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Relationship between CD4 count, viral load, and quality of life in HIV-infected patients on HAART attending a primary healthcare setting in South Africa

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ABASTRACT

Background: Biomedical markers remain major measures of HIV/AIDS disease-progression and well-being of people living with HIV (PLWHA) on treatment. It is important to measure health related quality of life (HRQOL) in PLWHA since HIV/AIDS is an incurable chronic disease. Adherence to Antiretroviral therapy (ART) enables PLWHA reach and maintain viral-suppression, reducing risk for secondary-transmission.

Aim: Determine relationship between biomedical-markers and HRQOL among PLWHA on HAART.

Method: A cross-sectional study was conducted in 100 HIV-infected attending an HIV-clinic. Sociodemographic-data were collected using standardized-questionnaire and HRQOL data using WHOQOL-HIV-BREF questionnaire. Biomedical-markers were obtained from patient's medical-records; ART-adherence from pill-count method. Data were analysed using SPSS-22 for basic descriptive. Independent-samples-test and ANOVA were used to determine significant differences at $P \leq 0.05$.

Results: Of 100 participants interviewed, 63% were females, and 37% males with mean-age of 38 years with 36% in age-range 31-40years. Of these, 47% had secondary-education, 20% were contract- employees, 32% receiving ≥ZAR10000 monthly, 55% living in rural-areas and 42% were singles. Good health-status was reported in 92%, 73% had initial-CD4-count ≥500cells/mm^3, 54% had initial-viral-load ≥10000copies/mL and 98% undetectable. Asymptomatic patients were 62% and 43% had WHO-clinical-stage-2. Only 24% had acceptable adherence-rate of ≥ 90%. A significant-association was observed between initial-CD4-count and employment-type (F = 4.0905, $P = 0.029$); income-earned (F = 7.131, $P = 0.010$); and HIV-status ((F = 4.758. $P = 0.032$), then initial-viral-load with gender (F = 15.362, $P < 0.001$); educational-level (F = 5.037, $P = 0.027$) and HIV-status (F = 4.806, $P = 0.031$). Highest-mean-scores (77.00±14.94) were obtained in environmental and lowest (26.25±26.44) in spiritual/religious/personal beliefs (SRPB) domains. A significant association was between initial-CD4-count and SRPB domain (F=5.473, $P = 0.021$). There was no association between WHOQOL-HIV domains and initial and current viral loads. Neither was an association between biomedical markers and adherence rates of study participants.

Conclusion: Results reveal no relationship between biomedical-markers and HRQOL in PLWHV. These biomedical markers alone may be inadequate eligibility criteria for social support. Therefore, monitoring these markers should be underscored in the management of HIV patients on HAART. PLWHA on ART will consistently have a huge impact on QOL.

Keywords: CD4 count, Viral load, Quality of Life, PLWHA.

Introduction

Immunological and virological outcomes are important markers of HIV disease progression and treatment failure due to an established relationship that exist between them.[1,2] MacArthur et al.[3] stated that CD4 cell count has been reported to have a strong association with progression to AIDS-related illness or death. According to authors Blaiss[4] and Kartz et al.[5] these markers are clinical indicators that have also been deemed to provide an incomplete view of disease impact thus creating a gap. It is therefore important to bridge this gap by incorporating measures of HRQOL in the traditional clinical measures of health. This shift will aim to provide a greater depth of information on the impact of the HIV/AIDS disease on the physical, social and emotional well-being of individuals. This will ensure a higher efficiency, responsiveness, and precision of delivery of care and support services.

According to UNAIDS (2019), HIV disease continues to be a major global public health issue. In 2018, the Global HIV and AIDS Statistics, estimated that 37.9 million people were living with HIV (including 1.7 million children) with a global HIV prevalence of 0.8% adults. Around 21% of these same people do not know that they have the virus.[6]

According to UNAIDS in 2019, SA had the biggest and highest–profile HIV epidemic in the World, with an estimated 7.7 million PLWHA (UNAIDS AIDS info, 2019).[7] South Africa accounts for a third of all new HIV infections in Southern Africa (UNAIDS, 2017).[8] In 2018, according to UNAIDS data for 2019, there were 240,000 new HIV infections and 71,000 South Africans died from AIDS-related illnesses (UNAIDS, 2019).[6]

