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EFFECT OF PEER SUPPORT INTERVENTION ON ADHERENCE TO ANTI-RETROVIRAL THERAPY AMONG HIV-POSITIVE YOUTHS IN TWO DISTRICTS IN THE ASHANTI REGION, GHANA

BY

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DECLARATION

I, Isaac Boadu, of the University of Ghana School of Public Health, Department of Population, Family and Reproductive Health, do hereby declare that this dissertation is my original work carried out under the supervision of Dr. Adom Manu, Dr. Emefa Modey and Prof. Richmond Nii Okai Aryeetey. References to other people's work have been duly acknowledged through citations.

I affirm that I have not previously submitted any portion or the entirety of this thesis for the purpose of obtaining any degree from any institution.

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DEDICATION

I dedicate this work to God Almighty, to whom all power belongs.

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"Nyame3 hyira 3m) paa"

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AIDS	Acquired Immunodeficiency Syndrome
AYA	Adolescents and Young Adults
AYPLHIV	Adolescents and Young People living with HIV
ART	Anti-Retroviral Therapy
ARV	Anti-retrovirals
GAC	Ghana AIDS Commission
GHS	Ghana Health Service
GSS	Ghana Statistical Service
HIV	Human immunodeficiency virus
HRQOL	Health Related Quality of Life
MOH	Ministry of Health
NACP	National AIDS/ STI Control Programme
PLHIV	Persons Living HIV
SSA	Sub Saharan Africa
STI	Sexually Transmitted Infections
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UNAIDS	United Nations Programme on HIV/AIDS
WHO	World Health Organisation

ABSTRACT

Background: Adherence to treatment in chronic diseases is a major challenge, particularly in HIV treatment and management, because Anti-Retrovirals (ARVs) are needed over a lifetime. Non-adherence to treatment is especially common among youth (15-24 years) living with HIV, with global and national evidence consistently showing lower adherence rates. Suboptimal adherence rates limit treatment effectiveness, increase the risk of disease transmission, increase morbidity and mortality, and undermine global HIV control efforts. There is limited evidence on strategies to improve adherence to ARV use among young people. This study assessed the effect of a peer support intervention on adherence to anti-retroviral therapy among young people living with HIV in Ghana.

Method: A quasi-experimental study involving a control and intervention arm was conducted among 228 youths aged 15-24 years diagnosed with HIV. Study participants were recruited from Anti-Retroviral Therapy (ART) clinics from two district hospitals in the Ashanti region, Ghana. With the support of clinic staff, HIV-positive peers were trained to deliver the study intervention. Participants from the intervention group received treatment support from their trained peers including a monthly home visit, daily Short Message Service (SMS) reminders on taking their medication, phone call reminders for scheduled clinic appointments, and monthly support group meetings in addition to HIV standard of care. The control group received the standard of care from the ART clinic as per the Ghana Health Service guidelines for the treatment and management of HIV. The primary outcome of the study, adherence, was measured using the Morisky medication adherence scale (MMAS-8) and complemented by the pill count method at enrolment and six (6) months after the intervention. In addition, data on participant's demographic and clinical characteristics, depressive state, stigma, disclosure, and viral load (from medical records) were obtained. Focus group discussions were conducted to explore the experience of participants on their involvement in the intervention.

Results: At pre-intervention, there was no significant difference in adherence levels (71.9% vs.70.2% by MMAS-8, 62.3% vs. 64.9% by pill count), depression state (31.6 % vs. 29.0%), internal stigma score (12.61 vs. 13.04), HIV disclosure (43.0% vs. 41.2%), and viral suppression (64.7% vs. 62.2%) between the intervention and control groups respectively. A difference-in-differences analysis showed that at post-intervention, the intervention group showed a significant improvement in ART adherence [change in MMAS-8: 19.1% (95% CI: 2.8, 35.4), change in Pill count: 30.2% (95% CI: 13.0, 47.4)]. Prevalence of depression state

decreased significantly in the intervention group (-26.1%, 95% CI: -42.6, -9.6), while internal stigma also showed a significant reduction of 2.61 (95% CI: -3.85, -1.35) percentage points. HIV disclosure and viral suppression improved slightly among the intervention group but were not statistically significant ($p>0.05$).

Conclusions: The peer support intervention was effective in improving adherence to ART, reduced depression and internal stigma among youths living with HIV. However, the intervention had no significant effect on HIV disclosure or viral suppression. These findings suggest that peer support intervention can be a valuable approach for enhancing ART adherence and addressing psychosocial challenges, such as depression and stigma among youths living with HIV. Additional strategies such as sustained adherence monitoring, prolonged intervention duration, and/or more frequent counselling may be required to achieve viral suppression and promote disclosure behaviours.

CHAPTER ONE

1.0 Introduction

This chapter covers the background to the study, problem statement, the main and specific objectives, significance of the study and the study hypotheses. It also entails the conceptual framework of the study.

1.1 Background to the study

Adolescents and young adults (AYA) represent a significant portion of the global population. Approximately 1.2 billion people (16%) of the world's population are adolescents. They account for about 6% of the global disease and injury burden, with over 1.2 million adolescent deaths occurring each year (UNICEF, 2019; WHO, 2020). In sub-Saharan Africa, adolescents comprise about 23% of the population, making them the largest demographic group in the region (UNICEF, 2019).

The World Health Organization (WHO) categorizes adolescents as individuals within the age bracket of 10-19 years, youths are between ages 15 and 24 years old and young people are between the ages 10 and 24 years old (WHO, 2021a). Adolescence is marked by major changes across multiple dimensions of human development including biological, physical, social, and psychological. These developmental changes present health risks and unique opportunities for health promotion (Sawyer et al., 2012; WHO, 2021b). The changes that occur during this period, significantly influence adolescents' attitudes, sexual behaviors, and social, economic, and health outcomes (WHO, 2021a).

Despite adolescents' increased health needs, high vulnerability, and large population size, global and national investments in adolescent and youth health have not gained much policy attention. This is often due to the perception that young people are generally healthy and have lower mortality risks compared to children and adults (Patton et al., 2016).

Adolescents and young adults are faced with many challenges as they transition to adulthood which require social support (Häggman-Laitila et al., 2019; Toth et al., 2018). Key among them is their sexual health and experience that exposes them to HIV/AIDS. Young people account for a considerable share of the global HIV-positive population. Globally, of the estimated 40.8 million people living with HIV at the end of 2024, over one million (1,010,000) were older adolescents aged 15-19 years (UNICEF, 2025a). In Ghana, young persons (15-24 years) accounted for about 27.5% (5,211) of all new HIV infections in 2020 (GAC, 2020). Adolescents are the only demographic group with rising mortality rates due to HIV in sub-Saharan Africa (SSA); SSA is home to about 81 percent of the world's HIV-positive adolescents (Casale et al., 2019; Judd et al., 2016).

The number of people living with HIV continue to increase due to the effectiveness of ART; this has increased survival of affected persons (Trickey et al., 2023). Together with the increasing number of new HIV infections, there is a growing number of persons living with HIV (Nguyen et al., 2021). The accurate diagnosis of youths living with HIV and ensuring that they are linked to care, and fully adhere to antiretroviral therapy (ART) is a unique intervention in the public health domain. The early initiation of ART has been shown to reduce mortality and morbidity in HIV patients, including AYA (Anglemyer et al., 2014; Bernays et al., 2014). As a result, the 2016 WHO ART recommendations suggested that all persons including children and adolescents diagnosed with HIV (CALHIV) are treated with ARV as soon as possible (WHO, 2016).

However, effective antiretroviral drug adherence is required for ART to be successful (Nachega et al., 2009). Adherence to ART does not only ensure the wellbeing of people living with HIV/AIDS but also helps to reduce the horizontal and vertical transmission associated with viral load suppression (Grimsrud et al., 2020). This outcome is important considering the

fragile and inadequate health systems in many sub-Saharan African countries where the majority of HIV-infected people live (Katz et al., 2018; Kharsany & Karim, 2016).

The effective control of the HIV epidemic requires interventions targeting young people and meeting their treatment needs. Such interventions require rapid linking of young people to care and maintenance of high levels of retention and adherence to ART. In addition, the interventions must be tailored to meet their specific needs such as stigma and depression which is common young people (Haberer et al., 2017; Murray et al., 2017). The role of peer supporters in the continuum of HIV care is critical and has been recognized (Mark et al., 2019; Willis et al., 2019).

Young people living with HIV face challenges regarding ART adherence; they also experience poor treatment outcomes (Mavhu et al., 2020; Nyongesa et al., 2022; Ryscavage et al., 2011). To support effective follow-up and monitoring of AYA living with HIV, peer-led interventions based in both community and clinical settings may play an important role in providing a differentiated care tailored to their unique needs (WHO, 2019a).

Using trained peer-led intervention, HIV positive young people can receive advice and support as well as share their experiences to improve outcomes such as retention in care, improved adherence to medication, and achieve viral suppression (Chinoda et al., 2020; WHO, 2019a). The concept of peer led group support is based on the idea that sharing information and experience will help people emotionally, socially, and practically (Simoni et al., 2011; Veinot, 2009). It has the potential to address the complex social and relational issues that have been linked to young people's desire to have a sustained adherence to HIV care and treatment (Grimsrud et al., 2020).

The WHO recommends peer support, including peer counseling for adolescents and young people living with HIV (AYPLHIV) aged 10-24 years (WHO, 2016). Peer support helps practitioners and programs to be more responsive, effective, sustainable, and important,

enabling AYPLHIV to pursue and stay in care and treatment (WHO, 2013). In other African countries such as Zimbabwe and Uganda, the engagement of peers in adolescent's HIV care and treatment has improved adherence to ART and other cascade of care of HIV (Mavhu et al., 2020; Willis et al., 2019).

Adolescents and young people living with HIV are either formally or informally engaged as peer supporters at health facilities or in communities to provide care for and promote the health and wellbeing of their peers (Mark et al., 2019; WHO, 2019a). A community and facility-based peer-led adolescent programme is therefore important to address the challenges faced by AYPLHIV such as a high level of depression, stigma and poor adherence to treatment.

1.2 Problem Statement

HIV/AIDS remains a global public health concern, having claimed approximately 44.1 million lives so far (UNAIDS, 2025). By the end of 2024, an estimated 40.8 million people were living with HIV worldwide, with 1.3 million new infections and 630,000 HIV-related deaths (WHO, 2025; UNAIDS, 2025). The HIV burden is disproportionally distributed as the African region accounted for 65% of all people living with HIV in 2024 (WHO, 2025). In Ghana, an estimated number of 342,307 people lived with HIV with 20,068 newly reported cases in 2019 and a prevalence rate of 1.6% (GAC, 2020).

Globally, adolescents and young people make up a growing proportion of those living with HIV. In 2024, adolescents and young people aged 15–24 years represented about 8% (3,264,000) of all people living with HIV, contributed 28% (364,000) of new infections, and accounted for 6% (37,000) of AIDS-related deaths (UNICEF, 2025a).

