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Predictors of early immunologic response among highly active anti-retroviral therapy naïve patients in Akwa Ibom State

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Abstract

Introduction: CD4 count is a reliable prognostic indicator of immune response to anti retroviral therapy. This study seeks to determine the proportion of HAART naive patients that achieved an early immunologic response at six months of commencing HAART and to predict factors of early immunological response to HAART.
Materials and Methods: This was an observational longitudinal study among 287 consecutively recruited HAART naive patients in 11 HIV treatment centres of Akwa Ibom using a semi-structured interviewer administered questionnaire for data collection. Data analysis was done using Stata statistical software at a level of significance of P<0.05.
Results: About 75% respondents achieved an early immune response. Multivariate analysis revealed that being female (OR 2.47, P=0.001) predicted achievement of early immunological response while being civil servants/professionals (OR 0.44, P =0.02), unemployed (OR 0.34, P= 0.04) and every 10 cell increase in CD4 cell count at baseline (OR 0.94, P=0.001) predicted non achievement of early immunological response.
Conclusion: The majority of HAART naïve patients commenced on anti-retroviral therapy achieved an early immunological response at 6 months on ART. Operating flexible HIV services that covers morning, afternoon, evening and weekend services and male friendly HIV services may improve civil servants and males' utilization of HIV care and support services. Job creation for the unemployed is also recommended.

Keywords: Early Immune Response, HAART Naïve, Akwa Ibom

Introduction

Highly Active Anti-Retroviral Therapy (HAART) has been the standard of care for HIV patients who have signs and symptoms of immune suppression in the developed world since 1996.[1] Its use has led to a marked reduction in mortality and morbidity of persons infected with HIV in Western Europe and the United States.[2-4] There is however, an unmet need in the vast majority of HIV-infected persons in Sub- Saharan Africa which has a higher burden of the disease in the world.[2,5] The goal of therapy is to suppress plasma HIV RNA to an undetectable level, rebuild the immunity of the patient by improving the number and quality (activity) of immune (CD4) cells, reduce HIV transmission, improve quality of

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life and prolong life. This is associated with a more durable treatment response, greater increase in CD4 count and improved clinical outcomes.[6-8] Treatment of HIV infected persons with anti-retroviral therapy, (ART) leads to immune reconstitution as shown by an increase in CD4 lymphocyte count, decreased risk of opportunistic infections and improved survival.[9]

In clinical practice, plasma HIV RNA levels and CD4 cell counts are used to monitor the efficacy of therapy. In industrialized countries, viral load has been the primary tool that clinicians and researchers use to monitor patients on ART to indicate when therapy should be changed.[1,10] Treatment guidelines from the World Health Organization (WHO) for the use of ART in resource-limited settings state that CD4 cell counts may be used to monitor clinical response to therapy in programs in which viral load testing is not available.[11] Discordant responses in HIV RNA level and CD4 cell counts are common, and patients with an immunologic response over 24 months, with or without a virologic response, are at less risk for clinical progression of the disease than those without an immunologic response, hence clinical outcome may improve if CD4 cell count increases.[12,13]

CD4 count is said to be the most reliable prognostic indicator of immune response to therapy and is thus a major criterion in the Centre for Disease Control, CDC/WHO classification of HIV infection, which is widely used to categorize patients for clinical management.[14-16] CD4 cell count may be of benefit in determining more accessible and specific predictors of not only treatment initiation but also immune response among treated patients in Sub-Saharan Africa.[17] Hence CD4 cell count is a consensual parameter for HIV/AIDS monitoring as it actually reflects the immunity dynamics and has been found to be related to both clinical evolution and viral replication.[18,19]

The most characteristic immunological feature of HIV infection is depletion of CD4 T cell numbers. The restoration of the CD4 cell subset during ART appears to occur in two principal phases. The initial rapid phase of CD4 cell recovery can usually be detected within the first 1–2 weeks of starting treatment and extends over 2–3 months. This phase largely represents a redistribution of activated CD4+CD45RO+ memory cells previously sequestered in lymphoid tissue and a reduction in apoptotic cell death. Those with the greatest pre-treatment viral loads and CD4 decline have the greatest rates of phase 1 CD4 cell count recovery. A slower second phase of CD4 cell expansion persists for 1–2 years with variable smaller increments occurring thereafter. This second thymus-dependent phase is associated with expansion of naïve CD45RA+CD62L+ cells and mostly is the consequence of generation of new T cells.[20]

