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Challenges of ART Clients and Adherence to Toxoplasmosis Preventive Measures among HIV Patients

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Abstract: *The study seeks to examine the challenges facing ART clients and adherence to toxoplasmosis preventive measures among HIV patients. 340 people were sampled out of the estimated 5430 in the municipality and studied in this quantitative cross-sectional survey. Convenience sampling was used. Cerebral toxoplasmosis remains one of the most important opportunistic infections in HIV worldwide. It is caused by a parasite (Toxoplasma gondii) found throughout the globe that infects almost every species of warm-blooded animals that act as intermediate hosts. Members of the cat family are the definitive hosts. This study has revealed that generally, ART clients who seek care at the Bono Regional Hospital are satisfied with the knowledge and expertise of the health workers taking care of their needs there, contrary to the observations from other studies also conducted in Ghana, where some health workers themselves lamented. However, strong predictors of adherence were occupation and satisfaction with ARVs. Interventions to improve adherence counseling and considerations of more favorable drug formulations will go a long way in improving adherence to these important medications among HIV positive clients of the hospital and in Ghana at large.*

Keywords: Toxoplasmosis, HIV Patients, ART clients, Ghana

1. INTRODUCTION

Cerebral toxoplasmosis continues to affect patients, including those who unfortunately learn their HIV status because of contracting the illness as well as those who are already enrolled in antiretroviral (ART) care and are anticipated to be receiving regular, efficient, and timely treatment. This is despite the abundance of knowledge about the risk factors that increase the risk of this life-long infection and increase the likelihood that HIV patients develop cerebral toxoplasmosis. At present, it is impracticable to destroy the tissue cysts of the parasite in humans by using medications (Kijlstra & Jongert, 2008a); the available treatments do not eliminate them, and hence individuals infected with HIV-associated cerebral toxoplasmosis are never immune to subsequent attacks unless they consistently take the precautionary measures of unflinching adherence to their antiretroviral medications and secondary prophylaxis with co-trimoxazole. Adherence to these treatments is what this study sought to measure as the outcome variable of interest.

The economic costs that come with cerebral toxoplasmosis among people living with HIV and AIDS because of its severity cannot be overemphasized. These costs come in the form of the complications of the disease, costs of treatment and its impact on the society (Kijlstra & Jongert, 2008a). An average of 1.26 million US dollars is estimated to go into the hospital bills, “annual productivity losses, special education and residential care costs” of each patient who acquires the disease every year (Kijlstra & Jongert, 2008a). The high rate of mortality is a cause for concern as well. In a study conducted in Tanzania to collect mortality data on toxoplasmosis over a 10-year period in 37 hospitals, it was found that 188 deaths (accounting for 0.08% of all the deaths recorded from all causes) were due to toxoplasmosis, with 70.7% of them being associated with HIV infection (Mboera et al., 2019). Additionally, this study found that the “age-standardized mortality rate per 100,000 population had increased from 0.11 in 2006 to 0.79 in 2015.” An upward trend of this nature is not the kind of outlook that any country or jurisdiction would expect to see for any human health condition.

The situation leaves much to be desired and suggests that probably there are some pitfalls that exist in HIV care in the health system and/or that are ingrained in the socio-cultural environment of the communities where HIV positive individuals spend most of their lifetime. However, literature is silent about these gaps, and the few studies that get close enough only examine the situation in the broader context of HIV management as a whole (mostly to assess adherence to antiretroviral treatment) and not specifically on cerebral toxoplasmosis, or were done elsewhere, on paediatric populations, on pregnant women or in environments that are very different from that of the jurisdiction under study (Sunyani). Examples of such studies are those of Addo et al. 2018, A. K. Amankwah, 2015, Ammon et al., 2018, Dosumu et al., 2019, Moriarty et al., 2018, Yarney et al., 2016.

Yarney et al (in 2016) and A. K. Amankwah (2015) conducted similar research works in the same municipality, and both studies involved the same hospital also chosen for this study as well as one other, but their emphases were on the “facilitators and barriers” to antiretroviral therapy adherence in general with no special emphasis on an important cerebral toxoplasmosis preventive practice such as co-trimoxazole preventive therapy (Amankwah, 2015; Yarney et al., 2016). The work of Ammon et al., 2018 was also a systematic review involving studies done among adolescents living with HIV in the whole of Sub-Saharan Africa to assess the various factors influencing adherence to ART (Ammon et al., 2018). Dosumu’s work came close enough by examining the level of adherence by HIV infected mothers with exposed infants aged from 6 weeks to 6 months who had been prescribed co-trimoxazole for prophylaxis of opportunistic infections, and it was done in Lagos, Nigeria (Dosumu, E. A. 2019). Still Addo in 2018 conducted a study among health professionals to ascertain the “availability of HIV services” and found some barriers to ART service delivery and adherence (Addo et al. 2018). Additionally Müller and his colleague conducted an extensive systematic review covering literature from some World Health Organization (WHO) designated high HIV burden countries spanning parts of Africa, Asia, the Pacific and the Americas. This study was very close in that it examined the facilitators and barriers to adherence to co-trimoxazole preventive therapy (CPT) which is captured in this current study and also isoniazid preventive therapy (IPT) both of which are very important interventions in HIV positive individuals (Müller & Velez Lapão, 2021).

The challenges known to influence the preventive practices against cerebral toxoplasmosis outlined in the literature review of this study are mostly of HIV as a whole or of OIs in general since there is scanty literature specifically on cerebral toxoplasmosis preventive practices. Hence, this study sought to uncover this lacuna in knowledge in order to help come out with recommendations that stakeholders could adopt that could help improve upon the quality of HIV care, the success of HIV programmes as well as the wellbeing of persons living with HIV/AIDS (PLWHA). Additionally, the consumption of raw and undercooked meat is the main means through which toxoplasmosis parasites obtain entry in man. However, studies reviewed did not assess objective ways to determine what is well cooked or otherwise.

Hence, in this study, in attempting to assess the risk factors of the disease, also described the various ways by which respondents tested how they determined that their cooked meats were thoroughly cooked.

