The Prevalence of Diabetes Mellitus among People Living with HIV/AIDS Receiving Anti-Retroviral Therapy in Chiradzulu District, Malawi: A Cross – Sectional Study

Article by Beatrice Chitsa
Public health, Texila American University
Email: b3chitsa@gmail.com

Abstract

The study was conducted to determine the prevalence of diabetes and its associated factors in people living with HIV/AIDS receiving Anti-Retroviral Therapy (ART) in Chiradzulu district, Malawi. A hospital-based cross-sectional study was conducted between April and October 2016. Using systematic random sampling, secondary data from patients' records registered at ART and diabetes clinics were extracted. Categorical variables were compared using Chi-square test, independent samples test was used to compare means and multiple logistic regressions were used to calculate adjusted odds ratios for the effect of potential risk factors on diabetes. Out of 440 participants (10%) were diabetic. After adjusting for other variables, age, BMI, DM family history, hypertension and WHO stage 2 remained significant predictors of diabetes $p<0.05$. In addition, use of TDF/3TC/ATV/r was also a strong predictor of diabetes mellitus and the adjusted odds ratio (AOR) for TDF/3TC/ATV/r users was 6.08, CI [31.82], P=0.032).

The study concluded that diabetes mellitus is a big concern for people on treatment living with HIV/AIDS. Therefore, the study recommends that HIV/ART exposed patients should be checked for DM regardless of the absence or presence of the common diabetes' risk factors. For the sake of planning and implementing targeted routine monitoring, diabetes risk factors need proper identification.

Keywords: HIV/AIDS, diabetes mellitus, Antiretroviral therapy, combined antiretroviral therapy, Body mass index, Atazanavir/ ritonavir.

Introduction

Diabetes is a big concern for people living with HIV/AIDS and receiving treatment. World-wide the whole population is at risk of developing diabetes regardless of age and HIV status (Ledergerber et al., 2007). However, HIV infected people are more prone to diabetes regardless of their BMI (Samarasinghe, 2004).

A number of studies have reported the occurrence of metaboloic syndrome in people using ART as evidence for the reported association between ART and diabetes (Florescu & Kotler 2009; Diouf et al. 2014; Moyo et al. 2014). According to Brown et al., (2005) HIV is an independent risk factor of insulin resistance as well as higher levels of insulin in circulation.

Previous studies also reported higher prevalence of diabetes among HIV/AIDS patients as well as those on antiretroviral treatment. For example, Brown et al., (2005) and Galli et al. (2012) reported 14% and 4 % of DM prevalence in HIV cases as compared to 5% and 2.5% that was found in non-HIV controls respectively. Calza et al. (2011) found that 4.5% of 775 HIV positive patients receiving combined antiretroviral therapy (cART) in Italy were diabetic. Similarly, a systematic review done by Nigatuharegu et al. (2013) documented 2.85% to 14.9% as a range of prevalence of diabetes among HIV positive patients.

In addition, long use of ART has been found to be associated with higher diabetes prevalence. For example, Mohammed et al. (2015) reported higher percentage of diabetic patients (11.6%) among those using HAART for a period of over 5 years as opposed to those taking HAART for less than 5 years (2%). Similarly, in Senegal, Diouf et al. (2012) found higher percentage of diabetes (14.5%) among HIV patients using ART for 9 years.

It is not only the duration that matters but also the type/regimen of ART. For example, use of stavudine was linked to 19% relative risk of developing diabetes among the participants of D: A:D cohort (De Wit et al., 2008). Chukwuanukwu et al. (2013) also reported higher proportion (6%) of diabetics among protease inhibitor (PIs) users. Justman et al. (2003) also found that diabetes was three times more likely to be diagnosed in HIV positive women using protease inhibitors (PIs) compared to non-PIs users. In Malawi, Van Oosterhout et al. (2012) reported 21.3% of peripheral neuropathy which is one of the features of diabetes; 14.7% of lipodystrophy, a risk factor of diabetes in ART and HIV/AIDS exposed individuals and 0.8% of diabetes among the stavudine users.

Several studies have also identified overweight and obesity (Samaras et al. 2007; Galli et al. 2012); age (Hasse et al. 2011; Butt et al. 2009; Mohammed et al 2015); presence of diabetes family history (Mohammed et al. 2015; Kalra et al. 2011; Jain. 2007) and gender (Douf et al. 2014; Capeau et al. 2012). as factors that increase the prevalence of diabetes among HIV/AIDS treated patients.

