percentage of loss to follow up was estimated to be about 30%: it was 33.6% in Kilifi, Kenya[20] and 34% in Nigeria[21].

Assuming a loss to follow up of ~30%, a two-tailed alpha of 0.05, with statistical power >80%, a sample size of at least 600 (300 in each cohort) PLHIV was sufficient demonstrate a 58% higher risk of loss to follow up among PLHIV in the test and start cohort (aHR 1.58) with 207 expected to be lost to follow up[22]. However,

because of the long follow-up period of 24 months, we recruited a total of 786 patients (316 for test & treat and 470 for delayed treatment), we analyzed the additional data to strengthen our evidence[19].

Sampling techniques: Probability proportionate to size sampling was used where each facility contributed numbers proportional to the number of PLHIV initiated on ART in the study period. Then within each facility, simple random sampling was used to select the sample.

Study variables: In this study, the dependent variables were clinical outcomes which were measured using viral load suppression. The NASCOP definition of viral load suppression was applied which is a state at which the HIV RNA is not detectable in blood or below 1000 copies/ml[23]. Viral Load suppression rate was therefore calculated as a proportion of clients in the cohorts who had HIV RNA of <1000 copies/ml and those with less than the lower detection limit (LDL) out of all those who shall have a viral load test done.Socio-demographic factors (age, gender/sex, and marital status), socio-economic factors (education level, occupational status) and clinical features (nutritional status, WHO stage, presence of opportunistic infections, ART regimen) were the independent variables in this study.

Data collection tools and sources: Data was collected from ART registers and patient files in the selected facilities using a data abstraction tooldesigned on Open Data Kit (Kobocollect©) exported andstored in Microsoft excel database then backed up externally.

Ethical considerations: The research proposal for this study was submitted for review and approved by the Pwani University Ethical Review Committee (ERC/MSc/032/2020).Highest level of confidentiality was maintained in handling data collected as part of this study.

Statistical analysis

In this study, data was collected from patients' files and registers using a questionnaire uploaded on Open Data Kit (Kobocollect©) and exported to STATA Version 16.1 (College Station, Texas 77845 USA) for analysis. Continuous variables were assessed for outliers and illogical variables flagged and corrected. Viral loads were classified as suppressed for patient with either undetectable or viral load ≤1000/ml and unsuppressed for patient with viral load > 1000/ml. For Body Mass Index (BMI), weight (Kg) was divided by square of height (metres) and classified following the WHO criteria: <18.5, 18.5 to 24.9, 25.0 to 29.9 and ≥30.0. An extra category named "missing" was included to all variables in regression models assuming that data was not missing at random.

Based on the underlying distribution, means (SD) or medians were used to report continuous variables while counts with their respective proportions were used to report categorical variables.The study main exposure was a binary variable classified as participants who were identified as HIV positive and initiated on ART before "test and start" was adopted in 2016 and those diagnosed after 2017. Since this was a cohort study with 24 months of follow-up after starting ART, the "test andstart" patients were those identified as HIV positive andinitiated on ART in 2017 and followed up for 24 months ending in 2019. Demographic, socio-economic and clinical features at time of starting ART are the other exposures that were analyzed in regression models. Viral load testing was done at months 6, 12 and 24 after starting ART on patients as per the national guidelines. At each follow-up point where viral load measurement was done, they were compared between the "delayed treatment" and "test and start" cohorts using chi-square/fishers exact test as appropriate. Features associated with unsuppressed viral loads were assessed using logistic regression analysis including the county variable as random intercept. A *base model* including the dependent variable i.e viral load, main exposure (test & treat vs delayed treatment), and *a priori* confounders; age, sex and county as random intercept were fixed for each time point (months 6, 12 and 24). Then multivariable logistic regression including all other collected potential confounders were added. Only patients with a viral load results were included in this analysis.

To account for differences in treatment services and other unobserved heterogeneity across the three counties (Kwale, Mombasa and Kilifi), we performed a shared gamma frailty Cox regression models. We started by running a *base model*, with the main exposure adjusted for age and sex with the three counties as random effect component in the shared gamma frailty Cox regression models. The final multivariable models included all other confounders collected at time of starting ARTs. CD4 counts were excluded in the regression models because a large proportion of patients (>50%) had no CD4 results at the time of starting ARVs. The measure of effect reported was adjusted hazard ratios and their respective 95% confidence intervals. Final multivariable discriminatory power was assessed using Area Under the Receiver Operating Characteristics curve (AUC).