2. MATERIAL AND METHODS

Study Area

The Bono Regional Hospital, located in Sunyani, which is the focus of this study, is a 350-bed regional level health facility that was opened for operation in 2003. The hospital serves as the highest point of referral from health facilities within the Bono, Ahafo, Bono East and some parts of the Ashanti, Western and Northern Regions.

It has a vibrant antiretroviral therapy (ART) clinic with a specialized laboratory that is equipped with a polymerase chain reaction (PCR) facility. This machine serves clients in the Sunyani Township, Sunyani Municipality as well as all the 3 regions formerly constituting the erstwhile Brong Ahafo Region, and even beyond. The estimated total number of ART clinic attendants in the hospital is 3089 according to the Health Information department. Most cases of cerebral toxoplasmosis in the municipality are referred there, and so has been the focal point for sampling patients to be participants in this study.

Sunyani is the capital of the Sunyani Municipality. The municipality was established by a legislative instrument (LI 1473) on March 10, 1989 and is one of the 260 metropolitan, municipal and district assemblies of the Republic of Ghana and among the 12 districts and municipalities within the Bono Region of the Republic of Ghana. It lies between latitudes 7° 20'N and 7° 05'N and longitudes 20° 10'W and 20° 10'W. It houses the capital of the Bono Region, Sunyani, which also happens to be the capital of the erstwhile Brong Ahafo Region from which the Bono Region was formed in 2016. Sunyani Municipality has a land area of 829.3 km² and is bordered on the north by the Sunyani West District, on the west by Dormaa East District, on the south by Asutifi South District, and on the south and east by Tano North Municipality. About one third of the land area is uninhabited arable agricultural land (Ghana Districts: A Repository of All Local Assemblies in Ghana, 2015).

There is an estimated total population of 147,982 people (according to the 2021 population and housing census) living within the municipality. An estimated 5430 persons are living with HIV in the municipality. There are 69 health facilities with 8 of them offering ART services. These are Bono Regional Hospital, Sunyani Municipal Hospital, Sunyani SDA Hospital, Sunyani Police Clinic, 3MRS Clinic, Abesim Health Centre, Yawhima Health Centre and Atronie Health Centre.

Study Design and Type

The study is a quantitative cross-sectional survey in the Bono Regional Hospital. The cross-sectional design is useful to obtain preliminary information about the topic at a specific point in time that could guide further advanced research, and is less expensive and time-consuming as compared to other types of observational studies. The quantitative type was to enable the testing of associations between the relevant explanatory and outcome variables. The study attempted to survey the prevailing potential risk factors as well as the preventive health behaviours among the population of HIV patients in the municipality. It was also employed to collect information regarding the health system related challenges mitigating against the implementation of preventive measures in this population. It also attempted to discover associations between these mitigating factors and the extent of potential risk factors present among this population.

Study Population

The study involved HIV positive clients who were regular attendants of the antiretroviral (ART) Clinic at the Bono Regional Hospital. The total number of patients in that population is estimated to be 3089 according to the hospital's electronic medical records. The ART clinic is held on Wednesdays and Fridays

at the Bono Regional Hospital. Participants recruited for the study were clients aged 11 to 70 years who were attending their usual scheduled review visits between October and December of 2022.

Sampling Technique and Sample Size

Convenience sampling was used to select currently well PLWHA attending ART clinic in the Bono Regional Hospital for the study. Data collectors at the ART clinic approached patients when they reported for their appointment visits and their permission sought to recruit them into the study. The Yamane formula for sample size estimation was used to calculate the sample size, owing to the fact that the population of HIV patients who attend clinic at the Bono Regional Hospital is finite and known. However, 340 out of 354 persons issued questionnaire responded willingly to them, giving a response rate of about 96%. The central limit theorem describes a sufficiently large sample size as thirty (30) or more, in order to achieve a normal sampling distribution of any particular variable in a population (Central Limit Theorem, 2017; Central Limit Theorem Explained - Statistics by Jim, 2020). Hence, the sample size of 340 is sufficient.

Study Variables

The study made use of measurements of 2 dependent variables and several independent variables. The independent variables being measured in this study are the socio-demographic characteristics of the respondents (age, level of education, income, marital status, occupation, living with family, religion and duration on ART), potential risk factors for toxoplasmosis (eating of unwashed fruits, eating of unwashed vegetables, farming and gardening activities, handling of cat excreta without personal protective gear, drinking of contaminated water and eating of raw or undercooked meat), the preventive measures in place to mitigate its occurrence (routine co-trimoxazole prophylaxis, adequate counseling about treatment, adequate virologic suppression indicating good antiretroviral treatment status and periodic monitoring of viral load levels), and the challenges affecting the implementation of such measures from the individual to the organizational levels (dissatisfaction with antiretroviral medications, financial challenges, knowledge about benefits of antiretrovirals, knowledge about co-trimoxazole benefits, stigma, lack of family support, unavailability viral load testing facilities, lack of expertise among health care providers, inadequate numbers of health care providers, shortage of antiretroviral medications and shortage of co-trimoxazole).

The dependent variables being measured are adherence to the 2 main preventive measures (i.e. co-trimoxazole preventive therapy also referred to as CPT and antiretroviral therapy i.e. ART) which is based on the subjective assessment of respondents based on a Likert type scale. The scale measured intake of the two medications on a scale of 1 to 10 where 1 is very poor and 10 is excellent compliance.

Data Collection Tools and Techniques

Clients attending ART Clinic on the designated clinic days (Wednesdays and Fridays) were individually issued with structured questionnaires designed by the author to complete, or were guided through the interview process using the questionnaire if unable to read and write the English language. The data collection was done by the author and 5 other persons, 4 of whom were staff at the ART clinic and who had been taken through the research techniques and expectations by the author. Conversations took place mostly in the Akan language for majority of participants, and in English for the few who were not comfortable with Akan. There did not arise any instance where any other language became necessary to communicate in apart from these two, and hence no interpreters were used for the interviews.