Various proportions of clients that achieved immunologic response to HAART have been reported by studies. Multicentre observational prospective cohort studies of HIV-1 infected clients in France and Europe of 1283 and 9803 clients reported that 64% and 43.4% clients respectively achieved an immunologic response.[21,22] Similar studies in Côte d'Ivoire, sub-Saharan Africa of 303 patients and in the Caribbean of 158 clients on HAART both reported 79.5% of clients achieving immunological response (gained of >50 CD4/µl after HAART initiation).[17,23] Smaller proportions of immunological responders of 46% and 49% were reported in studies in Peru and Uganda respectively probably because immunological response in these studies was defined as gain of >100 cells/ul of CD4 cells.[24,25] Early immunologic response is defined as a rise in CD4 + cell count ≥50 cells/mm3 between initiation of HAART and 6 months.[17,26]

Distinct patterns of virological and immunological responses to HAART have been described according to demographic and clinical factors such as age, sex, clinical stage and other factors.[27,28] Other positive predictors of immunologic response were low total lymphocyte counts, low CD4+ and CD8+ cell counts, high baseline viral load and adherence to therapy.[21,29,30] Viral co-infections such as hepatitis C or G and non viral co-infections such as tuberculosis and malaria also reported mixed findings regarding the recovery of CD4 count cells to HAART.[12,31-36]

Although access to HAART is increasing in developing countries, there are only a few published studies on the predictors of immunological response in persons initiating ART. The availability of information on predictors of immune response will provide further clinical guidance for ART clinicians and programme managers. It will also have important implications for treatment adherence and

patient prognosis. This is even more so in our setting where facilities for virologic response to HAART are not yet widely available or where available are not routinely used to monitor patients on HAART.

This study therefore seeks to determine the proportion of HAART naive patients in Akwa Ibom State who commenced HAART that achieved an early immunologic response at six months of commencing HAART and to predict factors of early immunological response to HAART.

Materials and methods

Study site: The study was carried out in Akwa Ibom State located in the Niger delta region in the south - south geopolitical zone of Nigeria. The state with 31 LGAs and a population of 3.9million people has consistently been a high burden state in the National HIV sentinel surveys of 2005, 2008 and 2010 with a rural prevalence higher than the urban prevalence in the 2010 HIV sentinel survey.[37,38] The State has 11 comprehensive HIV treatment centres located in various local government areas in each of the three senatorial districts with each centre supported by development partner(s).

Study Design: This was an observational longitudinal study involving newly diagnosed HIV positive patients attending the State 11 comprehensive HIV treatment centres from February to August 2011.

Study Population: This included all HAART naive patients entering ART care at the 11 comprehensive HIV treatment centres in the State.

Inclusion and exclusion Criteria: Respondents who were on first line HAART regimen and non pregnant adults aged above 15 years. Exclusion criteria were clients at WHO stage 4 who were commenced on ART without using CD4 cell count, clients given HAART regimen in emergency conditions like in post exposure prophylaxis (PEP) where CD4 cell counts are not used as criteria for ART initiation and pregnant women to eliminate the fluctuations in CD4 cell count that occur during pregnancy and immediate postpartum period and the relative haemodilution that occurs during pregnancy. Children were excluded because their immune response is better monitored using percentage CD4 cell count and not absolute count as used in adults as the absolute CD4 cell count are significantly higher in children than in adults.

Sample Size: A sample size of 300 was determined using the formula $n = Z^2 pq/d^2$,[39] where Z=1.96 standard normal deviate representing the 95% confidence limit, d= 0.05 as the acceptable margin of error, p=0.795, the proportion of respondents achieving an early immunological response (79.5%)[17] derived from a similar study in Cote d' Ivoire and q= 1-p to give a minimum sample size of 250. Allowing for a potential 20% attrition, a sample size of 300 was obtained.

Sampling Technique: The monthly average number of HAART naive patients (calculated over a three month period) reporting at each of the 11 comprehensive treatment centres in the state was used proportionally to make up the minimum sample size of 300. The number of patients contributed by each centre to the minimum sample size was obtained by dividing the monthly average number of patients seen at each centre by the total number of patients seen in all the centres in a month (355) multiplied by 300. Presented below is the monthly average number of clients per centre and the number contributed by each centre to the sample size of 300 (table 1).

At each of the 11 centres, every new HAART naive patient that presented was recruited consecutively until the number allocated for that centre was obtained.