III. Results

Descriptive statistics of study participants

The study enrolled 786 participants with 60% (470) being from the delayed treatment cohort and 40% (316) in the `test and start' cohort with 44% (341) coming from Kilifi county, 42% (332) from Mombasa and 14% (113) from Kwale. Table 1 shows the socio-demographic characteristics where majority of the participants

were female; 69% (539), the average age was 40.4 years and54% (423) of the participants were married. On the socio-economic characteristics, 41% (321) of the participants had secondary level education ,30% (236) were unemployedwhile 17% (136) of them were dependent as shown in table 2. Almost all, 93% (732), the participants were started on a combination of Tenofovir, Lamivudine and Efavirenz as their starting ART regimen with two-thirds;67% (527) of patients found to be WHO stage I and only 0.3% (2) were on stage IV when starting ART as shown in table 3 on clinical characteristics of study participants. Other clinical characteristics of the participants included nutritional status where approximately 50% (390) had normal BMI (18.5-24.9) while 15% (119) were malnourished (BMI<18.5). Only about 8% (62) of participants had opportunistic infections at the time of starting ART with majority having TB (59%, 36). Other opportunistic infections were herpes simplex virus (14%, 9), sexual transmitted infections (6.3%,4), 6 (9.4%) bacterial infections (9.4%, 6) and oral candidiasis (11%, 7).

Table 1: Demographic characteristics of study participants at start of ART (*Test and start group =316, Delayed group =470, Total patients =786)*

Characteristic		Test and start group n (%)	Delayed group n (%)	Total patients n (%)
Sex	Female	212 (67.1)	327 (69.6)	539 (68.6)
	Male	104 (32.9)	143 (30.4)	247 (31.4)
Age in years: mean (sd)		40.0 (10.5)	40.7 (11.1)	40.4 (10.8)
<30 years		53 (17)	76 (16)	129 (16)
30 to 40 years		115 (36)	166 (35)	281 (36)
40 to 50 years		99 (31)	137 (29)	236 (30)
≥50 years		49 (16)	91 (20)	140 (18)
Recruiting County	Mombasa	85 (26.9)	247 (53)	332 (42)
	Kwale	49 (15.5)	64 (14)	113 (14)
	Kilifi	182 (57.6)	159 (34)	341 (44)
Marital status	Married	165 (52)	258 (55)	423 (54)
	Single	48 (15)	94 (20)	142 (18)
	Divorced/separated/ widowed	103 (33)	118 (25)	221 (28)

Table 2: Socio-economic characteristics of study participants (*Test and start group =316, Delayed group =470, Total patients =786)*

Characteristic		Test and start group n (%)	Delayed group, n (%)	Total patients n (%)
Education level	No school	24 (8)	26 (6)	50 (6)
	Primary	136 (43)	143 (30)	279 (36)
	Secondary	117 (37)	204 (43)	321 (41)
	Tertiary	39 (12)	97 (21)	136 (17)
Employment status	Self employed	87 (28)	178 (38)	265 (33)
	Informal employment	89 (28)	112 (24)	201 (26)
	Formal employment	34 (11)	50 (10)	84 (11)
	Not employed	106 (33)	130 (28)	236 (30)
Economic status	Independent	99 (31)	151 (32)	250 (32)
	Semi-independent	168 (53)	232 (49)	400 (51)
	Dependent	49 (16)	87 (19)	136 (17)

Table 3: Clinical characteristics of study participants (*Test and treat group =316, Delayed group =470, Total patients =786)*

Characteristic		Test & treat group n (%)	Delayed group, n (%)	Total patients n (%)
Nutritional status (BMI in Kg/m^2) (Units?)	<18.5	59 (19)	60 (13)	119 (15)
	18.5 to 24.9	147 (47)	243 (52)	390 (50)
	25 to 29.9	45 (14)	75 (16)	120 (15)