Participants were asked to sincerely self-report on their adherence to the antiretroviral medications and co-trimoxazole over a lifetime and to rate themselves on a scale of 1 to 10 where a score of 1 referred to extremely poor adherence and a score of 10 referred to perfect adherence with no recall of missed doses. This was the basis for assessing the dependent variables in this study. The study took place among a special population that more often than not are bedeviled with considerable social stigma, stereotyping and marginalization, and as such some level of difficulty in getting participants on board to volunteer

information was unsurprisingly encountered, especially in the initial stages of the data collection process. All the interpersonal encounters took place with respect to the appropriate COVID-19 protocols, i.e. social distancing, hand hygiene and wearing of facemasks.

Data Analysis

Data collected via questionnaires were cleaned using SPSS version 26, which was also used to summarize the sociodemographic data into descriptive statistics (using frequencies and percentages) and was presented in tables for easy visual appreciation. The quantitative data were categorized and presented as frequencies and percentages with their respective p-values, odds ratios and 95% confidence intervals where applicable whereas the qualitative data were also presented as frequencies and percentages (Ogendi et al., 2013b).

Occupations of respondents other than the retired and students was further categorized into formal and informal sectors where formal sector refers to occupations that are under government supervision with structured salary, taxes and social benefits, and informal sector refers to all the other ones. Descriptive analysis was also used to outline the prevailing potential risk factors of cerebral toxoplasmosis (specific objective 1), the preventive measures in place at the antiretroviral (ART) site (specific objective 2), and the individual, interpersonal, community and institutional challenges affecting ART clients adherence to preventive protocols (specific objectives 3 and 4).

“Fisher’s exact test of independence” was run to identify any relationships that existed between the dependent variables (adherence to ART and CPT) and independent variables (socio-demographic characteristics and challenges affecting adherence at the 4 levels) at 95% confidence interval (CI) (Yarney et al., 2016). Where observations for any particular variable were more than 5, Pearson chi square was used instead. The same bivariable analyses were also performed to determine if any differences existed between the adherence to ART and adherence to CPT in the sample. Binary logistic regression was performed on all socio-demographic factors and challenges (specific objectives 3 and 4) that showed statistically significant relationships to the dependent variables (ART adherence and/or CPT adherence) at 95% confidence interval. The output was summarized as odds ratios, z scores, p values and 95% confidence intervals.

Based on the individual respondents’ assessment of their adherence to antiretroviral therapy (ART) and co-trimoxazole preventive therapy (CPT), which both constitute the dependent variables in this study, further categorization was done to distinguish adherent and non-adherent using a cut-off of 8 where adherent was defined as having a score of 8 and above and non-adherent was a score below 8 (Medication Adherence: The Elephant in the Room, 2018). Cronbach’s alpha test was used to determine the reliability of the Likert type questions used to assess adherence to ART and CPT in the questionnaire, and was found to have a value of 0.86, indicating a high level of reliability. This Likert scale was the basis of the dependent variables used for the logistic regression analysis.

Ethical Considerations

Permission was sought from the Ghana Health Service Ethics Review Committee and the institutional research committee of the Bono Regional Hospital. The Ghana Health Service Ethics Review Committee’s approval was dated 7th September, 2022 with a reference number GHS-ERC 042/06/22, and the approval letter has been attached at appendix 2 of this paper. Written informed consent was sought from all participants and sealed by signatures or thumbprints whichever was appropriate for each individual. No personally identifiable data was collected, and all information obtained from participants was kept anonymous and confidential. The data collection took place at a time when the COVID-19 pandemic was still around, and therefore all relevant protocols such as physical distancing, wearing of facemasks and hand hygiene were respected accordingly.

3. RESULTS

Socio-demographic Characteristics of ART Clients

The socio-demographic characteristics of the respondents are summed up in Table 1. 104 male (30.6%) and 236 female (69.4%) clients responded to questionnaire in this study. The mean age of the respondents was 44 years. Majority of them (237 persons, constituting 69.7%) belonged to the informal workforce, 43 (12.6%) were in the formal sector whereas retirees accounted for 2.9% (10 persons) of respondents. Students and the unemployed made up 10.3% and 4.4% respectively. 141 (41.5%) of the respondents had an educational level up to basic level, and 13.8% had no formal education at all. 97 (28.5) of them had had secondary education whereas 55 (16.2%) had reached the tertiary education level. Most (169 persons, constituting 49.7%) of the respondents earned less than 500 Ghana cedis a month as income, and only 10 persons (representing 2.9%) reported that they earned monthly incomes above 2000 Ghana cedis. The remaining 161 (47.4%) reported that they earned between 500 and 2000 Ghana cedis as monthly income. 97 (28.5%) of the respondents were married, 79 (23.2%) were single, 61 (17.9%) were widowed, 60 (17.6%) were co-habiting and 43 (12.6%) were divorced. 320 participants (94.1%) were living with their families, while the remaining 20 (5.9%) were not living with their families. There were 283 Christians accounting for 83.2% of the respondents, 52 were Muslims (15.3%) and 5 were Traditional religious worshippers (1.5%). Majority (174 persons making up 51.2%) of the respondents had been diagnosed as HIV positive and had been put on antiretroviral therapy for more than 5 years. The remaining 166 persons (48.8%) had been on antiretroviral therapy for at most 5 years.