In Ghana, the HIV epidemic continues to significantly affect this age group, with serious implications for long-term public health outcomes. Of the 20,068 new cases of HIV reported

in Ghana in 2019, 2,972 (15%) and 5,613 (28%) were children (0–14 years) and youth (15–24 years) respectively (GAC, 2019).

HIV-positive young people require targeted psychosocial support as they negotiate developmental obstacles as well as HIV-related concerns such as stigma, depression, and sustaining long-term HIV health (Woollett, 2016). Studies have shown that compared to adults living with HIV, young people experience poor retention in care, have lower rate of adherence to antiretroviral therapy, face challenges in achieving viral suppression and have higher mortality (MacPherson et al., 2015; Nachega et al., 2009). Suboptimal adherence to ART complicate treatment by reducing the effectiveness of the medication, increasing the likelihood of viral resistance, and making it more challenging to achieve or maintain viral suppression (Paterson et al., 2002). There is also increased risk of viral transmission due to rapid viral replication (Cohen et al., 2011; Ferrand et al., 2017).

In some parts of Africa, several interventions have been implemented to address retention in care, stigma reduction, improved adherence, viral load suppression and psychosocial wellbeing among HIV patients (Chinoda et al., 2020; DiClemente et al., 2008; Sabben et al., 2019; Ssewamala et al., 2020). Despite these efforts, there have not been targeted interventions for AYA, particularly those that involve adopting a peer-led approach for addressing poor adherence and other treatment outcomes faced by AYPLHIV in Ghana.

Barker et al. (2019) conducted a study in Kumasi on in-clinic peer engagement among adolescents, focusing on self- and perceived stigma as well as clinic attendance, but without assessing adherence to ART and including a comparison group limiting the ability to determine the efficacy of the in-clinic support intervention. The study found improvements in both self- and perceived stigma and increased clinic attendance. The authors concluded that the intervention is a promising approach for enhancing peer engagement in HIV care.

In other African contexts, peer support interventions have been effective in improving adherence and treatment outcomes, including reduced stigma, depression and viral suppression (Mavhu et al., 2020; Willis et al., 2019).

However, in Ghana, there is limited studies on their effectiveness in improving ART adherence AYPLHIV. Ridgeway et al. (2018) conducted a systematic review to assess interventions to improve adherence to ART among adolescents in low-and middle-income countries. Among the fifty-one (51) studies included, none were conducted in Ghana. Similarly, of the six studies included in the review by Griffee et al. (2022) to examine interventions aimed at improving ART adherence among youth living with HIV in sub-Saharan Africa, none were conducted in Ghana. The authors highlighted that most of these interventions primarily focused on a single approach, such as mobile health, rather than adopting a multicomponent strategy that could effectively address the multidimensional barriers to adherence. There is no multicomponent peer-led adherence intervention previously tested in Ghana. To address this knowledge gap in evidence-based interventions, this study aimed to assess the effect of a peer-led intervention on adherence to ART among youths living with HIV in two districts in the Ashanti region of Ghana.

1.3 Justification

There has been a strong expressed global commitment to end the HIV epidemic by 2030. Achieving this target requires greater attention to programmes aimed at improving and preventing HIV infection among adolescents and young people (UNICEF, 2025b). Young people living with HIV require special psychosocial support and care as they navigate developmental challenges in addition to HIV-related issues including stigma prevention, and maintaining long-term HIV health. The primary focus of peer support intervention will be to enable young people to gain the necessary information, attitudes, and skills for positive

behavioural modification that are important in the HIV treatment process. This is important to improve their psychosocial wellbeing, adherence to ART, reduce stigma, depression and retention in care.

In Zimbabwe and other African countries, peer support intervention has improved adherence and other clinical outcomes (Mavhu et al., 2020; Willis et al., 2019). However, data on how effective such interventions will work in the Ghanaian setting is limited. There is therefore a need for empirical evidence of the effectiveness of this intervention approach in improving HIV treatment outcomes of AYPLHIV. This is important to inform programs and strengthen health interventions. The findings of this study will be relevant to stakeholders such as the Ghana Health Service and the National STI and AIDS control programme as well as policy makers in designing appropriate interventions to address the several barriers of adherence faced by young people (15-24 years) in the HIV care continuum. This study will also add to the body of knowledge on interventions aimed at improving health and wellbeing of young people living with HIV in Ghana.

1.4 General Objective

This study aimed to evaluate the effectiveness of a peer support intervention on adherence to antiretroviral therapy among HIV-positive youths in two districts in the Ashanti Region, Ghana.

1.4.1 Specific Objectives:

The specific objectives of the study were to:

1. Synthesize available evidence on adherence to ART in Ghana.
2. Assess the level of adherence to ART among youths on HIV treatment in Ghana.
3. Identify factors associated with adherence to ART among youths living on HIV treatment in Ghana.
4. Assess psychosocial wellbeing among youths living with HIV in Ghana.

5. Examine the influence of an integrated peer support intervention on adherence and psychosocial wellbeing among youth living with HIV in Ghana.
6. Explore participants' experiences and perceptions of the peer support intervention.

1.5 Study Hypotheses

The current study was designed to test the hypothesis that an integrated peer-led facility and community-based support intervention will improve adherence to anti-retroviral therapy and other outcomes such as stigma, depression, and HIV status disclosure among youths living with HIV.

1.6 Conceptual framework

The conceptual framework in this study is drawn from the socio-ecological model (SEM). The SEM is a tool for addressing health behaviours by attributing health outcomes to a number of factors. It recognises individual behaviour (adherence to ART) to be influenced by a dynamic complex interaction of factors in the ecosystem the person lives (Figure 1).

The SEM includes these levels: individual/intrapersonal factors, interpersonal, community, institutional/organisational and policy level factors (Chimphamba Gombachika et al., 2012).

The *individual level* focuses on the belief and attitude of HIV (understanding and accepting status) and personal characteristics such as self-efficacy, substance use, disclosure, depression, and knowledge of the disease condition (Becker et al., 2020; Yakob & Ncama, 2016). These are influenced by the information they receive on HIV and ART, including the risks of non-adherence.

The *interpersonal level* factors focus on socio-cultural norms that create barriers to care. It also includes the extent of support provided by friends, family and health care providers (social relationships) (Castro et al., 2015; Cornelius et al., 2018). In many sub-Saharan African countries, including Ghana, this level includes cultural values and religious beliefs on the cause

of disease, especially chronic diseases such as HIV/AIDS and its management. Young people diagnosed with HIV who receive psychosocial support from their peers are more likely to accept their status, link to care, adhere to ART medications, retain in care and subsequently achieve viral suppression (Mavhu et al., 2020). Improved support will lead to improved quality of life and reduce viral transmission. Adherence behaviour is influenced not only by individual characteristics but also by societal factors, including family support, which provides emotional encouragement, medication taking reminders and financial assistance especially for young people who may be limited financially; to cover the expenses for transportation to clinic appointments (Castro et al., 2015).

The *institutional level* factors focus on the role of health care systems in supporting patient's care. The goal of ART is to help the patient to achieve viral suppression, improve immune function and stop disease progression (Yakob & Ncama, 2016). The patient needs to be abreast with details of the disease process including drug side effects, acquire adequate information of their condition and receive quality care. Health care provider's attitude (friendliness), issues of confidentiality and trust, and good counselling skills etc. are important to help shape patient's adherence behaviour (Castro et al., 2015).

At the *community level*, factors such as perceived stigma, societal perceptions, and beliefs about HIV significantly influence adherence to ART. HIV is often seen as a deadly disease linked to sexual promiscuity. These societal perceptions can influence an individual's adherence behaviour either positively or negatively. For example, perceived stigma may discourage individuals from disclosing their HIV status or seek alternative treatment (Cornelius et al., 2018; Yakob & Ncama, 2016).

At the *policy level*, adherence to ART is influenced by national HIV/AIDS policies and programs. Key factors include the consistent availability of antiretroviral medications,

adherence to standardized treatment guidelines, and effective monitoring and evaluation of program implementation (Becker et al., 2020; Castro et al., 2015; Cornelius et al., 2018).

This study focused on the intrapersonal and interpersonal level factors of the SEM in improving adherence among young people living with HIV. At the individual level, peer support intervention which includes home visits, support groups and SMS on medication and appointment reminders were used to improve adherence to ART and other secondary outcomes such as stigma reduction, depression, and disclosure. At the interpersonal level, the peer support intervention emphasized the importance of seeking support from family, friends, and healthcare providers through disclosure of HIV status. Participants were encouraged to prioritize ART over traditional medicines and to trust accurate information provided by healthcare providers rather than misinformation from religious leaders. This approach was aimed to build a supportive network to improve adherence.

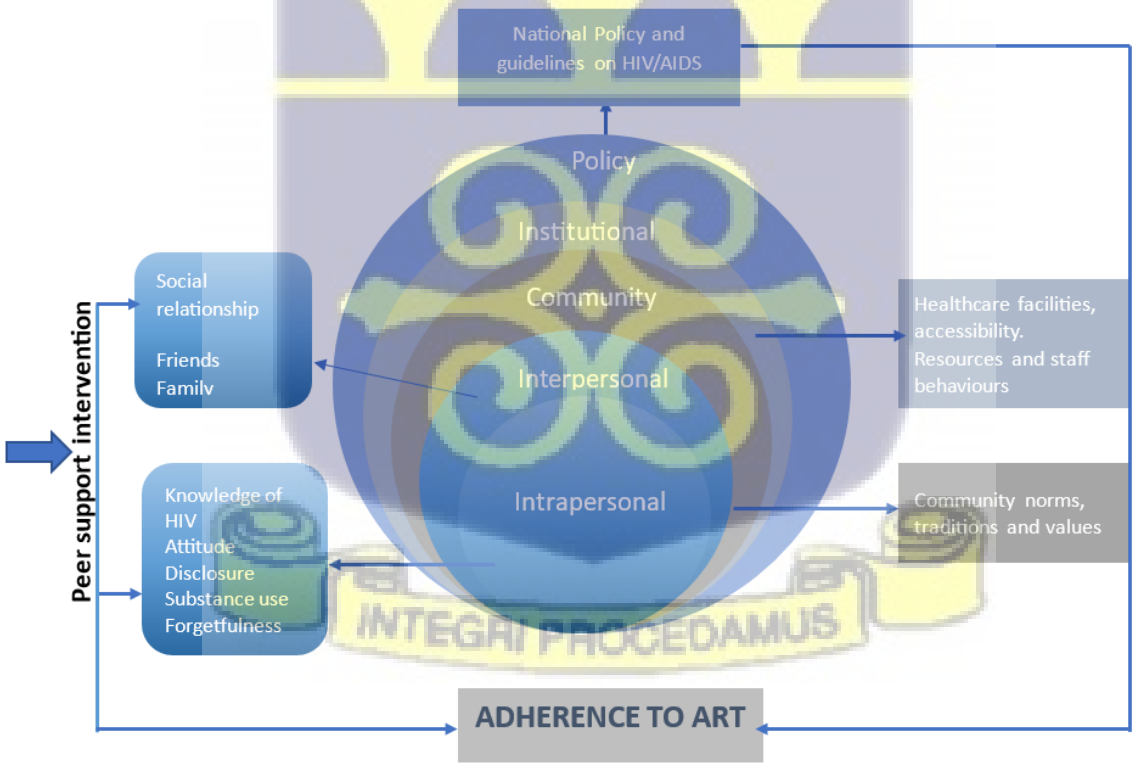

Figure 1. A conceptual framework of interrelated factors affecting Adherence to ART Adapted and modified from Bronfenbrenner (1994).