	≥ 30	20 (6)	44 (9)	64 (8)
	Missing	45 (14)	48 (10)	93 (12)
Starting ART regimen	TDF/3TC/EFV	301 (95)	431 (92)	732 (93)
	AZT/3TC/NVP	4 (1.5)	17 (3.4)	21 (2.7)
	TDT/3TC/NVP	6 (1.9)	5 (1.2)	11 (1.5)
	Others*	5 (1.6)	17 (3.4)	22 (2.8)
WHO stage	Stage I	208 (66)	319 (68)	527 (67)
	Stage II	86 (27)	107 (23)	193 (25)
	Stage III	20 (6.3)	44 (9)	64 (7.7)
	Stage IV	2 (0.7)	0 (0)	2 (0.3)
CD_4 level before ART initiation**	Mean (sd) (cells/mm^3)	328.5 (237)	395.0 (320)	377.9 (302)
Number of adherence sessions before ART initiation	≤1	125 (40)	140 (30)	265 (34)
	2	47 (15)	82 (18)	129 (16)
	≥3	109 (34)	171 (36)	280 (36)
	Missing data	35 (11)	77 (16)	112 (14)
	Had opportunistic infection	29 (9.2)	33 (7.0)	62 (7.9)

Viral load suppression rates at months 6, 12 and 24 among 'test and start" and delayed treatment groups

Table 4 shows results of analysis for viral load suppression among the groups at 6, 12 and 24 months. Among the 274 (35%) patients with a viral load reading at month six (6) after starting ARTs, 12 (9.8%) and 15 (9.9%) were unsuppressed among the "test and start" and delayed treatment group respectively, adjusted odd ratio 0.96 (95% CI =0.52−1.75) ,there was no difference in suppression rates in the two groups.

Table 4: Analysis for viral load suppression at months 6, 12 and 24 among 'test and start" and delayed treatment group (*Test and treat group =316, Delayed group =470, Total patients =786)*

Period after initiating ARVs	Test and Start group n (%)	Delayed group n (%)	Chi-square value	P-value[#]	Adjusted Odds ratio (95%CI) *
At month 6 (N=274)					
Suppressed	110 (90)	137 (90)	0.0001	0.95	Reference
Unsuppressed	12 (10)	15 (10)			0.96 (0.52−1.75)
At month 12 (N=288)					
Suppressed	117 (93)	155 (96)	1.08	0.30	Reference
Unsuppressed	9 (7)	7 (4)			1.71(0.95−3.09)
At month 24 (N=339)					
Suppressed	117 (91)	195 (93)	0.51	0.48	Reference
Unsuppressed	12 (9)	15 (7)			1.31 (0.79−2.15)

[#]*P-value from the chi-square test; *Odds ratios from a logistic regression model adjusted for age, sex, and county as random intercept.*

Chi-square test did not show any significant difference in the viral load suppression rates between the two groups at month 6 (P=0.95), at month 12 (P=0.30) and at month 24 (P=0.48) as shown in fig 1 below.

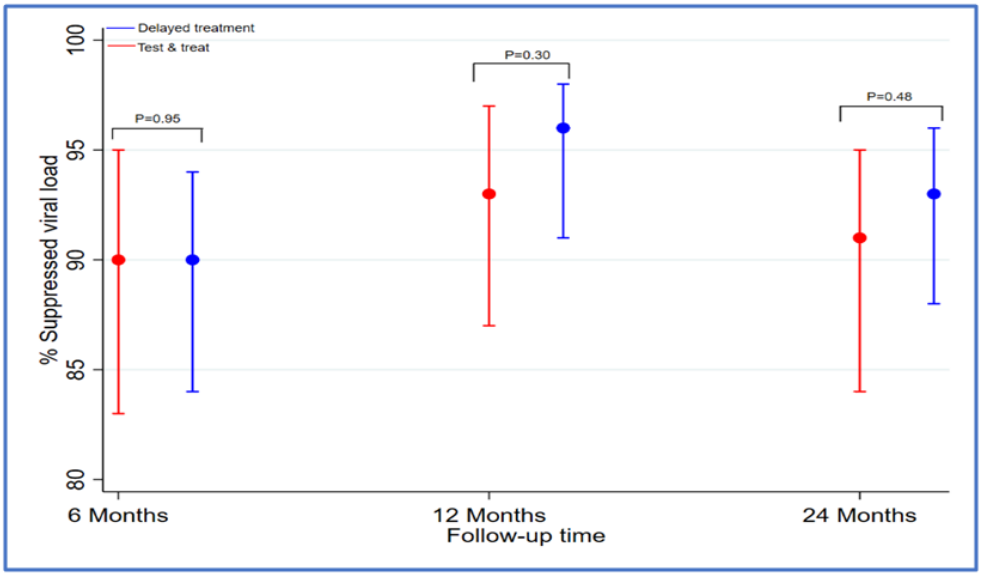

Figure 1: Comparing the viral load suppression rate (with their 95% CI) for the two groups at 6,12- and 24-months using Chi-square test*

Socio-demographic factors as determinants of viral load unsuppression at months 6, 12 and 24

The results are presented in Table 5 below. At 6 months into the study, being older than 30 years of age and single marital status (aOR=0.53 (95%CI 0.35−0.81, P=0.003) had protective effect on odds of being virally unsuppressed. All other factors had no significant effect.