In the second half of 1990s, there were advances in pharmaceutical research and advent of antiretroviral (ARV) protease inhibitors, and a new phase of ART internationally known as highly active antiretroviral therapy (HAART) (Levi & Vitoria, 2002).[9] There was a significant increase in life-expectancy after the advent of ART and therefore, an improvement in quality of life (QOL) is expected in PLWHA and on ART. There is a need to assess QOL in PLWHA and adherence to ART and monitoring the biological markers since they are important in HIV disease progression and treatment failure.[1,2]

According to the World Health Organisation (WHO), QOL is defined as individuals' perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, standards, expectations and concerns.[10] The concept of QOL itself captures exactly the notion that the ultimate goal of medical intervention is to improve the well-being of the patient. I agree with this statement and the argument by Olusina and Ohaeri[11] that assessment of QOL as a measure of treatment outcomes has become popular in Medicine.

Carrying out this study in this setting of a developing country like SA, is of paramount importance in contributing to new knowledge in as far as linking biomedical markers of the HIV and AIDS disease progression and HRQOL. As stated by Igumbor et al.[12] indeed there are few studies in developing countries that have tried to link this relationship. As compared to developed countries, most studies have been conducted where the health and social support systems are well established.

The studies that have been carried out specifically to assess the relationship between immunological and virological outcomes and QOL have reported conflicting outcomes. A case in point is for example were results from a randomised double-blind controlled study carried out by Weinfurt et al.[13] in 2000 for a period of 24 months, that revealed an association between a change in QOL and a

change in CD4 count, a stronger long-term predictor of QOL.

The aim of this study was to determine if there is a relationship between the level of CD4 cell count, viral load and HRQOL among PLWHA on HAART attending an HIV clinic in SA. It is assumed that when a patient is on ART, CD4 count should increase and viral load decrease to a level that is undetectable, resulting in better QOL. Therefore, this study tested this assumption thus contributing to the knowledge gap in developing countries. The aim of this study was achieved by collecting sociodemographic data of the study participants, correlating the information with the biological markers. As well as determining ART adherence rates of the participants. Then analyse the mean scores of the WHOQOL domains of the participants, as compared to CD4 count and viral loads and finally determine any associations.

Justification and Significance for the study

This study on correlation between CD4 count and viral load and HRQOL in HIV-infected patients on HAART attending an HIV public primary healthcare setting in SA is the first of this kind in this setting and this region.. A few other studies have been conducted in other provinces. Therefore, the study of this kind in this area will provide baseline information on the relationship between biomedical markers, HRQOL in HIV-infected who are receiving ART. QOL has become an important outcome variable to be monitored in addition to other clinical outcomes and biological markers such as CD4 count and viral load. In a resource-limited setting like this one where this study is being conducted, the focus in HIV care should no longer be on clinical outcomes such as morbidity and mortality but on QOL especially that these patients are on prolonged treatment and therefore prolonged survival.

Understanding this relationship will improve the effectiveness, receptiveness and accuracy of care and other support services in PLWHA in this resource-limited setting. This knowledge will fill in the gap of the importance of monitoring the biomedical markers of the HIV and AIDS disease progression.

The assessment of QOL does not only provide a comprehensive evaluation of the individual's well-being but also assesses their role functioning, community integration and personal adjustment. This is also supported by Losina and Ohaeri[11] that the assessment of HRQOL is also done through the reflection on the sense of well-being and satisfaction experienced by people under their current life circumstances. This also implies that HIV and AIDS does not only affect the physical well-being of PLWH, but also the overall QOL and perceptions of various aspects of their lives and daily living.

Ethical considerations

Permission to conduct this study at the HIV clinic was granted by the Walter Sisulu University - Research Innovation, Higher degrees, and Ethics Committees of the faculty of Health Sciences (approval # 031/2017) . The proposal was then approved by the provincial department of health, and thereafter the manager of the clinic where data was collected. A patient's information sheet was given to the patient by the principal researcher which stated the objectives and significance of the study. The principal researcher consented the participants using a patient consent form. Thereafter a written consent from each participant was obtained that granted us permission to participate in the study (though this was optional). Thereafter the questionnaire was administered to the participants. Participants were informed that refusal to participate in the study would not affect their care services in any way. The accuracy of the language was assured by first developing the patient's information sheets, consent forms as well as the Questionnaires in English and thereafter translated into the participants local language (ISIXHOSA). Confidentiality was maintained throughout the study by keeping the names and identification of the patients anonymous., from the data collection process to storage and analysis of the data. Codes were used for each document.