HIV/AIDS and DM in malawi

In 2011, 67% of all the people who were fit for ART had access to the treatment (MSF & UNAIDS 2013) and according to Muula & Kataika (2008) more women on ART compared to men. Increased ART coverage coupled with early diagnosis and commencement of ART for PLWHIV/AIDS, has led to 51.5% decrease of annual deaths that are related to HIV/AIDS (Malawi National AIDS Commission, 2015). As a result of improved care and effective treatment, people living with HIV/AIDS are living longer thereby being susceptible to old age-related chronic diseases such as diabetes.

Besides HIV/AIDS, diabetes is also challenging the Malawi's public health (GoM 2011) where 5.6% of the adult are reported to be diabetic (Allain, 2011) with more men (6.5%) having diabetes than women (4.5%) (Msyamboza et al., 2014). Due to higher HIV prevalence and increased coverage of ART (67%), Malawi's percentage of diabetic people is expected to rise. The rise might be partly due to the reported relationship with HIV/AIDS and ART which have been blamed for increasing the risk of diabetes (Vugt et al. 2007). The availability of ART has also been associated with increased life expectancy which in turn increases chances of chronic noncommunicable diseases such as diabetes mellitus (Calza et al. 2003). Literature also shows higher occurrence of diabetes and its associated factors among the HIV/AIDS population (Young et al. 2009) thereby suggesting future high burden of diabetes in Malawi where the prevalence of HIV is at 10.4%. Despite having high burden of HIV/AIDS, ART coverage and high prevalence of diabetes risk factors among the general population in Malawi, there is still insufficient data to explain the distribution and burden of diabetes and its associated risk factors among HIV/AIDS patients on treatment (Cohen et al. 2010).

Therefore, it is necessary to explore the distribution of the burden of diabetes among PLHIV receiving ART in Malawi where the traditional risk factors of diabetes are also on increase as indicated in Table 1.

Table 1. Prevalence of diabetes related risk factors

Risk factor	Females	Males	Total
Physical inactivity	8.0%	4.3%	6.2%
Overweight	26.8%	11.2%	19.0%
Obesity	7.3%	1.4%	4.3%

Source: (World Health Organization. 2016).

Purpose of the study

The study's purpose was to establish the prevalence of diabetes and its associated risk factors among people living with HIV/AIDS receiving ARVs in Chiradzulu district in Malawi.

Objectives of the study

The study sought to achieve the following objectives:

1. To establish the prevalence of diabetes among people aged from 15 years and above, living with HIV/AIDS receiving ARVs in Chiradzulu district hospital.
2. To investigate risk factors of diabetes among people living with HIV/AIDS receiving ARVs from Chiradzulu district, Malawi.
3. To make recommendations concerning the management of HIV/AIDS associated diabetes.

Significance of the study

Knowledge on the magnitude of diabetes and the distribution of its associated risk factors obtained from this study is expected to improve care of PLHIV, especially for those at risk of developing diabetes. The study's results are to inform planning and allocating of resources for diabetes management program. Furthermore, the findings of this study could guide and facilitate the development and review of policies that will help in management of HIV/AIDS associated DM, formulation of the action plan for reducing physical inactivity, obesity and overweight which are the modifiable risk factors for diabetes among HIV and non-HIV Malawians. The study could also provide a baseline for further studies aimed at managing and modifying diabetes risk factors among the HIV/AIDS treated patients.

Methodology

A cross-sectional study based on secondary data analysis was conducted at the ART and diabetes clinics of Chiradzulu district hospital located in the southern region of Malawi. Systematic sampling with daily attendance as a sampling frame was used to select the participants' files. Only files for those patients aged 15 years and above were eligible for selection. Files for pregnant women, breast feeding mothers and those aged below 15 years were not included. Data related to HIV/AIDS variables and socio-demographic data were extracted from the ART clinic while data related to diabetes and hypertension was extracted from the hypertension and diabetic clinic.

Sample size calculation

Single proportion formula was used to come up with a sample size. The minimum estimated sample size was 384. To cover for the missing data, 15% was added thereby having 440 as a minimum sample size of PLWHIV/AIDS receiving ART to be included.