Study Instrument: A semi-structured pretested interviewer administered questionnaire was developed by the researcher according to the objectives of this study based on literature from other studies.[21,25,40,41] It had four (4) sections: section A obtained data on socio-demographic and socio-economic characteristics, section B on clinical determinants (biochemical, haematological and anthropometric characteristics, baseline CD4 cell count, PCV, Urea, creatinine, Hepatitis B and C, tuberculosis status (determined by testing for Acid Fast Bacilli test x3), types of first-line anti-retroviral regimen and the initial WHO clinical staging at commencement of HAART. Baseline body mass index was determined). Section C obtained data from HIV Care and Support activities which the patient benefitted which included receipt of free condoms, use of the condoms by the clients, receipt and use of free insecticide-treated bed nets, receipts of free water treatment chemical and water storage

cans, regular use of these to treat and store their drinking water, receipt of health education/counseling activities by clients. Section D obtained data on CD4 cell count measured at 6 months (end of study).

Data management and analysis

The data collected were cleaned and entered into excel spreadsheets for analysis using the Stata 10 statistical software. Categorical variables were reported as frequencies and percentages. For biological variables which were normally distributed continuous data, mean and standard deviation was calculated. For continuous data not normally distributed, median and inter-quartile range was calculated. Student's t test was used to test for the difference between two mean values.

A binary variable was created to show the early immunological response of patients and coded as 0 for those who did not achieve at least 50 cells increase from baseline CD4 count (immune non responders) and 1 for those who achieved at least a 50 cell increase from baseline CD4 cell count (immune responders). Univariate logistic regression models were used to find associations between all the socio-demographic, clinical, care and support characteristics and immune response. Multivariate analysis using a stepwise logistic regression was applied to find factors that predicted achievement of early immunological response. A p-value of the Wald statistics <0.05 was taken as significant. Multivariate models were used to adjust for possible confounders. The items on care and support were scored with one mark allocated to each component. Overall score was 11 marks and respondents with scores of 0-5 marks were regarded as having poor care and support while 6-11 was regarded as good care and support.

Ethical approval was obtained from the Ethical Committee of the University of Uyo Teaching Hospital, (Ref No: UUTH/AD/S/96/VOL.VII/137) and the Ethical Committee of the Akwa Ibom State Ministry of Health (Ref No: MH/PRS/99/V.III/145). Individual's informed consent was obtained from patients before data collection.

Results

A total of 300 questionnaires were administered and 287 respondents completed the study giving a completion rate of 95.6%. Table 2 shows the socio-demographic and socio-economic characteristics of respondents. The majority of respondents were aged 25-34. The mean age of respondents was 34.62 years. One hundred and thirty-eight (48.08%) were married. Most 187 (65.16%) were females and 95 (33.10%) completed secondary education. Nine (3.14%) earned more than 100,000 naira and many 131(45.64%) earned between 10,000- 40,000 naira monthly. Most 163 (56.75%) were artisans, 73 (25.44%) were civil servants/professionals, while 20 (6.97%) were unemployed.

Table1: Contribution of Comprehensive HIV Treatment centres to minimum sample size

Centre name	Monthly average patients seen	Number contributed to the total
University of Uyo Teaching Hospital	20	17
General Hospital, Etinan	30	25
General Hospital, Ikot Ekpene	50	42
Daughters of Charity, Ukana Iba	30	25
General Hospital, Oron	40	38
General Hospital, Ikot Abasi	20	17
St Lukes Hospital, Anua	75	63
General Hospital, Etim Ekpo	20	17
General Hospital, Urua Akpan	15	13
General Hospital, Ikpe Annang	20	17
General Hospital, Eket	35	30
Total	**355**	**300**

Table 2: Socio-demographic Characteristics of HAART Naïve clients inAkwa Ibom State, 2011

Variables	Frequency	Percent
Age Groups		
15-24	38	13.24
25-34	122	42.51
35-44	82	28.57
45-54	33	11.50
>/=55	12	4.18
Mean +/-SD	34.62+/-10.18	
Marital Status		
Married	138	48.08
Single	100	34.84
Widowed	39	13.59
Divorced	10	3.48
Sex		
Females	187	65.16
Males	100	34.84
Educational Level		
No formal education	19	6.62
Primary	93	32.40
Secondary	95	33.10
Tertiary	80	27.87
Income (in Naira)		
No income	37	12.89
<10,000	131	45.64
10,000-40,000	92	32.06
>40,000-70,000	14	4.89
>70,000-100,000	4	1.39
>100,000	9	3.14
Occupation		
Artisans	163	56.75
Civil servants	73	25.44
Farmers	9	3.14
Students	22	7.67
Unemployed	20	6.97