1.7 Philosophical Paradigm

In research, philosophy informs the beliefs, values, and assumptions that shape study design, including how reality (ontology), knowledge (epistemology), and data collection (methodology) are understood (Creswell & Creswell, 2017). Common paradigms include positivism, interpretivism, and pragmatism (Willis, 2007). Positivism assumes an objective reality independent of human perception, relying on empirical data, measurement, and quantitative methods to generalize findings (Mertens, 2023). In contrast, interpretivism emphasizes subjective reality constructed through social experiences, using qualitative methods to understand the meanings people assign to their experiences (Creswell & Creswell, 2017). This research adopted the pragmatism approach to examine the influence of peer support interventions on ART adherence among youth living with HIV. Pragmatism prioritizes the use of multiple methods (both quantitative and qualitative methods) to gain more understanding of or address complex issues (Creswell & Plano Clark, 2018). The quantitative component measured adherence and secondary outcomes (depression, stigma, viral suppression, disclosure), while the qualitative component explored participant experiences through focus group discussions on the benefits of the intervention. Findings were integrated to provide a comprehensive insight on the effect of the intervention.

CHAPTER TWO

2.0 LITERATURE REVIEW

Introduction

This chapter presents a review of relevant literature on related works on HIV/AIDS among young people living with HIV/AIDS. This includes overview of HIV/AIDS, the Global situation of HIV/AIDS, the burden of HIV/AIDS in Africa and Ghana, HIV/AIDS among AYA, treatment and care for young people living with HIV, Introduction of anti-retroviral therapy, supportive interventions for AYPLHIV, peer support models, interventions to improve adherence to ART among AYA including mobile health technology (mHealth) and peer support interventions.

2.1 Overview of HIV/AIDS

Acquired immunodeficiency syndrome (AIDS) is a chronic, life-threatening condition of the immune system caused by the human immunodeficiency virus (HIV). HIV targets and infects immune cells, impairing their function and increasing the body's susceptibility to opportunistic infections (Ramana, 2014; Rosen & Narasimhan, 2006). The disease was first reported by the US Centre for Disease Control and Prevention among gay men in the US in 1981 who presented with unusual clusters of *Pneumocystis carinii* pneumonia and Kaposi's sarcoma (Morison, 2001).

The most advanced stage of HIV infection is acquired immunodeficiency syndrome (AIDS), which occurs when the immune system becomes severely compromised and can no longer defend the body against illnesses/opportunistic infections, or when the number of immune system cells (CD4) falls below a recommended level (WHO, 2020). HIV transmission can occur through vertical transmission (mother-to-child; either in utero, intrapartum or postnatally through breast feeding), unprotected sex with infected partner, blood transmission etc (Ganguly et al., 2018; Myburgh et al., 2020; Nakamura et al., 2017; Shah & Kaware, 2019). HIV is not

transmitted through everyday activities like sharing food, water, or personal belongings, or through casual contact such as hugging, kissing, or shaking hands (WHO, 2020).

Behavioural factors that increase HIV sexual transmission include multiple sexual partners, and concurrent partnerships (Tanser et al., 2011). Depending on the stage of HIV infection, symptoms may vary among individuals. Common symptoms in the few weeks of infection include fever, headache, rash or sore throat. With time, as infected individual become immunocompromised, other symptoms including weight loss, fever, swollen lymph nodes, cough and diarrhoea may be observed (WHO, 2020).

Complications in patients with HIV/AIDS include neurologic, wasting syndrome, liver disease, certain cancers, hematologic disorders, cardiopulmonary, cardiovascular disease, kidney disease, gastrointestinal and metabolic disorders, tuberculosis, oral lesions (WHO, 2020). Several studies (Afessa et al., 1998; Leao et al., 2009; Letendre, 2011; McArthur et al., 2005; Sloand, 2005) have reported on these complications among HIV patients. In a Systems-Based Approach review on the complications of HIV Infection, Chu and Selwyn (2011) identified key complications of HIV to be neurologic, cardiopulmonary, and gastrointestinal disorders (CDC, 2011; Chu & Selwyn, 2011). At present, no vaccine exists to prevent HIV infection, and there is no cure for AIDS. Nevertheless, HIV transmission can be avoided by taking preventive steps to protect both oneself and others (WHO, 2020).

2.2 Global Burden of HIV/AIDS

Since the discovery of HIV/AIDS in 1981, the disease has spread rapidly and now considered as a global health issue. Despite several gains in reducing the disease burden among populations, HIV/AIDS continues to claim the lives of many people across the globe. As of the end 2024, estimates show that about 44.1 million people have died of AIDS related illness (WHO, 2025). Globally, an estimated 40.8 million people were living with HIV (PLHIV) at

the end of 2024, with 1.3 million new infections and 630,000 AIDS-related deaths (WHO, 2025; UNAIDS, 2025). The burden of HIV/AIDS is disproportionately distributed, with the African region accounting for the majority (65%; 26 million) of all people living with HIV in 2024 (UNAIDS, 2025). Demographic stratification of HIV/AIDS infection at the end of 2024 shows that, of the 40.8 million people living with HIV/AIDS, 39.4 million and 1.4 million were adults (15 years and older) and children aged 0-14 years, respectively (UNAIDS, 2025).

Globally, young people aged 15–24 years have a high prevalence of HIV and AIDS cases, with females being disproportionately impacted (Dellar et al., 2015; MacPherson et al., 2012). Women and young girls are more susceptible to HIV infection than men and boys. This is because biologically, women have a greater mucus area which expose them to HIV during penile penetration and those under age 17 years are even more at risk because of underdeveloped cervix and low vaginal mucus production (Reis Machado et al., 2014). Women's risk is also associated with their exposure to societal gender inequities. Social and economic stresses as a result of poverty increases women's risk of HIV infection (Frew et al., 2016; Krishnan et al., 2008; Reis Machado et al., 2014). HIV transmission is also increased with concurrent sexually transmitted diseases (Frew et al., 2016; Reis Machado et al., 2014; Sathiyasusuman, 2015).

In 2024, key populations such as transgender people and their partners, female sex workers (FSWs), men who have sex with men (MSM), people who inject drugs, accounted for over half of all new HIV infections (UNAIDS, 2024). The global target of reducing HIV to 500,000 by the end of 2020 was not achieved, as 680000 people died of AIDS. At the end of 2020, 84 percent (31.6 million) of HIV-positive persons knew their status, 73 percent who knew their status (27.4 million) were receiving treatment, and 66 percent of those on treatment (24.8 million) had their viral load suppressed (UNAIDS, 2021). Despite these achievements, the 90-90-90 targets were not met. Some important questions that warrant consideration include;

which population failed to reach the targets and why, how can meeting the targets be equitable among populations and what can be done differently in terms of service provisions to ensure that these targets are met in the future?

The global financial response to HIV disease is becoming a challenge. With the onset of the global COVID-19 pandemic, countries are channelling resources to address the impact of the threatening pandemic. The global improvements in the reduction of morbidity and mortality among people living with HIV/AIDS is driven by several investments. Estimates from the UNAIDS show that at the end of 2024, US$ 18.7 billion was available for the fight against HIV/AIDS in low and middle-income countries, with around 52% coming from domestic sources (UNAIDS, 2025).

The Global Fund has estimated an amount of US$29.3 billion annually to be required to end HIV/AIDS as a global public health threat. Despite the proposed increased amount to respond to HIV/AIDS, global funding seems to be declining (UNAIDS, 2024). According to UNAIDS fact sheet on HIV/AIDS, funding has declined by 5% and 7% between 2022 to 2023 and 2020 to 2023 respectively (UNAIDS, 2024). This substantial reduction is likely to have an impact on the global response to HIV/AIDS, mainly in treatment and services.

2.3 HIV/AIDS Burden in Africa

Over the years, Africa has been home to a greater number of HIV/AIDS infections and its related deaths. The global HIV/AIDS epidemic is much centred in Africa. As of the end of 2023, about 65% of people with HIV/AIDS were living in the Africa region (UNAIDS, 2021). It is estimated that in sub-Saharan Africa, approximately six out of every seven new HIV infections occur among adolescent girls aged 15–19 years. Additionally, about 4,200 adolescent girls and young women aged 15–24 years are newly infected with HIV every week (WHO, 2021; UNAIDS, 2021). The advent of antiretrovirals introduced in early 2000s in most

African countries has improved survival and reduced AIDS related mortality. As of the end of 2023, AIDS related deaths stood around 390,000, a decrease of about 56% from 2010 (UNAIDS, 2024a).

The drive in the high prevalence of the HIV epidemic in Africa has been ascribed to a complex interplay of social issues including poverty a well as cultural and behavioural factors (Godfrey-Faussett et al., 2022). For instance, poverty puts women into prostitution increasing their risk of infection. High promiscuity (men engaging in extra-marital affairs when their wives deliver) and unprotected sex (low condom use) and low coverage of pre-exposure prophylaxis (PrEP) especially among high risk groups such as FSWs and MSM, on the other hand seems to be another major problem with the HIV burden in the African region (Dwyer-Lindgren et al., 2019; Parikh, 2007). Although significant progress has been made globally in controlling the HIV epidemic in the past 40 years, many countries in sub-Saharan Africa are still falling behind UNAIDS targets. Compared to some high income countries like the UK and Sweden where UN targets of 90-90-90 (2020) were met and even 95-95-55 (2030) have already been met in some cities such as London in the UK, meeting these targets has been a challenge in many Africa countries (Gisslén et al., 2017).

The lack of adequate preventive and treatment services is a major challenge in HIV response among many Africa nations. While some countries in Western and Northern Africa have concentrated epidemics, the continental countries in Southern and Eastern Africa all have generalized epidemics; a categorization independent of the burden of disease in population subgroups (UNAIDS, 2021). The AIDS epidemic varies greatly from northern to southern African states. Countries in Northern Africa have significantly lower prevalence rates, as their populations typically engage in fewer high-risk cultural norms that promote the transmission of the virus. Southern Africa is the worst-affected region on the continent, with approximately 25% of new infections. Heterosexual contacts are the main route of transmission in Africa, and

sex work and sexual violence contribute significantly to the spread of the disease (Dwyer-Lindgren et al., 2019). The success in achieving a collective global target implies a greater focus on HIV/AIDS prevention in sub-Saharan Africa.