Table 1: Socio-demographic characteristics of ART clients at Bono Regional Hospital (BRH)

Characteristic	Values	Frequency (n)	Percentage (%)
Age group (years)	11 to 20	22	6.5
	21 to 30	36	10.6
	31 to 40	74	21.8
	41 to 50	86	25.3
	51 to 60	83	24.4
	61 to 70	39	11.5
Sex	Male	104	30.6
	Female	236	69.4
Occupation	Formal sector	43	12.6
	Informal sector	237	69.7
	Retired	10	2.9
	Unemployed	15	4.4
	Schooling	35	10.3
Income (Ghana cedis)	Less than 500	169	49.7
	500 to 1000	120	35.3
	1001 to 2000	41	12.1
	Above 2000	10	2.9
Education	Primary	141	41.5
	Secondary	97	28.5
	Tertiary	55	16.2
	None	47	13.8

Marital status	Single	79	23.2
	Married	97	28.5
	Co-habiting	60	17.6
	Divorced	43	12.6
	Widowed	61	17.9
Living with Family	Yes	320	94.1
	No	20	5.9
Religion	Christianity	283	83.2
	Islam	52	15.3
	Traditional	5	1.5
Duration on antiretroviral therapy	Up to 2 years	87	25.6
	3 to 5 years	79	23.2
	More than 5 years	174	51.2

Chi Square Analysis of Individual, Interpersonal and Community Level Challenges Affecting Adherence to ART and CPT among ART Clients

The bivariate analysis of the individual, interpersonal and community level challenges affecting adherence to ART and CPT are summarized in table 2 below. 257 out of 340 participants (75.6%) were satisfied with their antiretroviral (ARV) medications and their dosing schedules while 49 (14.4%) of them had issues with pill burden, and 20 (5.9%) were bedeviled with unpleasant side effects that adversely affected their adherence to treatment. There were highly statistically significant relationships between satisfaction with the antiretroviral medications (ARVs) and adherence to ART and CPT ($p = 0.001$ for both) at 95% confidence interval (CI).

A vast majority (306; 90%) of respondents reported that they had no financial challenges that affected their accessibility to ART services. There was no statistically significant relationship between financial constraints and adherence to either co-trimoxazole or ARVs ($p = 0.207$ and $p = 0.654$ respectively) at 95% CI.

262 participants (77.1%) understood exactly what their ARV medications did for them in terms of HIV viral suppression; whereas the remaining 78 (22.9%) of respondents thought they had other benefits, some of which were improvement of appetite, protection from diseases, boosting blood, among others. Interestingly 3 of the respondents were unable to tell what their medications were meant for. There was a highly statistically significant relationship between knowing why their ARVs are necessary and being compliant with them ($p = 0.000$) at 95% CI. As could be expected, there was no statistically significant relationship between knowledge on ARVs benefits and compliance with CPT ($p = 0.139$) at 95% CI.

There was a highly statistically significant relationship between knowledge about the role of co-trimoxazole and adherence to the same ($p = 0.003$) at 95% CI. Interestingly, there was also a statistically significant relationship between knowledge about co-trimoxazole benefits and adherence to ART as well ($p = 0.020$) at 95% CI.

There was no statistically significant relationship between perceived stigma in the home setting and adherence to either co-trimoxazole ($p = 0.399$) or ARVs ($p = 1.000$) at 95% CI. Similarly, there existed no

statistically significant relationship between stigma in the work and school settings and adherence to either co-trimoxazole ($p = 0.382$) or ARVs ($p = 0.583$) at 95% CI.

2 respondents admitted that they lacked family support and were on their own so far as their HIV status and treatment were concerned. There was, however, no significant relationship between lack of family support and compliance with either co-trimoxazole or ARVs ($p = 1.000$ for both) at 95% CI.

Table 2: Chi Square Analysis of Individual, Interpersonal and Community Level Challenges and Adherence to ART and CPT among ART Clients in BRH

Variable	ARV Adherent		ARV Non-adherent		P-value for ART	CPT Adherent		CPT Non-adherent		P-value for CPT
	Freq. (n)	%	Freq. (n)	%		Freq. (n)	%	Freq. (n)	%	
ARV dissatisfaction										
Pill burden	30	11.1	19	27.5	0.001	22	10.8	23	29.9	0.001
Adverse effects	14	5.2	6	8.7		8	3.9	4	5.2	
Nil	217	80.1	40	58.0		165	81.3	48	62.3	
Other	10	3.7	4	5.8		8	3.9	2	2.6	
Financial challenges										
Yes	26	9.6	8	11.6	0.654	20	9.8	12	15.6	0.207
No	245	90.4	61	88.4		183	90.2	65	84.4	
Knowledge on ARVs benefits										
Yes	217	80.1	45	65.2	0.000	165	81.3	53	68.8	0.139
No	54	19.9	24	34.8		38	18.7	24	31.2	
Knowledge on co-trimoxazole benefits										
Yes	161	70.3	33	64.7	0.020	152	74.9	42	54.5	0.003
No	68	29.7	18	35.3		51	25.1	35	45.5	
Stigma at home										
Yes	42	18.3	11	15.9	1.000	36	17.7	17	22.1	0.399
No	229	81.7	58	84.1		167	82.3	60	77.9	
Stigma at work/school										
Yes	46	17.0	9	13.0	0.583	33	16.3	16	20.8	0.382
No	225	83.0	60	87.0		170	83.7	61	79.2	
Lack of family support										
Yes	2	0.7	0	0	1.000	2	1.0	0	0	1.000
No	269	99.3	69	100		201	99.0	77	100	

Logistic Regression Analysis of Individual, Interpersonal and Community Level Challenges and Adherence to ART and CPT among ART Clients in BRH

The findings of the logistic regression analysis of the variables that were statistically significant on chi square analysis are as shown in Table 3 below.

ARV satisfaction represents whether the study participants had no problems with their antiretroviral (ARV) medications or not. The odds ratio (OR) for ARV satisfaction in relation to ART adherence is 1.583, which means that the odds of adherence to ART are 1.583 times higher for individuals who are satisfied with their ARV therapy compared to those who are not satisfied. The z-score for ARV satisfaction is 2.17,

which is statistically significant ($p < 0.05$) at 95% confidence interval, indicating that ARV dissatisfaction is a significant predictor of the adherence to ART. The 95% confidence interval for the OR of ARV dissatisfaction ranges from 1.045 to 2.399.