The medical records where the clinical information were collected were also coded corresponding to each participant.

Method

Study site and participant

The study site was at the HIV clinic of the public primary health care clinic, in Mthatha – Eastern Cape Province of South Africa. The clinic serves a population of 45,600. Of this population, 3800 are HIV-positive who attend the AIDS clinic and are on ART. The study was conducted from 1st January to 28th February 2020.

The inclusion criteria were adult patients aged 18 years and above living with HIV and AIDS who attend the HIV clinic monthly for their ART repeat treatment and or medical reviews. Patients were excluded if they did not consent or were acutely ill and required medical or surgical treatment or admission to the hospital.

Sample size

The sample size was calculated from the average and variance. The number in each group was calculated to be representative of the population at 95% confidence. The sample size was determined using the Taro Yamane's formula n = N / 1+N (e)2. Where:

n = signifies sample size,

N = signifies population under study,

e = tolerable / margin error (5%).

n = 133 / 1+ N (e) = 133 / 1+133(0.05)2 = 100

The sample size of 100 patients was agreed upon and were given the questionnaires.

Study design

A cross-sectional study was conducted on 100 HIV-positive patients from those attending the HIV clinic at a PHC in SA. A convenient sampling method was used to enrol 100 participants who consented to take part in the research from 133 who had attended the clinic on that day. The participants were sampled consecutively from the queue until the 100 who consented were obtained. The data was collected in 5 days.

Study instrument and Data Collection

A standardized paper questionnaire was distributed to the participants by the data collectors who conducted a structured face-to-face interviews on sociodemographic characteristics such as age, gender, marital status, socioeconomic status (employment status, income per month and level of education). Clinical characteristics like WHO disease stage, biomedical markers CD4 count and viral loads were retrieved from the clinical records of the participants. The questionnaire was administered in the respective local language.

Adherence to ART was obtained from the pill-count method[14] and the following formula used to calculate the percentage of adherence: % of adherence = Number of drugs dispensed – number returned X 100 /expected to be taken. Accepted adherence % was set at ≥90. A cut off 90% was used to determine adherence (≥ 90%) and non-adherence (< 90%). According to Sangeda et al.[15] a cut off of 90% adherence was associated with better viral suppression.

The same paper questionnaire also contained questions that measured QOL. Related Quality of life data was collected using a WHOQOL-HIV BREF questionnaire using a 5-point Likert scale. WHOQOL-HIV instrument questionnaire[10] was developed and validated by the WHO specifically for PLWH. It evaluates QOL based on six domains and includes questions specific to HIV/AIDS. WHOQOL-HIV BREF is a short version containing 31 questions/items/facets distributed among one overall perception component and six QOL assessment domains, these being: physical health; psychological health; level of dependence; social relationships; environmental

health; and spiritual/religious/personal beliefs (SRPB). These questions were distributed among six domains as already stated.

The physical health domain measures the following facets: pain and discomfort, energy and fatigue, sleep and rest. The psychological health domain measures facets like positive feelings, thinking, learning, memory and concentration, self-esteem, bodily image and appearance and negative feelings. The level of independence domain measures facets of mobility, daily life activities, dependence on medications or treatments, and work capacity. The social relationships domain includes facets of personal relationships, social support, social inclusion and sexual activity. The environmental domain measures physical safety and security, home environment, quality of health and social care, opportunities for acquiring new information and skills. Lastly SRPB domain describes the following facets: personal beliefs, forgiveness and blame, concerns about their future, death and dying.

The questions of the WHOQOL-HIV BREF are structured in a Likert type scale with the grades depending on the nature of the domains and facets. Each item is rated on a 5-point Likert scale with 1 indicating a negative perception and 5 indicating a positive perception. Thus, final scores are scaled in a positive direction where higher scores indicate better QOL. To make the QOL score comparable to WHOQOL-100 score, the mean domain scores of each domain was added to 25, so that scores ranged from 00 (minimum) to 100 (maximum) with highest scores indicating a better quality of life. The scores of the questions within each QOL domain are used to calculate the domain score, this being the mean of the scores of the questions.