2.4 HIV/AIDS in Ghana

In Ghana, the burden of HIV/AIDS is of concern. Reports from the Ghana AIDS Commission shows a modest progress in responding to the disease burden. In 2019, the national prevalence of HIV among adults was reported to be 1.69% with 20, 068 new infections. This is about 23% decrease from 2006 (2.2%). Children (0 –14 years) and youth (15 – 24 years) accounted for 2,972 (15%) and 5,613 (28%) respectively of these new infections (GAC, 2019). The HIV/AIDS burden is disproportionately distributed across districts and regions in the country. The top three regions with the highest number of people living with HIV by all ages as of 2019 according to the Ghana AIDS commission, was Greater Accra (94,104), Ashanti (76,672) and Eastern (42,446). Recent data from the AIDS Commission in Ghana in 2023 shows that about 334,095 people live with HIV with 17,774 new infections and 12,480 AIDS-related deaths (GAC, 2024).

At the districts level, the prevalence of HIV in 2019 varies from 5.56% (highest) in Lower Manya Krobo to 0.07% (lowest) in the Tolon and Karaba districts (GAC, 2019). Women and girls account for the greater number of HIV infections in Ghana. Estimates show that about two-thirds (2/3) of Ghanaians living with HIV are women (GAC, 2020). Of the number of people living with HIV (342, 307) in 2020, 64% (219, 986) were females. Surveys in Ghana indicate high proportion of HIV burden among high risk groups. For example, the integrated biological surveillance data in 2017 and 2019 shows that FSWs and MSM accounted for 18.1% and 4.6% of the HIV prevalence in Ghana respectively (GAC, 2019).

Since the discovery of HIV/AIDS in Ghana in 1986, national response to address the disease burden has been impressive. These include the establishment of the National AIDS control programme (NACP) in 1987 and the Ghana AIDS commission (GAC) in 2000. The NACP and GAC are mandated to monitor the spread and incidence of HIV in Ghana and to develop policies to help protect people living with HIV (Opoku et al., 2022). Strategic frameworks (national HIV and AIDS Strategic Plan 2011-2015 and the National HIV and AIDS Strategic Plan 2016-2020) have been developed to guide national response to the epidemic (GAC, 2019). The sole aims of the strategic plans are to save lives and avert new infections among populations. In 2020, a new national HIV/AIDS strategic plan was developed. The framework's preventative objectives include reducing new HIV infections in the general population by 85% by 2025 and in young people (15–24 years old), particularly adolescent girls and young women, by 85% by 2025 (NACP, 2020).

While Ghana could not meet the 2020 UNAIDS goals of 90-90-90 (UNAIDS, 2019), there is impressive progress to meet the 2030 UNAIDS 95-95-95 goals. As of 2021, 64% of people living with HIV knew their HIV status, 96% of those living with HIV were on ART and 73% of people on ART achieved viral suppression (GAC, 2021).

Despite progress in national response to HIV/AIDS, there exist several challenges in HIV care and prevention in Ghana. Challenges include poor adherence to ART, low condom use and increase in new infections (GAC, 2019).

Patient's adherence to ART is important for improving CD4 count, achieving viral suppression, and quality of life while preventing medication resistance (Dzansi et al., 2020). In 2016, Ghana adopted the 'TREAT ALL' policy in accordance with the WHO Consolidated guidelines on the use of ART for the treatment and prevention of HIV infection which is currently being implemented nationally (UNAIDS, 2019). Compared to 2003 when ART was introduced in

Ghana, coverage has improved significantly, reaching 46.6% among adults aged 15 years and above, 53.8% among women aged 15 years and above, and 25.6% among children aged 0–14 years in 2019 (GAC, 2019). Despite Ghana's efforts to meet both national and global HIV targets, progress has been minimal; in 2020, HIV-related mortality was estimated at 13,616 deaths; with those 15 years and above; 11,175 (82%) and children aged 0–14 years (2,441; 18%) (GAC, 2020).

Stigma reduction is among the major factors for the success of HIV/AIDS programme targeting prevention and control (Mak et al., 2017; Nyblade et al., 2021). In Ghana, a major barrier to address HIV burden is stigma (GDHS, 2014). Stigma has been widely shown to impede treatment services leading to higher rates of morbidity and mortality (Ankomah et al., 2016). For instance, the 2014 national demographic and health survey (GDHS) data showed that majority of women (92%) and men (85%) expressed unacceptable attitudes towards persons living with HIV (GDHS, 2014).

HIV related Stigma has been reported at almost everywhere including schools, churches, communities, homes and social clubs (GDHS, 2014; Kwansa, 2013). As effort to achieve zero discrimination of HIV/AIDS, there is the need to address the misconceptions of HIV/AIDS in Ghana.

2.5 HIV/AIDS among young people

The occurrence of HIV/AIDS among young people is of great public health concern because infection during adolescence is associated with long-term health complications, poor treatment adherence, psychosocial challenges, and increased risk of onward transmission (Yi et al., 2018). In sub-Saharan Africa, many adolescents living with HIV acquire the infection perinatally (through mother-to-child transmission), and with improved access to ART, increasing numbers of perinatally infected children are surviving into adolescence. This makes

vertical transmission an important contributor to the burden of HIV among young people (Yi et al., 2018). Adolescents living with HIV face several challenges that hinder adherence to ART. These include poor adherence to medications, increased stigma, delayed diagnosis, and non-disclosure of their HIV status (Hlophe et al., 2023). Fear of revealing their HIV status often leads to non-disclosure, with some adolescents also experiencing denial of care by legal parents or guardians due to personal reasons. In addition, structural factors such as poverty (cost to health care centres) and beliefs in alternative treatments further complicate adherence (Kim et al., 2017). Restrictive legal and policy environments, which limit adolescents' ability to consent to healthcare services, exacerbate these barriers, making it makes it more challenging for them to access and consistently adhere to essential treatment (Busza et al., 2016; Ramirez-Avila et al., 2012; Siu et al., 2012; Zgambo et al., 2018). These problems worsens treatment outcomes and increases the chances of infection and prevention of the disease (Casale et al., 2019).

Despite significant global gain in HIV response, the treatment, care and prevention of HIV among adolescents lags behind other age groups (UNAIDS, 2016). Every year, a substantial number of AYA get infected with HIV and records a high mortality rate. For example, in 2025, UNICEF estimated that approximately 370,000 young people between the ages of 15 to 24 were newly infected with HIV (UNICEF, 2025a). In Ghana, new HIV infections among young people aged 15 to 24 were estimated at 5,211 in 2020. Young people also accounted for 0.70% of the total prevalence of HIV/AIDS in 2022 (NACP, 2020). These numbers have been projected to increase without appropriate interventions targeting young people.

According to the UNAIDS, adolescents represent the only age group in which HIV-related mortality is not declining (UNAIDS, 2016). This persistent mortality burden is attributed largely to limited attention to adolescents within national HIV strategies, inadequate access to

and uptake of HIV testing, counselling, and treatment services, as well as insufficient support systems to facilitate retention in care and medication adherence (WHO, 2019a).

HIV presents several health and social challenges in the lives of adolescents. These include cognition (developmental delays and learning problems), emotional difficulties which may be as a result of a loss of HIV positive parent, school problems (miss school to attend clinic appointments) and peer problems as a result of stigma associated with HIV (Abubakar et al., 2016; Gilliam et al., 2011; Kimera et al., 2020; Zinyemba et al., 2020). Adolescents and young adults have multiple and complex health needs, including nutrition, sexual and reproductive health, and mental health, as well as education, livelihoods, and other social services that contribute to their overall wellbeing (UNICEF, 2021).

The attainment of the UN sustainable goal 3 of "ensuring healthy lives and promote wellbeing for all at all ages" and HIV/AIDS global target of '95-95-95' require an urgent need for investment in the design and implementation of a more intensive, feasible, culturally sensitive and sustainable interventions to address the several challenges facing AYPLHIV.

The improvement of HIV-related outcomes among adolescents requires a comprehensive and integrated approach that responds to their unique and evolving needs. Such efforts can be strengthened by aligning with global commitments to adolescent health, including the Global Strategy for Women's, Children's and Adolescents' Health (2016–2030) and the Global Accelerated Action for Adolescents' Health framework. These initiatives provide structured guidance for policymakers in the prioritization, planning, implementation, monitoring, and evaluation of adolescent health programs, including those addressing HIV prevention, care, and treatment (WHO, 2019a).

2.6 Knowledge and attitudes of HIV/AIDS

An important aspect of HV/AIDS treatment and prevention programmes is knowledge of people in these domains (treatment and prevention) and transmission pathways (Guure et al., 2020). Knowledge of HIV/AIDS among young people is important in decision-making and designing intervention strategies to protect them from infection. There is an increasing body of evidence on HIV-related knowledge and attitudes of young people in high-income countries (Andrew et al., 2020; Andrew et al., 2019; Gebremedhin & Keane, 2020), in Ghana (Abruquah & Bio, 2008; Asamoah et al., 2017; Darteh, 2020; Kenu et al., 2014; Oppong & Oti-Boadi, 2013; Seth et al., 2012; Tarkang et al., 2019) and other Africa countries (Badru et al., 2020; Beebwa et al., 2021; Estifanos et al., 2021; Hong et al., 2012; Kejela et al., 2015; Pharr et al., 2017; Shamu et al., 2020).

An individual's knowledge of HIV may influence medication adherence either positively or negatively, depending on the depth, accuracy, and personal interpretation of the information. In a qualitative study in Tanzania, increased knowledge of HIV and support for treatment were identified as the factors positively influencing ART adherence among adolescents (10 -19 years) (Audi et al., 2021). There are disparities in the findings of the level of knowledge among young people from different settings. For instance, in the study by Andrew et al. (2020) in US, the authors concluded that most students (96.5%) demonstrated high levels of HIV/AIDS knowledge and positive attitudes (87.8%). In addition, there was an association between knowledge of the disease and positive attitudes toward HIV/AIDS patients. Similarly, Abiodun et al. (2014) found high knowledge of HIV among undergraduate adolescents in Nigeria with males having significantly higher knowledge than females.

On the other hand, a household survey conducted in South Africa showed low level of knowledge of HIV among the participants; less than half (44.7%) had correct knowledge of HIV prevention (Shamu et al., 2020). In the study of Tagoe and Aggor (2009) low level of

knowledge was observed among female undergraduate students. The difference in the knowledge level of these studies could be due to the characteristics of the study participants (undergraduate or senior high school students), the study setting (urban or rural; community or in-school). Other possible explanation could be due to the year the study was conducted. Due to the current scale of HIV education interventions, more people are becoming aware of HIV transmission dynamics including treatment and prevention of the disease (Perazzo et al., 2017).