The clinical, haematological and biochemical parameters of respondents is described in table 3. One hundred and thirty-three (46.34%) were in WHO clinical stage 2. The mean body mass index (BMI) was 20.94+/-4.16. Most 173 (60.28%) had a normal BMI of 18.5-24.9. Twenty-six (9.06%) had tuberculosis and the majority 254 (88.50%) were on ZDV, 3TC, NVP combination. Fifty-one (17.77%) had baseline CD4 less than 50 cells/ul with a mean CD4 of 141.23 and a median of 130. Most respondents 176 (61.32%) had a packed cell volume (PCV) of <30% and the mean PCV was 30.70 +/-5.78. Nine (3.14%) had Hepatitis B while 3 (2.94%) were Hepatitis C positive. The mean creatinine and urea of respondents was 109.23 mmol/L and 3.82 mmol/L respectively

One hundred and forty-eight (51.57%) received free condom and 120 (41.81%) claimed they use the condoms. Seventy (24.39%) received free insecticide treated nets and 82 (28.56%) used them. Free water guard for treatment of water was

Table 3: Baseline Clinical, hematological and Biochemical Parameters of HAART Naïve patients in Akwa Ibom State, 2011

Variables	Frequency	Percent
WHO Clinical staging		
1	41	14.29
2	133	46.34
3	101	35.19
4	12	4.18
BMI in Kg/m^2 (Mean +/-SD)	20.94+/-4.16	
<18.5	74	25.78
18.5-24.9	173	60.28
25.00-29.90	26	9.06
30.00-35.00	12	4.18
>35	2	0.70
TB Status		
Negative	261	90.94
Positive	26	9.06
ARD Type		
ZDV, 3TC, NVP	254	88.50
ZDV, 3TC, EFV	16	5.57
TRUVADA, EFV	5	1.74
TRUVADA, NVP	8	2.79
TDF, 3TC, NVP	4	1.39
CD4 cell count (cells/ µl)		
< 50	51	17.77
50-199	154	53.66
200-350	82	28.57
Mean +/-SD	141.23 +/-87.51	
Median (IQR)	130 (66-205)	
Packed Cell Volume (%)		
<30	176	61.32
>/=30	111	38.68
Mean +/- SD	30.70 +/-5.78	
Hepatitis B		
Negative	278	98.86
Positive	9	3.14
Hepatitis C (n=102)		
Negative	99	97.06
Positive	3	2.94
Chemical Parameters		
Creatinine (mmol/L)(Mean +/-SD)	109.23+/-92.40	
Urea (mmol/L) (Mean +/-SD)	3.82+/-3.32	

ZDV=Zidovudine, 3TC=Lamivudine, NVP=Nevirapine, EFV=Efavirenz

Table 4: Predictors of Early Immunological response using binary logistic regression among HAART Naïve respondents in AKS, 2011

Variable	Univariate Analysis			Multivariate Analysis		
	OR	**95%CI**	**P Value**	**OR**	**95%CI**	**P value**
Age	1.01	0.98-1.03	0.51	1.02	0.99-1.09	0.09
Sex						
male	1					
Female	1.83	1.04-3.20	0.03*	2.47	1.32-4.63	0.005*
Occupation						
Artisans	1			1		
Civil servants/Prof	0.50	0.26-0.95	0.04*	0.44	0.22-0.88	0.02*
Farmers	0.52	0.13-2.15	0.37	0.28	0.06-1.36	0.11
Students	0.90	0.28-2.89	0.86	0.90	0.25-3.19	0.87
Unemployed	0.39	0.15-1.03	0.06	0.34	0.12-0.96	0.04*
Marital Status						
Divorced	1					
Married	1.61	0.39-6.61	0.51			
Single	1.00	0.24-4.13	1.00			
Widowed	1.42	0.31-6.69	0.65			
Education						
None	1					
Primary	1.79	0.51-6.25	0.36			
Secondary	1.04	0.30-3.68	0.94			
Tertiary	1.97	0.47-8.27	0.36			
CD4 Baseline/10cells	0.94	0.91-0.97	<0.001*	0.94	0.91-0.98	0.001*
PCV baseline	0.97	0.93-1.02	0.77			
BMI baseline	0.99	0.93-1.06	0.90			
ARD Type						
ZDV,3TC,NVP	1					
ZDV,3TC,EFV	0.48	0.17-1.39	0.18			
TRUVADA,EFV	1.16	0.13-10.61	0.89			
TRUVADA,NVP	0.87	0.17-4.44	0.87			
TDF,3TC,NVP	0.87	0.09-8.54	0.91			
TB status						
Negative	1					
Positive	0.41	0.18-0.93	0.03*	0.48	0.19-1.17	0.11
HBV Status						
Negative	1					
Positive	0.35	0.10-1.19	0.09			
HCV Status						
Negative	1					
Positive	0.61	0.05-7.07	0.70			
WHO Stage						
1	1					
2	1.21	0.54-2.68	0.63			
3	1.11	0.48-2.55	0.25			
4	1.77	0.33-9.39	0.50			
Urea baseline	1.02	0.93-1.12	0.59			
Creatinine baseline	1.00	1.00-1.01	0.43			
Care &Support						
Poor	1					
Good	2.39	0.53-10.73	0.25			
TLC/10cells	1.07	0.90-1.28	0.43			