Statistical analysis

Data entry and analysis were performed with the statistical package for social science (SPSS) software, version 22. The response rate was 100%. The questionnaires were edited to check errors and omissions. Data collected were checked for consistency and completeness Descriptive statistics such as frequency, percentage, mean and standard deviation were employed. Basic descriptive analysis of participant's socio-demographic and QOL measures were done. Student t-test was used to for the analysis of statistical differences between the mean scores of QOL for dichotomous variables. Correlations and ANOVA were performed to determine significant differences between domain-scores. The level of statistical significance was set at $P \leq 0.05$.

Results

Sociodemographic data and Clinical Characteristics of the HIV-infected patients

Of the 100 interviewed HIV-patients in the study, 63% were females and 37% males with mean age of 38.0 years (range 18-53 years). The highest (36%) were in age-range of 31-40 years, 47% obtained secondary level of education, 20% were employed on contracts, 52% received ≥ZAR10000 monthly and 55% living in rural-areas. In terms of marital status forty-two percent were singles. The majority (92%) reported having good health-status. More than half (73%) had initial CD4 count ≥500 cells/mm^3, with 54% having initial viral load of >10000 copies/mL and 98% with undetectable levels. Sixty-two percent were asymptomatic and (43%) had WHO clinical-stage 2. Only 24% had acceptable adherence-rate of ≥ 95% (Table 1).

Table 1: Socio-demographic data and clinical characteristics of the HIV-infected patients (n = 100)

Variable	n	%
Gender		
Female	63	63
Male	37	37
Age group (years)		
18 – 30	30	30
31 – 40	36	36
41 – 50	24	24
> 50	10	10
Educational level		
No education	2	2
Primary	24	24
Secondary	47	47
Tertiary	27	27
Marital Status		
Single	42	42
Married / Co-habiting	44	44
Separated / Divorced	9	9
Widowed	5	5
Employment type		
Permanent	12	12
Contract	20	20
Unemployed	53	53
Self-employed	15	15
Income earned per month		
≥5000	22	22
5000-10000	26	26
>10000	52	52
Residence Area		
Urban	45	45
Rural	55	55
Health Status		
Neither poor nor good	3	3
Good	92	92
Very good	5	5
Initial CD4 count		
<500	73	73
>500	27	27
Current CD4 count		
<500	75	75
>500	25	25
Initial Viral Load		
>10000	54	54
<10000	45	45
Current Viral Load		
>10000	2	2
<10000	98	98
Adherence rate		
Acceptable	24	24
Unacceptable	76	76
WHO staging		
Asymptomatic (Stage 1)	34	34
Mild Symptomatic (Stage 2)	43	43
Advanced (Stage 3)	23	23
HIV status		
Asymptomatic	62	62
Symptomatic	38	38

Mean scores of Health-Related Quality of Life of study participants

The highest mean-scores (77.00±14.94) were in environmental domain followed by social relations domain (74.25±22.88), psychological domain (74.00±12.77), level of independence domain (64.84±19.84), physical domain (48.25±25.09) and the lowest (26.25±26.44) was in spiritual/religious/personal beliefs domain (Table 2).

Table 2: The mean scores of Health-Related Quality of Life domains of study participants.

Dependent Variables	Study Participants (N=100)		
Domain	*Mean (±SD)*	*Minimum*	*Maximum*
Environmental health	77.00 (±14.94)	25	100
Social relations	74.25 (±22.88)	00	100
Psychological health	74.00 (±12.77)	25	100
Level of Independence	64.50 (±19.84)	00	100
Physical health	43.25 (±25.09)	00	75
Spiritual/Religious/Personal Beliefs	26.25 (±26.44)	25	100

SD=StandardDeviation

Comparisons of the combined sociodemographic data of participants and the biological markers

Comparisons of the combined sociodemographic data and the biological markers were done and revealed significant associations between initial viral load and gender, educational level, and HIV status. There were also significant associations between initial CD4 count, employment type, income earned per month, and HIV status. (Table 3).