2.7 Treatment and Care for Young People Living with HIV

The treatment and care services provided for young people with HIV are key to achieving the global targets of ending the HIV epidemic. It is recommended that the care and services provided for this population should be friendly and tailored in addressing their complex needs (WHO, 2019a). It is important that health care providers interact with adolescents bearing in mind that these are individuals with unique needs, wants and hopes for the future. For instance, disclosure of HIV status by healthcare workers need to be done in such a way that it does not present psychological, emotional harm and adherence problems.

Several programs, strategies and interventions have been implemented to respond to the unique challenges encountered by AYAPLHIV. These interventions include counselling, support groups, mentorship programs, community adherence clubs, mobile health (mHealth) initiatives, delivered through community-based platforms, school settings, health facilities, or a combination of these approaches (UNICEF, 2021; WHO, 2013). These services have had a positive impact on HIV outcomes including retention in care, adherence and viral load suppression (UNICEF, 2021).

Lee et al. assessed the influence of youth-friendly care structures on retention in HIV care among AYA in the United States. Their findings indicated that youth living with HIV (YLHIV) were more likely to be retained in care at clinics with youth-friendly waiting areas and where

providers had received specialized training in adolescent health. The study concluded that youth-friendly service structures play a critical role in improving retention among YLHIV (Lee et al., 2016). The WHO recommends that adolescent-friendly HIV services should be guided by key principles including equity (ensuring that all adolescents can access needed services), accessibility (making services reachable and usable by adolescents), acceptability (aligning services with adolescents' needs and expectations), and appropriateness (delivering the right services). However, in many low- and middle-income countries, including Ghana, adolescents living with HIV often do not receive services that fully adhere to these principles, contributing to suboptimal treatment outcomes in this population (WHO, 2019a).

2.8 Introduction of Anti-Retroviral Therapy

Since the discovery of HIV in 1981, there has not been any cure for the epidemic; the virus is managed with anti-retroviral therapy (ART). Antiretroviral therapy (ART) is the standard treatment for individuals living with HIV/AIDS and typically involves a combinatioytujh6mnn of three or more antiretroviral medications (Aderemi-Williams et al., 2021).

In 1987, the first ART was introduced, Azidothymidine (AZT), now Zidovudine, in the US to help prevent disease progression by slowing viral replication (ART blocks different stages of the virus life cycle) (Pau & George, 2014; Vella et al., 2012; Zolopa, 2010). The paediatric AIDS clinical trial group (ACTG) study (a randomized, double-blind, placebo-controlled trial) demonstrated that zidovudine administered to HIV-positive pregnant women decreased vertical transmission from 22.6 to 7.6 percent, demonstrating the prophylactic advantages of ART (Connor et al., 1994). However, the mechanism of action of the drug was poorly understood and presented some challenges including limited accessibility in resource-limited settings and side effects (Clavel & Hance, 2004; Pawar et al., 2019). This necessitated the development of a combination of drugs.

In 1996, a triple combination of drugs, highly active antiretroviral therapy (HAART) was introduced to address the challenges of AZT mainly to increase potency and reduce viral resistance (Clavel & Hance, 2004; Esté & Cihlar, 2010; Lange & Ananworanich, 2014). Sub-Saharan Africa continued to battle with HIV until 2000 where HAART was first introduced in South Africa (Marseille et al., 2002). In Ghana, HAART was introduced in 2003 at few sites that were highly burdened with HIV (Ayisi Addo et al., 2018). Globally, access to ART has improved. As of the end of 2024, it was estimated that about 77% people had access to ART across the world (WHO, 2025).

To intensify global efforts of HIV prevention, pre-exposure prophylaxis (PrEP) and post exposure prophylaxis (PEP) was introduced. PrEP is the use of ARV drugs by HIV-non-infected individuals to prevent HIV infection while PEP involves the use of ARVs drugs by people who are not infected with HIV but have been exposed to the virus (WHO, 2016). These drugs are usually recommended to high risk groups (key populations) such as female sex workers (FSW), men who have sex with men (MSM), and people who inject drugs (WHO, 2016). Countries around the world are at different stages of ART coverage with much lower coverage in most developing countries. In 2016, WHO published the second consolidated guidelines on the use of antiretroviral drugs for HIV treatment and prevention. The guidelines endorse the "Treat All" approach, recommending that all individuals diagnosed with HIV initiate antiretroviral therapy regardless of their clinical stage or CD4 cell count (WHO, 2016).

2.8.1 Benefits of Anti-retroviral therapy

Antiretroviral therapy (ART) has significantly transformed the lives of people living with HIV, providing several benefits. One of the most notable improvements is the increased life expectancy (Dlamini, 2021; Galvão, 2002; Rodger et al., 2013; Wasti, Van Teijlingen, et al., 2012). Systematic reviews and cohort analyses increasingly show that untreated HIV infection is associated with the development of several non-AIDS-defining conditions, including cardiovascular, kidney, and liver diseases, various cancers, and neurocognitive disorders (Kanters et al., 2016; Zwahlen & Egger, 2006). Starting ART earlier reduces the occurrence of these conditions and enhances survival (Gathe Jr, 2003; Kanters et al., 2016; Sterne et al., 2005).

ART has changed HIV from a fatal disease into a manageable chronic condition, allowing individuals who adhere to the therapy to live near-normal lifespans. This has also led to a significant reduction in HIV-related mortality, as the therapy suppresses viral replication and prevents the progression to AIDS. Estimates from UNAIDS shows that global HIV/AIDS related deaths have declined by over 40% since 2003 when ART was scaled up in many countries (UNAIDS, 2019).

Antiretroviral therapy works to maintain a higher CD4 cell counts that helps reduce an individual's risk of opportunistic infections and other HIV-related illnesses. In addition, the severity and frequency of symptoms such as fatigue, weight loss, and recurrent infections are greatly reduced, contributing to better overall health (Sterne et al., 2005).

Antiretrovirals plays a crucial role in preventing HIV transmission. By suppressing the viral load to undetectable levels, ART ensures that the virus cannot be transmitted sexually, a concept referred to as "U=U" (Undetectable = Untransmittable) (Piscaglia et al., 2021). Furthermore, ART significantly lowers the risk of HIV transmission from mother to child

during pregnancy, childbirth, and breastfeeding, thereby offering protection to infants against the virus (Siegfried et al., 2011).

The social and economic benefits of ART are substantial. Improved health enables individuals to continue working, and support their families, which in turn ensure economic productivity. In addition, by preventing HIV-related illnesses, ART reduces the need for hospitalizations and treatments for opportunistic infections, thus lowering overall healthcare costs (Sterne et al., 2005). On a psychosocial level, ART has contributed to a reduction in the stigma associated with HIV. As people see HIV as a manageable condition rather than a death sentence, the social perception has shifted, leading to decreased discrimination. This, along with the physical health benefits, has a positive impact on mental health, reducing anxiety and depression related to HIV status (Piscaglia et al., 2021). These advancements underscore the critical importance of ensuring continued access to ART and support for people living with HIV.

2.8.2 Challenges to the use of Anti-retroviral therapy

Despite the success of ART in improving treatment outcomes and quality of life of persons living with HIV, there has been several challenges associated with management of the disease with ART. Getting the most out of ART is a complicated individual behavioral process influenced by a variety of factors, including patient characteristics, social support, and health-care systems (Agwu & Fairlie, 2013). Human attitudes and beliefs are also important: Inadequate understanding and negative attitudes toward antiretroviral therapy (ART), drug side effects, financial limitations, service-related factors, stigma, discrimination, inability to disclose HIV status, and other socio-cultural issues may prevent patients from obtaining treatment or adhering to their ARV medications (Agwu & Fairlie, 2013; Shacham et al., 2017).

2.8.3 Adherence to Antiretroviral Therapy

Antiretroviral therapy has been shown to be an effective method in the treatment of people living with HIV/AIDS and coverage has been increasing over the years. For instance, as of the end of 2022 ART coverage has increased to 29.8 million from 7.7 million in 2010 (WHO, 2024). The effectiveness of ART, depends on individual medication adherence. The WHO describes medication adherence as the degree to which a person's actions such as taking medicines, following dietary advice, and making lifestyle changes, align with the treatment plan agreed upon with a healthcare provider (WHO, 2016). To a large extent, adherence to medication depends on the patient's lifestyle, beliefs, attitudes, knowledge and not merely directives from health care providers. Optimal adherence to ART is essential for achieving viral suppression, preventing drug resistance and HIV transmission, reducing morbidity and mortality, and promoting the overall wellbeing of individuals living with HIV. Poor adherence may include missed or delayed doses, treatment interruptions, discontinuation of therapy, or incomplete dosing (WHO, 2016).

Although adherence and compliance are synonymous, adherence involves more flexible methods with a focus on the patient's needs, whereas compliance is more about the patient following the prescriber's orders (Richards, 2014; Williams & Friedland, 1997). While adherence offers some degree of flexibility and the patient's greatest willingness to remain consistent and persistent with therapy, compliance focuses more on the patients' act of following a suggested course of treatment (Richards, 2014). Adherence is considered the preferred term and considered more accurate because it implies and recognizes patient choice in therapy (Williams & Friedland, 1997).

Adolescents living with HIV face unique barriers to maintaining high adherence levels because they progress through major milestones in cognitive and social development and transition to adult HIV care. It can also be a difficult time for adhering because of response to feeling

different from peers. Different levels of identity, such as sexuality, morality, and religious identities, are entwined in these processes (Shaw & Amico, 2016).

2.8.3.1 Prevalence of Adherence to ART

The prevalence of ART among individuals living with HIV can vary widely and is determined by several factors including stigma, depression, and access to health facility etc. Adherence level greater than 95% has been reported to be effective to achieve viral suppression, prevent disease progression and transmission (Byrd et al., 2019a; Paterson et al., 2000). However, the literature shows suboptimal levels of adherence to ART. A systematic review conducted among adolescents in low and middle income countries found that the rate of adherence to ART range from 16-99% (Hudelson & Cluver, 2015). A similar review conducted among AYA across 53 countries showed a 62.3% pooled prevalence of adherence to ART. The lowest average rates of ART adherence was reported in North America (53%), followed by Europe (62%) and South America (63%), while higher adherence levels was observed in Africa, averaging 84% (Kim et al., 2014). A mixed method review among adolescents (10-19 years) in sub-Saharan Africa found the prevalence of adherence to be 65% and viral suppression to be 55% (Hlophe et al., 2023).

Despite the reported high prevalence of adherence in Africa (84%) by Kim et al., it does not meet the ≥ 95%recommendation for optimal viral treatment success. Country specific studies in sub-Sahara Africa show low adherence level to ART among people living with HIV/AIDS. A cross-sectional study in Senegal found the prevalence of adherence to ART to be 26.7% among adults living with HIV (Mbengue et al., 2019). Zhou et al. (2021) reported a prevalence of 45.3% among adolescents living with HIV in South Africa. Self-reported adherence rate of 79.1% has been reported among Ethiopian adolescents living with HIV (Firdu et al., 2017).

