FACTORS ASSOCIATED WITH CRYPTOCOCCAL MENINGITIS AMONG PEOPLE LIVING WITH HIV INFECTION IN THE SUMBAWANGA MUNICIPAL COUNCIL, RUKWA, TANZANIA

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By

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A Dissertation Submitted in(Partial) Fulfilment of the Requirements for the Degree of Master of Public Health of

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CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation titled; **‘‘Factors associated with cryptococcal meningitis among people living with HIV infection in Sumbawanga Municipal Council, Rukwa, Tanzania,** in (partial) fulfillment of the requirement for the degree of Master of Public Health of Muhimbili University of Health and Allied Sciences.

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Prof. Billy Ngasala

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Date

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Dr. Monica Shabani

(Co-Supervisor)

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Date

DECLARATION AND COPYRIGHT

I, **Veronica Eleutherius Mwanyika**, declare this **dissertation** is my original work. It has not been presented and will not be given to any other university for a similar degree award.

Signature…… **Date**……

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DEDICATION

I dedicate this work to my beloved Parents, Mr. and Mrs. Eleutherius Mwanyika, my sister, Leticia Mwanyika, and my young sister, Monica Mwanyika.

ABSTRACT

Background: Despite the significant rate of mortality and morbidity caused by Cryptococcal meningitis among people living with HIV (PLHIV) in Tanzania. There are limited findings on the disease burden and associated factors among PLHIV. Understanding factors associated with cryptococcal meningitis such as immunological factors, knowledge, attitude, and perception among PLHIV is crucial for disease prevention and management strategies. This study assessed factors associated with cryptococcal meningitis among PLHIV in Sumbawanga Municipal Council where there is a high prevalence of HIV infection, and limited findings assessed the magnitude of diseases and related factors**.**

Objectives: To assess factors associated with cryptococcal meningitis among people living with HIV infection in Sumbawanga Municipal Council, Rukwa, Tanzania.

Methodology: This study was a cross-sectional survey employing quantitative data collection methods for 639 PLHIV attending nine health facilities in the Sumbawanga municipal council. The health facilities were selected using a multistage sampling technique. Descriptive statistics were used to summarise the data, including means, frequencies, and percentages. Inferential statistics such as chi-square or Fisher's exact tests and logistic regression were used to analyze the strength of the association between the independent and dependent variables. An odd ratio with a P-value of ≤ 0.05 was considered statistically significant, and the confidence level will be 95%.

Results: The prevalence of cryptococcal meningitis was 11/639(1.7%), with 20.9% occurring in participants with a CD4 count <200 and 4.8% with >1000 viral copies. Only 1.3% of participants demonstrated a high knowledge level, while the majority (68%) had a low level of knowledge. Additionally, over half (55%) have positive attitudes, and almost three-quarters (62%) have negative perceptions of cryptococcal meningitis. Duration on ART, Participant adherence, and CD4 count were statistically associated with those who tested positive for CrAg P-value ≤ 0.005

Conclusion: HIV implementing programs strengthen continuous education for PLHIV to increase awareness on cryptococcal meningitis, scale up CD4 testing, and enhance follow-up PLHIV with poor adherence, CD4 count <200, and naïve to ART as these factors are associated with cryptococcal meningitis.

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LIST OF ABBREVIATIONS

AHD	Advanced HIV diseases
AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral Therapy
CM	Cryptococcal meningitis
CrAg	Cryptococcal Antigen
CTC	Care and Treatment Clinic
EDTA	Ethylenediamine tetraacetic acid
HIV	Human Immunodeficiency Virus
HVL	HIV Viral Load
MoH	Ministry of Health
NACP	National Aids Control Programme
OI	Opportunistic Infection
PEPFAR	The U.S. President's Emergency Plan for AIDS Relief
PLHIV	People living with HIV
SPSS	Statistical Package for the Social Science
UNAIDS	The joint United National programme on HIV/AIDS
WHO	World Health Organization

DEFINITION OF KEY TERMS

Attitude: This refers to personal views and feelings regarding the causes, symptoms, preventions, and effects of cryptococcal meningitis.

Cryptococcal meningitis: Refers to a fungal infection and inflammation affecting the membranes that envelop the spinal cord and brain, which causes illness and death in people with advanced HIV disease(1) .

HIV infection is a viral infection that attacks the immune system, specifically CD4 T-cells(2).

Knowledge: Refers to a person's understanding of the cause, symptoms, transmission, effects, and prevention of cryptococcal meningitis.

Perceptions: Refers to the ability of individual awareness and interpret information on causes, symptoms, prevention, and effects of cryptococcal meningitis.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Cryptococcal meningitis is a fungal infection that affects membranes covering the spinal cord and brain and is caused by *cryptococcal neoformans* and *cryptococcal gattii* fungi (3). Immunocompromised people with a CD4 count below 200 cells/μL or HIV stages 3 and 4 are highly susceptible to cryptococcal meningitis (4). Which is characterized by symptoms such as headache, neck stiffness, fever, altered mental status, abnormal vision, seizures, and skin lesions commonly present with bumps(5). Delay identification and treatment are leading to high morbidity (coma and seizure), disability such as blindness, intellectual disability, focal neurological deficit, and mortality (6).

It was estimated that 18% of all HIV-related deaths globally are caused by cryptococcal meningitis, and 75% are from sub-Saharan Africa (7,8). HIV impact survey assessments carried out in nine PEPFAR-supported countries between 2016 and 2018 showed that the prevalence of cryptococcal meningitis is 11─22%(8). The prevalence of cryptococcal meningitis among PLHIV was reported in different African countries, including Uganda, with a prevalence of 1.4% (9). and Malawi 3.5% (10).

In Tanzania, the majority of PLHIV who were diagnosed with cryptococcal meningitis are adolescents and adults admitted to hospitals at a late stage due to delayed ART initiation, PLHIV with poor adherence to ART treatment and management, and an unsuppressed viral load (11). Studies conducted in various regions and districts of Tanzania (Ulanga, Kilombero, Mwanza, Dar es Salam, and Kilimanjaro have revealed a prevalence of cryptococcal meningitis ranging from 4% to 12%(12–15) .

With a population of 1.8 million; the Rukwa region is among the areas with a high HIV positivity in Tanzania, with a prevalence of 3%. Sumbawanga municipality is among the districts with a high prevalence of HIV among four councils in the Rukwa region with a total of 10719 PLHIV on ART(16) . limited studies have reported on the prevalence of cryptococcal meningitis among PLHIV; several indicated that areas with limited resources

in developing countries with a high prevalence of HIV also have a high rate of cryptococcal meningitis as well (17,18).

In Tanzania, the standard of care available for the management of cryptococcal meningitis to people living with HIV includes Screening and diagnosis of cryptococcal meningitis infection to newly diagnosed HIV/AIDS clients, clients with persistently high viral load, clients with interrupted ART for more than three months, tested CD4 counts less than 200cells/µL, and patients with WHO stages 3 and 4 through CrAg test followed with lumber puncture with measurement of cerebrospinal fluid (CSF) by Indian Ink test and CSF culture for *cryptococcal neoformas* to patient with CrAg Positive and has sign and symptoms of meningitis (19,20). Pre-emptive therapy for cryptococcal infection and treatment of cryptococcal meningitis, such as fluconazole, flucytosine, and amphotericin B, is done in three phases: induction, consolidation, and maintenance.

Assessing factors associated with cryptococcal meningitis among PLHIV, such as immunological factors, knowledge, attitude, and perception of cause, effect, and prevention, is crucial because it will identify the magnitude of the disease; hence, the establishment of interventions that focus on awareness of cryptococcal meningitis causes, symptoms, and associated health impacts such as morbidity, disability, and mortality which directly aligned with UNAIDS targets of reducing AIDS-related deaths 78 by 2025 and 90% by 2030 (21–23). Also, it will help in the enhanced early identification of disease, adherence to ART, and other prophylaxis interventions, which reduce the risk of developing cryptococcal meningitis. PLHIV Perception of risk-developing cryptococcal meningitis will influence willingness to engage in preventive measures and health-seeking behaviors and address misconceptions and myths about cryptococcal meningitis.

1.2 Problem statement

Cryptococcal meningitis is a life-threatening opportunistic infection in Tanzania, especially in areas with a high prevalence of HIV; for instance, in Sumbawanga municipal council contributed 15 % of HIV-related deaths(15). Different interventions are adopted from WHO and national guidelines for the management of HIV/AIDS, such as cryptococcal antigen (CrAg) screening for clients with CD4< 200 cells /µL or WHO clinical stages 3 and 4, increased accessibility to ART, and complementary treatments for cryptococcal meningitis (24,25).

Despite these interventions, there are limited findings on the disease burden and associated factors for cryptococcal meningitis among PLHIV in the Sumbawanga municipal council. Current data on the prevalence of cryptococcal meningitis among PLHIV is required for preventive measures and management strategies as we are heading to 2025 to ensure we achieve UNAIDS targets of reducing HIV-related deaths by 78% and 90% by 2030(21–23). Immunological factors such as CD4 count and viral load are critical tests for early identification of cryptococcal meningitis however, there is limited understanding of these immunological markers especially in resource-limited health care settings. Influence of Knowledge on causes, symptoms, and prevention of cryptococcal meningitis. Also, attitudes towards early engagement in HIV services, adherence to ART, poor clinical follow-ups and perception of risk, and community myth of HIV complications have not been studied (5,26,27).

Therefore, this study aimed to determine the prevalence and associated factors for cryptococcal meningitis among PLHIV in the Sumbawanga municipal council to address the gap.

1.3 Conceptual framework

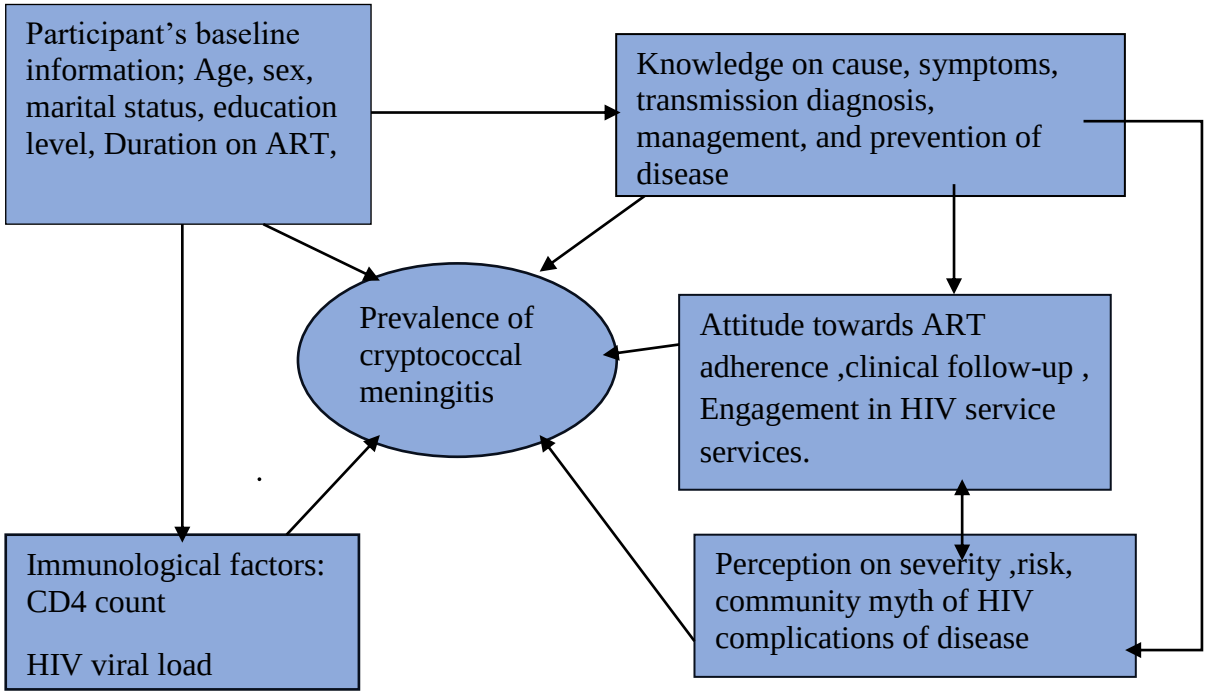


Figure 1: Conceptual framework for investigating factors for cryptococcal meningitis among people living with HIV

Description of the conceptual framework

The dependent variable was the prevalence of cryptococcal meningitis among people living with HIV.

Independent variables were participants' baseline information, immunological factors, knowledge of causes, symptoms, transmission, diagnosis management, and prevention of cryptococcal meningitis, attitude toward ART adherence, clinical follow-up and engagement in HIV services, and perceptions towards severity, risk and community myth of HIV complications of the disease.

The prevalence of cryptococcal meningitis may be influenced by the client's social demographic factors, such as age, sex, and location increases the likelihood of having the disease. Immunological suppression increases vulnerability to cryptococcal meningitis by having low CD4 counts and high HIV viral copies. Knowledge of PLHIV on the cause, symptoms, management, and prevention of cryptococcal meningitis will improve ART

adherence and early health seeking by recognizing disease symptoms. The client's attitude towards cryptococcal meningitis will influence health-seeking behaviors and preventive lifestyle choices. The client's perception of cryptococcal meningitis susceptibility will influence engagement in health preventive measures and ART treatment adherence.

1.4 Rationale of Study

The findings of this study will provide helpful information on the current status of cryptococcal meningitis and its associated factors among people living with HIV in the Sumbawanga municipal council. The information will help design strategies that focus on populations with a high risk of the disease and provide data that will help policymakers and HIV implementing programs on planning to reduce HIV-related mortality and morbidity, for example, conducting continuous education to PLHIV regarding opportunistic infections and advanced HIV diseases, as well as prompt screening and identification of cryptococcal meningitis. Determine whether factors such as ignorance, stigma, myth, and cultural beliefs are obstacles to HIV care and treatment.

1.5 Research Questions

1.5.1 Main Research Question

What are the factors associated with cryptococcal meningitis among people living with HIV in the Sumbawanga municipal council?

1.5.2 Specific Research Questions

1. What is the prevalence of cryptococcal meningitis among People living with HIV in the Sumbawanga municipal council?
2. What are the immunological factors associated with cryptococcal meningitis among people living with HIV in the Sumbawanga municipal council?
3. What is the level of knowledge about cryptococcal meningitis among people living with HIV in the Sumbawanga municipal council?
4. What is the attitude of people living with HIV towards cryptococcal meningitis in the Sumbawanga municipal council?
5. What is the perception of people living with HIV regarding cryptococcal meningitis in the Sumbawanga municipal council?