Table 3: Combined tests of significance of socio-demographic characteristics of study participants and initial CD4 count and initial viral load

Characteristic	Initial CD4	F	*P*	Initial viral Load	F	*P*
Gender	<500 >500	0.254	0.615	>10000 undetectable	**15.362**	**<0.001**
Age group	<500 >500	1.262	0.264	>10000 undetectable	0.825	0.366
Educational level	<500 >500	0.000	1.000	>10000 undetectable	**5.037**	**0.027**
Marital status	<500 >500	0.924	0.339	>10000 undetectable	0.001	0.978
Employment type	<500 >500	**4.905**	**0.029**	>10000 undetectable	0.214	0.645
Income earned	<500 >500	**7.131**	**0.010**	>10000 undetectable	0.084	0.776
Residential area	<500 >500	0.015	0.903	>10000 undetectable	0.033	0.856
WHO staging	<500 >500	4.996	0.903	>10000 undetectable	0.000	1.000
HIV status	<500 >500	**4.758**	**0.032**	>10000 undetectable	**4.806**	**0.031**

Comparisons of the combined average WHOQOL-HIV domains mean scores with initial CD4 loads status

Test of significance of variation (Independent sample t-test) in combined average HRQOL-HIV domains scores and initial CD4 was performed. The correlation of categories of biological markers with HRQOL-HIV domains did not show significant association between initial CD4 count and physical domain (F = 3.779; *P* = 0.055, level of independence domain (F = 3.217; *P* = 0.076). However, there was an association with SRPB domain with initial CD4 counts (F = 5.473; *P* = 0.021) (Table 4).

Table 4: Comparisons of the combined average WHOQOL-HIV domains mean scores of study participants with initial viral loads status

Domain	Status		Mean	SD	F	P
Physical	>10000	54	±69.441	9.037	3.041	
	undetectable	45	± 68.015	8.443	0.084	
Level of	>10000	54	±67.284	11.429	0.070	
Independence	undetectable	45	±67.288	11.976	0.792	
Social	>10000	54	±76.041	14.145	0.569	
Relations	undetectable	45	±76.161	13.899	0.327	
Psychological	>10000	54	±58.424	7.927	0.124	
	undetectable	45	± 60.273	8.641	0.726	
Environment	>10000	54	±72.500	10.543	0.102	
undetectable	45	±72.361	10.679	0.750		
SPRB	>10000	54	±25.148	25.514	0.100	
	Undetectable	45	±25.122	5.374	0.752	

Comparisons of the combined average HRQOL-HIV domains scores of study participants with current viral loads were done.

Test of significance of variation (one-way ANOVA test) in HRQOL domain and biological markers – current viral load were done. One-way ANOVA revealed no association of statistical significance between current viral load and HRQOL-HIV domains (Table 5).

Table 5: Test of significance of variation (one-way ANOVA test) in WHOQOL-HIV domains of study participants and current viral load status

Domain	Current viral loads status			
	>10000	Undetectable	F	P
Physical	57.142	68.949	3.664	0.059
Level of dependence	62.500	67.462	0.357	0.551
Social relations	78.125	76.107	0.041	0.840
Psychological	60.000	59.337	0.115	0.735
Environment	75.000	72.445	0.002	0.969
SPRB	25.000	24.290	0.901	0.344

Comparisons of the combined average WHOQOL-HIV domains of study participants mean scores with initial CD4 count status (N = 100)

Tests were done to compare WHOQOL-HIV domains of study participants mean scores with initial CD4 count status. The results obtained revealed no significant associations between the following domains: physical F= 3.779; *P* = 0.055); level of independence (F = 3.127*; P* = 0.076). However, there was an association between SPRB and initial CD4 (F = 5.473; *P* = 0.021) (Table 6).

Table 6: Comparisons of the combined average WHOQOL-HIV domains of study participants mean scores with initial CD4 count status (N = 100)

Domain	Status	n	Mean	SD	F	P
Physical	<500	73	68.252	± 9.638	3.779	0.055
	>500	27	69.709	± 5.891		
Level of	<500	73	67.750	±12.109	3.217	0.076
Independence	>500	27	66.975	± 9.936		

Social Relations	<500	73	76.222	±14.482	0.755	0.387
	>500	27	75.527	±12.558		
Psychological	>500	73	58.226	±7.993	0.010	0.387
	<500	27	62.311	±8.558		
Environment	<500	73	71.822	±10.498	0.040	0.841
	>500	27	73.611	±10.230		
SPRB	<500	73	24.902	±27.205	**5.473**	**0.021**
.	>500	27	23.148	±20.423		

Comparisons of combined average biomedical markers mean scores and adherence rate of study participants

Test of significance of variation (one-way ANOVA test) in biomedical markers and adherence rates of study participants revealed no association between biomedical markers and adherence rates of study participants (Table 7).