Table 5: Multivariate analysis for socio-demographic characteristics as determinants of viral load unsuppression at months 6, 12 and 24

Characteristic		**Month 6** (n=274)		**Month 12** (n=288)		**Month 24** (n=339)	
		Adjusted OR (95%CI) *	P-value	Adjusted OR (95% CI) *	P-value	Adjusted OR (95% CI) *	P-value
Age in years							
<30		Reference		Reference		Reference	
30 to 40		0.27 (0.09-0.84)	**0.02**	1.06 (0.23-5.71)	0.94	0.46 (0.13-1.58)	0.22
40 to 50		0.45 (0.26-0.80)	**0.006**	2.90 (0.29-28.9)	0.37	0.13 (0.01-2.80)	0.19
≥ 50		0.21 (0.05-0.80)	**0.02**	0.79 (0.04-14.1)	0.88	0.22 (0.03-1.57)	0.13
Sex	Female	Reference		Reference		Reference	
	Male	1.31 (0.53−3.23)	0.56	1.07 (0.55−2.07)	0.85	0.59 (0.30−1.13)	0.11
Maritalstatus	Married	Reference		Reference		Reference	
	Single	0.53 (0.35−0.81)	**0.003**	1.80 (0.83−3.90)	0.14	0.49 (0.07−3.29)	0.46
	Divorced/ Separated/ Widowed	0.83 (0.29−2.37)	0.73	3.22 (0.47−22.2)	0.24	2.18 (0.74−6.41)	0.16

Socio-economic factors as determinants of viral loads unsuppression at months 6, 12 and 24

At 6 and 24 months, compared to patients who are self-employed, patients in informal employment had significantly higher odds of being unsuppressed, aOR1.63 (95%CI 1.11−2.40) and aOR 2.09 (95%CI 1.09−4.03) respectively. Patients who did not attend any school at all were found to have significantly higher odds of unsuppressed viral load, aOR 2.47 (95%CI 1.04−5.86) when compared to those with secondary education & above at month 12.Compared with patients with independent economic status, semi-independent patients had significantly lower odds of having unsuppressed viral load, aOR 0.49 (95%CI 0.30−0.81) at month 24 (Table 6)

Table 6: Multivariate analysis for socio-economic features as determinants of viral load unsuppression at months 6, 12 and 24

Characteristic	Month 6 (n=274)		Month 12 (n=288)		Month 24 (n=339)	
	Adjusted OR (95%CI) *	P-value	Adjusted OR (95% CI) *	P-value	Adjusted OR (95% CI) *	P-value
Education level						
No school	3.07 (0.61−15.3)	0.17	2.47 (1.04−5.86)	**0.02**	0.94 (0.32−2.75)	0.91
Primary	1.01 (0.29−3.51)	0.98	0.45 (0.23−1.08)	0.08	1.72 (0.42−7.01)	0.45
Secondary & above	Reference		Reference		Reference	
Employment status						
Self employed	Reference		Reference		Reference	
Informal employment	1.63 (1.11−2.40)	**0.01**	3.29 (0.34−32.2)	0.31	2.09 (1.10−4.03)	**0.03**
Formal employment	0.32 (0.05−1.99)	0.22	0.64 (0.37−1.14)	0.13	1.55 (0.26−9.20)	0.63
Not employed	0.37 (0.06−2.13)	0.27	3.76 (0.70−20.3)	0.12	1.85 (0.54−6.29)	0.33
Economic status						
Independent	Reference		Reference		Reference	
Semi-independent	0.47 (0.18−1.19)	0.11	0.32 (0.07−1.37)	0.12	0.49 (0.30−0.81)	**0.006**
Dependent	2.92 (0.55−15.5)	0.21	0.22 (0.04−1.08)	0.06	0.53 (0.10−2.83)	0.46

Clinical features as determinants of viral loads unsuppression at months 6, 12 and 24

As for clinical factors, it was found that at month 6, there was no clinical feature determining viral load suppression (Table 7). However, at month 12, being in WHO stage II and number of adherence sessions were important determinants. Those in WHO stage II were 2.6 times likely to be virally unsuppressed compared to those in WHO stage 1, aHR 2.60 (0.98−6.90), though this was statistically not significant. Patients with only two adherence counseling sessions had significantly higher (more than four times) odds of being unsuppressed compared to those with three adherence counseling sessions (aOR=4.60, 95%CI=1.65−12.9, P=0.004).