1.6 Research objectives

1.6.1 Main research objective

To assess factors associated with cryptococcal meningitis among people living with HIV in the Sumbawanga Municipal Council.

1.6.2 Specific objectives

1. To determine the Prevalence of cryptococcal meningitis among People living with HIV in the Sumbawanga Municipal Council.
2. To assess immunological factors associated with cryptococcal meningitis among people living with HIV in the Sumbawanga Municipal Council.
3. To assess the level of knowledge about cryptococcal meningitis among people living with HIV in the Sumbawanga Municipal Council.
4. To assess the attitudes of people living with HIV towards cryptococcal meningitis in the Sumbawanga Municipal Council.
5. To assess the perception of people living with HIV regarding cryptococcal meningitis in the Sumbawanga Municipal Council.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 To determine the prevalence of cryptococcal meningitis among People living with HIV in Sumbawanga municipal council.

Cryptococcal meningitis is a life-threatening disease for people living with HIV (PLHIV). Reported cases from areas with a high prevalence of HIV disease, particularly to people with advanced HIV infection(8). WHO suggests the prevalence of cryptococcal meningitis among PLHIV globally is 6%, which is commonly presented to adolescents and adults naïve to ART, interrupted treatment, and patients susceptible to treatment failure (4,28,29). Additionally, the global burden of disease research from 2009 to 2020 estimated that between 0.04 and 12% of PLHIV would experience cryptococcal meningitis among PLHIV in developing countries (30). Based on global HIV reports, the incidence of cryptococcal meningitis is decreasing each year (720,000 in 2007, 162,500 in 2014, and 82,000 in the 2020s). Despite this decline, developing countries continue to have a significant burden of cryptococcal infection (31).

A systematic review and meta-analysis of cryptococcal meningitis studies reported that the prevalence of a disease among PLHIV in Africa ranges between 1.4% and 20%, particularly in immunosuppressed individuals (32). In Sub-Saharan Africa, different studies reported the prevalence of cryptococcal meningitis, including the studies conducted in South Africa and Uganda, whereby the prevalence of cryptococcal meningitis ranges from 7% to 8% (9). Research conducted on nine PEPFER-supported countries in Sub-Saharan Africa from 2016 to 2018 observed that the prevalence of cryptococcal meningitis ranged from 11─22% among PLHIV who had a CD4 count ≤200 cells/μL (33).

There have been few investigations carried out in Tanzania on the prevalence of cryptococcal meningitis in people living with HIV. These studies were conducted in Mwanza, Morogoro, Dar es Salam, and the northern regions of Tanzania. The prevalence was calculated by dividing PLHIV-tested CrAg Positive among study participants. In Mwanza, the prevalence of cryptococcal meningitis was 5% among PLHV with CD4 ≤100 cells/μL (34). The study reported that in Northern Tanzania, there was a prevalence of

4.5% of cryptococcal meningitis among PLHIV-screened patients with a serum cryptococcal antigen test (35). Also, Morogoro reported a prevalence of 6.1% among those with CD4 ≤150 cells/µL and 7.5% in those with CD4≤100 cells/µL (36). Dar es Salam, the prevalence of cryptococcal meningitis was 11.9 among PLHIV with CD4 below 200 cells/µL (15).

Therefore, there is a need to conduct more studies on the burden of this deadly HIV opportunistic infection in Tanzania including the Sumbawanga municipal council, which has a high prevalence of HIV for better interventions to control the disease and to ensure we meet UNAIDS targets of reducing HIV related death 78% by 2025.

2.2 To assess immunological factors associated with cryptococcal meningitis among people living with HIV in Sumbawanga municipal council.

Cryptococcal meningitis has a significant association with individuals with weakened immune systems, particularly those with HIV/AIDS. Studies reported a prevalence of cryptococcal meningitis in PLHIV with a low CD4 count (CD4 count below 200) and a persistently high viral load due to progressive immune suppression, although there is minimal evidence to support CrAg screening for an unsuppressed viral load regardless of CD4 count. Cryptococcal meningitis is observed in clients with compromised immunity due to delays in HIV care and treatment, as well as poor adherence to ART and ART resistance (37,38).

A study conducted in Asian countries reported a prevalence of cryptococcal meningitis ranging from 34% to 72% among PLHIV with immunological suppression. Those identified with advanced HIV diseases, including cryptococcal meningitis, are associated with delayed engagement with HIV services until they have complications related to cryptococcal meningitis (39).

A retrospective survey conducted in Lagos, Nigeria, observed that one PLHIV per five newly diagnosed adolescents and adults has an opportunistic fungal infection with a prevalence of 19%, and cryptococcal meningitis contributes 0.4%. Those PLHIV are characterized by a low CD4 count below 200 cells/µL (40). However, a study conducted in

Mbale Regional Referral Hospital in eastern Uganda showed that 4.4% of participants tested CrAg positive among participants with CD4 counts below 200(41).

A study conducted in Morogoro, Tanzania, reported a 37% prevalence of cryptococcal meningitis among PLHIVs associated with immunological factors. This study identified newly diagnosed PLHIVs with a CD4 count below 200, irrespective of viral load. (42).
Limited studies have assessed immunological factors for cryptococcal meningitis in Tanzania, including Sumbawanga Municipal Council. Conducting this study will help to improve the diagnosis, treatment, and prevention of cryptococcal meningitis among immunocompromised individuals.

2.3 Assessing knowledge level about cryptococcal meningitis among people living with HIV

Assessing knowledge on cryptococcal meningitis among PLHIV is crucial for developing effective education programs in health facilities offering HIV care and treatment and improving health outcomes by influencing health-seeking, preventive measures, adherence to ART, prophylaxis, antifungals, and other medications related to cryptococcal meningitis (43). Despite intervention for early identification and treatment of cryptococcal meningitis, knowledge deficits among PLHIV, including causes, symptoms, and effects, and preventive measures are not well implemented in developing countries; this causes a high number of patients identified with cryptococcal meningitis in those with poor adherence to ART and delayed engagement in HIV care and treatment (44). A study conducted in China and Asia to assess knowledge of PLHIV regarding cryptococcal meningitis observed that knowledge level ranges from 34% to 72% on causes, symptoms, and preventive measures of disease (39). In South Africa, a study was carried out to evaluate the understanding of cryptococcal meningitis in people living with HIV. It was observed that only 19% of PLHIV were aware of the disease, thus leading to a high mortality rate of cryptococcal meningitis, which is associated with insufficient knowledge about clinical characteristics and disease risk (45). In Uganda, a survey to determine understanding of the causes and impact of cryptococcal meningitis showed that 60% of PLHIV had never heard of the disease before their diagnosis; hence, they lacked knowledge and education regarding cryptococcal meningitis (46). The cohort study conducted at Kilombero Ulanga, Tanzania,

assessed the level of understanding of advanced HIV diseases among patients attending CTC clinics and showed that 62.2% of Participants have awareness regarding cryptococcal meningitis. The low knowledge is from PLHIV-interrupted treatment and poor ART adherence due to cultural beliefs and stigmatization (47).

Limited studies in the Sumbawanga Municipal Council assessed PLHIV's knowledge regarding cryptococcal meningitis, created the need to conduct this study which will provide an overview of understanding of the disease among PLHIV and hence will help for planning to reduce mortality and morbidity associated with cryptococcal meningitis.

2.4 To assess the attitude of people living with HIV towards cryptococcal Meningitis

Attitude can positively or negatively influence individuals' behavior, such as health-seeking behavior and preventive measures. Assessing the attitude of PLHIV towards cryptococcal meningitis, including its causes, symptoms, severity, and health impact (morbidity and mortality), will influence healthcare-seeking behavior, treatment adherence to ART and antifungals, and health preventive behaviors (48). A study conducted in Sierra Leone showed negative attitudes among participants toward factors associated with cryptococcal meningitis among people living with HIV, such as stigma and disclosure of HIV status, discouraged health-seeking behaviors, and adherence to ART contributed to a 30% prevalence of the disease (49,50).

A study conducted in Uganda observed that 7.5% of PLHIV have negative attitudes towards health-seeking behavior, they were seeking traditional medications and religious healing instead of early admission to medical care and adherence to ART. Only 35% of participants have a positive attitude toward seeking medical care after having symptoms of cryptococcal meningitis (46). This contributed to a high prevalence of cryptococcal meningitis in areas burdened with HIV.

In Tanzania, including the Sumbawanga municipal council, limited studies have been conducted to assess the attitude towards cryptococcal meningitis among people living with HIV; the proposed research will help to identify PLHIV attitudes such as stigma, adherence to treatment and health-seeking behaviors which is crucial for policies and guidelines formation and implementing HIV programs on cryptococcal meningitis.

2.5 To assess the perception of people living with HIV regarding cryptococcal meningitis

Assessing the perception of PLHIVs about cryptococcal meningitis is crucial to identifying individuals more susceptible to disease and perceived barriers in preventive measures and treatment adherence(51). In a study conducted in Durban, 50% of PLHIV agreed that perceived barriers to early identification of cryptococcal meningitis, such as stigma, access to health care, myth, and native belief among PLHIV, cause cases associated with cryptococcal meningitis (52). A study conducted in Nigeria to analyze PLHIV perceptions towards cryptococcal meningitis showed that 60% were late to HIV care and treatment and were diagnosed with cryptococcal meningitis due to perceived cultural beliefs, values, and practices (53). However, a study conducted in Uganda showed a negative perception of PLHIV to early engagement in HIV services. Before seeking medical care, attempted self-medication using local medicine and painkillers to treat cryptococcal meningitis symptoms (54). In northern Tanzania, 17% of study participants have previously experienced stigma, and 33.5% perceived that self-stigma and self-medication could cause delayed engagement in HIV services, which can lead to HIV complications, including cryptococcal meningitis(14). The Rukwa region has reported different perceptions of the management of HIV services. However, there is limited information about the perception of cryptococcal meningitis among people living with HIV in the Sumbawanga municipal council which is crucial for enhancing awareness, early diagnosis, and disease management. Conducting the proposed research will address the gap**.**

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study area description

Sumbawanga Municipal Council is one of four districts in the Rukwa region of Tanzania, located an average of 1700m above sea level. It has a total area of 1,374 km^2 and a population of 303,986 per the census conducted in 2022, dominated by tribes including Fipa, Sukuma, and Nyiha (38). It is bordered to the north by Lake Rukwa, to the east by the Songwe region, to the south by the Sumbawanga rural district, and to the west by Nkasi District.

Sumbawanga Municipal Council has a tropical wet and dry, or savanna, climate with an average temperature of 27°C during the dry season. The temperature falls to 16°C and even 5 °C during the cold season. Everyday human activities include subsistence farming, small enterprises, fishing, and livestock keeping.

Sumbawanga Municipal Council has 35 health facilities, including one regional referral hospital, a designated district hospital, three health centers, and 30 dispensaries. Among 35 health facilities, 17 were supported by the PEPFAR program, implementing HIV indicators such as HIV testing, linkage to HIV care and treatment, viral load coverage, and suppression. With approximately 10719 PLHIVon ART the reported HIV opportunistic infections are TB, cryptococcal meningitis, oral candidiasis, and toxoplasmosis. The rationale for the selected study area was among districts with a high HIV prevalence in the Rukwa region, and limited studies were conducted to assess the prevalence and factors for cryptococcal meningitis (16).

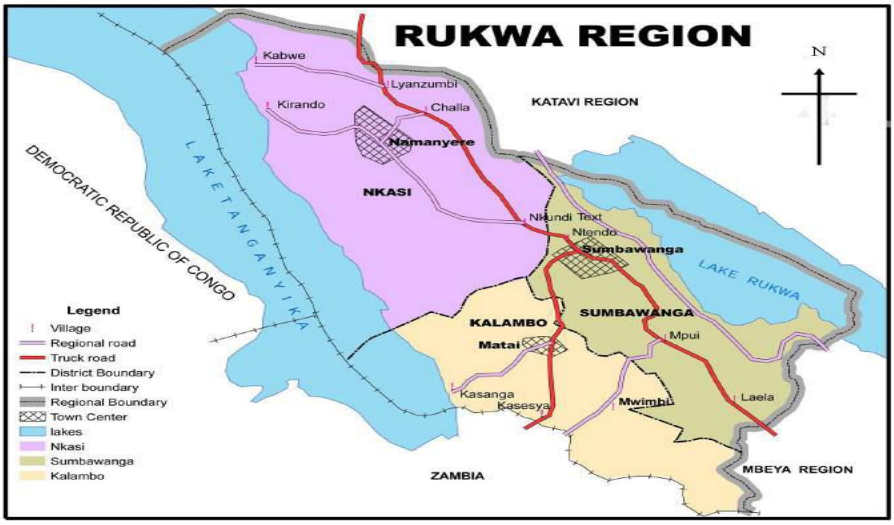


Figure 2: Map of Sumbawanga municipal council in Rukwa Region

3.2 Study design

The design was a hospital-based cross-sectional study involving the quantitative data collection method in selected health facilities in the Sumbawanga Municipal Council to determine the prevalence and factors associated with cryptococcal meningitis among people living with HIV.

3.3 Study population

The study population was people living with HIV attending HIV care and treatment clinics in the Sumbawanga municipal council Rukwa region.

3.4 Sample size and selection

The sample size was calculated using Cochran's formula ($N=z^2p(100-p)/ \mathcal{E}^2$) using a prevalence of cryptococcal meningitis from PLHIV (P) of 50% (set for prevalence is 50% due to lack of previous data from the study area). The margin of error ($\mathcal{E}$) is 5, and the standard average deviation (Z) is 1.96 at a 95 % confidence level (CI). The sample was later adjusted for a 10% non-response rate.