In Ghana, adherence to ART has been found to be 44.6% among persons 18 years and older (Addo et al., 2022). Among AYA at a Teaching hospital in Ghana, Biney et al. (2021) found the prevalence of adherence to be 78.7% using the Morisky Medication Adherence Scale. Similarly, a study of ART adherence among adolescents and young adults (10 -20 years) at Komfo Anokye Teaching Hospital, Ghana, by Anokye-Kumatia et al. (2018), ART adherence was found to be low (76.4%). Other authors have reported a lower adherence to ART in Ghana. Nichols et al. (2019) reported 47.5% optimal adherence among children and adolescents aged 7-18 years living with HIV. Sefah et al. (2022) have reported a similar sub-optimal adherence to ART (42.9%). Variation in the prevalence of adherence could be explained by the different methods used in the assessment of adherence and the different study population (among children, adolescents, young people and adults).

2.8.3.2 Factors Influencing Adherence to ART

There is often a false perception that adherence to mediation is the sole responsibility of the patient. This is misleading and results in failure to acknowledge other forms of factors that influence adherence. Medication adherence is a complex behaviour that results from interplay of multidimensional factors (WHO, 2016). The WHO broadly classifies these factors into five dimensions; 1. Socioeconomic factors; 2. Healthcare related factors 3. Clinical condition related 4. Therapy or Drug related and 5. Patient related factors (WHO, 2003). Detailed discussion of these domains is presented below.

2.8.3.2.1 Socioeconomic Factors

Multiple sociodemographic factors can influence adherence to ART, and understanding these factors is essential for tailoring interventions to improve adherence to therapy. Some of these include sex, age, educational level, marital status, distance to facility, religion and place of residence.

a. Age

Several studies have explored the relationship between age and adherence to ART, but findings have been inconsistent based on the specific population studied, adherence method assessment and the local context (Hudelson & Cluver, 2015). Studies have demonstrated increasing age with adherence to therapy (Desta et al., 2020; Nigusso & Mavhandu-Mudzusi, 2020). Generally, older adults tend to have better adherence to ART compared to younger individuals (Reif et al., 2020). Possible reasons include a more stable lifestyle which might facilitate a regular medication routine, previous experiences with the consequences of non-adherence, either personally or through witnessing the experiences of others and a better understanding or appreciation of the benefits of treatment (Mills et al., 2006). However, older adults may also face challenges such as polypharmacy (taking multiple medications) and cognitive decline which could impact adherence (Desta et al., 2020). Other studies have reported no significant association of age with adherence to ART (Letta et al., 2015; Molla et al., 2018). For instance, a study by Kim and colleagues (2017) in Malawi found no association of adherence to ART with age among adolescents living with HIV.

b. Educational level

One's level of education has a significant influence on medication adherence in several ways. Higher levels of education positively influence medication adherence through improved health literacy, cognitive skills, knowledge and awareness, socioeconomic status, attitudes and beliefs, communication with healthcare providers, self-efficacy, practical skills, and social

support networks (Asaolu & Agbede, 2022; Hiregoudar et al., 2019). These factors collectively enhance an individual's ability to understand, manage, and adhere to their prescribed medication regimen. Educational level has been identified as a significant factor influencing ART adherence among young people aged 15–24, with individuals who have attained at least a senior high school education being more likely to adhere to treatment compared to those with lower educational attainment (Asaolu & Agbede, 2022).

c. Marital Status

Marriage is often associated with economic, social and emotional support that are necessary to foster medication adherence. Compared with single, divorced or widowed participants, marital status has been associated with adherence to ART (Odili et al., 2017; Tarkang et al., 2024; Tuot et al., 2023). Partners who have disclosed their status to each other can remind each themselves to take medications, attend medical appointments together, and provide encouragement to follow treatment (Adeniyi & Ajayi, 2020). Additionally, married individuals typically experience higher levels of emotional support, which can reduce stress and anxiety related to managing a health condition (Odili et al., 2017). This emotional support can increase an individual's motivation to adhere to their medication regimen, as they feel more supported and less isolated in dealing with their health issues (Adeniyi & Ajayi, 2020). Again, the sense of responsibility towards a partner can motivate individuals to take better care of their health, including adhering to ART regimens. Knowing that their health directly affects their loved ones can be a powerful incentive to follow prescribed treatments. In contrast, single individuals, including those who are divorced, widowed, or never married, may lack these forms of support and may therefore face more challenges in maintaining medication adherence (Tarkang et al., 2024). They might not have someone to remind them to take their medications, provide emotional encouragement, or assist with practical tasks related to their healthcare. This lack of

support can lead to difficulties in establishing consistent medication routines and managing health effectively (Adeniyi & Ajayi, 2020; Tuot et al., 2023).

d. Place of residence

The proximity of a person's residence to healthcare facilities can impact their access to healthcare. Long distances and lack of transportation options can be barriers to regular clinic visits and obtaining medication refills (Filimão et al., 2019). Shorter distance to ART centers have been found to be associated with better adherence (Shigdel et al., 2014; Wasti, Simkhada, et al., 2012). In contrast, in Ghana, Addo et al. (2022), found that patients living close (less than 30 minutes) to ART centers were less likely to be adherent. Proximity to ART centers may lead to procrastination, forgetfulness, and lower adherence, especially if patients do not feel ill after missing appointments. They may also avoid nearby ART centers for fear of stigma (Addo et al., 2022).

Patients who live in urban settings have also been found to have better adherence to ART compared to their rural counterparts (Dorcélus et al., 2021; Filimão et al., 2019). Urban patients generally have shorter distances to travel to reach healthcare facilities, reducing transportation barriers to adherence (Gela et al., 2024). Accessibility can significantly influence the ease with which individuals can adhere to their ART regimen. A recent study reported that not living in an urban area was associated with decreased odds of adherence to ART among persons aged 18+ years living with HIV in Ghana (Nutor et al., 2023).

2.8.3.2.2 Condition/Disease related factors

The severity of HIV/AIDS and the presence of symptoms can impact how consistently patients take their medication. Individuals with more severe symptoms or advanced stages of the disease may be more motivated to adhere to their ART regimen to manage symptoms and improve their quality of life (Schreiner et al., 2020; WHO, 2003). The presence of commodities

such as tuberculosis, hepatitis, or mental health disorders can also affect HIV patient's adherence to medication (WHO, 2003).

2.8.3.2.3 Therapy or Drug related

Antiretroviral therapy (ART) can have side effects, ranging from mild to severe (Chen et al., 2013). The fear or experience of these side effects can discourage patients from taking their medication regularly. Side effects such as nausea, fatigue, or more severe reactions can lead to non-adherence if patients find them intolerable (Chen et al., 2013). HIV treatment often involves a combination of medications that must be taken at specific times and under certain conditions (e.g., with or without food). The complexity of these regimens often impact negatively on adherence. Several studies have found association of experience of side effects of ART with non-adherence (Liu et al., 2024). Among adolescents in Cameroun, side effects was reported to predict non-adherence to ART (Bongfen et al., 2020).

2.8.3.2.4 Patient-related factors

The behaviour, lifestyle, attitude, knowledge of HIV and ART of patients living with HIV have influence on treatment adherence. Patient-reported adherence barriers include forgetfulness, sickness, depression, stigma, and pill burden (Bijker et al., 2017).

a. ***Stigma as a barrier to adherence***

Stigma remains a major barrier to ART adherence among HIV-infected patients. HIV-related stigma often lead to feelings of shame, guilt, and self-blame (Katz et al., 2013), which can contribute to psychological distress and diminished self-esteem. These emotional challenges may reduce motivation and self-efficacy, ultimately compromising consistent adherence to medication (Katz et al., 2013). The fear of disclosure of one's HIV status due to stigma can lead to secrecy, even from close family members and healthcare providers. In one study among youths living with HIV (Rao et al., 2007), half of the participants indicated that they skipped

doses (ARVs) for fear of friends or family finding out about their status (Rao et al., 2007). This fear can create barriers to accessing HIV care and support services, including obtaining ART medications and attending medical appointments. A systematic review examining barriers to ART adherence among adolescents in sub-Saharan Africa identified stigma as the most prominent barrier, followed by antiretroviral side effects, lack of support, and forgetfulness (Ammon et al., 2018). In Ghana, perceived stigma following the disclosure of HIV status has been identified as a significant barrier to treatment adherence among adolescents living with HIV (Ankrah et al., 2016). Other several studies have reported on the association of stigma with adherence to ART (Buh et al., 2023; Hlophe et al., 2023; Kim et al., 2014).

b. *Forgetfulness as a barrier to adherence*

Within the literature, forgetfulness has been widely reported as the main barrier to ART adherence. For instance, In the study by Anokye-Kumatia et al. (2018) among adolescents in Ghana, the main reason cited for missing their medication were forgetfulness, and their inability to go for refill. In a similar study at Korle-Bu Teaching hospital, forgetfulness was also found to be the commonest reason for non-adherence to ART (Biney et al., 2021). The study by Kim et al. (2017) in Malawi among adolescents also found forgetfulness as the common barrier to adherence.

c. *Disclosure as a barrier to adherence*

HIV self-disclosure refers to an individual's independent decision to share their HIV status with one or more people of their choice (Adejumo, 2011). Revealing one's HIV status can lead to various positive outcomes, such as gaining emotional support, reducing the psychological stress associated with secrecy, facilitating better access to healthcare services, and promoting greater adherence to antiretroviral therapy (Katz et al., 2013; Thoth et al., 2014). It can also foster trust in relationships, promote safer sexual practices, and reduce the risk of transmitting the virus to others (Thoth et al., 2014). A review of hospital records found disclosure to be

associated with lower mortality and lost to follow up (Ngeno et al., 2019). Disclosure of HIV status was reported to be significantly associated with adherence to ART (Amankwah-Poku et al., 2021; Heestermans et al., 2016). Nutor and colleagues (2023) have also found non-disclosure to ART as an independent predictor of non-adherence to ART among adults (18+ years) in the Volta regional capital, Ho. In a qualitative study, some patients in Northern Vietnam admitted that it is not that they forget to take their medication, but simply they just want others to know (Van Tam et al., 2011).

Despite the established benefits of disclosure, the decision of patients with HIV especially the youths to disclose their status is a major challenge. Cultural, social and psychological factors such as stigma and depression have been cited to negatively impact on HIV status disclosure (Gabbidon et al., 2020). In a qualitative study conducted in Zimbabwe, adolescents highlighted stigma, discrimination from peers, and a lack of HIV knowledge as key barriers to disclosing their status (Khan et al., 2023).