At month 24, important determinants were being in WHO stage II and having two adherence counseling sessions before starting ART. Those in WHO stage II were three times more likely to be unsuppressed compared to those in WHO stage 1 (aOR=3.13, 95%CI=1.26−7.78, P=0.01) , while those with two adherence counseling sessions had significantly higher odds (three times) of not being virally suppressed compared to those with three adherence counseling sessions (aOR=3.01, 95%CI =1.03−8.75, P=0.04). Although not significant, those with one or less adherence counseling sessions has almost twice the odds of having no viral suppression compared to those with ≥3 adherence sessions**.**

Table 7: Multivariate analysis for clinical features as determinants of viral load unsuppression at months 6, 12 and 24.

Characteristic	Month 6 (n=274)		Month 12 (n=288)		Month 24 (n=339)	
	Adjusted OR (95%CI) *	P-value	Adjusted OR (95% CI) *	P-value	Adjusted OR (95% CI) *	P-value
BMI group						
<18.	2.54 (0.69−9.43)	0.16	0.72 (0.28−1.88)	0.51	0.35 (0.06−1.89)	0.22
18.5 to 24.9	Reference		Reference		Reference	
≥ 25	1.46(0.41−5.24)	0.56	1.36(0.85−2.18)	0.2	1.02 (0.27−3.90)	0.97
Missing data	-$		0.95 (0.24−3.75)	0.94	0.65 (0.07−5.74)	0.7
Type of ART						
TDF/3TC/EFV	Reference		Reference		Reference	
Others#	0.64(0.04−9.95)	0.75	1.46 (0.34−6.36)	0.61	1.52 (0.33−6.95)	0.59

WHO stage						
Stage I	Reference		Reference		Reference	
Stage II	1.03 (0.31−3.42)	0.96	2.60 (0.98−6.90)	0.06	3.13 (1.26−7.78)	**0.01**
Stage III & IV	1.78 (0.48−6.60)	0.39	1.30 (0.01−256)	0.92	0.85 (0.24−3.03)	0.8
Number of adherence sessions before ART initiation						
≤1	1.15 (0.32−4.17)	0.83	1.45 (0.37−5.62)	0.59	1.93 (0.99−3.77)	0.05
2	1.14(0.35−3.71)	0.83	4.60 (1.65−12.9)	**0.004**	3.01 (1.03−8.75)	**0.04**
≥3	Reference		Reference		Reference	
Missing data	2.69 (0.23−31.3)	0.43	-$		0.65 (0.26−1.64)	0.36
Had opportunistic infections	0.46 (0.12−1.82)	0.27	0.69 (0.06−7.39)	0.76	0.40 (0.04−3.73)	0.42

IV. Discussion

Viral load suppression

In this cohort study, the proportion of patients with unsuppressed viral load in the before and after "test and start" cohorts was not significantly different at month 6 (P=0.95), 12 (P=0.30) and month 24 (P=0.48). These findings are comparable to other studies that compared viral load suppression among those who started ART immediately after HIV diagnosis and those started later. Two U.S. studies found similar viral load suppression rates at 24 and 48 weeks among those who started ART on same day of diagnosis, within one week of diagnosis and those who started later [25,26]. However, both studies had only 86 participants each which are small sample sizes. A Ugandan study of 367 children, found better viral load outcomes among those who started ART within 7 days of diagnosis than those who delayed in starting ART contradicting our findings[27].

Predictors of viral load suppression

In this study, there was no significant difference in viral load suppression among males and females, which is in keeping with data from the NASCOP viral load dashboard for Kenya [15]. Similar findings were obtained in a cross-sectional study involving 1255 PLHIV in Vietnam where gender did not affect viral load suppression [28]. A meta-analysis [29] did not find gender as a significant factor in viral load outcomes at 48 weeks; this is supported by other studies [30,31,32]. A study in South Africa by Barth et al. [16]and an American one by Hader et al. found male gender to be predictive of viral load suppression[16,33]. The two studies above analyzed retrospective data from one clinic each while this study analyzed data from 18 sites across 3 counties with a larger sample size, randomly selected, and covers for the bias that may have arisen in the two studies. In Kenya, and at the coast in particular, there are no socio-economic, cultural or health system factors that would favor males on ART or otherwise, which may be the case in the South African and American studies.