$n= 1.96^2*50(100-50)/5^2$

n=384

The assumption for a non-response rate of 10%

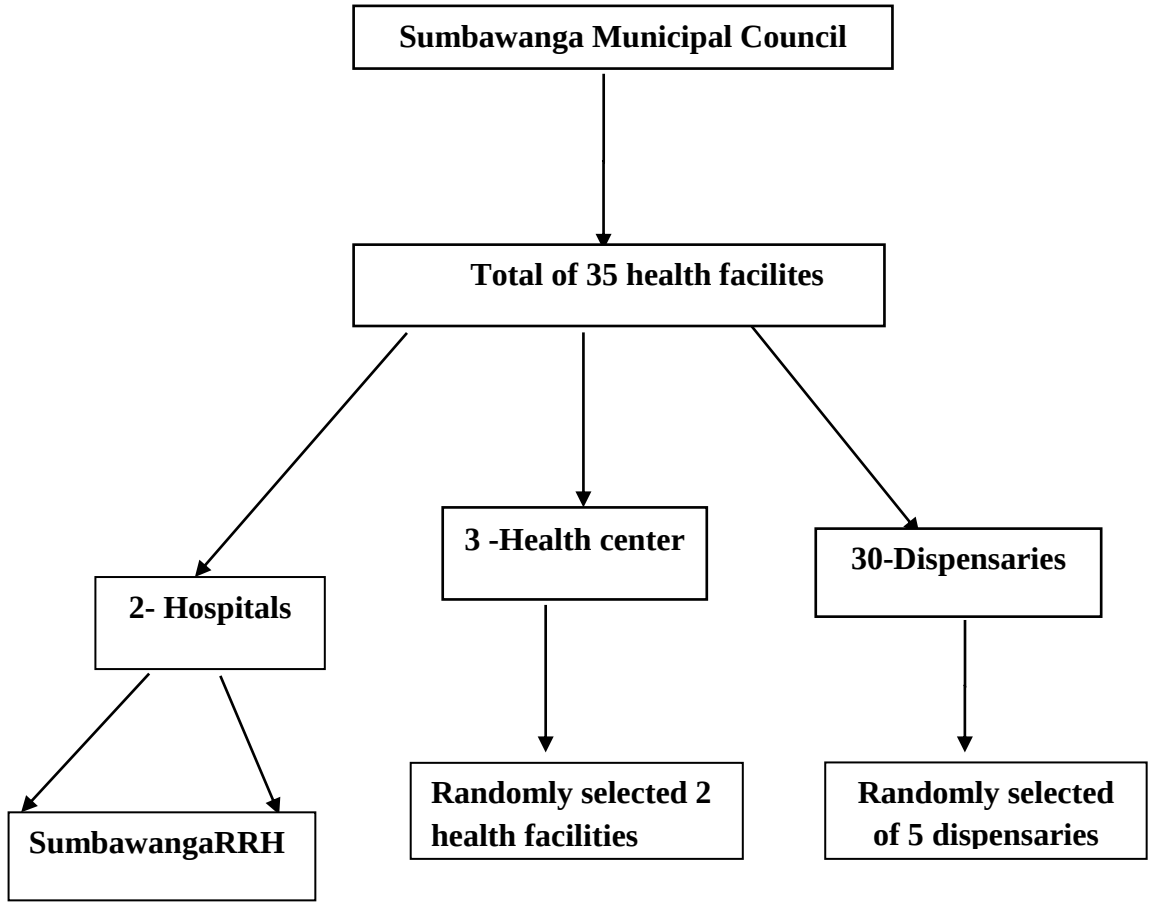
The calculation for sample size after adjustment of non-response of 10%=1/R
R=0.9 or 90%
The number of participants (n)= 384*1.11=426 Therefore 1/0.9=1.11
Account for designing effect (DE)=1.5
426*1.5=639

Therefore, the total sample size estimated in this study was 639 participants.

3.5 Sampling technique

The three multi-stage sampling techniques were employed to recruit 639 PLHIV-attended health facilities at Sumbawanga Municipal Council. In the first stage among 35 health facilities in Sumbawanga municipal council nine health facilities were randomly selected (two hospitals, two health centers, and five dispensaries). The second stage involved a strata-based selection of 639 participants from nine health facilities in Sumbawanga RRH among 1634 PLHIV 113 study participants were selected, in Dr. Atman Hospital among 1252 PLHIV 90 study participants were selected, in Mazwi HC among 2264 PLHIV 160 study participant were selected, Katandala HC among 1323 PLHIV 92 study participants was selected, SDA dispensary among 967 PLHIV 68 study participants were selected, Kizwite dispensary among 911 PLHIV 65 study participants was selected, Majengo dispensary among 264 PLHIV 18 participants was selected, Kilimahewa dispensary among 209 PLHIV 15 participants were selected and Tamasenga dispensary among 247 PLHIV 18 study participants was selected. In the third stage participants from their health facilities were recruited through systematic random sampling by calculating the number of PLHIV expected to attend the clinic through the appointment register, followed by deciding the sample size of participants to be interviewed on a respective day, followed by calculating the sampling interval (K) =N/n (where N is the size of the study population and n is the size of the sample). The first participant will be randomly selected from sampling interval units, followed by including every K^{th} unit from the frame in the sample.

Flow chart for sampling technique Sumbawanga Municipal Council



Total PLHIV= **1634**

Selected participant **113**

Total PLHIV=**1252**

Selected =**90**

-Mazwi HC selected **160**

Among **2264** PLHIV

Katandala HC selected **92** among **1323**

SDA selected **68** among **967** PLHIV

Kizwite selected **65** among **911** PLHIV

Majengo selected **18** among **264** PLHIV

Kilimahewa selected **15** among **209**

Tamasenga selected **18** among **247**

3.6 Inclusion and exclusion criteria

3.6.1 Inclusion criteria

- The study included PLHIV attending HIV care and treatment at selected health facilities in the Rukwa region.
- Participants with 18 years old and above because were mature enough to respond to questions without treatment supporters. Also, they had full disclosure of their HIV status and awareness of the ART usage
- All PLHIV agreed to participate in the study by signing the consent form.

3.6.2 Exclusion criteria

- Pregnant and breastfeeding women attending PMTCT clinics due to compromised immune systems also have complications that might be related to cryptococcal meningitis.
- An unconscious PLHIV who was admitted to the study facilities.

3.7 Variables

3.7.1 Dependent variable

The dependent variable was the prevalence of cryptococcal meningitis among people living with HIV. This variable was measured by calculating the number of participants who tested positive from serum CrAg divides, with 639 participants selected to participate in the study in the Sumbawanga municipal council. Results are expressed in percentage form.

3.7.2 Independent variable.

The independent variables were

- Participant baseline in (Age, sex, location, facility level, Marital status, participant adherence, duration on ART, and education level)
- Immunological factors (CD4 count and HIVVL)
- Knowledge level of PLHIV on the causes, symptoms, transmission diagnosis management, and prevention of cryptococcal meningitis.
- Attitudes of PLHIV toward ART adherence, clinical follow-up, and engagement in HIV services,

- Perceptions of PLHIV towards severity, risk, and community myth of HIV complications of cryptococcal meningitis.

3.8 Data Collection Method

The study recruited study participants who came to CTC for their routine visit, after their services qualified doctors examined and interviewed selected study participants on cryptococcal meningitis. The procedure took place approximately 20 to 30 minutes

3.8.1 Criteria for diagnosis of cryptococcal meningitis

Cryptococcal meningitis was diagnosed based on AHD screening algorithms recommended in the Tanzania national guideline for the management of HIV/AIDS. The group of PLHIV required for a diagnosis of cryptococcal meningitis were newly diagnosed individuals, individuals returning after being interrupted to treatment for more than six months, individuals with more than 1000 viral load copies after EAC, Patients with WHO stage 3 or 4 and patients with symptoms related with cryptococcal meningitis such as Severe headache, fever, Neck stiffness, cranial nerve palsy, confusion, focal neurological deficit include blurred vision, sensitivity to light, decreased hearing and difficult in walking (24). Qualified doctors examined a study participant at room located in the CTC area after a routine

3.8.2 Questionnaire Survey

Data was meticulously collected using a structured questionnaire designed to comprehensively assess factors for cryptococcal meningitis in people living with HIV infection. The questions, adapted from the WHO Guide for Developing Knowledge, attitude, and Perception Surveys, were carefully revised to ensure they captured all information related to the intended objectives (55). The principal investigator and research assistants interviewed the PLHIV at selected facilities in the Sumbawanga Municipal Council. The questionnaires contained four sections containing patient social demographic information (patient age, sex, location, marital status, and education level), and information like adherence status and patient regime was recorded from CTC2 files, knowledge assessment, attitude assessment, and perception regarding cryptococcal meningitis infection, such as the cause symptoms, transmission, diagnosis, management, and disease

prevention the participant responses documented in a structural questionnaire in Swahili or English version.

3.8.3 Sample collection for CD4, HVL and CrAg Test

- Participants eligible for diagnosis of cryptococcal meningitis infection, registered and trained healthcare providers (nurses or laboratory personnel) collected blood samples in the phlebotomy area of facilities using a labeled EDTA tube and a well-documented request form.
- For a facility with a laboratory testing point, samples for CD4 and CrAg are tested per laboratory operating procedure and guidelines, and CD4 samples are tested using BD FACSPresto machines or Pima CD4 testing machines. Results with a CD4 count of fewer than 200 cells/µL followed by cryptococcal meningitis testing using CrAg testing kits (36).
- For a facility without a CD4 testing point, samples are transported to a testing point by maintaining temperature in a cooler box and sample triple package to maintain sample quality. They were tested per laboratory CD4 testing and CrAg testing operating procedures.
- For HIVVL results status, we used the participants' recently documented HIVVL results in their CTC2 files. All participant eligible for viral load test samples were collected and tested at Sumbawanga Molecular Laboratory, and their results were used for the study.

3.8.4 Results feedback to the study participants

Turnaround time from sample collection to results feedback from the testing laboratory was approximately three days. We used community health care providers to inform participants who tested CrAg positive to visit health facilities for pre-emptive therapy for cryptococcal infection.

3.9 Validity and reliability issues

3.9.1 Validity

The Data Collection team underwent rigorous and comprehensive training, which included the study's goals, the data collection instrument, the procedures used to gather data, ethical

issues, and quality assurance procedures. Furthermore, the team received extensive instructions and training in interpersonal and communication skills to establish a connection with participants and guarantee accurate and comprehensive data collection.

3.9.2 Preliminary testing of data collection tools

Pre-tests for data collection instruments, such as the questionnaire and compilation data sheet, were piloted at Dr. Atman Hospital and involved 10% of the calculated sample size of participants (64PLHIV). The pilot study aimed to test whether data collection tools captured all intended information before implementation, allowing the principal investigator and research assistant to familiarize themselves with the tools. The contents and language were revised per the findings derived from the pre-test results and actual data collected, excluding piloted data collected in this hospital.

3.10 Data management and analysis

The collected data was uploaded into the statistical software SPSS version 26. software cleaned and analyzed.

Objective one: To determine the prevalence of cryptococcal meningitis among PLHIV. The prevalence of cryptococcal meningitis was calculated by dividing the number of participants who tested positive for the CrAg test by the total number of participants involved in the study, expressed in percentage form—cross tabulation with a percentage form used to describe patient characteristics. The chi-square or Fisher exact test is used to compare categorical variables. An odd ratio and a P-value of ≤ 0.05 were considered statistically significant for the strength of the association.

Objective two: To assess the immunological factors associated with cryptococcal meningitis, we used chi-square testing to analyze the association between CD4 count and HIV viral load relative to cryptococcal meningitis. It is calculated at a 95% confidence level, with a 5% significance level, and the independent variable with a p-value <0.25 will be considered a potential confounder.

Objective three: To assess PLHIV knowledge on cryptococcal meningitis, a score scale was used to evaluate participants' knowledge level from 10 multiple choice questions that assigned numerical values to responses such as correct response=1 and incorrect response

=0. The highest score was 11, and the lowest was 0. The knowledge level is categorized into low, moderate, and high, such that from 0 to 4, is regarded as a low level of knowledge; from 5 to 7 was a moderate level of knowledge; and from 8 to 11, was a high level of knowledge. The overall score of each individual is used to calculate the mean score and identify areas of knowledge where participants scored high or low for cryptococcal meningitis, its cause, symptoms, transmission, management, and prevention. Compare the mean score across PLHIV demographics such as age, sex, location, and education level. A Fisher's exact test will be used to measure the strength of the association; $p \leq 0.05$ in a 95% confidence interval indicates statistical significance.

Objective Four and Five: A five-point Likert scale is used to determine the attitude and perception of PLHIV towards cryptococcal meningitis. Attitudes are evaluated by assigning a numerical value to each response: strongly disagree =1, disagree =2, not sure =3, agree=4, and strongly agree=5 to 12 questions. Perception is evaluated by assigning a numerical value to each response as 1=Never, 2=Rare, 3=Sometime, 4=Often, and 5=Every Time to 8 questions. A Descriptive statistic such as frequency and percentage will be used to summarize the attitude and perception of PLHIV on the cause, symptoms, transmission, management, and prevention of cryptococcal meningitis. Inferential statistics, such as the t-test, will be used to measure the strength of the association. A p-value ≤ 0.05 will be regarded as statistical significance with a 95% confidential interval.

3.11 Ethical Consideration

The Institutional Review Board (IRB) of the Muhimbili University of Health and Allied Sciences (MUHAS) granted the approved ethical clearance (MUHAS-REC-05-2024-2299) and introduction letter. This comprehensive process ensures that the research is conducted with the utmost respect for the rights, privacy, and confidentiality of the individuals participating. Subsequently, approved ethical and introduction letters were used to request approval from the Sumbawanga Municipal Council Administrative secretary and Health facility management to access data from PLHIV attending to their facilities, and approval was granted. Written informed consent was obtained from each recruited participant. Participants were assured that all information would be kept confidential and anonymous.

The primary objective of obtaining permission is to guarantee that the research is conducted with the utmost rights, privacy, and confidentiality for individuals participating.

CHAPTER FOUR

4.0 RESULTS

4.1 Baseline information of study participants

Six hundred thirty-nine (639) participants were recruited for the study, and the response rate was 100%. Their age ranged from 18 to 65. The mean age was 39.44, SD=11.5. The study participants were 72% female; 84% were in urban areas and 16% in rural areas. Their marital status: 73% were married, and 17% were unmarried. 84% were literate, 16% were illiterate, and 98.3% were on the first ART regimen. Most participants were on ART for more than five years 49%).