The OR for ARV satisfaction in relation to CPT adherence is 1.848, which means that the odds of adherence to CPT are 1.848 times higher for individuals who are satisfied with their ARV therapy compared to those who are not dissatisfied. The z-score for ARV satisfaction is 3.68, which is highly statistically significant ($p < 0.05$) at 95% confidence interval, indicating that ARV satisfaction is a very strong predictor of adherence to CPT. The 95% confidence interval for the OR of ARV dissatisfaction ranges from 1.333 to 2.561. Knowledge on Co-trimoxazole benefits: This variable represents the level of knowledge that study participants had on the benefits of co-trimoxazole (a prophylactic antibiotic used to prevent opportunistic infections in people with HIV). The OR for knowledge of co-trimoxazole benefits in relation to ART adherence is 1.061, which means that the odds of adherence to ART are 1.061 times higher for individuals with higher knowledge on co-trimoxazole benefits compared to those with lower knowledge. The z-score for knowledge on co-trimoxazole benefits is 0.41, which is not statistically significant ($p > 0.05$) at 95% confidence interval, indicating that knowledge on co-trimoxazole benefits is not a significant predictor of ART adherence. The 95% confidence interval for the OR of knowledge on co-trimoxazole benefits ranges from 0.799 to 1.410.

The OR for knowledge on co-trimoxazole benefits in relation to CPT adherence is 0.906, which means that the odds of adherence to CPT are 0.906 times lower for individuals with higher knowledge on co-trimoxazole benefits compared to those with lower knowledge. The z-score for knowledge on co-trimoxazole benefits is -0.86, which is not statistically significant ($p > 0.05$) at 95% confidence interval, indicating that knowledge on co-trimoxazole benefits is not a significant predictor of adherence to CPT. The 95% confidence interval for the OR of knowledge on co-trimoxazole benefits ranges from 0.724 to 1.135. The OR for knowledge on ARV benefits is 0.826, which means that the odds of adherence to ART are 0.826 times lower for individuals with higher knowledge on ARV benefits compared to those with lower knowledge. The z-score for knowledge on ARV benefits is -1.05, which is not statistically significant ($p > 0.05$) at 95% confidence interval, indicating that knowledge on ARV benefits is not a significant predictor of ART adherence. The 95% confidence interval for the OR of knowledge on ARV benefits ranges from 0.576 to 1.182.

Table 3: Logistic Regression Analysis of Individual, Interpersonal and Community Level Challenges and Adherence to ART and CPT among ART Clients in BRH

Variable	Adherence to ART				Adherence to CPT			
	Odds Ratio	z	p-value	95% Confidence Interval	Odds Ratio	z	p-value	95% Confidence Interval
ARV satisfaction	1.583	2.17	0.030	1.045 – 2.399	1.848	3.68	0.000	1.333 – 2.561
Knowledge of Co-trimoxazole benefits	1.061	0.41	0.683	0.799 – 1.410	0.906	-0.86	0.391	0.724 – 1.135
Knowledge of ARV benefits	0.826	-1.05	0.296	0.576 – 1.182				

Fig. 1 below is a pie chart summarizing the various suggestions that were mentioned by respondents for improving upon their antiretroviral medications and their schedules in order to help them adhere better to their treatments. From the graph, majority (46.9%) of the respondents who reported having difficulties

with their medications thought that if these drugs came in the form of monthly injections they would comply better with them. 18.8% of them thought that if the quantities of the medications were reduced such that they only received a single combined pill per dose they would adhere better to them. Another 18.8% of dissatisfied ART clients also thought that a reduction in the sizes of their pills would suffice for them such that they would be more willing to take them every day. A further 6.3% felt that if their antiretroviral medications required them to take them less frequently they were going to be more willing to take them. Yet another 3.1% wished that their antiretroviral medications came in the form of syrups and suspensions, which they could easily take and thereby be more adherent to them. A further 3.1% of the dissatisfied ART clients thought that if their antiretroviral medications required them to take them only as single doses at the times they were retiring to bed each night, it would be easier for them to adhere better to them. Interestingly, 3.1% of these clients reported that even though they were not entirely contented with their antiretroviral medications, they were receptive to whatever modifications the authorities thought good to make on these drugs for their wellbeing.

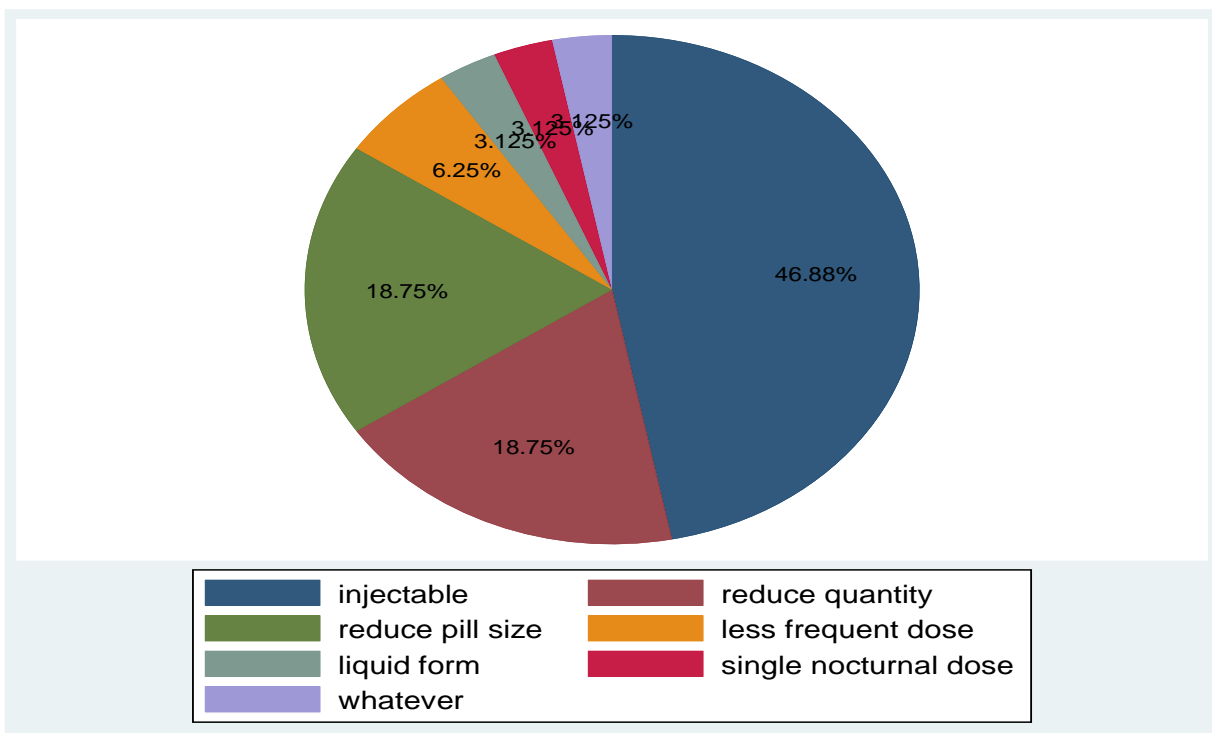


Fig. 1: Pie Chart Showing Suggestions Given by ART Clients for Improving Upon Antiretroviral Medications