Older age was associated with lower odds for viral load unsuppression in this study, consistent with program data from the NASCOP dashboard[15]. A study in Swaziland by Jobanputra et al.(19) and the SEARCH study, a community level cohort study done in Kenya and Uganda also found that being young (15-24 years) was associated with of viral load unsuppression[17,18]. At the age of 15-24 years, many people are in the phase of self-awareness, in new relationships and most have not disclosed their HIV status to their mates, thus finding it difficult to adhere to taking their drugs leading to viral load unsuppression.

Low socio-economic status has been strongly associated with poor HIV outcomes, including poor adherence to ART and subsequently low rates of viral load suppression[34,35]. Improving the economic status was found to improve viral load suppression rates among adolescents living with HIV in Uganda[36]. In this study, PLHIV in informal employment and those with no education had significantly higher odds of having viral load unsuppression compared to those in self- employment or with secondary level education and above respectively, results which is in keeping with the above studies. Patients who were semi-independent economically had significantly lower odds of having viral load suppression compared to those who are independent, unlike in the above studies. This could be due to higher levels stigma among this class of people, who often miss their clinical appointments, do not enroll in support group sessions, and pick drugs from far facilities from their homes. They thus lack treatment accountability partners, treatment buddies and home visit support by peer educators or community health volunteers for closer adherence counselling and support.

Our study had some limitations. First, there are various thresholds used for the definition of viral load suppression ranging from ≤20, ≤50, ≤200, ≤400 to <1000 copies/ml[26]. As guided by the Ministry of Health's guidelines in Kenya, this study used a threshold of <1000 copies/ml which is different from many other studies. This threshold will have to be put into consideration when interpreting the viral load suppression rates for both

cohorts. Secondly, the study did not select sites randomly but selected the high-volume facilities which are mostly well resourced that small volume facilities.

V. Conclusions And Recommendations

The viral load suppression rate among cohorts of people living with HIV started on anti- retroviral therapy before and after implementation of "Test and Start" program is similar in Mombasa, Kwale and Kilifi counties. PLHIV who are young, live in informal settlements and with low levels of education had a higher risk of being virally unpressed. HIV programs should implement strategies tailored towards addressing specific challenges faced by PLHIV with the above characteristics.

In this study, patients who were semi-independent economically were found to have significantly lower odds of achieving viral load suppression compared to those who are independent, unlike in the other studies. I recommend both qualitative and quantative studies be done to explain the lower odds for viral load suppression in this group of patients. This study focused on individual level factors that affect viral load suppression rates in the cohorts under study. I recommend that other studies look at the health system factors that affect viral load suppression rates, particularly the effects of each of the WHO health system building blocks.

References

[1]. UNAIDS. End Inequalities. End AIDS. Global AIDS Strategy 2021-2026 [draft]. 2021; Available from: https://www.unaids.org/sites/default/files/media_asset/PCBSS_Global_AIDS_Strategy_2021--2026_EN.pdf

[2]. World Health Organization. Guideline on When To Start Antiretroviral Therapy and on Pre-Exposure Prophylaxis for HIV. 2015;(September):1–76.

[3]. NASCOP. Ministry of Health, National AIDS & STI Control Programme: Guidelines on Use of Antiretroviral Drugs for Treating and Preventing HIV Infection in Kenya. 2016. 188 p.

[4]. Samji H, Cescon A, Hogg RS, Modur SP, Althoff KN, Buchacz K, et al. Closing the gap: Increases in life expectancy among treated HIV-positive individuals in the United States and Canada. PLoS ONE. 2013;8(12):6–13.

[5]. Granich RM, Gilks CF, Dye C, De Cock KM, Williams BG. Universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission: a mathematical model. The Lancet [Internet]. 2009;373(9657):48–57. Available from: http://www.sciencedirect.com/science/article/pii/S0140673608616979

[6]. Donnell D, Baeten JM, Kiarie J, Thomas K, Stevens W, Cohen CR, et al. therapy : a prospective cohort analysis. 2010;375(9731):2092–8.