Table 1: Baseline characteristics of the study participants

Variables	N	Percentage (%)
Age		
18 to 35	259	40.5
36 to 60	352	55.1
>60	28	4.4
Sex		
Male	177	27.7
Female	462	72.3
Duration on ART		
<1yr	113	17.7
1to 5yrs	212	33.2
>5yrs	314	49.1
Location		
Rural	102	16.0
Urban	537	84.0
Facility level		
Dispensary	184	28.8
Health Center	252	39.4
Hospital	203	31.8
Marital status		
Married	456	72.8
Unmarried	174	28.2
Adherence status		
Good	590	92.3
Moderate	36	5.6
Poor	13	2.0

Prevalence of Cryptococcal meningitis according to baseline information of study participants

The prevalence of cryptococcal meningitis was 1.72 % (95%, CI=0.71-2.73). According to the participants' baseline information, the prevalence of cryptococcal meningitis was statistically significant at the facility level (P=0.032), marital status of participants (p=0.04), participant adherence (P= <0.000), and duration on ART(p=<0.000)

Table 2: Influence of study participant baseline characteristics to the prevalence of cryptococcal meningitis

Variables	Number of participants	Cryptococcal meningitis prevalence (%)	P-Value
Age category			
18 to 35	259	07(2.7)	0.102
36 to 60	352	03 (0.9)	
>60	28	01 (3.6)	
Sex			
Male	177	03 (1.7)	0.999
Female	462	08 (1.7)	
Duration on ART		06 (5.4)	0.002
<1yr	111	04 (1.9)	
1to 5yrs	212	010.3)	
>5yrs	314		
Location			
Rural	102	02 (2.0)	0.691
Urban	537	09 (1.7)	
Facility level			
Dispensary	184	00 (0.0)	0.032
Health Center	252	04 (1.6)	
Hospital	203	07 (3.4)	
Marital status			
Unmarried	174	06 (3.4)	0.040
Married	465	05 (1.1)	
Adherence status			
Good	590	05 (0.8)	<0.000
Moderate	36	03 (8.3)	
Poor	13	03 (23.1)	

Fisher's exact test, P-value≤0.05, indicates a significant level.

4.2 Immunological factor associated with cryptococcal meningitis among study Participants

Both low CD4 count and High HIV viral load were used to assess the association of immunological factors with cryptococcal meningitis. Among 639 participants, 43 (6.7%) had CD4 below 200 cells/ µL, while in HVL testing, 30 (4.7%) participants had a high viral load above 1000 copies, and 24 (3.8) were not eligible for the HVL test per Tanzania national algorithm for HVL testing. The prevalence of cryptococcal meningitis among Participants with CD4 below 200 cells/ µL was 20.9% (95%, C1=8.75, 33.05). The prevalence of cryptococcal meningitis among participants with a viral load above 1000 copies was 13.3% (95%, C1=1.1,25.5). Both low CD4 count(P=0.000) and high viral load (0.000) have statistical significance for cryptococcal meningitis.

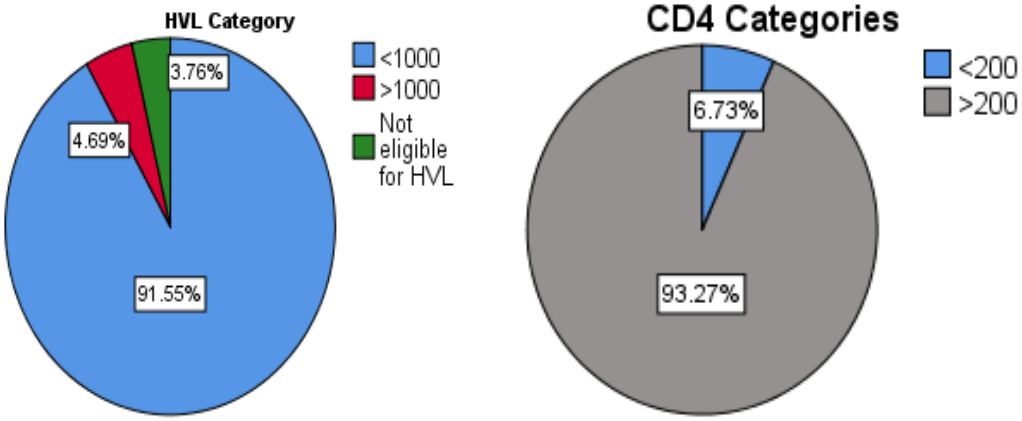


Figure3a&3b: HVL category and CD4 category to study participants

Table 3: Association study participant CD4 count and viral load with prevalence of cryptococcal meningitis

Variables	N (%)	C. Meningitis positive	C. Meningitis Negative	P-value
HIV Viral Load				
<1000	585 (91.5)	0 (0.0)	585 (100)	<0.000
>1000	30 (4.7)	4 (13.3)	26 (86.7)	
Not eligible for HVL test	24 (3.8)	7 (29.2)	17 (70.8)	
CD4 count				
<200	43 (6.7)	9 (20.9)	34(79.1)	<0.000
>200	596(93.3)	2(0.3)	594(99.7)	

Fisher's exact test, p-value≤0.05, indicates a significant level.

4.3 Knowledge study participants regarding cryptococcal meningitis.

More than half of the respondents had heard about cryptococcal meningitis (55%), and less than half (45%) had never heard about the disease. Among them, almost two-thirds (62%) of participants responded that they had heard about cryptococcal meningitis in health facilities, more than half (58%) responded that cryptococcal meningitis is a severe disease, less than a quarter (19%) of participants responded correctly on the causes of cryptococcal meningitis, and less than almost a half (44%) didn't know the symptoms of cryptococcal meningitis. Regarding people who were more susceptible to disease, the majority of the participants responded correctly(82.2%) (where half (54%) responded to patients with poor adherence to ART, a quarter (14%) responded to patients with CD4 below 200, and other quarter (15%) responded to individuals delayed on ART initiation) also on treatment of cryptococcal meningitis less than a half (40%) responded correctly. Two-thirds of respondents responded correctly to preventing cryptococcal meningitis (66%), shown in Appendix 3.

A low level of knowledge regarding cryptococcal meningitis was observed (68%) among study participants (figure 2). There was a statistically significant difference between participant levels of knowledge and participant adherence (P=0.029)

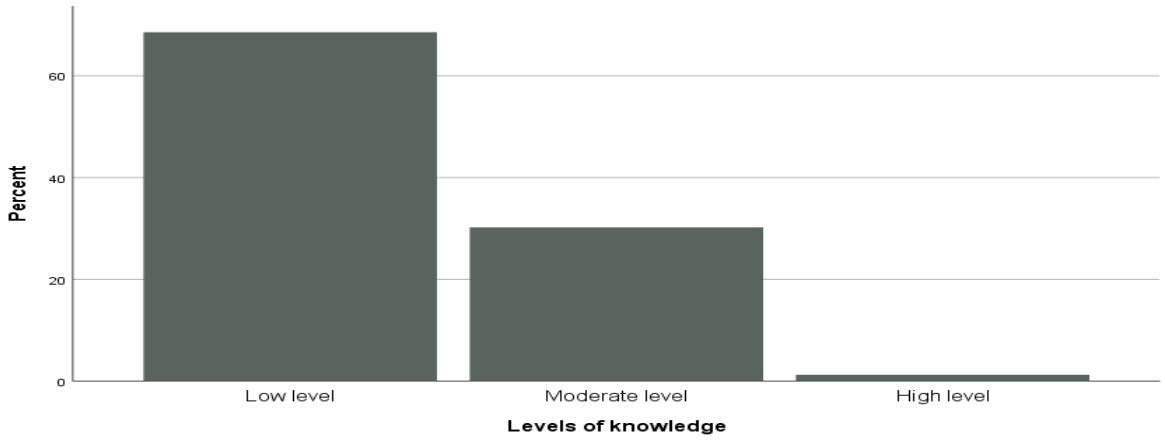


Figure 4: Classification of study participant's knowledge levels regarding cryptococcal meningitis.

Table 4:Influence of participant baseline characteristics on the level of knowledge regarding cryptococcal meningitis.

Variables	Low knowledge	moderate knowledge	High knowledge	P-Value
Age category				
18 to 35	177 (66.8)	83 (32.0)	03 (1.2)	0.873
36 to 60	244 (69.3)	103 (29.3)	05 (1.4)	
>60	21 (75.0)	07 (25.0)	00 (0.0)	
Sex				
Male	114 (64.4)	61 (34.5)	02 (1.1)	0.334
Female	324 (70.1)	132 (28.6)	06 (1.3)	
Duration on ART				
<1yr	73.3 (64.6)	37 (32.7)	03 (2.7)	0.415
1to 5yrs	142 (67.0)	68 (32.1)	02 (0.9)	
>5yrs	223 (71.0)	193 (38.0)	0.3(1.0)	
Location				
Rural	65 (63.7)	35 (34.3)	02 (2.0)	0.333
Urban	373 (69.5)	158 (29.4)	06 (1.1)	
Facility level				
Dispensary	125 (67.9)	57 (31.0)	02 (1.1)	0.156
Health Center	167 (66.3)	84 (33.3)	01 (0.4)	
Hospital	146 (71.9)	52 (25.6)	05 (2.5)	
Marital status				
Unmarried	128 (73.6)	44 (25.3)	02 (1.1)	0.251
Married	310 (66.7	149 (32.0)	06 (1.3)	
Adherence status				
Good	410 (69.5)	174 (29.5)	06 (1.0)	0.029
Moderate	23 (63.9)	11 (30.6)	02 (5.6)	
Poor	05 (38.5)	08 (61.5)	00 (0.0)	

Fisher's exact test, P-value≤0.05, indicates a significant level.

4.4 Attitude of study participants towards cryptococcal meningitis

During the assessment of participants' attitudes towards cryptococcal meningitis, less than half (38.8%) of participants agreed they didn't receive continuous education about opportunistic infection, including cryptococcal meningitis, about two thirds (64.16%) of participants agreed they sought health care after having HIV complications related to cryptococcal meningitis. About half (56.49%) of participants agreed that PLHIV needs awareness of symptoms and preventive measures for cryptococcal meningitis, which will influence the peers and community to engage in early HIV services and adhere to ART because PLHIV delays seeking health care due to the belief they healed through Local medicine and Prayers. In comparison, less than half (43%) agreed that financial constraints caused poor adherence to ART, and more than a quarter (21%) of participants agreed they once experienced stigmatization, as shown in the figure below.

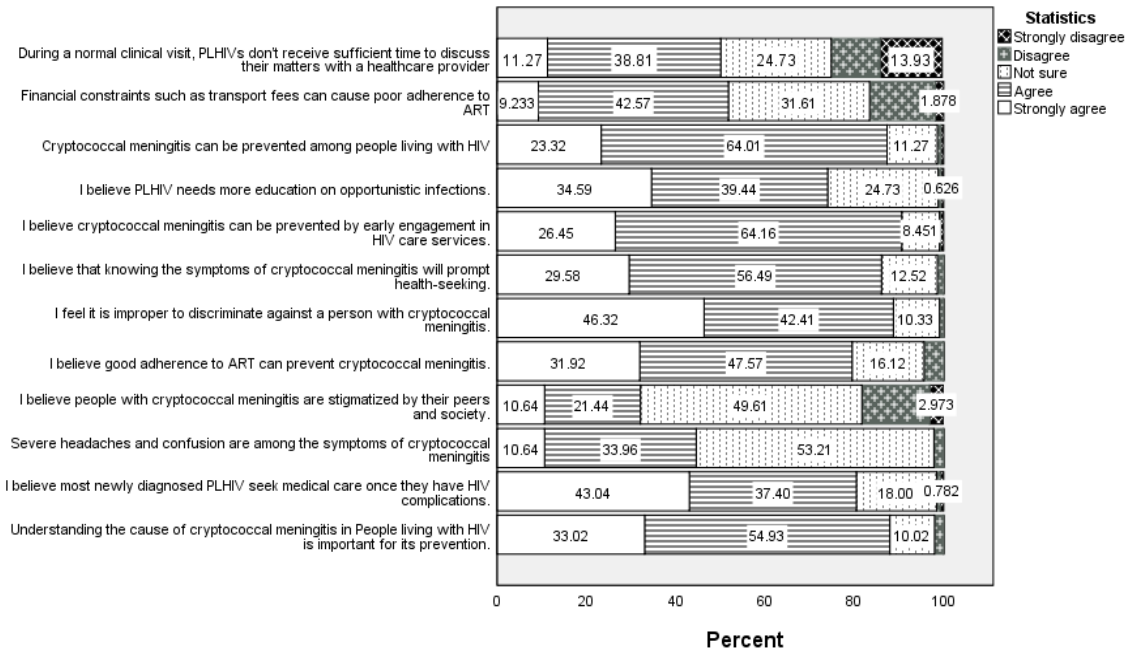


Figure 5: Attitude of study participants towards cryptococcal meningitis

4.5 Perceptions of study participants regarding cryptococcal meningitis

Considering study participants' perceptions regarding cryptococcal meningitis, about one-third (37%) were sometimes satisfied, and more than a quarter (26.65%) were satisfied

with health services received in managing HIV complications related to cryptococcal meningitis. Half (54%) of participants did not perceive self-stigma and community discrimination as barriers to early engagement in HIV services and adherence to ART, which is associated with cryptococcal meningitis. More than half (55%) of participants have perceived the benefit of early engagement in HIV services and PLHIV awareness of the cause and symptoms of cryptococcal meningitis. It will help to improve health outcomes. Less than half (40%) of participants have agreed that they rarely discuss cryptococcal disease with their healthcare providers, while almost a quarter (13%) responded that they never addressed it with healthcare providers. Also, more than one-third (42%) of participants once experienced symptoms related to cryptococcal meningitis, while less than a quarter (14%) never experienced symptoms related to cryptococcal meningitis.