Data analysis

Data extraction form was used to extract data from the patients' files. The extracted data were entered onto an excel spreadsheet where coding was done. When all data was coded, it was imported to the IBM statistical package for social science (SPSS) version 21 for analysis and recoding of the continuous variables.

Analytical statistics done were Chi-square test which was used to explore the association between the categorical variables and the dependent variable (diabetes status) as well as Independent samples t-test which was also done on the normally distributed continuous variables to compare the means between the diabetic patients and non-diabetic ones. To determine the factors that influenced the prevalence of diabetes multiple logistic regression was used and variables that were significant at 0.20 at the chi-square and independent samples t-test were included. All the tests were considered significant at p value of <0.05.

Ethical consideration

. Permission letter to access data was obtained from Chiradzulu District Health Office. During data extraction, numbers were used instead of patients' names and de-identification of data was done at the point of data extraction so as to ensure confidentiality. Password was used in computer where data were being kept. All data collected in papers were kept in lockable drawers and only the researcher has access to the data.

Study results

Participants' characteristics

The study enrolled a total of 440 participants aged between 15 years and 78 years. One hundred and ninety-five participants (44.3%) were aged below 40. There were more females (60.2%) as compared to males (39.8%). All the participants were on Anti-Retroviral Therapy (ART) for a period ranging from 2 months to 15 years. The majority of the participants, 384 (87.3%) were on WHO clinical stage 1 while 87.3% of the study participants were on regimen 5A, a fixed dose of Tenofovir (TDF), Lamivudine (3TC) and Efavirenz (EFV). Most of the participants had normal weight (63.2%) and CD4 count of over 350 cells per cubic millimeter (61.1%). Drug adherence level was more than 95% in 93% of the participants and viral load was undetected in 82.9% of the total participants. Out of 440 patients, 278 (63.2%) had normal body mass index (BMI) falling between $18.5kg/m^2$ and $25kg/m^2$ while 17.5% had a BMI ranging between $25.kg/m^2$ and $29.9kg/m^2$ and were classified as being overweight. Twenty-nine participants, representing 6.6% were categorized as being obese while 12.7% were underweight.

Mean and Standard Deviation of the patients' age, BMI, FCBG and ART duration

The participants' mean and standard deviation for the different variables are given in table 2:

Table 2. Mean and standard deviation of the patients' age, BMI, FCBG and ART duration

Variable	Number	Range		Mean	Standard deviation	95% Confidence Interval
Age	440	15 - 78		41.7	11.94	40.52 – 42.80
BMI	440	$13.0 – 40.5kg/m^2$		22.7	4.16	22.32 – 23.06
CD4 Count	440	$9 – 1406$ cells/mm^3		444.0	223.36	423.45 – 465.36
Fasting capillary blood glucose (diabetics only)	44	99 - 381mg/dl		106.2	12.46	153.43 –203. 12
ART Duration	440	0.03 – 15.00 years		6.5	3.95	6.15 – 6.86

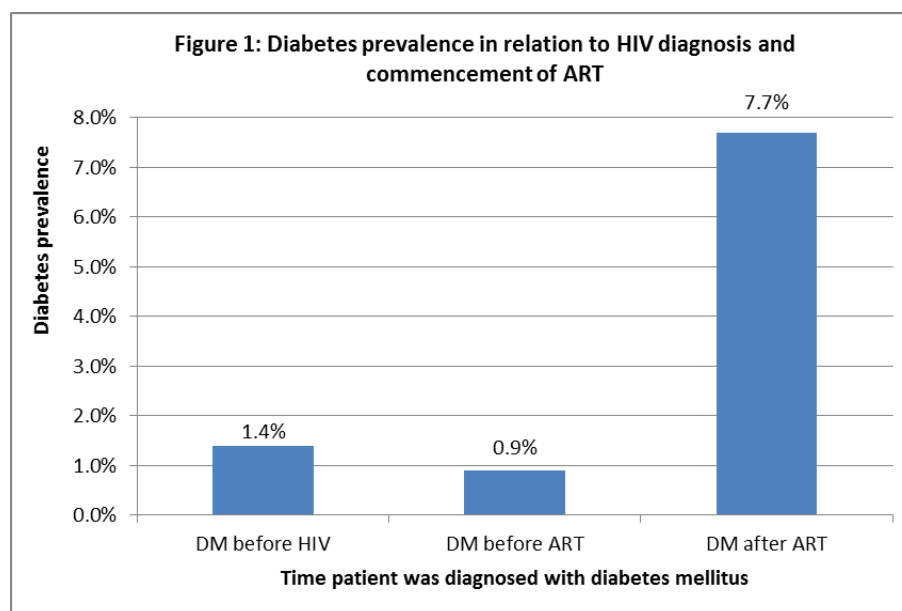### Prevalence of diabetes among the study participants