[7]. Reynolds SJ, Makumbi F, Nakigozi G, Kagaayi J, Gray RH, Wawer M, et al. HIV-1 transmission among HIV-1 discordant couples before and after the introduction of antiretroviral therapy. Aids. 2011;25(4):473–7.

[8]. U.S. President's Emergency Plan for AIDS Relief. Monitoring , Evaluation , and Reporting Indicator Reference Guide. Available from: https://www.state.gov/wp-content/uploads/2019/10/PEPFAR-MER-Indicator-Reference-Guide-Version-2.4-FY20.pdf. Accessed April 1, 2021. 2019;0(September).

[9]. Sheet F, Day WA, People V. Global hiv statistics 26.0. 2020;(June):1–6.

[10]. Pathmanathan I, Nelson R, de Louvado A, Thompson R, Pals S, Casavant I, et al. High Coverage of Antiretroviral Treatment With Annual Home-Based HIV Testing, Follow-up Linkage Services, and Implementation of Test and Start: Findings From the Chókwè Health Demographic Surveillance System, Mozambique, 2014-2019. Journal of acquired immune deficiency syndromes (1999). 2021 Apr;86(4):e97–105.

[11]. Herce ME, Hoffmann CJ, Fielding K, Topp SM, Hausler H, Chimoyi L, et al. Universal test-and-treat in Zambian and South African correctional facilities: a multisite prospective cohort study. The lancet HIV. 2020 Dec;7(12):e807–16.

[12]. Bennett DE, Bertagnolio S, Sutherland D, Gilks CF. The World Health Organization's global strategy for prevention and assessment of HIV drug resistance. Antiviral Therapy. 2008.

[13]. Elliott JH, Bertagnolio S, Jordan MR. ulletin of the World Health Organization iral suppression after 12 months of ntiretroviral therapy in low- and middle- income countries: a systematic review. 2019;1–16.

[14]. NASCOP. Kenya AIDS Indicator Survey 2012: Final Report. Journal of acquired immune deficiency syndromes (1999) [Internet]. 2014;66 Suppl 1:1–530. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24732813

[15]. Cherutich P, Kim AA, Kellogg TA, Sherr K, Waruru A, De Cock KM, et al. Detectable HIV Viral Load in Kenya: Data from a Population-Based Survey. PLoS ONE. 2016;

[16]. Joint United Nations Program on HIV/AIDS. to help end the AIDS epidemic. United Nations. 2014;

[17]. National AIDS and STI Control Programme (NASCOP). NASCOP viral load dashboard. 2021.

[18]. Barth RE, Tempelman HA, Moraba R, Hoepelman AIM. Long-term outcome of an HIV-treatment programme in Rural Africa: Viral suppression despite early mortality. AIDS Research and Treatment. 2011;2011.

[19]. Jobanputra K, Parker LA, Azih C, Okello V, Maphalala G, Kershberger B, et al. Factors associated with virological failure and suppression after enhanced adherence counselling, in children, adolescents and adults on antiretroviral therapy for HIV in Swaziland. PLoS ONE. 2015;10(2):1–12.

[20]. Petersen M, Balzer L, Kwarsiima D, Sang N, Chamie G, Ayieko J, et al. Association of Implementation of a Universal Testing and Treatment Intervention With HIV Diagnosis, Receipt of Antiretroviral Therapy, and Viral Suppression in East Africa. 2017;94110(21):2196–206.

[21]. National AIDS and STI Control Programme. Kenya HIV Estimates 2015. 2016;1–28.

[22]. Hirasen K, Fox MP, Hendrickson CJ, Sineke T, Onoya D. HIV treatment outcomes among patients initiated on antiretroviral therapy pre and post-universal test and treat guidelines in South Africa. Therapeutics and Clinical Risk Management. 2020;16:169–80.

[23]. Hassan AS, Fielding KL, Thuo NM, Nabwera HM, Sanders EJ, Berkley JA. Early loss to follow-up of recently diagnosed HIV-infected adults from routine pre-ART care in a rural district hospital in Kenya : a cohort study. 2012;17(1):82–93.

[24]. Stafford KA, Odafe SF, Lo J, Ibrahim R, Ehoche A, Niyang M, et al. Evaluation of the clinical outcomes of the Test and Treat strategy to implement Treat All in Nigeria: Results from the Nigeria multi-center ARt study. PLoS ONE. 2019;14(7):1–20.

[25]. Schoenfeld D. The asymptotic properties of nonparametric tests for comparing survival distributions. Biometrika. 1981;68(1):316–9.