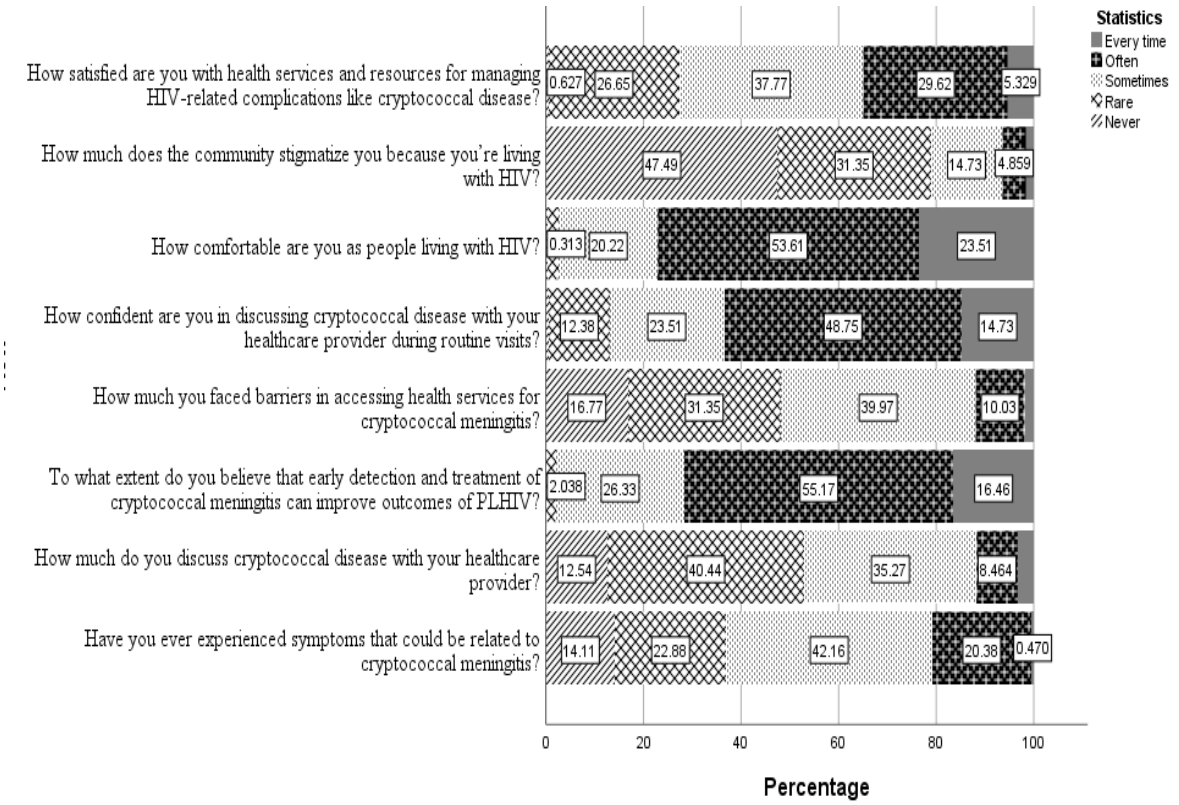


Figure 6: Perceptions of study participants regarding cryptococcal meningitis.

Classification of study participants' attitudes and perception towards cryptococcal meningitis

There was a statistical significance between study participant attitude and socio-demographics such as age category (P=0.003), duration of participant on ART (P=0.005), and participants' health facility levels and health facilities (p=0.000). The statistical significance between study participant perception and socio-demographics (p=0.000) on the participants' facility level and health facilities is shown in the table below.

Table 5: Influence study participant's baseline characteristics on attitude and perception towards cryptococcal meningitis.

Variables	Level of attitude			Perception level		
	Negative	Positive	P-Value	Negative	positive	P-Value
Age Category						
18 to 35	108 (41.7)	151 (58.3)	0.003	166 (64.1)	93 (35.9)	0.144
36 to 60	155 (44.2)	195 (55.8)		208 (59.1)	144 (40.9)	
>60	22 (75.0)	07 (25.0)		21 (75.0)	07 (25.0)	
Sex						
Male	81 (46.0)	95 (54.0)	0.656	107 (60.5)	70 (39.5)	0.716
Female	203 (43.9)	259 (56.1)		288 (62.3)	174 (37.7)	
Duration on ART						
<1yr	59 (52.2)	54 (47.8)	0.005	65 (57.5)	48 (42.5)	0.547
1to5yrs	106 (50.0)	106 (50.0)		135 (63.7)	77 (36.3)	
>5yrs	120 (38.2)	194 (61.8)		195 62.1)	119 (37.9)	
Location						
Rural	52 (51.0)	50 (49.0)	0.157	64 (62.7)	38 (37.3)	0.912
Urban	233 (43.3)	304 (56.7)		331 (61.6)	206 (38.4)	
Facility level						
Dispensary	76 (40.8)	109 (59.2)	0.000	120 (65.2)	64 (34.8)	0.000
Health Center	93 (37.1)	158 (62.9)		172 (68.3)	80 (31.7)	
Hospital	116 (57.1)	87 (42.9		103 (50.7)	100 (49.3)	
Marital status						
Unmarried	82 (47.4)	91 (52.6)	0.372	107 (61.5)	67 (38.5)	0.927
Married	202 (43.4)	263 (56.6)		288 (61.9)	177 (38.1)	
Adherence status						
Good	257 (43.6)	333 (56.4)	0.240	362 (61.4)	228 (38.6)	0.759
Moderate	20 (57.1)	15 (42.9)		24 (66.7)	12 (33.3)	
Poor	07 (53.8)	06 (46.2)		09 (69.2)	04 (30.8)	

°Fisher's exact test, °°chi-square, *p-value ≤0.05 indicate significant level

Less than half of the study participants (45%) had a negative attitude, and more than half (55%) had a positive attitude towards cryptococcal meningitis, as shown in Figure 6. In comparison, most Participants (62%) have a negative perception of cryptococcal meningitis, while less than half (38%) have a positive perception of the disease, as shown in Figure 7.

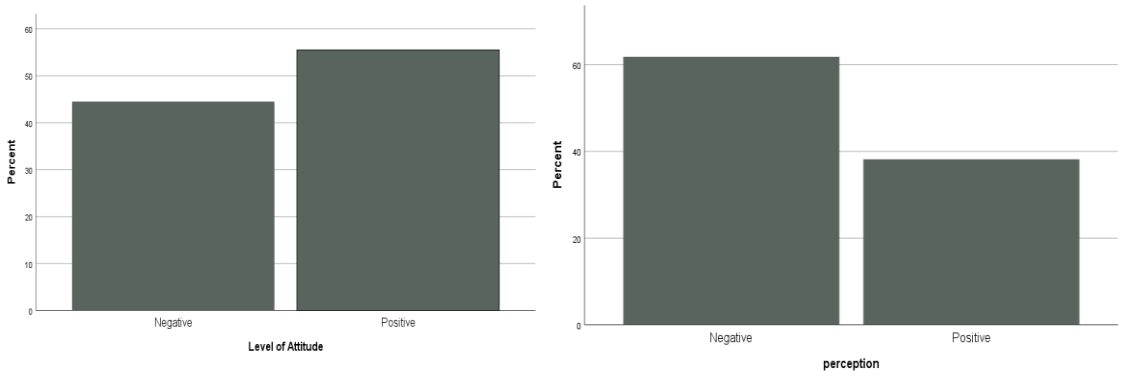


Figure 7: Classification of study participants' attitudes and perceptions towards cryptococcal meningitis

Prevalence of cryptococcal meningitis according to the level of knowledge, attitude, and perception among study participants.

The prevalence of cryptococcal meningitis was not statistically significant to participant knowledge, attitude, and perception, with all variables with a P-value > 0.005. However, many cryptococcal meningitis cases were observed in participants with low knowledge 6 cases (1.4 %) compared to participants with high knowledge one case (11.1%). However, a high prevalence of cryptococcal meningitis was observed in participants with a positive attitude of 2.3% compared to those with a negative attitude of 1.1%. Also, the number of cases was high for the participants with negative perceptions, 6 cases (1.5%) compared to those with positive perceptions, 5 cases (2.0).

Table 6: Influence of study participants' knowledge level, attitude, and perception of the prevalence of cryptococcal meningitis.

Variables	N (%)	cryptococcal meningitis cases	p-value
Knowledge level			
Low	438	06 (1.4)	0.138
Moderate	193	04 (2.1)	
High	08	01(11.1)	
Attitude level			
Negative	285	03 (1.1)	0.361
Positive	354	08 (2.3)	
Perception level			
Negative	395	06 (1.5)	0.617
Positive	244	05 (2.0)	

Fisher's exact test, P-value ≤ 0.05, indicates a statistically significant level.

Factors associated with cryptococcal meningitis among the study participants

The table summarizes the findings in univariate and multivariate logistic regression analysis tests. The results from the Univariate analysis of Participants' duration on ART, education level, adherence, CD4 category, and knowledge level were statistically significant. In the multivariate analysis, the ART duration, adherence, and CD4 category were statistically significantly associated with cryptococcal meningitis (p-value≤0.005).

Table 7: Factors associated with cryptococcal meningitis by univariate and multivariate logistic analysis.

Variables	Univariate analysis COR (95% CI)	P-Value	Multivariate analysis AOR (95% CI)	P-Value
Age category				
18 to 35	1.333 (0.16-11.25)	0.791	0.435 (0.04- 4.48)	0.498
36 to 60	4.309 (0.43-42.84)	0.213	0146 (0.01-1.56)	0.138
>60	Ref			
Sex				
Male	1.022(0.27-3.89)	0.975		
Female	Ref			
Duration on ART				
<1yr	0.56 (0.007-0.47)	0.008	13.953 (1.45-134.16)	0.022
1to 5yrs	0.165 (0.11-1.49)	0.108	4.097 (0.41-40.64)	0.228
>5yrs	Ref		Ref	
Location				
Rural	0.852(0.181-4.003)	0.84		
Urban	Ref			
Adherence				
Good	Ref		Ref	
Moderate	3.300(0.57-18.98)	0.181	0.170 (0.02-1.22)	0.078
Poor	35.1(7.362-167.35)	<0.000	0.022 (0.04-0.13)	0.000
CD4 category				
<200	0.013(0.003-0.061)	<0.000	7.091 (1.30-46.91)	0.025
>200	Ref		Ref	
HVL Category				
<1000	0.000(0.000)	0.999	0.000(0.000)	0.999
>1000	2.676(0.68-10.56)	0.16	0.220 (0.04-1.11)	0.067
Not eligible for the HVL Test	Ref		Ref	
Knowledge level				
Low level	9.00 (0.96-83.66)	0.056	0.274(0.01-6.15)	0.415
Moderate	5.587 (0.58-58.76)	0.132	0.172(0.01-4.22)	0.281
High	Ref		Ref	
Attitude				
Positive	Ref			
Negative	2.173(0.571-8.269)	0.255		
Perception				
Positive	Ref			
Negative	1.356 (0.409-4.493)	0.618		

P-value ≤0.05 indicates a statistically significant level, C0R-Crude odds ratio, AOR-Adjusted odd ratio.

CHAPTER FIVE

5.0 DISCUSSIONS

5.1 Prevalence of cryptococcal meningitis among study participants

The overall prevalence of cryptococcal meningitis in our study was found to be 1.7% which is slightly low compared to other studies conducted in Tanzania, such as studies done in Mwanza the prevalence was 7.1%, northern Tanzania the prevalence was 3% and in Dar es salam the prevalence was 11.7% (13,15,34). Similar to the global estimate of cryptococcal meningitis among people living with HIV (0.04 to 12) as well as the prevalence of disease in African countries ranging from 0.4 to 20% (30,32). The low prevalence of cryptococcal meningitis among study participants might be attributed to increased access to ART and HIV testing services in Sumbawanga Municipal Council in response to the national program on HIV/AIDS to achieve 95-95-95 targets (by 2025, 95% of all people living with HIV will know their HIV status; 95% of all people diagnosed with HIV to be on ART and 95% of people who are on ART to be viral suppressed) (6). Also, the variation in the prevalence of cryptococcal meningitis among the regions conducted in Tanzania might be due to different study designs and data collection methods.

Findings from this study have shown that the duration of participants in ART has a statistical significance on the prevalence of cryptococcal meningitis. Similar to the studies done in Malawi and Morogoro-Tanzania, results show that PLHIV naïve to ART has statistical significance to cryptococcal meningitis (36,56). However, different results were observed from a study conducted in Sierra Lione; the prevalence of cryptococcal meningitis among newly diagnosed was 6.6%, although it was not significantly associated with the disease (7). These findings are attributed to many PLHIV who have been diagnosed with HIV in late-stage when their immune systems were already severely compromised as a result of having opportunistic infections, including cryptococcal meningitis. It also may be attributed to poor adherence to ART because most of the participants (5.4%) were in a transition period of acceptance of their HIV status. Hence, they need more education and support to maintain adherence.

Participant adherence to ART has shown statistical significance associated with the prevalence of cryptococcal meningitis. This indicates that PLHIVs with poor adherence to ART are highly susceptible to opportunistic infections such as cryptococcal meningitis. Similar observations to a study conducted in Dar es Salam showed that PLHIVs who interrupted ART were statistically significant for cryptococcal meningitis(15). Interruption to ART unsuppressed viral load, compromising the immune system and leading to cryptococcal meningitis.

The prevalence of cryptococcal meningitis was significantly higher in hospitals (3%) than in health centers and dispensaries. The findings are similar to those of the study done in Lira, Uganda; almost half of the participants(35%) with cryptococcal meningitis sought health care at the primary level and were referred to tertiary hospitals. (54). This may reflect that most people diagnosed with cryptococcal meningitis have a high likelihood of having severe HIV complications caused to be referred/treated at Hospital levels because they have advanced diagnostic and treatment capabilities compared to health centers and dispensaries. This makes a call to action to improve diagnostic and treatments in primary health facilities (Dispensaries and Health centers), which will help early detection and management of HIV complications.

5.2 Immunological factor associated with cryptococcal meningitis

Findings have shown that participants with severely immunocompromised (CD4 below 200) have a statistically significant association with cryptococcal meningitis. Hence, the prevalence of cryptococcal meningitis among participants with a CD4 count of less than 200 was 20.9%. The result is slightly higher than the study conducted in Nigeria; the prevalence was 19% among PLHIV with CD4 below 200. However, the studies conducted in Dar es Salam and Morogoro showed that the prevalence of cryptococcal meningitis among PLHIV with CD4 count below 200 was higher compared to this study, which was 81.3% and 37%(15,47). Also, findings from Asia ranged from 34% to 72%, and the study highlighted that immunocompromised PLHIV are those who delayed ART and patients with unsuppressed viral load(39). This outcome highlights PLHIV with a low CD4 count in the risk profile for cryptococcal meningitis.

Among 639 study participants, 30 (4.8) % had viral load copies above 1000. The prevalence of cryptococcal meningitis among participants with a high viral load was 13.3%). However, the association between HVL copies and cryptococcal meningitis was not statistically significant. Similar to the outcomes of the study conducted in Botswana, CrAg positivity to PLHIV with unsuppressed viral load ranged from 4.8% to 21.9% but was not statistically significantly associated with cryptococcal meningitis (57). However, the results are slightly lower than the study conducted in Uganda; the prevalence of cryptococcal meningitis was 11% (26). Achieving and maintaining suppressing viral load to PLHIV is crucial in preventing cryptococcal meningitis.

5.3 Knowledge of study participants regarding cryptococcal meningitis

The findings reveal a significant gap in knowledge among most study participants regarding the cause, symptoms, effects, and preventions of cryptococcal meningitis (68%). Similar findings were observed in a study conducted in China and Asia, with participants with low knowledge levels ranging from 34% to 72% but slightly low in a survey conducted in South Africa. Participants with low knowledge levels were more than three-quarters (81%) in Asia (39,45). There is a need for strengthened continuous education and more interventions on awareness of cryptococcal meningitis because most HIV interventions prioritize awareness of other HIV opportunistic infections (58).