Table 7: Comparisons of combined average biomedical markers mean scores and adherence rate of study participants (N=100)

Biological Marker	Status	N	Mean	SD	F	P
Initial CD4 count	Acceptable	24	1.125	±0.337	3.540	0.063
	Nonacceptable	76	1.320	±0.469		
Current CD4 count	Acceptable	24	1.000	±0.000	1.250	0.290
	Nonacceptable	76	1.333	±0.500		
Initial Viral Load	Acceptable	24	1.541	±0.508	0.960	0.330
	Nonacceptable	76	1.426	±0.497		
Current Viral Load	Acceptable	24	2.000	±0.000	0.623	0.427
	Nonacceptable	76	1.980	±0.164		

Discussion

The objective of this study was to establish the relationship between the CD4 count, viral burden and HRQOL in HIV-infected patients on ART. The mean QOL scores are highest in the environmental domain. This domain measures the patients' safety with daily life, availability of the information needed daily, opportunity for leisure activities, satisfaction with access to healthcare services and transport. The second domain was psychological health domain assesses patients' level of concentration, quality of life, satisfaction with health problems, taking life to be meaningful and therefore satisfied with oneself indicating good QOL.

The study main findings of this study were the following: there were associations of statistical significance between some demographics of study participants and biomedical markers. There were associations between initial viral loads and gender, educational level, HIV statues, then between initial CD4 count and employment type, monthly income earned, HIV status. However, there were no associations of statistical difference between HRQOL-HIV domains of patients and biomedical markers except between SPRB domain and initial CD4 cell count. Lastly there was no association between biomedical markers and adherence rates of study participants. All stated are discussed below.

Patients in this study reported their health status to be good indicating good QOL. These results are contrary to the study by Fatireguan et al.[16] conducted in Nigeria. Their study revealed lower scores in the environmental and social domain. Although results from this study revealed no association between CD4 and environment domain the patients reported high mean scores in both initial and current CD4 count.

Another possibility could be due to the majority (62%) of patients being asymptomatic with the majority (72%) having high levels of CD4 count >500 cells/μL, therefore, these patients had good QOL. They were no association between current CD4 count because there may be insufficient change in their CD4 count to make a significant change in their QOL.

Majority of patients had current CD4 count > 500 cells/μL As reported in earlier studies done in Uganda by Stangi et al.[17] and Bajunirwe et al.[18] ART was initiated in patients who were quite ill; thus this meant that the change in CD4 count could easily be related to improve-

ment in QOL because patients went from experiencing severe ill-health to rapid recovery of health and functioning, which are likely to impact QOL.

In 2016, SA implemented the 'test and treat' strategy, making everyone with a positive diagnosis eligible for treatment regardless of how advanced HIV is in their body (KwaZulu-Natal Dept. of Health, 2016).[19] This supports the results of this study for a non-significant association between initial current CD4 count and QOL domain and no association between current CD4 count and QOL domain.

Results from this study revealed that some sociodemographic characteristics were significantly associated with initial CD4 count. A case in point is that employment type and income earned had associations of statistical significance with F = 4.905; *P* = 0.029, and F = 7.132; *P* = 0.010. These results support the high mean scores of patients in the environment domain which assesses facets like patients having enough money to meet their needs, satisfaction with access to health facilities and satisfaction with transport. Patients in this study are employed on contract basis earning more than ZAR10000 per month. These results are also supported by Mutabazi-Mwesigye and colleagues who in their qualitative data showed that QOL as well as general well-being were influenced by income relationships, emotional well-being and health status.[20] And to support this 92% of patients in this study reported having good health status.