[26]. NASCOP M of H (2018 E. G on U of AD for T and PH in KNA and SCP, 217:pp V. Kenya-ARV-Guidelines-2018-Final_20thAug2018. 2018;217:6.
[27]. Christopher D. Pilcher M, , Clarissa Ospina-Norvell, FN-P1, Aditi Dasgupta, BS2 D, Jones, RN1, Wendy Hartogensis, PhD1, Sandra Torres, MSW1, Fabiola Calderon M, Erin Demicco, MPH1, Elvin Geng, MD1, Monica Gandhi, MD1, Diane V. Havlir, MD1 A, Hiroyu Hatano M. The Effect of Same-Day Observed Initiation of Antiretroviral Therapy on HIV Viral Load and Treatment Outcomes in a U.S. Public Health Setting. J Acquir Immune Defic Syndr. 2018;74(1):44–51.
[28]. Hoenigl M, Chaillon A, Moore DJ, Morris SR, Mehta SR, Gianella S, et al. Rapid HIV Viral Load Suppression in those Initiating Antiretroviral Therapy at First Visit after HIV Diagnosis. Scientific Reports [Internet]. 2016;6(1):32947. Available from: https://doi.org/10.1038/srep32947
[29]. Ssebunya R, Wanyenze RK, Lukolyo H, Mutto M, Kisitu G, Amuge P, et al. Antiretroviral therapy initiation within seven days of enrolment: Outcomes and time to undetectable viral load among children at an urban HIV clinic in Uganda. BMC Infectious Diseases. 2017;17(1):1–8.
[30]. Rangarajan S, Colby DJ, Giang LT, Bui DD, Hung Nguyen H, Tou PB, et al. Factors associated with HIV viral load suppression on antiretroviral therapy in Vietnam. Journal of Virus Eradication [Internet]. 2016;2(2):94–101. Available from: https://doi.org/10.1016/S2055-6640(20)30466-0
[31]. Soon GG, Min M, Struble KA, Chan-Tack KM, Hammerstrom T, Qi K, et al. Meta-analysis of gender differences in efficacy outcomes for HIV-positive subjects in randomized controlled clinical trials of antiretroviral therapy (2000-2008). AIDS patient care and STDs. 2012 Aug;26(8):444–53.
[32]. Nicastri E, Angeletti C, Palmisano L, Sarmati L, Chiesi A, Geraci A, et al. Gender differences in clinical progression of HIV-1-infected individuals during long-term highly active antiretroviral therapy. Aids. 2005;19(6):577–83.
[33]. Thorsteinsson K, Ladelund S, Jensen-Fangel S, Johansen IS, Katzenstein TL, Pedersen G, et al. Impact of gender on response to highly active antiretroviral therapy in HIV-1 infected patients: A nationwide population-based cohort study. BMC Infectious Diseases. 2012;12.
[34]. Prins M, Meyer L, Hessol NA. Sex and the course of HIV infection in the pre- and highly active antiretroviral therapy eras. Aids. 2005;19(4):357–70.
[35]. Haider MR, Brown MJ, Harrison S, Yang X, Ingram L, Bhochhibhoya A, et al. Sociodemographic factors affecting viral load suppression among people living with HIV in South Carolina. AIDS Care [Internet]. 2019 Dec 19;1–9. Available from: https://doi.org/10.1080/09540121.2019.1703892
[36]. Mcallister J, Beardsworth G, Lavie E, Macrae K, Carr A. Financial stress is associated with reduced treatment adherence in HIV-infected adults in a resource-rich setting. HIV Medicine. 2013;14(2):120–4.
[37]. Burch LS, Smith CJ, Anderson J, Sherr L, Rodger AJ, O'Connell R, et al. Socioeconomic status and treatment outcomes for individuals with HIV on antiretroviral treatment in the UK: cross-sectional and longitudinal analyses. The Lancet Public Health [Internet]. 2016;1(1):e26–36. Available from: http://dx.doi.org/10.1016/S2468-2667(16)30002-0
[38]. Bermudez LG, Ssewamala FM, Neilands TB, Lu L, Nakigozi G, Mellins CA, et al. HHS Public Access. 2018;22(11):3763–72.

Isaac Chome Mwamuye, et. al. "Viral load suppression rates among people living with HIV started on ART before and after implementation of "Test and Start" policy in Kilifi, Kwale and Mombasa counties of Coastal Kenya."*IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 20(06), 2021, pp. 36-45.