Knowledge of study participants regarding cryptococcal meningitis was statistically associated with participants' adherence and facilities' health levels. Similar findings observed in the study conducted in Uganda and Botswana have shown uneven knowledge of PLHIV regarding cryptococcal meningitis among health levels, and Nigeria observed low expertise among health care providers in primary health care regarding cryptococcal meningitis causing undiagnosed and untreated patients(48,59). This indicates that PLHIV, who have a better understanding of cryptococcal meningitis, have a high likelihood of having good adherence to ART. Statistically significant differences in knowledge based on health facilities reflect that some facilities, for example, hospitals, have trained staff to educate patients compared to health centers or dispensaries. This highlights the need for proactive measures, such as implementing programs to enhance educational efforts at all

healthcare levels, including continuous education to PLHIV and training healthcare providers.

5.4 The attitude of study participants towards cryptococcal meningitis

The study found that more than half of the participants had a positive attitude toward cryptococcal meningitis (55%) on aspects such as early engagement in HIV services, adherence to treatment, and avoiding discrimination among PLHIV. Similar findings were observed in the study conducted in Sierra Lione(7). The participants showed negative attitudes towards stigma, local beliefs, and discrimination which discouraged health-seeking among participants with cryptococcal meningitis. However, the majority of study participants(69%) believed awareness of cryptococcal meningitis can influence better health outcomes. Similar outcomes were observed in the study conducted in Uganda agreed patients delayed seeking medical care due to low knowledge of HIV complications including cryptococcal meningitis (54). These findings highlight the need to strengthen awareness of cryptococcal meningitis to PLHIV and community help to change attitudes of discrimination, stigma, and local beliefs that cause delayed engagement in HIV services and treatment adherence.

Based on characteristics of study participants; age category and duration on ART were statistically associated with attitudes towards cryptococcal meningitis. Differences in the age groups can cause varying experiences and knowledge regarding diseases. Also, those aged 18 to 35 are more prone to HIV disease. Similar findings were observed in a study conducted in Southern India (54.57 %) of youth with <35 years reported a high prevalence of cryptococcal meningitis compared to other age groups (60). This signifies the need for HIV implementation programs to strengthen health education for youth for better health outcomes.

5.5 The study participants' perception regarding cryptococcal meningitis

Study findings show that about two-thirds (62%) of participants have negative perceptions of cryptococcal meningitis. However, no statistically significant association existed between the study participants' perception and cryptococcal meningitis. This observation might be attributed to the low level of knowledge of study participants, which is supported

by studies conducted in Uganda and Nigeria on the role of continuous education and increased awareness of cryptococcal meningitis influencing perceptions of PLHIV on health-seeking behavior, prompt to early engagement to HIV services and adherence to ART. Hence, 60% of negative perceptions towards cryptococcal meningitis are associated with perceived cultural beliefs, and attempting to use painkillers and local medicine to heal themselves(53,54).

The baseline characteristics of study participants' perceptions regarding cryptococcal meningitis were statistically significant at the facility levels. These findings indicate the crucial role of health facilities in sharpening the perception of PLHIV through having trained healthcare providers, equipped training materials, and increased provider and patient interactions, which influence awareness of the disease, identify barriers and improve patient outcomes.

5.6 Study limitation

- 24 Participants (3.8%) were not tested for HVL because they were not eligible for the test; they didn’t attain six months on ART as recommended with national algorithms for HVL testing. This was mitigated by only the CD4 test used to assess the immunological status of study participants.
- Recall bias on past behaviors among study participants related to cryptococcal meningitis such as demographic information, ART regime, and adherence status. This was mitigated by excluding participants with inconvenient details from the study.
- The study didn’t assess the participants' environmental factors and living conditions, which might cause contact with cryptococcal species commonly found on bird droppings. This is mitigated by using proper statistical methods to control potential confounding factors, such as environmental factors in data analysis

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Based on our study findings, we conclude the following

The prevalence of cryptococcal meningitis among people living with HIV in Sumbawanga Municipal Council based on the cryptococcal antigen test (CrAg) was 1.7 %. This highlights the occurrence of this opportunistic infection in the population. PLHIV with a CD4 count below 200, poor adherence, and a duration of less than one year on ART were significantly associated with cryptococcal meningitis.

Despite the majority of PLHIV having low knowledge and negative perception, and nearly half have negative attitudes towards cryptococcal meningitis were not statistically associated with cryptococcal meningitis.

6.2 Recommendations

- To strengthen continuous education to PLHIV to increase awareness of cryptococcal meningitis
- Integration of HVL test to PLHIV diagnosed with cryptococcal meningitis and those with CD4 count less than 200 to check their Viral load after three months on ART.
- Scale up CD4 testing as well as ensure availability of reagents and test kits to promptly early identification of cryptococcal meningitis

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APPENDICES

Appendix I: Informed Consent Form (English Version)

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

DIRECTORATE OF RESEARCH & PUBLICATIONS

ID Number

Consent to participate in this study

Greetings. My name is Veronica Mwanyika. I am a student pursuing a Master of Public Health from Muhimbili University of Health and Allied Sciences. I want to invite you to participate in my research with the title, "to assess factors associated with cryptococcal meningitis among people living with HIV in the Sumbawanga Municipal Council, Rukwa, Tanzania."

You will be given details about the study. Feel free to ask if you require further explanation or need anything else.

Purpose of the study

This study aims to assess factors associated with cryptococcal meningitis among people living with HIV in the Sumbawanga Municipal Council.

Participation requirement involves

If you agree to participate in this study, the following will occur.

1. You will sign the consent form to confirm your agreement to participate in this study.
2. You will sit with a trained PI/Research assistant, and you will be required to answer questions that have been prepared for the study through a questionnaire to assess factors associated with cryptococcal meningitis among PLHIV.
3. You will be required to collect blood samples in one EDTA tube for a CD4 and CrAg test to examine cryptococcal meningitis.
4. All participant-identifying information, such as name, will be confidential and anonymous.

Confidentiality

I assure you that all the information collected from you will be kept confidential. Only people working on this research study will have access to the information. We will ensure that any information in your report does not identify you as a respondent, as we will not put your name or other identifying information on the records of the information you provide.

Possible risks

We do not expect any harm to happen because you participated in this study. Participating in this study does not cause any significant harm; participants will experience minor pain during blood sample collection. Also, participants might feel uncomfortable answering certain questions related to their attitudes and perceptions. Participants have the right to refuse to answer any particular question at any time.

Rights to withdraw and alternatives

Your participation in this study is entirely voluntary. If you decide not to participate in the research or if you choose to stop participating in the study, you will not get any harm. You can stop participating in this study at any time, even if you have already consented.

Benefits

The information you provide is essential and valuable and will inform policymakers, HIV implementing programs, and other stakeholders in the planning and effective implementation of strategies to reduce morbidity and mortality related to cryptococcal meningitis among PLHIV. The data collected will help to determine the prevalence and identify the associated factors for cryptococcal meningitis. Positively identified participants will be enrolled in treatments for cryptococcal meningitis. Also, after completion of study will help me to write and submit the dissertation as a requirement to be awarded my master's degree.

In case of injury

We are not anticipating that any harm will occur as a result of your participation in this study.

Compensation

There will be no compensation for time spent during the interview; however, your participation is highly appreciated**.**

Who to contact

If you have any questions about this study, please do not hesitate to contact

Veronica Mwanyika, the principal investigator, MUHAS, P.O.BOX 65001.Dar es Salaam. Tel: +255757941534, Email: veronicaemwanyika@gmail.com

A consent document.

Participant: I have read the consent form and understand the study's content and methodology. I agree to participate in this study.

Participant agrees ( )

Signature of participant _____

Signature of P.I/ research assistant _____

Date of signed consent _____

Appendix II: Fomu Ya Idhini Ya Taarifa (Toleo La Kiswahili)

CHUO KIKUU CHA AFYA NA SAYANSI SHIRIKISHI MUHIMBILI

KURUGENZI YA UTAFITI NA MACHAPISHO

Nambari ya Utambulisho

Kukubali kushiriki katika utafiti huu

Salamu. Jina langu ni Veronica Mwanyika. Mimi ni mwanafunzi anayefuatilia Shahada ya Uzamili ya Afya ya Umma kutoka Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili. Napenda kuwakaribisha kushiriki katika utafiti wangu na kichwa, "kutathmini mambo yanayohusiana na ugonjwa wa uti wa mgongo unaosababishwa na cryptococcal kati ya watu wanaoishi na VVU katika Halmashauri ya Manispaa ya Sumbawanga, Rukwa, Tanzania."

Utapewa maelezo kuhusu utafiti. Ikiwa unahitaji maelezo zaidi au kitu chochote usichoelewa jisikie huru kuuliza.

Madhumuni ya utafiti

Utafiti huu una lengo la kutathmini mambo yanayohusiana na ugonjwa wa uti wa mgongo unaosababishwa na cryptococcal kati ya watu wanaoishi na VVU katika Halmashauri ya Manispaa ya Sumbawanga.

Mahitaji ya ushiriki inahusisha

Ikiwa unakubali kushiriki katika utafiti huu, yafuatayo yatatokea.

1. Utasaini fomu ya idhini ili kuthibitisha makubaliano yako ya kushiriki katika utafiti huu.
2. Utakaa na msaidizi mkuu/ msimamizi msaidizi wa Utafiti aliyefunzwa, na utahitajika kujibu maswali ambayo yameandaliwa kwa ajili ya utafiti kupitia dodoso ili kutathmini mambo yanayohusiana na homa ya uti wamgongo unaosababishwa na cryptococcal kati ya watu wanao ishin na maambukizi ya VVU.

3. Utahitajika kukusanya sampuli za damu katika chupa moja la EDTA kwa kupimaji wa CD4 na CrAg kuchunguza ugonjwa wa homa ya uti wamgongo unao sababishwa na cryptococcal.
4. Taarifa zote za kutambua mshiriki, kama vile jina, zitakuwa za siri na zisizojulikana.

Usiri

Ninawahakikishia kwamba taarifa zote zilizokusanywa kutoka kwako zitawekwa siri. Watu tu wanaofanya kazi katika utafiti huu watapata habari. Tutahakikisha kwamba taarifa yoyote katika ripoti yako haikutambua kama mhojiwa, kwani hatutaweka jina lako au maelezo mengine ya kutambua kwenye kumbukumbu za habari unayotoa**.**

Hatari zinazowezekana

Hatutarajii madhara yoyote kutokea kwa sababu ulishiriki katika utafiti huu. Kushiriki katika utafiti huu hakusababishi madhara yoyote makubwa; Washiriki watapata maumivu madogo wakati wa ukusanyaji wa sampuli ya damu. Pia, washiriki wanaweza kujisikia wasiwasi kujibu maswali fulani yanayohusiana na mitazamo na mitazamo yake. Washiriki wana haki ya kukataa kujibu swali lolote wakati wowote.

Haki za kujiondoa na njia mbadala

Ushiriki wako katika utafiti huu ni wa hiari kabisa. Kama wewe kuamua si kushiriki katika utafiti au kama wewe kuchagua kuacha kushiriki katika utafiti, huwezi kupata madhara yoyote. Unaweza kuacha kushiriki katika utafiti huu wakati wowote, hata kama tayari umekubali.

Faida

Taarifa unayotoa ni muhimu na ya thamani na itajulisha watunga sera, mipango ya kutekeleza VVU, na wadau wengine katika kupanga na utekelezaji mzuri wa mikakati ya kupunguza magonjwa na vifo vinavyohusiana na ugonjwa wa meningitis ya cryptococcal kati ya PLHIV. Takwimu zilizokusanywa zitasaidia kuamua kuenea na kutambua sababu zinazohusiana na ugonjwa wa meningitis ya cryptococcal. Washiriki waliotambuliwa vyema watajiandikisha katika matibabu ya ugonjwa wa meningitis ya cryptococcal. Pia, baada ya kukamilika kwa masomo itanisaidia kuandika na kuwasilisha tasnifu kama mahitaji ya kupewa shahada ya bwana wangu.

Katika kesi ya kuumia

Hatutarajii kwamba madhara yoyote yatatokea kutokana na ushiriki wako katika utafiti huu

Fidia

Hakutakuwa na fidia kwa muda uliotumika wakati wa mahojiano; hata hivyo, ushiriki wako unathaminiwa sana**.**

Nani wa kuwasiliana

Ikiwa una maswali yoyote kuhusu utafiti huu, tafadhali usisite kuwasiliana

Veronica Mwanyika, mpelelezi mkuu, Chuo kikuu cha afya na sayansi shirikishi Muhimbili ,S.L.P 65001.Dar es Salaam. Tel: +255757941534, Barua pepe: veronicaemwanyika@gmail.com

Hati ya idhini.

Mshiriki: Nimesoma fomu ya idhini na kuelewa maudhui na mbinu ya utafiti. Ninakubali kushiriki katika utafiti huu

Saini ya mshiriki _____

Saini ya P.I / msaidizi wa utafiti _____

Tarehe ya idhini iliyosainiwa _____

Appendix III: Research Questionnaire

STUDY TITLE: FACTORS ASSOCIATED TO CRYPTOCOCCAL MENINGITIS AMONG PEOPLE LIVING WITH HIV IN SUMBAWANGA MUNICIPAL COUNCIL.