Institutional Challenges and Adherence to ART and CPT among ART Clients

A summary of the results of Chi square analysis of health service related factors affecting adherence to ART and CPT is given in table 4. Overall, 338 respondents (99.4%) reported having access to laboratory testing services for HIV viral load whenever the test was requested for them by their health care providers. There was a statistically significant relationship between access to viral load testing and adherence to ARVs ($p = 0.041$) at 95% confidence interval. The same could not be said about the relationship between access to the test and adherence to co-trimoxazole ($p = 0.075$) at 95% confidence interval. All (340 out of 340; making up 100%) of the respondents agreed that generally, the staff involved in their care at the ART centre were well versed in HIV and therefore competent enough to manage their conditions. 332 of the respondents (97.6%) thought that there were adequate numbers of health staff attending to clients at the ART centre; only 8 (2.4%) thought that more hands were needed to help the clients receive more prompt care. There

were no statistically significant relationships between staff availability and adherence to either co-trimoxazole ($p = 0.222$) or ARVs ($p = 0.667$) at 95% confidence interval.

Majority (327 of 340, making up 96.2%) of the respondents always received their supply of ARV medications whenever their refill times were due; the remaining 13 (3.8%) had experienced at least one episode of stock-out for which reason they had to be given alternative regimens to make up for the period of unavailability. No statistically significant relationship was found between ARV non-availability and adherence to them ($p = 1.000$) or to co-trimoxazole ($p = 0.294$) at 95% confidence interval. Of the 280 respondents who were on co-trimoxazole preventive treatment, 111 of them (39.6%) always received their refills on schedule whereas the remaining 169 (60.4%) had witnessed one or more episode of unavailability since commencing their treatment at the ART clinic. There was no statistically significant relationship between shortage of co-trimoxazole and adherence to the same ($p = 0.337$) at 95% confidence interval. The same pertained to adherence to ARVs; no statistically significant relationship was found between co-trimoxazole availability at the ART centre and adherence to the ARVs ($p = 1.000$) at 95% confidence interval.

Overall, there was a statistically significant difference between adherence to ART and adherence to co-trimoxazole ($p = 0.000$) 95% confidence interval. Availability of viral load test, which had a statistically significant relationship with ARV adherence with the chi square test, had an odds ratio of 1 on logistic regression analysis, implying no relationship actually exists between the two variables.

Table 4: Chi Square Analysis of Health System Related Challenges and Adherence to ART and CPT among ART Clients in BRH

Variable	ARV Adherent		ARV Non-adherent		P-value for ART	CPT Adherent		CPT Non-adherent		P-value for CPT
	Freq. (n)	%	Freq. (n)	%		Freq. (n)	%	Freq. (n)	%	
Viral load test										
Available	271	100	67	97.1	0.041	203	100	75	97.4	0.075
Not available	0		2	2.9		0		2	2.6	
Staff expertise										
Good	271	100	69	100		203	100	77	100	
Not good										
Staff numbers										
Good	265	97.8	67	97.1	0.667	199	98.0	73	94.8	0.222
Not good	6	2.2	2	2.9		4	2.0	4	5.2	
ARV shortage										
Yes	11	4.1	2	2.9	1.000	9	4.4	1	1.3	0.294
No	260	95.9	67	97.1		194	95.6	76	98.7	
Co-trimoxazole shortage										
Yes	139	60.4	30	60.0	1.000	126	62.1	43	55.8	0.337
No	91	39.6	20	40.0		77	37.9	34	44.2	

4. DISCUSSION

Individual, Interpersonal and Community Level Challenges of ART Clients and Adherence to Toxoplasmosis Preventive Measures

It was found from the study that some clients complained about pill burden being a barrier to good adherence to therapy. This is similar to the findings from a systematic review done across some high HIV burden countries in which some patients felt overwhelmed by the quantity of medications they were being given at the ART centres, and this was worse among those who were also on treatment for other co-morbidities such as hypertension, diabetes and asthma (Müller & Velez Lapão, 2021). This current study looked at satisfaction with ARV medications (of which pill burden was the most dominant complaint) and its relationship with adherence to both co-trimoxazole preventive therapy (CPT) and antiretroviral therapy (ART), and found statistically significant relationships with ART and CPT adherence in both the bivariate and multivariate analyses. Clients who were satisfied with their antiretroviral (ARV) medications had higher odds of adherence to both therapies as opposed to those who reported having negative concerns with them. Clients who reported being dissatisfied suggested smaller sized pills, injectable formulations and pills with less frequent dosing as interventions that could help them improve compliance. This is a novel aspect of this research that could be explored further in future studies by stakeholders in an attempt to improve upon medication compliance among HIV infected individuals in the Sunyani municipality, Bono Region and Ghana at large. Future interventions toward improving adherence could then target these suggested pharmacological aspects of drug formulation.