*statistically significant p values. OR= Odds ratio. CI= Confidence interval
Area under ROC=70.7%

received by 73 (25.44%) respondents and 15 (5.23%) received free containers (jerry cans) to store water. Many (97.21%) received free health education in the facilities, six (2.09%) had home visits and 25 (8.71%) received telephone calls. Two (0.70%) received home based kits and 27 (9.41%) belonged to a support group. Two hundred and twenty-seven (78.75%) never missed their drugs in the period; 60 (20.91%) received free food and 44 (15.33%) received supplements.

Two hundred and sixteen (75.26%) achieved early immunological response. Univariate analysis shows some factors that were associated with early immunological response. Females were significantly more likely to achieve an early immunological response (OR=1.83, P=0.03). Occupation, civil servants/professional respondents were significantly less likely to achieve an early immunological response (OR=0.50, P=0.04). Every 10 cells increase in baseline CD4 count reduced the chances of achieving an early immunological response by 6% (OR=0.94, P<0.001). Tuberculosis positive at baseline reduces respondents' chances of achieving an early immunological response (OR=0.41, P=0.03). At multivariate analysis, females (OR=2.47, P=0.005) were significantly more likely to achieve an early immunological response while civil servants/professionals (OR=0.44, P=0.02) and the unemployed (OR=0.34, P=0.04) were significantly less likely to achieve an early immunological response. For every 10 cells increase in CD4, chances of achieving an early immune response significantly reduced (OR=0.94, P=0.001). (Table 4)

Discussion

This study determined the factors that predicted early immunologic response in HAART naive patients in Akwa Ibom State. At baseline, the study revealed that the mean CD4 of respondents was 141.23 cells/µl + 87.51(median of 130 cells/µl). This was lower than that the mean of 153cells/µl of a study in Ethiopia[42] but higher than 127± 89 cells/µl reported in a study in Ghana with 60.3% of patients in WHO stage 3 or 4 disease.[43] Majority of the patients (73.3%) had a baseline CD4 cell count below 200 cells/ µl comparable to 76.3% in the Ethiopian study.[42] At six months, the mean CD4 cell of respondents was 340.33 ± 203.98cell/µl (median of 322). For both sexes at 6 months, the mean CD4 cell gain was 199.10 cells/µl and a median of 192.5. This increase was statistically significant (p<0.001).

The study found that majority of respondents achieved an early immunological response. This corroborates findings in the Cote d Ivoire and the Carribeans studies where 79.5% achieved early immune response.[17,23] It was much higher than figures reported by multicentre studies in France and Europe where 64% and 43.4% achieved an early immunologic response respectively.[21,22] This is an important finding since the short term immunological response is known to be associated with a better long term immunological response and hence a better prognosis for clients.[44] Furthermore, an earlier study has shown that the immunologic response after 6 months on HAART indicates a favourable clinical outcome in HIV-infected patients regardless of virologic response.[3]

The study at both univariate and multivariate analysis found no significant relationship between age and achievement of immune response. This contrasts with findings from some studies that reported in both univariate and multivariate analysis that younger age was independently a predictor of immunologic response at four months after initiation of HAART and that older patients have poorer immune response.[21,40,41,45,46] Other studies however, agreed with the findings of this study that age at starting HAART was not related to an increase in CD4 cell count over a 6 month period.[23-25,44,47,48] Hence, older patients on HAART can achieve the same immunological response although they present a more severe HIV infection and their lower survival could be due to late diagnosis.[49,50] The true relationship of immune response with age in this study may be difficult because age was sometimes elicited subjectively as few participants didn't know their ages while some volunteered their ages with no objective means of confirmation like the use of birth certificates.