1. Form number **……**
2. Interview date **……**
3. Facility name……
4. Facility level**…….**
5. Patient ART regime
    a) 1st line
    b) 2nd line
    c) 3rd line
6. Patient adherence status on ART
    a) Good
    b) moderate
    c) Poor
7. Patient duration on ART ……

Part A: Social demographic information

Patient Age	
Sex	a) Male b) Female
BMI	a) Weight b) Height
Location	a) Rural b) Urban
Education level	a) Literate b) Illiterate
Marital Status	a) Single b) Married

Part B: To assess immunological factors associated with cryptococcal meningitis

CD4 count	a) Below 200	CrAg Test	a) Positive
	b) Above 200		b) Negative
HIVVL	a) HIVVL above 1000 copies	CrAg Test	a) positive
	b) HIVVL below 1000 copies		b) Negative

C: Knowledge assessment of cryptococcal meningitis **(cycle the correct answer)**

1. Have you ever heard of cryptococcal meningitis? (**check the one mentioned)**
   a) Yes
   b) No
2. Where do you hear/Learn about the cryptococcal meningitis? (**check all mentioned)**
   a) Health facility (hospital, Health centers and dispensary)
   b) School
   c) Family, friends, neighbors and colleagues
   d) Mass media (TV, Radio, Newspaper and billboards)
   e) Other (please explain)……
3. In your opinion how serious is cryptococcal meningitis? (**check the one mentioned)**
   a) Very serious
   b) Somewhat serious
   c) Not very serious
   d) I don't know
4. What is the cause of cryptococcal meningitis? (**check the one mentioned)**
   a) Viral infection
   b) Bacterial infection
   c) Malaria
   d) Fungal infection
   e) I don't know
   f) Other (please explain) ……

5. What are the symptoms of cryptococcal meningitis?
   a) Headache
   b) Diarrhea
   c) Neck stiffness
   d) Confusion
   e) I don't know
   f) Other (please explain) ……
6. What kind of people are more likely to get cryptococcal meningitis (**check all mentioned)**
   a) Patient with poor adherence to ART
   b) Patient with one month of ART dispensing
   c) Patients with CD4 below 200
   d) Patients with undetectable viral load
   e) Delayed ART initiation
   f) Patients more than 18 years old
   g) I don't know
   h) Other (please explain) ……
7. How can a person prevent getting Cryptococcal meningitis?
   a) Regular exercise
   b) Vaccination
   c) Lost to follow up
   d) Good adherence to ART
   e) I don't Know
   f) Other (please explain) ……
8. Why early diagnosis of cryptococcal meningitis is important?
   a) It prevents the infection from spreading to other people
   b) It allows for early treatment to reduce the risk of severe complications
   c) It helps to reduce the number of PLHIV
   d) It increases the interaction between patients and healthcare providers
   e) I don't Know
   f) Other (please explain) ……

9. How can PLHIV reduce the risk of contracting cryptococcal meningitis?
    a) By avoiding sugary food and regular exercise
    b) By communicating regularly with treatment supporter
    c) By maintaining a high CD4 count through effective ART adherence
    d) By having a sufficient amount of blood to dilute the HIV viral load
    e) I don't know
    f) Other (Please explain) ……...
10. How can someone with cryptococcal meningitis be cured?
    a) Herbal remedies
    b) Praying
    c) Specific drugs given to health facilities
    d) ARVs
    e) I don't know
    f) Other……

PART D: Attitude assessment on cryptococcal meningitis among People living with HIV

NO	Statements	Strongly disagree	Disagree	Not sure	Agree	Strong agree
1.	Understanding the cause of cryptococcal meningitis in People living with HIV is important for its prevention.	**1**	**2**	**3**	**4**	**5**
2.	I believe most newly diagnosed PLHIV seek medical care once they have HIV complications.	**1**	**2**	**3**	**4**	**5**
3.	Severe headaches and confusion are among the symptoms of cryptococcal meningitis	**1**	**2**	**3**	**4**	**5**
4.	I believe people with cryptococcal meningitis are stigmatized by their peers and society.	**1**	**2**	**3**	**4**	**5**
5.	I believe good adherence to ART can prevent cryptococcal meningitis.	**1**	**2**	**3**	**4**	**5**
6.	I feel it is improper to discriminate against a person with cryptococcal meningitis.	**1**	**2**	**3**	**4**	**5**
7.	I believe that knowing the symptoms of cryptococcal meningitis will prompt health-seeking.	**1**	**2**	**3**	**4**	**5**
8.	I believe cryptococcal meningitis can be prevented by early engagement in HIV care services.	**1**	**2**	**3**	**4**	**5**
9.	I believe PLHIV needs more education on opportunistic infections.	**1**	**2**	**3**	**4**	**5**
10	Cryptococcal meningitis can be prevented among people living with HIV	**1**	**2**	**3**	**4**	**5**
11	Financial constraints such as transport fees can cause poor adherence to ART.	**1**	**2**	**3**	**4**	**5**
12	During a normal clinical visit, PLHIVs don’t receive sufficient time to discuss their matters with a healthcare provider	**1**	**2**	**3**	**4**	**5**

PART E: Perception assessment on cryptococcal meningitis among People living with HIV

NO	Question	Frequency
1.	Have you ever experienced symptoms that could be related to cryptococcal meningitis	1) Never 2) Rare 3) Sometimes 4) often 5) Every time
2.	How much do you discuss cryptococcal disease with your healthcare provider	1) Never 2) Rare 3) Sometimes 4) often 5) Every time
3.	To what extent do you believe that early detection and treatment of cryptococcal meningitis can improve outcomes of PLHIV?	1) Never 2) Rare 3) Sometime 4) often 5) Every time
4.	How much you faced barriers in accessing health services for cryptococcal meningitis	1) Never 2) Rare 3) Sometimes 4) often 5) Every time
5.	How confident are you in discussing cryptococcal disease with your healthcare provider during routine visits?	1) Never 2) Rare 3) Sometimes 4) often 5) Every time
6.	How comfortable are you as people living with HIV	1) Never 2) Rare 3) Sometimes

		4) often 5) Every time
7.	How much does the community stigmatize you because you're living with HIV	1) Never 2) Rare 3) Sometimes 4) often 5) Every time
8.	How satisfied are you with health services and resources for managing HIV-related complications like cryptococcal disease?	1) Never 2) Rare 3) Sometime 4) often 5) Every time

Signature of P.I/research assistant _____

Date of signed _____

Kiambatisho IV: Maswali Ya Utafiti

UTAFITI WA KICHWA: MAMBO YANAYOHUSIANA NA UGONJWA WA HOMA YA UTI WA MGONGO KATI YA WATU WANAOISHI NA VVU KATIKA HALMASHAURI YA MANISPAA YA SUMBAWANGA.

1. Namba ya fomu .....

2. Tarehe ya mahojiano .....

3. Jina la kituo.....

4. Kiwango cha kituo.....

5. Daraja la dawa za mgonjwa wa VVU

   a) Daraja la kwanza
   b) Daraja la pili
   c) Daraja la tatu

6. Hali ya uzingatiaji wa mgonjwa kwenye matumizi ya dawa za virusi vya ukimwi

   a) Nzuri
   b) wastani
   c) Mbaya

7. Muda wa mgonjwa kwenye matumizi ya dawa za virusi vya ukimwi.....

Sehemu ya A: Taarifa ya idadi ya watu

Umri wa Wagonjwa	
jinsia	c) Kiume d) Kike
Kielelezo cha molekuli ya mwili	c) Uzito d) Urefu
Mahali	c) Vijijini d) Mjini
Kiwango cha elimu	c) Kujua kusoma na kuandika d) Kutojua kusoma na kuandika
Hali ya ndoa	c) Hajaoa/hajaolewa d) Ameoa/ ameolewa

Sehemu B: Kutathmini sababu za kinga zinazohusiana na ugonjwa wa homa ya uti wa mgongo

Wingi wa CD4	c) Chini ya 200	Kipimo cha CrAg	a) Chanya b) Hasi
	d) Zaidi ya 200		
Wingi wa virusi vya ukimwi	c) Wingi wa virusi zaidi 1000	Kipimo cha CrAg	a) chanya b) Hasi
	d) Wingi wa virusi chini ya 1000		

Sehemu C: Tathmini ya maarifa ya ugonjwa wa homa ya uti wa mgongo (mzungusha jibu sahihi)

1. Je, umewahi kusikia kuhusu ugonjwa wa homa ya uti wamgongo? (**angalia moja iliyotajwa)**
   a) Ndiyo
   b) Hapana
2. Usikia wapi / kujifunza kuhusu homa ya uti wamgongo? (**angalia yote yaliyotajwa)**
   a) Kituo cha afya (hospitali, vituo vya afya na zahanati)
   b) Shule
   c) Familia, marafiki, majirani na wafanyakazi wenzake
   d) Vyombo vya habari vya umma (TV, Redio, Magazeti na mabango)
   e) Wengine (tafadhali fafanua) .....
3. Kwa maoni yako ugonjwa wa uti wa mgongo una hatari kiasi gani? (**angalia moja iliyotajwa)**
   a) Kubwa sana
   b) kwa kiasi chake ni mbaya
   c) Sio mbaya sana
   d) Sijui
4. Ni nini sababu ya ugonjwa wa homa ya uti wa mgongo? (**angalia moja iliyotajwa)**
   a) Maambukizi ya virusi
   b) Maambukizi ya bakteria
   c) Malaria
   d) Maambukizi ya Fungal
   e) Sijui
   f) Wengine (tafadhali fafanua) .....
5. Ni dalili gani za ugonjwa wa homa ya uti wa mgongo?
   a) Kuumwa kichwa sana
   b) Kuhara
   c) Kukakamaa kwa shingo
   d) Kuchanganyikiwa

e) Sijui

f) Wengine (tafadhali fafanua) .....

6. Ni aina gani ya watu wana uwezekano mkubwa wa kupata ugonjwa wa homa ya uti wa mgongo? (**angalia yote yaliyotajwa)**

a) Mgonjwa mwenye ufuasi mbaya wa dawa za kupunguza makali ya VVU

b) Mgonjwa anaye pewa dawa za VVU kwa mwezi mmoja moja

c) Wagonjwa wenye CD4 chini ya 200

d) Wagonjwa walio na virusi visioweza kutambulika

e) Kuchelewa kuanzishwa dawa za VVU

f) Wagonjwa zaidi ya umri wa miaka 18

g) Sijui

h) Wengine (tafadhali fafanua) .....

7. Mtu anawezaje kuzuia kupata ugonjwa wa homa ya uti wa mgongo?

a) Mazoezi ya mara kwa mara

b) Chanjo

c) Kupotea kwa kufuatilia

d) Kufuata vizuri sanaa

e) Sijui

f) Wengine (tafadhali fafanua) .....

8. Kwa nini utambuzi wa mapema wa ugonjwa wa homa ya uti wa mgongo ni muhimu?

a) kuzuia maambukizi kuenea kwa watu wengine

b) Inasaidia kupunguza hatari ya kupata matatizo makubwa

c) Inasaidia kupunguza idadi ya maambukizi ya VVU

d) Inaongeza ushirikiano kati ya wagonjwa na watoa huduma za afya

e) Sijui

f) Wengine (tafadhali fafanua) .....

9. Mtu mwenye virusi vya ukimwi anawezaje kupunguza hatari ya kuambukizwa ugonjwa wa homa ya uti wa mgongo ?

a) Kwa kuepuka vyakula vyenye sukari na mazoezi ya kawaida

b) Kwa kuwasiliana mara kwa mara na msaidizi wa matibabu

c) Kwa kudumisha wingi wa CD4 na uzingatiaji mzuri wa dawa za VVU

d) Kwa kuwa na kiasi cha kutosha cha damu ili kupunguza wingi virusi vya ukimwa
e) Sijui
f) Nyingine (Tafadhali fafanua) .....

10. Mtu mwenye ugonjwa wa homa ya uti wa mgongo anawezaje kutibiwa?
    a) Tiba ya mitishamba
    b) Kuomba
    c) Dawa maalum zilizotolewa kwa vituo vya afya
    d) Dawa za virusi vya ukimwi
    e) Sijui
    f) Nyingine.....

SEHEMU D: Tathmini ya mtazamo juu ya ugonjwa wa homa ya uti wa mgongo kati ya Watu wanaoishi na VVU.

N	**Taarifa**	**Kutokubaliana kwa nguvu**	**Hawakubaliani**	**Sina uhakika**	**Kukubaliana**	**Kukubaliana kwa nguvu**
1.	Uelewa juu ya visababishi vya ugonjwa wa homa ya uti wa mgongo wa watu wanaoishi na virusi vya ukimwi ni muhimu ili kuzuia maabukizi	**1**	**2**	**3**	**4**	**5**
2.	Nina amini wagonjwa wanaogunduliwa na maambukizi	**1**	**2**	**3**	**4**	**5**

	ya VVU hutafuta tiba baada ya kupata matatizo yanayotokana na kuchelewa kuanza dawa za VVU					
3.	Kuumwa kichwa sana na kuchanganiki wa ni moja ya dalili za homa ya uti wa mgongo.	**1**	**2**	**3**	**4**	**5**
4.	Nina amini watu wenye homa ya uti wa mgongo wana nyanyapaliwa na jamiii	**1**	**2**	**3**	**4**	**5**
5.	Ninaamini kufuata vizuri kwa ART kunaweza kuzuia ugonjwa wa homa ya uti wa mgongo	**1**	**2**	**3**	**4**	**5**
6.	Nina amini si busara kumnyanyapa mgonjwa mwenye homa ya uti wa mgongo.	**1**	**2**	**3**	**4**	**5**
7.	Ninaamini kwa	**1**	**2**	**3**	**4**	**5**

	kufahamu dalili za ugonjwa wa homa ya uti wa mgongo kuna ongeza uharaka kufuata huduma za afya					
8.	Ninaamini homa ya uti wa mgongo inaweza kuzuiliwa kwa kutafuta mapema huduma za afya	**1**	**2**	**3**	**4**	**5**
9.	Naamini watu wanao ishi na VVU wanahitaji elimu zaidi juu ya maambukizi nyemelezi ya virusi vya ukimwi.	**1**	**2**	**3**	**4**	**5**
10	Ina wezekana kuzuia homa ya uti wa mgongo kwa watu wenye maambukizi ya virusi vya ukimwi	**1**	**2**	**3**	**4**	**5**
11	Vikwazo vya kifedha kama vile ada ya usafiri	**1**	**2**	**3**	**4**	**5**

	vinaweza kusababisha kufuata vibaya kwa ART.					
12	Katika mahudhurio ya kawaida kwa wagonjwa wa VVU, hawapati muda wa kutosha wa luzungumza na mtoa huduma wa afya	**1**	**2**	**3**	**4**	**5**

SEHEMU E: Tathmini ya utambuzi juu ya ugonjwa wa homa ya uti wa mgongo kati ya Watu wanaoishi na VVU

Namba	**Swali**	**Kiasi**
1.	Umewahi kupata dalili ambazo zinaweza kuhusishwa na ugonjwa wa homa ya uti wamgongo?	1. Kamwe 2. Nadra 3. Wakati mwingine 4. Mara nyingi 5. Kila wakati
2.	Kwa kiasi gani unajadili ugonjwa wa homa ya uti wa mgongo na mtoa huduma wako wa afya	1. Kamwe 2. Nadra 3. Wakati mwingine 4. Mara nyingi 5. Kila wakati
3.	Kwa kiwango gani unaamini kwamba kugundua mapema na matibabu ya ugonjwa wa homa ya uti wa mgongo inaweza kuboresha matokeo ya kuishi na maambukizi ya VVU	1. Kamwe 2. Nadra 3. Wakati mwingine 4. Mara nyingi 5. Kila wakati