Low socioeconomic status is a fairly recognized risk factor for acquisition of latent toxoplasma infection and serum positivity, making Sub-Saharan Africa one of the high burden areas (Elsheikha et al., 2020b). The finding from various studies that adherence to antiretroviral therapy is worsened in a setting of low socioeconomic status among HIV infected individuals further compounds the problem. This study has also confirmed that some HIV patients occasionally have financial difficulties in accessing ART services even though the ARVs themselves are free, a finding, which is similar to what others, found in a multi case study within the Sunyani municipality (Yarney et al., 2016). Although statistically this study found no significant relationship between financial inadequacy and adherence to any of the two preventive therapies, financial capability is undoubtedly very vital for the uptake of any form of intervention, be it in the health setting, business or the arts. If for financial reasons refill appointments are missed, medication schedules are more likely going to be poorly adhered to, doses of important medications may be missed, leading to ineffective treatment, lower immune status and a high predisposition to opportunistic infections of which cerebral toxoplasmosis ranks among the most important (B. Addo et al., 2018). Separate appointment dates for review and medication refills were notably mentioned in several studies as financially draining to ART clients living in this low income economy, and the reason is that each appointment day requires a separate transport fare to access the health facility (Ankrah et al., 2016b; Yarney et al., 2016; Amankwah, 2015; Müller & Velez Lapão, 2021).

Low health literacy is one of the predisposing factors accounting for the higher rates of primary and latent toxoplasmosis in Africa and other low income countries (Elsheikha et al., 2020b). With this increased risk already present in this geographical jurisdiction, the lack of relevant knowledge about the fundamental benefits of interventions necessary for HIV patients to maintain optimal health further makes their situation worse. It was found from this study that some patients do not have much knowledge about the basic essence of the antiretroviral medications and co-trimoxazole, which are often routinely prescribed and administered to them. From this study, the relationship between knowledge about the importance of the ARVs and adherence to the same was statistically significant. Misconceptions such as boosting appetite, blood building, among others perceived by some patients as the fundamental reasons for which these important medications are given to them are particularly worrying, more so because there was a reported 100% coverage of adherence counseling in this study. Adherence counseling could be improved

upon to emphasize this fundamental information, making sure it stays in memory well. When people understand why they are required to do something they are more likely to follow through with them with a high degree of seriousness. In much the same way, adequate knowledge about the usefulness of co-trimoxazole was statistically significant in relation to compliance with the same as well as with adherence to ART in this study.

Stigma at home and in the society continues to be a key factor negatively impacting the lives of and also affecting adherence to treatment among HIV patients as realized in other studies done in other parts of the country; even perceived marginalization based on being HIV positive is enough to render these patients so apprehensive about others discovering their status that it cripples them and makes them sometimes willingly skip their medication doses or leave them behind when they anticipate being in the presence of others outside their private spaces (Amankwah, 2015; Ankrah et al., 2016b; Yarney et al., 2016; Owusu, 2020). Some health workers actually acknowledge the presence of stigma against patients as one of the factors affecting adherence to ART (S. A. Addo et al., 2018). However, this current study identified no statistically significant relationships between any form of social stigma and adherence to either ART or CPT.

“There is no place like home” is an adage that holds true for most people. One’s home is where they are accepted for who they are, where they feel loved and validated, where they feel most comfortable to be. The support and encouragement present among family members within the home circle make it easier to surmount many obstacles posed by the outside world, such as the fear of rejection and discrimination due to having an HIV positive status. Lack of family support is a challenge for only a handful of HIV patients who access care at the Bono Regional Hospital, according to this study. Statistically, no significant relationship existed between lack of family support among respondents and adherence to the antiretroviral medications or co-trimoxazole. This is in contrast to what was found in some studies in other countries across Africa and beyond where lack of family support was identified to be among the key barriers to good adherence to various therapies among HIV patients (Müller & Velez Lapão, 2021). This may reflect the probable existence of more supportive and inclusive sociocultural practices, societal norms and family values unique to the people in this geographical location as opposed to the social contexts in which those studies were done. However, the actual reason(s) could best be explored in further studies.

Institutional Level Challenges of ART Clients and Adherence to Preventive Measures

Insufficiency in the distribution of testing facilities is widely documented as one of the major setbacks in the management of PLWHA in Ghana (Addo et al., 2018; Ankrah et al., 2016b; Yarney et al., 2016). In one study it was found that, out of 172 health facilities sampled across the country, only 10 (accounting for 0.06%) had equipment for testing for HIV viral load levels (S. A. Addo et al., 2018). One of the above quoted studies i.e. that of Yarney and colleagues, actually focused on the Bono Regional Hospital (BRH) together with one other major hospital in the Sunyani municipality. However, findings from this current study seem to suggest that an overwhelming majority of ART clients who access care at Bono Regional Hospital are able to access such facilities with relative ease, with a statistically significant relationship existing between availability of such facilities and adherence to ART at the bivariable stage of the analysis. Even though no significant relationship existed at the multivariable stage of the analysis, this may reflect an improvement in resources availability and distribution over the years from the time of that study (i.e. 2016 to 2022), which is a commendable achievement. Total coverage of viral load testing services to be inclusive of all ART centres within the country at large must therefore be the ultimate goal so as to enable the country stride progressively toward achieving the last 95 as stipulated in the United Nations Joint Committee on HIV/AIDS (UNAIDS) 95-95-95 goal that has been set for all nations in the world.

The importance of high knowledge and expertise among any individual or group of people engaged in any endeavor towards achieving their expected goal cannot be overemphasized. Knowledge is what drives the success of any programme, and when the individuals involved in any venture are well informed, are abreast

with the standards of practice and know exactly what to do and how to do it, that mission almost certainly tends to become successful. The findings of a previous systematic review indicated that lack of requisite knowledge among ART care staff is another factor that often stands in the way of useful interventions that help improve adherence to treatment among HIV patients (Müller & Velez Lapão, 2021). This study has revealed that generally, ART clients who seek care at the Bono Regional Hospital are satisfied with the knowledge and expertise of the health workers taking care of their needs there, contrary to the observations from other studies also conducted in Ghana where some health workers themselves lamented “inadequate on the job training” as a challenge in HIV “service delivery” (S. A. Addo et al., 2018).