Figure 1. Gives the prevalence of diabetes in relation to HIV diagnosis and commencement of ART

Overall there were 44 patients with diabetes representing a prevalence of 10%. As indicated in Figure 1, 1.4% of the diabetic patients were diagnosed before the HIV diagnosis while 0.9% were found to be diabetic before starting ART. Among the diabetic cases, 18.2% had normal fasting capillary blood glucose (<110mg/dl), while 11.4% and 70.5% of the diabetics had sugar levels up to 125mg/dl and over 125mg/dl respectively.

Risk factors associated with diabetes mellitus (DM)

Variables associated with diabetes in chi-square test were age (p= 0.002), BMI (p = 0.002), ART Regimen (p = 0.003), hypertension (P = < 0.001) and diabetes family history (p = 0.001). On the other hand, no significant association was found between DM and gender (p = 0.871), WHO's HIV clinical stage (p>0.05), adherence to HIV/AIDS treatment (p= 0.528), viral load (p= .832), ART duration (p= 0.181) and CD4 count, p = 0.536.

Table 3 presents the results of chi-square tests of the association between, social demographic factors as well as clinical factors and DM.

Table 3. Association between potential risk factors and DM in people living with HIV/AIDS receiving ART in Chiradzulu district, Malawi

Variable	RESULTS OF DIABETES DIAGNOSIS		Total (Percentage)	P value of X^2 TEST
	Non-diabetic Number (%)	Diabetic Number (%)		
Age in years				
<40years	185 (94.9%)	10 (5.1%)	195(44.3%)	
>_40	211 (86.1%)	34 (13.9%)	245 (55.7%)	0.002
Sex				
Male	158 (90.3%)	17 (9.7%)	175(39.8%)	
Female	238 (89.8%)	27(10.2%)	265(60.2%)	0.871
BMI				
Underweight	55 (98.2%)	1 (1.8%)	56 (12.7%)	
Normal weight	254 (91.4%)	24 (8.6%)	278 (63.2%)	0.002
Over weight	61 (79.2%)	16 (20.8%)	77 (17.5%)	
Obese	26 (89.7%)	3 (10.3%)	29 (6.6%)	
WHO HIV Clinical stage				
Stage1	346 (90.1%)	38 (9.9%)	384 (87.3%)	
Stage 2	22 (78.6%)	6 (21.4%)	28 (6.4%)	0.066
Stage 3	19 (100%)	0 (0%)	19 (4.3%)	
Stage 4	9 (100%)	0 (0%)	9 (2.0%)	
ART Regimen				
TDF/3TC/EFV	348 (90.6%)	36 (9.4%)	384 (87.3%)	
AZT/3TC/EFV	31 (93.6%)	2 (6.1%)	33 (7.5%)	0.003
AZT/3TC/NVP	10 (90.9%)	1 (2.1%)	11 (2.5%)	
TDF/3TC/Atv/r	7 (58.3%)	5 (41.7%)	12 (2.7%)	
ART duration in years				
<5years	158 (92.4%)	13 (7.6%)	171 (38.9%)	0.536
>_5years	238 (88.5%)	31 (11.5%)	269 (61.1%)	
CD4 Cell Count/mm				
<350	152 (88.9%)	19 (11.1%)	171 (38.9%)	??
<350cells	244 (90.7%)	25 (9.3%)	269 (61.1%)	

Hypertension?				
No	359 (93.7%)	24 (6.3%)	383 (87.0%)	< 0.001
Yes	37 (64.9%)	20 (35.1%)	57 (13.0%)	
DM family history	351 (91.9%)	31 (8.1%)	382 (87.6%)	0.001
No	42 (77.8%)	12 (22.2%)	54 (12.2%)	
Yes				
ART Adherence				
>95%	370 (90.2%)	40 (9.8%)	410 (93.2%)	0.528
<95%	26 (86.7%)	4 (3.3%)	30 (6.8%)	
Viral load test results				
Undetected	323 (89.7%)	37 (10.3%)	360 (81.8%)	0.832
Detected	67 (90.5%)	7 (9.5%)	74 (16.8%)	

Independent samples t- test

The results of an independent samples t-test which was done to compare age, BMI, ART duration years, CD4 cell count, between diabetic participants and non-diabetic participants are presented in Table 4.