While several interventions such as peer counselling and support groups have been put in place to address disclosure of HIV status among youths, studies have reported on a low prevalence of HIV status disclosure among children, adolescents and youths living with HIV. In Ghana, the cross-sectional study by Kallem et al. (2011) on prevalence and patterns of HIV disclosure in children showed a prevalence of 21%. The authors reported factors such as age, educational level of the child, deceased biologic father and longer duration on HIV medication to be significantly associated with disclosure. Similarly, disclosure prevalence of 23.3% (among children 5-18 years) (Appiah et al., 2021) and 33.5 % (among children 6-15 years) (Amankwah-Poku et al., 2021) have been reported in Ghana.

d. *Depression as a barrier to adherence*

Depression can significantly impact adherence to ART among individuals living with HIV/AIDS. Depression often leads to feelings of sadness, hopelessness, and worthlessness, which can interfere with an individual's motivation and ability to adhere to their ART regimen (Kim et al., 2015). The emotional burden of depression may make it challenging for individuals to maintain consistent medication adherence. Studies have consistently shown how depression is associated with poor adherence. In a systematic review and meta-analysis in low, middle and high income countries, higher depressive symptoms was found to be associated with lower adherence to ART (Uthman et al., 2014). In a similar review in sub-Saharan Africa, the prevalence of depression was found to be 31.2% with 55% lower chance of achieving optimal adherence among participants with depression. In South Africa, Kitshoff and Naidoo (2012) reported similar poor adherence among people with moderate to severe depressive symptoms. In China, a cross-sectional study found depression and HIV status non-disclosure to be associated with poor adherence (Yu et al., 2018). Wagner et al. (2020) examined the bidirectional relationship between depression and ART adherence in a prospective study in Uganda. The authors noted association of depressive symptoms with poor adherence and highlighted the potential benefits of depression care and adherence support for improving both outcomes.

2.8.3.2.5 Facilitators of Adherence to ART

Several factors, including access to healthcare services, comprehensive care and support, appropriate patient education, social support, patient positive attitudes, reduced stigma, collectively facilitate adherence to ART. A systematic review examining factors that influence adherence among adolescents living with HIV identified peer support groups, caregiver involvement, and knowledge of HIV as key facilitators of treatment adherence (Ammon et al., 2018). Dzansi et al. (2020) found that participants' perceived benefits of ART, perception of

the medication as part of their daily routines, awareness of the regimen, food accessibility and transparency facilitated adherence to ART. Adherence has also been reported to be positively influenced by the taking of other medication and duration of illness. A study conducted among HIV patients in the Highlands of Papua New Guinea found that taking other medications alongside ART and being on ART for one year or more were positively associated with adherence, based on self-reported data and pill count measures, respectively (Gare et al., 2015).

2.8.4 Measurement of Adherence to Medication

Accurate assessment of ART is important for patients with HIV/AIDS. Adherence assessment does not only help in the effective planning and treatment but helps to ensure that HIV treatment outcomes can be attributed to recommended regimen (Jimmy & Jose, 2011). In addition, it helps health care providers to make better decision in terms of changing medication and/or communication style to promote treatment. Hence, measuring and monitoring adherence to ART is a key component in achieving treatment success (Jimmy & Jose, 2011).

Although several methods have been used to measure adherence to ART, none of the methods to date have been agreed to be of universal "gold standard" and there is a recommendation of combining methods to better estimate patient's adherence level (Marcellin et al., 2013; Saberi et al., 2020). Medication adherence methods have been broadly categorized into two, subjective and objective methods or direct and indirect (Nguyen et al., 2014; Sabaté, 2003). Subjective methods rely on evaluations by either the patient or healthcare provider regarding medication-taking behavior. Self-reporting and assessments by healthcare professionals are the most widely used methods to estimate adherence. However, a common limitation is the tendency of patients to underreport non-adherence, often due to fear of judgment or disapproval from healthcare providers (Vik et al., 2004).

Methods such as the pill count, secondary database analysis, and biochemical tests, are considered an improvement over subjective methods and considered more reliable than self-reported approaches in assessing medication adherence. It is recommended that these objective measures be used to validate and complement subjective assessments (Arafat & Ibrahim, 2018; Vik et al., 2004). However, a meta-analysis on adherence outcomes suggests that using multiple subjective measures may offer greater sensitivity, though not necessarily more accuracy, compared to a single objective measure (Dew et al., 2009). It is important to note that both subjective and objective methods have their strengths and limitations, and using them together is recommended (Arafat & Ibrahim, 2018).

Direct methods involve measurement of the concentration of drug in biological sample (blood, urine or hair) while the indirect methods involve pill count, patient self-reported questionnaire, pharmacy records, electronic monitoring events systems. Details of the methods are presented below with their advantages and disadvantages.

2.8.4.1 Self-reported Adherence

Self-reported adherence assessment is one of the simplest and commonly used methods of assessing adherence to medication. For example, Marcellin et al. (2013) conducted a review on the methods of assessing adherence to HIV in randomized clinical trials and found that more than half of the methods used were self-report. Most of the studies included in the review were conducted in the US, followed by Africa, Asia and Europe. The assessment of adherence using self-report involves asking patients how often they take or miss their medication (Usitalo et al., 2014). A simple survey question or a range of questions in a questionnaire can be used to assess patient's self-report measure of adherence. Methods of self-reporting include patient kept diaries, patient interviews corresponding to the accuracy of medication regimen adherence and the use of standardized, validated survey instruments (Stirratt et al., 2015). Among other

questions, self-report questions can include “In the past 3 days, 7 days or a month, is there any day you did not take your ART medication?”. Validated survey instruments take into consideration patients’ intentional and unintentional behaviours. Some of these include the Morisky-Medication adherence Scale (MMAS-8), the medication adherence questionnaire (MAQ), Brief medication questionnaire (BMQ) etc. (Anghel et al., 2019).

2.8.4.2 Morisky Medication Adherence Questionnaire (MMAS-8)

The MMAS-8 is a widely used tool to assess medication adherence across various diseases, including HIV/AIDS. Its development was based on the original Morisky scale, which had four items (Morisky et al., 1986). The MMAS-8, as indicated by its name, includes eight questions that assess different aspects of medication adherence. These include forgetfulness, carelessness, discontinuing medication when feeling better or worse, understanding of the medication, planning medication intake, challenges in maintaining consistent use, and avoiding medication due to potential side effects (Aguiar et al., 2020; Morisky et al., 2008). The MMAS-8 includes 7 yes/no questions and 1 item with a 5-point Likert scale response option. Scores range from 0 to 8. For the yes/no items: "Yes" responses receive 0 points and "No" responses receive 1 point. For the Likert-scale item (the last question): Answers can range from 0 to 1 in 0.25 increments (Janežič et al., 2017). Total scores can then be classified into three levels of adherence: high adherence: 8 points, medium adherence: 6 to 7 points and low adherence: <6 points. The MMAS-8 has been validated in several languages and found to be reliable in various patient populations, including those with HIV/AIDS (Janežič et al., 2017).

In clinical practice, self-report method measure is easy to use and offers low cost (Stirratt et al., 2015). However, they are prone to recall bias and social desirability bias (respondents may want to please health care providers) and may result in overestimation of adherence level (Kagee & Nel, 2012; Marcellin et al., 2013). The limitations of self-report can be improved by

combining it with other recall periods and asking multiple questions in different ways to reduce social desirability bias (Marcellin et al., 2013).

2.8.4.3 Pill Count

Pill count is a commonly used, objective method to assess adherence to antiretroviral (ARV) medication. This simply implies counting the number of pills left and comparing it with the number that should have been taken (Achieng et al., 2013). In essence, it involves physically counting the number of pills returned by the patient during scheduled clinic visits, comparing the count to the expected number of pills the patient should have consumed over the same period. Pill count method is grounded in the idea that the fewer pills returned, the higher the adherence rate; often expressed in proportions. For example, a patient receives a prescription to take 1 tablet for 30 days but takes 24 tablets in the 30 days period will have adherence level of 24/30= 80%. Pill count measure is often supplemented with self-report as used in some studies to improve adherence assessment (Farley et al., 2008). It is simple to use and less expensive. However, the accuracy of the pill count relies largely on patients' honesty and their understanding of the significance of adhering to the prescribed medication. Patients may discard pills before clinic visits to appear more adherent.

2.8.4.4 Pharmacy Refill Records

The use of pharmacy records to measure adherence to medication offers an objective data and captures patterns over time. Pharmacy records or prescription refill data are reviewed to track the frequency, timing, and quantity of medication refills (Vollmer et al., 2012). Measures like the Medication Possession Ratio (MPR) or the Proportion of Days Covered (PDC) are often used to compute adherence based on these records. The MPR is determined by calculating number of doses dispensed in refill / Number of doses prescribed) x 100 (Mekuria et al., 2017). An MPR of 100% means the patient has refilled their medication perfectly on time. An MPR

less than 100% indicates potential non-adherence. The proportion of days covered (PDC) is an alternative to MPR. The PDC calculates the proportion of days a patient has medication available. For patients on multiple medications, PDC might be a more accurate reflection of adherence. Pharmacy refill records provide concrete data, which can be less prone to the biases of self-report (Mekuria et al., 2017). The main disadvantage is that refilling a prescription doesn't guarantee the medication was taken as prescribed (Mekuria et al., 2017; Vollmer et al., 2012).

2.8.4.5 Medication Event monitoring Systems (MEMS)

The MEMS is the most common tool used for electronic adherence monitoring. Medication containers are covered with electronic caps as part of the MEMS (Paterson et al., 2000). A pressure-activated microcontroller included inside MEMS caps keeps track of the day and time when each container is opened and closed.

Individual adherence patterns can be examined using cap opening counts and rates throughout different time periods. The resulting estimate of adherence, however, might be skewed because it assumes that taking a medication always corresponds with opening a container, which isn't necessarily the case. One practice that may cause an underestimating of adherence is "pocket dosing," which is taking multiple doses out of the container when it is opened and saving the additional doses for a later time. Conversely, opening a container out of curiosity (also known as "curiosity opening") might cause overestimation. The cost of this method is another disadvantage because each medication container needs to have a MEMS cap on it (Adefolalu & Nkosi, 2013). This means that multiple caps must be used or one or two ART medications must be chosen for adherence assessment. This method has been used in previous study to measure adherence to ART (Paterson et al., 2000).

2.8.4.6 Measurement of biological sample

A direct way of assessing adherence is to measure drug (ART) concentration levels in a biological sample, direct observation of patient medication taking behaviour and the measurement of a biologic marker (Lam & Fresco, 2015). However, even amongst patients getting same dosages of treatment, significant differences in drug levels in the plasma might be seen. Factors such as diet, weight, and gastrointestinal absorptive capacity and rate of excretion, can affect the pharmacokinetics of antiretroviral therapy (ART) (Vitolins et al., 2000; WHO, 2003). While it is typically less than inter-individual variability, intra-individual variability can also occur and is caused by a variety of factors, such as inaccurate reporting of the time of last dose intake, and deviations from dietary recommendations (Marcellin et al., 2013). Viral load measurement has also been used to assess medication adherence. A decrease in viral load indicates better medication adherence (Hussen Tale et al., 2023).

In summary, assessment of adherence to medication is necessary to monitor treatment success but largely rely on patients' behaviour. While some of the methods are expensive eg MEMS and some depending on information technology eg. Pharmacy records which may not be available in many low-income countries, it is important to consider supporting factors in choosing any of the methods. These may include availability of resources, burden on the patient, and adherence goal. In all these, the chosen method should meet psychometric standards of reliability and validity. Finally, no single method has been identified to be optimal and a combination of methods is recommended to improve on adherence estimate levels.