At univariate and multivariate levels of analyses, being a female significantly increased the likelihood of achieving an early immunological response. This may be due to the fact that females presented earlier for treatment, received food supplement more than males and so had a higher mean increase in CD4 cell count after 6 months on HAART. The finding

disagrees with similar studies in Uganda, the Carribeans and in France where gender was not related to achievement of immune response after adjusting for confounders.[23,25,51] However, some studies agree with this finding and reported after univariate and multivariate analysis, that women had greater CD4 count increase compared to men.[21,52]

Some occupations showed an association with achievement of early immunological response. Civil servants/professionals at both univariate and multivariate analysis showed reduced chances of achieving an early immunological response. This may be due to the structured nature of their jobs which may permit them little time to attend clinics and support group activities compared to artisans who have a lot of time. Civil servants may be getting their drugs from treatment supporters and may not be so involved in other care programs apart from drugs. The study also showed that being unemployed reduced the chances of achieving an early immune response. This may be due to poor adherence. Despite the fact that antiretroviral drugs are provided free for clients, the unemployed may not be able to afford transport to clinics and so may miss appointments and drugs. They may not be able to feed on time and so may not take medications on time. The quality of food may affect nutritional status which may have effect on immune response.[53]

The study showed that the lower the CD4 cell count, the higher the chances of achieving an early immune response and for every 10 cells increase in CD4 cell at baseline, there was a reduced likelihood of achieving an immune response. This agrees with other studies that from a quantitative point of view, low CD4 cell count at HAART initiation correlated with a greater increase of CD4 cell count during follow up.[28,54,55] The inverse correlation between the baseline CD4 cell count and its increase at 6 months demonstrates that patients at higher risk of disease progression as signified by their low baseline CD4 cell count can rapidly recover their immune function after initiating HAART. The finding becomes very necessary in our state where the majority of our patients presented with a low mean baseline CD4 cell count at HAART initiation. Hence, there is hope for an early immunological response for most of our patients who present with low baseline CD4 cell count. Patients with high baseline CD4 cell count may be close to normal levels (ceiling effect).[24] However, other studies found that achievement of immunological response to HAART was independent of pre-HAART CD4 cell count.[23,25]

The study also showed that being tuberculosis positive at baseline reduces respondents' chances of achieving an early immune response at the univariate analysis level. This finding agrees with other studies that TB risk is not only strongly associated with advanced baseline immunodeficiency but also with suboptimal CD4 cell count responses during HAART.[34] Tuberculosis is known to cause transient CD4 lymphocytopenia which may in part reverse during treatment though this may not sufficiently explain the major CD4 cell count difference between those with TB and those without it .[56]

Univariate analysis of other clinical and anthropometric variables like baseline PCV, BMI, type of first line antiretroviral drugs used, hepatitis B and C co-infection, WHO clinical staging, baseline renal status showed no association with achievement of early immunological response. Other studies reported that baseline PCV, hepatitis B and C positivity, WHO clinical staging and renal status though not associated with an early immune response were strongly associated with mortality.[40,57,58]

Good utilization of care and support aspects of HIV management had no association with achieving an early immune response compared with those with poor care and support characteristics. However, care and support activities including provision of food and food supplements, water treatment chemicals and condoms have been known to promote immunological response.[59,60]

Absolute lymphocyte count [ALC] is sometimes used as a substitute marker for CD4 cell count in monitoring HIV patients. Though not the most accurate, an ALC of less than 1200 cells/mm^3 roughly corresponds to a CD4 cell count of less than 200 cells/ µl and an ALC of 1700 cells/mm^3 is about the same as a CD4 cell count of 350.[61,62] Diseases that reduce total lymphocyte count (for example tuberculosis, malaria, parasitic infections) thus reduce CD4 cell count. This study showed no association between ALC and achieving an early immune response.

Conclusion and recommendation: In this study, a good proportion of HAART naive patients achieved an early immune response six months after commencing HAART in Akwa Ibom state. Numerous predictors of achievement of early immunological response were identified and the following recommendations made.

- Introduction of male friendly clinics into the HIV program will improve male utilization of HIV care and support services and their immune response
- A flexible HIV services that runs morning, evening and weekend shifts may increase civil servants' utilization of the HIV care services in treatment centres.
- Provision of more employment opportunities will reduce the unemployment problem which is a determinant of non achievement of early immunological response in this study
- Provision of comprehensive care and support activities in HIV treatment centres that include interventions on the control of TB, malaria, and other parasitic infections known to prevent immune response.

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