Table 4. Comparison of age, BMI, ART duration and CD4 Count between diabetics and non-diabetics

Characteristic	**Mean (95% CI)**		**Mean difference (95% confidence Interval of the mean difference)**	**t-test p value**
	Diabetics	**Non-diabetics**		
Age	47.48	41.00	6.48 (95% CI, 2.79 – 10.16)	0.001
BMI	24.65	22.46	2.19 (95% CI, 0.91 – 3.47)	0.001
ART duration	6.92	6.44	0.48 (95% CI, -.76 – 1.71)	0.448
CD4 Cell Count	451.30	443.13	8.16 (95% CI, -61.67 – 78.00)	0.818

The independent samples t-test showed that the diabetic participants had statistically significant higher means of age with a mean difference of 6.475, 95% CI [-3.3140, - 1.0701], and was significant at $p = 0.001$. Diabetic participants had also statistically significant higher means of BMI at $p = 0.001$. The results suggest that increases in age and BMI can raise one's chances of having diabetes. There was no statistically significant difference between mean ART duration years and CD4 cell count for the diabetic participants and non-diabetic participants, $p > .05$.

Logistic regression analysis

To ascertain the effect of age groups, BMI categories, hypertension, family history of DM, HIV/AIDS stages and ART regimens on the likelihood that participants could be diabetic, multiple logistic regression analysis was performed on 436 participants. The results of multiple logistic regressions are presented in Table 5

Table 5. Adjusted odds ratios for association of potential risk factors with diabetes in patients on ART

Variable	**Adjusted Odds ratio**	**95% CI for Odds ratio**	**P - Value**
Age group <40 years >_40 years	Reference group 2.27	1.014 – 5.058	0.046
DM family history No Yes	Reference group 2.58	1.101 – 6.055	0.029

Hypertensision			
No	Reference group	3.174 – 15.154	<0.001
Yes	6.94		
BMI categories	Reference group		
Underweight	6.26	.760 – 51.479	0.088
Normal weight	12.63	1.489 – 107.150	0.020
Overweight	6.31	.549 – 72.476	0.139
Obese			
WHO HIV/AIDS Stage[2]	Reference stage	1.231 – 14.639	0.022
Stage 1	4.25		
Stage 2			
Stage 3[1]			
Stage 4			
ART Regimen	Reference group	0.087 – 2.030	
TDF/3TC/EFV	0.42	0.096 – 12.717	0.281
AZT/3TC/NVP	1.11	31.815	0.935
AZT/3TC/NVP	6.08		0.032
TDF/3TC/ATV/r			

WHO stages 3 and 4 were not analyzed because there were no cases, however stage 2 was significantly different from stage 1.

The logistic regression analysis showed that participants aged 40 years and above were two times more likely to have diabetes as compared to those aged below 40 years OR = 2.27, 95% CI [1.01 – 5.06], p = 0.046. The presence of family history of diabetes as well as being hypertensive raised one's chances of exhibiting diabetes mellitus, AOR = 2.58, 95% CI [1.101 – 6.06], p = 0.029 and AOR = 6.94, 95% CI [3.17 – 15.15 respectively. Besides, overweight was a strong predictor of diabetes mellitus as compared to being underweight, AOR = 12.63, 95% CI [1.49 – 107.15], p = 0.020.

The analysis also showed that being on WHO's HIV/AIDS stage 2 increased the odds of one having diabetes mellitus AOR = 4.25, 95% CI [1.23 - 14. 64], p = 0.022 as compared to being in stage 1. In addition, use of fixed dose of Tenofovir, Lamivudine, and Atazanavir or ritonavir increased the odds of being diabetic as compared to being on fixed dose of Tenofovir, Lamivudine and Efavirenzi.