4.	Ni kiasi gani ulikabiliwa na vikwazo katika kupata huduma za afya zinazo husiana na homa ya uti wa mgongo	1. Kamwe 2. Nadra 3. Wakati mwingine 4. Mara nyingi 5. Kila wakati
5.	Unapata ujasiri gani katika kujadili ugonjwa wa homa ya uti wa mgongo na mtoa huduma wako wa afya wakati mahudhurio ya kawaida?	1. Kamwe 2. Nadra 3. Wakati mwingine 4. Mara nyingi 5. Kila wakati
6.	Kwa mara ngapi unajikubali kwa kuwa unaoishi na virusi vya ukimwi?	1. Kamwe 2. Nadra 3. Wakati mwingine 4. Mara nyingi 5. Kila wakati
7.	Jamii inakunyanyapaa kiasi gani kwa sababu unaishi na VVU	1. Kamwe 2. Nadra 3. Wakati mwingine 4. Mara nyingi 5. Kila wakati
8.	Umeridhika vipi na huduma za afya na rasilimali za kudhibiti matatizo yanayohusiana na VVU kama ugonjwa wa homa ya uti wa mgongo.	1. Kamwe 2. Nadra 3. Wakati mwingine 4. Mara nyingi 5. Kila wakati

Saini ya P.I / msaidizi wa utafiti _____

Tarehe ya _____ iliyosainiwa

Appendix V: Study participants responses in percentage on Knowledge assessment regarding cryptococcal meningitis

Variables	N	Percentage (%)
Have you ever heard of cryptococcal meningitis?		
Yes	351	54.9
No	288	45.1
Where did you hear/ learn about cryptococcal meningitis?		
Health facility	399	62.4
School	127	19.9
Family, friends, neighbors, and colleagues	77	12.1
Mass media	31	4.9
Other	05	0.8
In your opinion, how serious is cryptococcal meningitis		
Very serious	376	58.8
Somewhat serious	94	14.7
Not very serious	53	8.3
I don't know	116	18.2
What is the cause of cryptococcal meningitis?		
Viral infection	175	27.4
Bacteria infection	29	4.5
Malaria	04	0.6
Fungal infection	119	18.7
I don't know	299	46.9
More than one response	13	2.0

What are the symptoms of cryptococcal meningitis?		
Headache	171	26.8
Diarrhea	133	20.8
Neck stiffness	15	2.4
Confusion	28	4.4
I don't know	281	43.9
More than one response	11	1.7
What kind of people are more likely to get cryptococcal meningitis?		
Patients with poor adherence to ART	343	53.8
Patient with one month of ART dispensing	09	1.4
Patients with CD4 below 200	86	13.5
Patients with undetectable viral load	20	3.1
Delayed ART initiation	95	14.9
Patients more than 18 years old	04	0.6
I don’t know	82	12.8
How can a person prevent getting cryptococcal meningitis?		
Regular exercise	58	9.1
Vaccination	28	4.4
Lost to follow up	44	6.9
Good adherence to ART	363	57.0
I don't know	137	21.4
More than one response	09	1.4

Why early diagnosis of cryptococcal meningitis is essential?		
It prevents the infection from spreading to other people	128	20.1
It allows for early treatment to reduce the risk of severe complications	246	38.6
It helps to reduce the number of PLHIV	54	8.5
It increases interaction between patients and healthcare providers	35	5.5
I don't know	176	27.5
How can PLHIV reduce the risk of contracting cryptococcal meningitis?		
By avoiding sugary food and regular exercise	01	0.2
Communicating regularly with treatment supporter	19	3.0
Maintaining a high CD4 count through adequate ART adherence	417	65.5
Having a sufficient amount of blood to dilute the HIV viral load	26	4.1
I don't know	163	25.5
More than one response	13	2.0
How can someone with cryptococcal meningitis be cured?		
Herbal remedies	15	2.4
Praying	03	0.5
Specific drugs given to health facilities	216	33.9
ARV's	274	43.0
I Don't Know	118	18.4
More than one response	13	2.0

Appendix VI: Approval for ethical clearance

UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

OFFICE OF THE DIRECTOR – RESEARCH, PUBLICATIONS AND INNOVATION

Ref. No.DA.282/298/01.C/ 2299 Date: 31/05/2024

MUHAS-REC-05-2024-2299
Veronica Eleutherius Mwanyika
School of Public Health and Social Sciences,
MUHAS.

RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED:

FACTORS ASSOCIATED WITH CRYPTOCOCCAL MENINGITIS AMONG PEOPLE LIVING WITH HIV INFECTION IN SUMBAWANGA MUNICIPAL COUNCIL, RUKWA, TANZANIA.

Reference is made to the above heading,

I am pleased to inform you that the Chairman has on behalf of the University Senate, approved ethical clearance of the above-mentioned study, on recommendations of the Senate Research and Publications Committee meeting accordance with MUHAS research policy and Tanzania regulations governing human and animal subjects research.

APPROVAL DATE: 31/05/2024
EXPIRATION DATE OF APPROVAL: 31/05/2025

STUDY DESCRIPTION:
Purpose:

The purpose of this study is to assess Factors associated with cryptococcal meningitis among people living with HIV infection in Sumbawanga Municipal Council, Rukwa, Tanzania.

The approved protocol and procedures for this study is attached and stamped with this letter, and can be found in the link provided:
https://irb.muhas.ac.tz/storage/Certificates/Certificate%20-%2014532.pdf and in the MUHAS archives.

The PI is required to:

1. Submit bi-annual progress reports and final report upon completion of the study.
2. Report to the IRB any unanticipated problem involving risks to subjects or others including adverse events where applicable.
3. Apply for renewal of approval of ethical clearance one (1) month prior its expiration if the study is not completed at the end of this ethical approval. You may not continue with any research activity beyond the expiration date without the approval of the IRB. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.
4. Obtain IRB amendment (s) approval for any changes to any aspect of this study before they can be implemented.
5. Data security is ultimately the responsibility of the investigator.
6. Apply for and obtain data transfer agreement (DTA) from NIMR if data will be transferred to a foreign country.
7. Apply for and obtain material transfer agreement (MTA) from NIMR, if research materials (samples) will be shipped to a foreign country,
8. Any researcher, who contravenes or fail to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine as per NIMR Act No. 23 of 1979, PART III section 10 (2)
9. The PI is required to ensure that the findings of the study are disseminated to relevant stake holders.
10. PI is required to be versed with necessary laws and regulatory policies that govern research in Tanzania. Some guidance is available on our website https://drp.muhas.ac.tz/.

Dr. Nahya S. Masoud

For Chairperson, MUHAS Research and Ethics Committee



Appenidix VII: Introduction Letter

UNITED REPUBLIC OF TANZANIA
MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY
MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
OFFICE OF THE DIRECTOR – POSTGRADUATE STUDIES

In reply quote;
Ref. No. HD/MUH/T.728/2022

31ST May, 2024

The Municipal Director.
Sumbwanga Municipal Council,
P.O. Box 187,
SUMBAWANGA

Re: INTRODUCTION LETTER

The bearer of this letter is Veronica Eleutherius Mwanyika (HD/MUH/T.728/2022) a student at Muhimbili University of Health and Allied Sciences (MUHAS) pursuing MPH-Distance Learning.

As part of her studies she intends to do a study titled: **"FACTORS ASSOCIATED WITH CRYPTOCOCCAL MENINGITIS AMONG PEOPLE LIVING WITH HIV INFECTION IN SUMBAWANGA MUNICIPAL COUNCIL, RUKWA, TANZANIA."**

The research has been approved by the Chairman of University Senate. Kindly provide her the necessary assistance to facilitate the conduct of her research.

We thank you for your cooperation.

Mr. Sebe Mohamed
For: DIRECTOR, POSTGRADUATE STUDIES

c.c. Veronica Eleutherius Mwanyika

9 United Nations Road; Upanga West; P.O. Box 65001, Dar Es Salaam: Tel. G/Line: +255-22-2150302/6; Ext. 1015; Direct Line:+255-22-2151378;Telefax:+255-22-2150465;E-mail:dpgs@muhas.ac.tz;Web:https://www.muhas.ac.tz

JAMHURI YA MUUNGANO WA TANZANIA
OFISI YA RAIS
TAWALA ZA MIKOA NA SERIKALI ZA MITAA
HALMASHAURI YA MANISPAA YA SUMBAWANGA

Unapojibu tafadhali taja

Kumb. Na.SMC/D.50/23/37 **04 Juni, 2024**

Vituo vyote vya Afya,
Manispaa ya Sumbawanga,
S.L.P 187,
SUMBAWANGA.

YAH: KUMTAMBULISHA NDUGU VERONICA ELEUTHERIUS MWANYIKA.

Tafadhari rejea mada tajwa hapo huu.

2. Ofisi ya Mkurugenzi wa Manispaa ya Sumbawanga ilipokea barua kutoka kwa Mkuu wa Chuo-MUHAS yenye **kumbu Na. HD/MUHT/T.728/2022** ya tarehe 31 Mei, 2024 iliyohusu kumtambulishwa ndugu tajwa hapo juu.

3. Kwa barua hii,napenda kumtambulisha ndugu tajwa hapo juu kuwa ni mwanafunzi wa Chuo Kikuu cha Afya Muhimbili anayetarajia kukusanya taarifa (Data collection in " ***Factors Associaed with Cryptoccal Meningitis among people living with HIV Infection*** ") katika Vituo vya Afya. Kazi hii itaanza tarehe 05 Juni, 2024 hadi 05 Julai, 2024. Hivyo mpatieni ushirikiano wenu.

4. Nashukuru kwa ushirikiano wako.

N. R. Ngua
KNY: MKURUGENZI WA MANISPAA
SUMBAWANGA.

KNY: MKURUGENZI
HALMASHAURI YA MANISPAA
SUMBAWANGA

Nakala:
Mkuu wa Chuo,
Chuo Kikuu cha Afya-Muhimbili,
S. L. P 65001,
DAR ES SALAAM

Appendix VIII: Digital Receipt

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Digital Receipt

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File size:	885.73K
Page count:	51
Word count:	10,566
Character count:	62,853
Submission date:	23-Oct-2024 09:57AM (UTC+0300)
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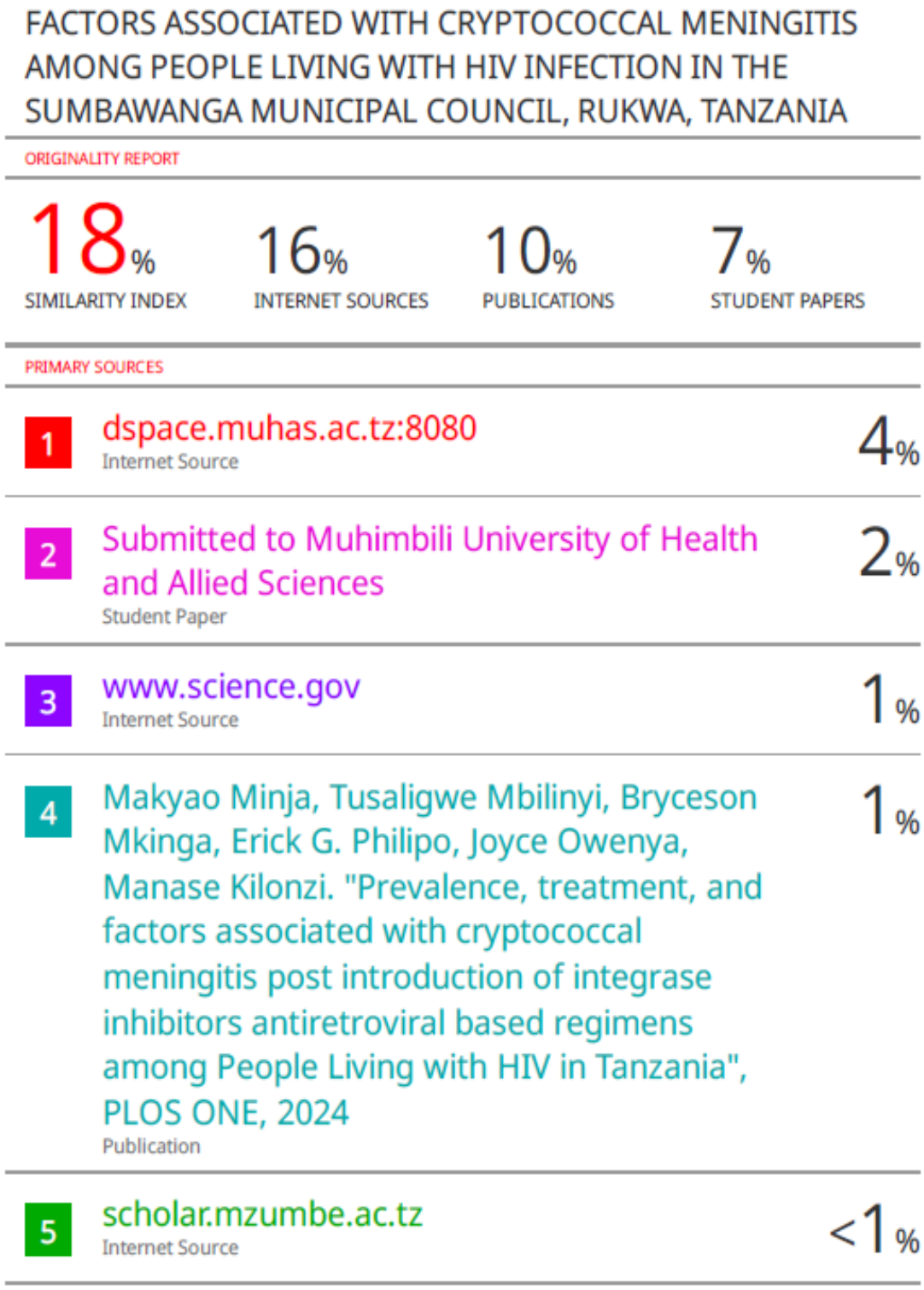
FACTORS ASSOCIATED WITH CRYPTOCOCCAL MENINGITIS AMONG PEOPLE LIVING WITH HIV INFECTION IN THE KEMBWANGA MUNICIPAL COUNCIL, IRINGA, TANZANIA

Veronica Khadevian Mwanyika

MSc. (Public Health) Dissertation
Muhimbili University of Health and Allied Sciences
October, 2024

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Appendix IX: Plagiarism report



FACTORS ASSOCIATED WITH CRYPTOCOCCAL MENINGITIS AMONG PEOPLE LIVING WITH HIV INFECTION IN THE SUMBAWANGA MUNICIPAL COUNCIL, RUKWA, TANZANIA

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