According to Igumbor et al.[12] older age has also been reported to have a poor association with poor QOL and this is like the results in this study whereby there was no association between initial CD4 count and age group. There was an association an statistical significance between initial CD4 count and HIV status. As already stated, majority (62%) were asymptomatic and had higher levels of CD4 count > 500 cells/μL which is above the baseline of < 200 cells/μL. As reported by Oguntibeju (2012), a higher CD4 count was associated with better HRQOL, especially with regard to physical domain.[21] Physical domain assesses the patients' energy for everyday life, ability to get around and perform daily activities, satisfaction with sleep. Therefore, all this reflects good QOL. There was no association between initial CD4 and any of the HRQOL. Results of this study coincide with other studies that reported that CD4 count did not show statistically significant associations with any of the domains of HQoL.[22-23]

Spirituality/religious/personal beliefs (SRPB) assesses the patients on their fear for the future and how much they worry about death. So, the same argument could be used that these patients want to live longer therefore will take their treatment and would have higher CD4 cell count. This is also supported by a significant association between initial CD4 count and SRPB domain (F = 5.473; P = 0.021). These results differ with results obtained by Sim and Wright[24] whose study revealed correlations between environmental domain and SPRB domains stating that the correlations for psychological domain were too low to suggest any associations with CD4 cell count.

Although results from this study reported no association with viral load and adherence rate but their mean scores were higher. Majority of patients in this study were initiated on treatment when their viral load was > 10000 copies/mL but with the change of time 98% reported undetectable viral load < 10000 copies/mL. When patients become clinically stable they tend to relax or stop taking their ART thinking they have been cured. Therefore, a lot of education needs to be continuously done. Majority of patients (47%) in this study had secondary level of education. Therefore, had poor understanding of disease and treatment than those patients with higher education. According to Abellan et al.[25] patients who were instructed by trained nurses about their treatment had better understanding of what adherence to treatment is all about and similarly Guimaraes et al.[26] found out that greater degree of difficulty adhering to treatment occurred in patients with low understanding of medical advice.

Effective treatment is defined by achieving high CD4 count and low undetectable plasma HIV RNA levels (copies/mL). HAART needs to be administered daily over the course of patients' lifetime to keep HIV RNA levels suppressed, decrease rates of resistance and prevent progression to AIDS and HIV related death.

Strengths and limitations

Since this is the first study of this kind in this region and in public health, results from this study will add to the scarce literature in the area of relationship of quality of life of HIV/AIDS and biomedical markers in South Africa. A case in point is that the results demonstrated the prominence of physical, level of independence and SRPB domains and the link with CD4 count and viral load which was not established in other studies. Therefore, these the results obtained in this study will be helpful in showing points of intervention to stakeholders to intervene towards improving care in the management of PLWHA.

The study had a limitation that current CD4 was not recorded which could mean that regular tests are not performed because CD4 count is not considered a good marker for treatment adherence. More to that due to the 'test and treat' strategy, implementation in South Africa in 2016, all patients presenting with the symptoms are tested for CD4 cell count. All those with a positive diagnosis are eligible for treatment regardless of how advanced HIV is in their body. The tests of current CD4 count are taken after a year, thus this meant that the change in CD4 count easily be related to improvement in QOL

The small sample size was only from one clinic, so the

results of this study cannot be generalised across this region of South Africa because not all PLWHA are exposed to every intervention and supportive service available to PLWHA at the ARV clinic where the study was conducted. Different ARV centres have different implementing partners and different mandates in terms of service delivery.

Implications and Recommendations for future research

This study used only one study design which was cross-sectional study limiting the researchers to use only patients taking HAART. Therefore, it is recommended that in future researchers use other study designs like longitudinal studies that would follow up the same patients. More to include qualitative methods. Due to the small sample size used in this study, it is recommended that the study includes PLWHA in other clinics in the municipality. And also have a multi-centre study across the region and later across the country to measure the relationship between QOL and CD4 and viral load. Furthermore, a large sample size and a longitudinal design should be used in further studies to specifically assess the association between immunological and virological markers and QOL.

Conclusion

The study described the relationship between HRQOL of PLWHA and biomedical markers of HIV/AIDS which included CD4 cell count and viral load. The data also suggest that an increase or decrease in CD4 count may not translate to better or worse QOL within a certain period among PLWHA with relatively high CD4 count. PLWHA on ART will consistently have a huge impact on QOL. Having stated that it is paramount that clinicians and policy makers monitoring QOL among HIV/AIDS patients, should also consider other factors like income and psychosocial support and not to rely on change in immunological and virological markers alone. With the advent of HAART, HIV/AIDS is now an incurable chronic condition, therefore, a good QOL together with prolonged survival is paramount.

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