Discussion

This was a facility-based study conducted in order to determine the prevalence of diabetes in PLWHIV/AIDS receiving ART in Chiradzulu, Malawi. The study results have provided evidence on the burden and distribution of diabetes mellitus and its associated risk factors among PLWHIV/AIDS receiving ART in Malawi. According to Msyamboza et al. (2014), Malawi's national adult prevalence of diabetes was estimated to be 5.6% in the general adult population. In addition, WHO (2016) reported an age standardized diabetes prevalence of 4.3% among Malawian adults aged from 30 years and above, both of which are lower than this study's overall diabetes prevalence (10%). The excess in prevalence of diabetes observed in this study could be attributed to HIV/ART which have been reported to increase the prevalence of diabetes in HIV/AIDS people receiving ART (Calza et al. 2011; Calza et al. 2003). Since the prevalence of diabetes in HIV/AIDS people on ART is different from that of the general population of Malawi, it can be concluded that there is an association between use of ART and increased diabetes prevalence.

Prevalence of DM in HIV patients reported by different studies: 4.5% (Calza et al.2011), 2.85% (De Wit et al. 2008), 6.4% (Mohammed et al.2015) all of which were lower than current study's prevalence. In Botswana, Moyo et al. (2014) reported a diabetes prevalence 10.8% which was comparable with this study's overall prevalence (10%). On the other hand, the study's prevalence of diabetes was lower than what was

reported in Senegal, 14.5% (Diouf et al., 2014), in the Multicenter AIDS Cohort Study, 14% (Brown et al., 2005) and in a systematic review study (12.5%) done by NigatuHaregu et al., (2013). The differences observed in the prevalence of diabetes could be due to the effects of variation in how diabetes was defined, age distribution among the HIV/AIDS patients, and availability of ART regimens and rate of obesity as well as differences in life style (Samaras 2009).

Several studies that involved HIV positive persons reported women out numbering men (Mohammed et al. 2014; Sachithananthan et al. 2013). The current study comprised of 60.2% of women and 38.6% men with similar prevalence in males and females (9.7% vs 10.2%).

Other studies also reported high prevalence of metabolic syndrome in HIV positive women using HAART (Jevtovic et al., 2005). Having more females in the study explains well the predominance of females in patients receiving ART in Malawi (Muula & Kataika 2008; Van Oosterhault et al. 2005). However, the study's results were different from the results found in Malawi's general population where more men reported to be diabetic compared to women (Msyamboza et al. 2014).

Majority of the diabetic patients (77.3%) in this study were equal to or more than 40 years of age. Besides, the mean age for the diabetics was significantly different from that of the non-diabetics at p value <0.05. This showed that the prevalence of diabetes increases with increasing age. Similar findings were reported in the studies done elsewhere (Butt et al. 2009; Mohammed et al. 2014). This is also true for the general adult population irrespective of HIV (Msyamboza et al., 2011; Hasse et al., 2011). Old age has an influence on the prevalence of diabetes as this study's findings indicated that those aged 40 years and above were twice more likely to be diabetic than those aged below 40 years.

Higher prevalence of obesity among HIV positive patients was reported in Philadelphia (14%) (Amorosa et al., 2005) compared to this study's findings (6.6%). However, the study's prevalence of obesity was higher than the nation's prevalence of 4.3% (WHO, 2016). In this study diabetes was more prevalent among the overweight (20.8%) and obese (10.3%) groups which was similar to what was reported in Italy (Galli et al., 2012). Obesity is also a factor that influences the prevalence of diabetes among the general population (MOH & WHO, 2010). In this study, BMI mean for the diabetics was significantly different from that of the non-diabetics. The results imply that higher BMI is a factor that can influence the prevalence of diabetes in both general population and treated HIV positive population.

Previous studies have demonstrated that longer duration of ART use increases the risk of diabetes (Ritchter et al., 2005; Hudges et al., 2005). In this study, diabetes was more prevalent (11.5%) among those using ART for more than 5 years compared to 7.5% in less than five years ART users. However, the mean difference for ART duration between the diabetic and non-diabetic patients was non-significant. Similar results were reported in Ethiopia (Mohammed et al., 2014) and Senegal (Sachithananthan et al. 2013).