However, in a quantitative cross-sectional study conducted among nurses within the Kumasi metropolis, a high level of knowledge was generally found even though some of them still held on to some misconceptions regarding the transmission of the HIV virus (Boakye & Mavhandu-Mudzusi, 2019). Expertise of ART staff was acknowledged by all respondents to be satisfactory in this current study. No further statistical test was done on its relationship with compliance with medications. The reason for this may need further probing; however, it may be a result of the presence of periodic and ongoing training and re-training available to staff of the hospital owing to its urban location, making them abreast with current trends in HIV management as opposed to those in the hinterlands who may not easily have access to such privileges. It could also partially be explained by the fact that most of the data collectors were staff at the ART centre where the data were collected, and as such, respondents may have felt reluctant to disclose their true opinions to them in this regard for personal reasons such as the fear of being labeled. Further studies to assess this area of staff expertise could make use of an objective and well-structured questionnaire employing a Likert type scale with high reliability in order to obtain truer and more in-depth results that describe the real situation at the hospital.

One of the major problems negatively influencing health care delivery and access to health services in Sub-Saharan Africa is the highly reduced numbers of health care professionals; this is further compounded by the emigration of skilled workers, poor conditions of service and lack of incentives (Zachariah et al., 2009). In the setting of a high burden of infectious diseases such as pertains in the sub-region (Zachariah et al., 2009), this undoubtedly remains a key barrier to universal health coverage. Lack of adequate staff to attend to clients at ART clinics is a challenge for many HIV patients as documented by several studies in other parts of Ghana, the African continent, some parts of Asia, the Pacific and the Americas (Addo et al., 2018; Ankrah et al., 2016b; Yarney et al., 2016; Müller & Velez Lapão, 2021). In one study involving many health facilities at all levels in the country, some staff complained bitterly of high numbers of patients at their ART centres being a challenge to service delivery (S. A. Addo et al., 2018). However, this study revealed that low staff to patient ratio is generally not a problem from the perspective of the HIV clients themselves (who are at the receiving end) who access ART care at the Bono Regional Hospital. No statistically significant relationship was observed between staff availability and adherence to either ART or CPT, contrary to most studies as quoted above.

Antiretroviral medications administered as combinations of 3 or more drug components are the breakthrough treatment that has significantly stayed the course of the HIV pandemic, restored the immune system in individuals in whom imminent death was inevitable and kept opportunistic infections to their barest minimum. Without them HIV disease would run an utterly deadly course, leading many to their early graves. In much the same way, co-trimoxazole, though inexpensive and quite readily obtainable, is the single most important drug in the prevention of opportunistic infections in people living with HIV and even in people who have other forms of immune compromise. These medications both require dedicated and sustained effort as well as unflinching compliance in order to reap the best benefits from them. Inconsistent supply owing to occasional stock-outs of these medications is very much retrogressive for these patients, and need to be kept at bay as much as possible. Medication (both ARVs and co-trimoxazole) shortages as found by this study to occur only rarely to ART clients who seek ART services

at the Bono Regional Hospital, is one of the problems encountered by PLWHA across Ghana and other parts of the world (Yarney et al., 2016; Müller & Velez Lapão, 2021). No statistically significant relationships were found between availability of ARVs and co-trimoxazole and adherence to therapies with same, contrary to the views of some health workers in a previous study (S. A. Addo et al., 2018). The reason for this difference may stem from the distribution of resources, which may tend to favour a health facility at that level (regional) where high outpatient attendance and referral rates are anticipated and effectively planned for. However, that may require further research to fully understand the reasons behind that.

5. CONCLUSION AND RECOMMENDATION

This study has added a novel dimension to the adherence studies on antiretroviral therapy on HIV that exist in the literature, that is soliciting for the views and suggestions for improving upon these medications in order to facilitate adherence to them. None of the various studies reviewed in the literature did capture this aspect; however, many of the studies on adherence that were reviewed documented traces of what participants wished to be done to refine their medications owing to the qualitative natures of these research works which allowed them to freely express their views unbridled. As such, not so many and varied suggestions were obtained in all these literatures combined as was raised in this study. The author believes that by getting to know what lies in the minds of our ART clients, health care providers, adherence counselors and other stakeholders can better understand them, be empathic in our dealings with them, know the best ways to counsel them to surmount some of these obstacles and overall support them to achieve excellent compliance with these important medications. Additionally, this document could serve as a reference tool for humanitarian groups, philanthropists and pharmaceutical manufacturers to refer to when looking for ways to better formulate medications to suit the needs of people living with HIV.

From this study, therefore, interventions to be geared towards improving adherence to these important treatments that are so vital to the wellbeing of HIV patients must target these factors. This study set out with the aim of identifying some pitfalls in HIV care, accounting for the cases of cerebral toxoplasmosis among HIV patients on highly active antiretroviral therapy; to identify knowledge gaps regarding cerebral toxoplasmosis preventive practices among HIV patients; to narrow the context of studies on HIV management to toxoplasmosis preventive practices; to estimate the possible prevalence of consumption of undercooked meat by objectively determining how individuals judge meat to be well cooked; and also to make recommendations for improved care based on the key findings. These were to be achieved by addressing the challenges that are negatively influencing their adherence to the two most important preventive practices among the study population.

It is therefore important to substantially understand the possible reasons why HIV patients in this setting develop cerebral toxoplasmosis despite the many efforts being made towards achieving the UNAIDS 95-95-95 goals. For this reason, this study sought to investigate the potential factors accounting for the cases of cerebral toxoplasmosis that are seen among persons living with HIV and AIDS in the municipality, so as to come out with some recommendations to stakeholders to take the necessary action. This is expected to, in the end, lead to public health interventions that could help to significantly reduce the incidence and burden of the disease. This study is unique in that it holistically focuses on the prevailing potential risk factors of HIV-associated cerebral toxoplasmosis as a single entity, what is done among PLWHA (both consciously and unconsciously) that contribute to mitigating its occurrence, and what barriers exist against adherence to the two major preventive strategies at the first four levels of the social ecological model (namely individual, interpersonal, community and institutional levels). Whereas most other studies in the area of HIV focus on HIV as an entity, opportunistic infections as a whole, or tuberculosis as one opportunistic infection, this study goes further to touch on cerebral toxoplasmosis as an important opportunistic infection as well as assesses adherence not only to antiretroviral therapy (ART) but also co-trimoxazole preventive therapy (CPT) which is the chief cornerstone protective measure.

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Data Availability

Data used for this research is available upon request from the corresponding author.

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