DM Family history was present for 12.4% of the study participants and this is comparable to the study from Ethiopia where 11.7% of the participants had DM family history (Mohammed et al., 2015). However, the study differs from a study done in Texas, USA where 57% of the participants reported to have family history of diabetes (Jain 2007). In addition, logistic regression analysis revealed that the presence of DM family history was a strong predictor of diabetes in people living with HIV/AIDS receiving ART and this was similar to what Kalra et al. (2011) reported.

Study reports indicate that HIV increases one's risk of developing hypertension (Jung et al., 2004). Higher prevalence of hypertension has been reported among ART exposed HIV patients (30.0%) compared to those not on ART (21.9%) (Kagaruki et al., 2014) all of which are higher than this study's prevalence (13%). The current study's prevalence of hypertension is also lower than the country's general adult population's prevalence which is 35% (Msyamboza et al., 2011). This could be due to lack of routine assessment of blood pressure in HIV/AID treated patients. This study also demonstrated that hypertension was a strong predictor of diabetes.

The univariate results showed a statistically significant association between ART regimen and DM but the association was not significant after adjusting for Age, BMI, Family history and hypertension logistic regression model except for one regimen. The study found that diabetes was more prevalent (41.7%) in TDF/3TC/Atv/r users. The regression analysis also showed higher odds of diabetes among people using this

improved protease inhibitor (PI) containing ART regimen. The study's results agreed with a study conducted by Chikwuanukwu et al. (2013) and Samaras et al., (2007). However, the results were not consistent with what Tien et al. (2012) reported.

The data for this study indicated a statistically significant increase in risk of diabetes in WHO stage 2 compared to stage 1. However, stages 3 and 4 were not calculated because there were no patients. Ritchter, et al., (2005). also reported that starting HIV/AIDS treatment later in the course of the disease is associated with the risk of having diabetes. This indicated that there is need to have a study with a bigger sample so that there is sufficient number of cases that could make it easy to assess all the stages.

The study also failed to demonstrate association between ART adherence as well as viral load and diabetes (p = >0.05). This could be a true effect but could also be a result of having HIV/AIDS stable treated patients only, hence making it impossible to differentiate the effects of ART and HIV.

Conclusion

The higher diabetes prevalence in HIV/AIDS patients receiving ART as compared to the general population signifies that being HIV positive or being exposed to ART could increase one's risk of diabetes. Therefore, all HIV positive patients who are receiving ART need to be thoroughly screened for diabetes regardless having the traditional risk factors of diabetes. In addition, the study demonstrated higher mean blood sugar levels among the diagnosed and treated diabetic patients thereby indicating failure to control blood glucose level and poor management of diabetes in HIV/AIDS patients on ART in Chiradzulu, Malawi. Besides lack of sufficient data on blood sugar test results among the non-diabetic patients could be a missed opportunity to evidence-based planning of diabetes prevention activities.

Recommendations

In view of the findings of the study, the following recommendations are made
1. There is need to revise the HIV/AIDS and NCDs' (diabetes) national management protocols so that screening of diabetes includes all HIV/AIDS patients starting ART at the time of HIV diagnosis so as to reduce illnesses and deaths associated with delayed diagnosis of diabetes and conditions associated with high blood sugar levels.
2. The government should consider training all HIV/AIDS health care providers on how to prevent, diagnose and manage HIV/AIDS associated diabetes.
3. The hospital should also collect and keep data on estimates of pre-diabetes which can guide in planning of targeted diabetes prevention initiatives.
4. The hospital should also consider providing integrated services for HIV/AIDS and NCDs such as diabetes mellitus so as to make proper use of the limited resources and cut patients time spent during each hospital visit.

Future studies

This was a cross-sectional study that helped to determine the prevalence of diabetes mellitus among people living with HIV/AIDS receiving ART in Chiradzulu, Malawi. However, future studies should include a national follow up study among HIV positive patients on ART to establish the incidence of diabetes among this population.

There is also need for a study that will include sufficient sample with comparison groups of HIV positive patients on ART, untreated patients and non-HIV individuals to determine the effect of ART, HIV and host factors (age, BMI) on the prevalence of diabetes. Lastly, an exploratory study, to assess knowledge level, attitude of the providers and patients about the diabetes risk factors and ways of preventing them should be carried out in future.

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