2.8.5 Patients need to be supported not blamed-(Patient-provider relationship)

Healthcare professionals must recognize the complexities of adhering to long-term therapies like HIV treatment and provide appropriate support. While adherence is crucial for health outcomes, it's equally important to foster a compassionate, non-judgmental environment

(WHO, 2003). Adolescents and young adults often face unique barriers, including stigma, fear of disclosure, and social pressures, which complicate consistent adherence (Kim et al., 2014). Healthcare professionals are various ART clinics need to embrace empathy, understand the reasons behind non-adherence, and provide appropriate support and interventions to improve adherence (Iuga & McGuire, 2014). Blaming patients for non-adherence can harm the patient-provider relationship, leading to guilt, shame, and reluctance to share challenges. Instead, healthcare professionals should build trust and rapport, encouraging open communication to help patients overcome adherence barriers (WHO, 2003).

2.9 Adherence to ART Interventions for Young people living with HIV

Over the years, several interventions have targeted young people (10-24 years) living with HIV to improve on treatment outcomes (Barker et al., 2019; Reback et al., 2021; Willis et al., 2019). These interventions often focus on key problems facing young people in the HIV care continuum including increased testing, linkage to care, retention in care, stigma, depression, adherence to ART, and improved viral suppression. Interventions are delivered either in the health facility (Barker et al., 2019), school-based (Johnson et al., 2018), community-based or a combination of these (Willis et al., 2019). A wide range of strategies have been used to deliver these interventions including counseling, health education, psychosocial support including support from their peers and interventions delivered through mobile health technology (mHealth) (Casale et al., 2019; Griffee et al., 2022). Interventions that have focused on improving adherence among young people are discussed in this section.

2.9.1 Peer support model

The inclusion of peer support for AYPLHIV is progressively becoming a key component of adolescent and youth-focused service delivery. Peer support can help AYA and their families live successfully with HIV through motivation, experience sharing, provision of independence and sense of maturity, self-efficacy and accept their HIV status (Rencken et al., 2021). Recognizing the several challenges faced by these AYA, the WHO new consolidated guidance for use of ART for the treatment and prevention of HIV infection recommends that community-based treatments that enhance ART adherence and retention in care should now include psychosocial support and involve peers in service delivery (WHO, 2016).

Recent peer support interventions among young people in Africa have focused on the Zvandiri model, an integrated programme by Africaid in Zimbabwe. The primary goal is to equip HIV-positive children, adolescents, and young adults with knowledge, skills, and resilience to lead healthy, fulfilling lives. Zvandiri provides a comprehensive package of services, including support for HIV status acceptance, care retention, medication adherence, sexual and reproductive health, and mental wellbeing. The programme is led by trained peers, known as Community Adolescent Treatment Supporters (CATS), who offer HIV information, counselling, and psychosocial support under the supervision of healthcare professionals (Willis et al., 2019). Recognized by the World Health Organization, the model has been scaled up in nine African countries, including Ghana with preliminary findings showing improved adherence to ART and other treatment outcomes such as reduced depression and stigma among young people (Willis et al., 2018).

Peer support groups, a key element of peer support interventions is recommended in HIV treatment (WHO, 2015). A support group is a group of people who come together to discuss the difficulties and experiences of coping with the HIV without passing judgment, placing

blame, stigmatizing themselves, or feeling alone (Kalichman et al., 1996; Mbah et al., 2021).. HIV support groups often include a wide range of discussion topics, including disclosure, reducing stigma and depression, living well with HIV, and building trusted relationships (Tumwikirize et al., 2015).

An involvement in support group has been associated with reduced stigma, discrimination, depression, improved adherence, self-efficacy and better management of disclosure (Mundell et al., 2011; Paudel & Baral, 2015; Tumwikirize et al., 2015). Findings from a randomized control trial among AYA peer support intervention show that adolescents in the intervention group were 3.9 times more likely to adhere to their medication (Willis et al., 2019). There was a decrease in linkage and retention to services in the control group compared to an increase in the intervention arm. Peer-support based intervention has also been substantially shown to improve on HIV virological suppression among AYA population (Abiodun et al., 2021; Mavhu et al., 2020; Ndhlovu et al., 2021).

2.9.2 Mobile Health (mHealth) Technology

The use of mobile wireless technologies for health (mHealth) has widely been reported to play a significant role in supporting health service delivery and improving the health outcomes of people living with HIV (Kemp & Velloza, 2018; Muessig et al., 2017; WHO, 2019b). mHealth includes the use of cell phones, patient nursing devices, and mobile applications to help patients manage their health and wellbeing (Al-Azzam, 2021). Follow-up studies have explored the acceptability, feasibility, and cost-effectiveness of using mHealth mainly through phone calls and text-messaging in improving the health of patients with chronic diseases including HIV (Belzer et al., 2015; Mulawa et al., 2018; Ybarra & Bull, 2007).

The low cost of mHealth technology coupled with its convenience and easy accessibility makes it advantageous for its use in countries with limited resources such Ghana (Drake et al., 2020;

Feroz et al., 2021). Text messages have been shown to improve retention in care, increase ART adherence, and improves HIV suppression among adolescents (Abiodun et al., 2021; Murray et al., 2017; Reback et al., 2021).

In a systematic review, Mehra et al. (2021) assessed the effectiveness of text messaging, as a form of mHealth intervention, on adolescents' adherence to ART. Findings indicate that text messaging interventions could improve ART adherence (Mehra et al., 2021). Several individual studies and systematic reviews have reported on the effectiveness of mHealth technology, mainly on the use of mobile phone calls and text messages to improve adherence to ART. For example, Dowshen et al. (2012) assessed the feasibility and acceptability of short message service (SMS) reminders to improve adherence among youths (14-29 years) in a 24-week follow-up period and found that SMS were feasible, acceptable and significantly improved on self-reported adherence.

Similarly, Garofalo et al. (2016) assessed the efficacy of a two-way text message reminder interventions among poorly adherent adolescents and young people (16-29 years) in a randomized control trial in US and reported that at 3 months of follow up, adherence between the intervention and control group was 7 percentage points (95 % CI 0.91–13.9) and the odds ratio for ≥ 90 % adherence was 2.57 (95 % CI 1.01–6.54), indicating a significant difference between the two study groups. The authors though recognizing the study limitations of self-report of adherence, convenience sampling of participants in the study location and lack of measuring complete biological correlate of adherence (viral suppression) concluded that text messaging in a two-way manner is a promising intervention to improve adherence among AYPLHIV and can help them live a healthier life.

In a randomized controlled trial, Lester et al. (2010) evaluated the impact of mobile phone communication via SMS between healthcare providers and patients initiating antiretroviral

therapy in Kenya. The study found that 61.5% (168/273) of patients in the SMS intervention group reported adherence to ART, compared to 49.8% (132/265) in the control group, indicating a positive effect of the intervention on treatment adherence. Again, a recent study found that automated text messaging significantly improves adherence to ART among young (15-24 years) trans women (Reback et al., 2021).

While text messages have been shown to be effective in improving adherence, other authors have reported contrasting results. In a one-year randomized controlled trial intervention to improve adherence to ART among older AYA (18-22 years) in Uganda, Linnemayr et al. (2017) found electronically measured mean adherence to be 67%, 64% and 61% in the control group, 1-way SMS group and in the 2-way SMS group, respectively in an intent-to-treat analysis. The authors concluded that despite previous evidence of text messaging in improving adherence, the strategy is not always a hallmark for behaviour change.

Supporting the findings of Linnemayr et al. is the CAMPS trial (Cameroon mobile phone SMS), where no significant difference in adherence was observed between the intervention and control group (Mbuagbaw et al., 2012). In a recent systematic review of digital interventions to improve ART adherence among youths living with HIV in SSA, of the six included papers, four reported no significant effect on adherence to ART (Griffee et al., 2022), Several factors could account for the mixed findings including the population studied (adolescents, young adults and adults), the duration of the intervention, the type of intervention (one way or two-way text message), the ART characteristic of the population (starting or already on ART) and the method authors used in measuring adherence to ART (self-report, pill count, pharmacy refill, and electronic event monitoring system). For instance, participants in the study of Linnemayr et al. had been in the ART clinic for 6 years compared with ART initiators in the study of Lester et al. Again, self-report was used to measure the adherence of ART in the study of Garofaro et al. compared with the electronic event monitoring system in the study of

Linnemayr et al. The use of text messaging could be feasible to improve ART adherence of patients due to the common problem of forgetfulness (Biney et al., 2021).

In addition to text-messaging, phone call reminders have proven to be effective in improving adherence to ART among adolescents living with HIV. Belzer et al. (2014) examined whether receiving phone call support among youths (15-24 years) living with HIV will improve adherence to ART. The study found that self-reported adherence over the past month was significantly higher in the intervention group at both the 24-week and 48-week follow-up. Other studies (Bigna et al., 2014; O'Connor et al., 2022) have reported similar findings.

2.9.3 Home Visits

Home visits for HIV adherence support by peers have been recognized as an effective strategy to enhance medication adherence and overall health outcomes for individuals living with HIV. Conducting home visits brings the support directly to the individual's living environment. This strategy can be particularly beneficial for addressing barriers such as transportation issues, stigma associated with clinic visits, and providing a more personalized form of support (Griffee et al., 2022). Peers can provide reminders, assist with medication management, and offer motivation to stay on track with the treatment plan (Mavhu et al., 2020).

Beyond medication adherence, peer support at home can positively impact mental health as well as address the feelings of isolation and contribute significantly to improving the overall wellbeing. While Kelly et al. (2018) and Achieng et al. (2012) found no differences in adherence levels between HIV patients receiving various frequencies of home visits, Williams et al. (2006) reported that home visits by a nurse or community worker, was associated with improved adherence to antiretroviral therapy (ART). To better ensure the success of adherence interventions, it is essential to complement other supportive care measures such as telephone calls or SMS reminder messages. An experimental study (pre-post) in China by Wang et al.

(2010) showed that home visits and telephone calls are effective in promoting adherence to antiretroviral treatment and in improving the participants' quality of life and depressive symptoms.

2.10 Multi-component Interventions

A multicomponent intervention refers to an approach that involves implementing multiple strategies simultaneously to address a specific issue or achieve a desired outcome. This holistic approach recognizes the complexity of adherence challenges and addresses them in a comprehensive manner (WHO, 2013). Single and multicomponent interventions are the two main approaches often used to address treatment adherence (Xu et al., 2020). While single component intervention employ a single method such as patient education, reminders (mainly through SMS), psychotherapies etc. multicomponent intervention use multiple strategies such as a combination of support groups, reminder messages, home visits, phone calls etc. simultaneously (Xu et al., 2020).

In the context of healthcare, multicomponent intervention approach is gaining more attention in improving patients' behaviours including adherence to medication. The goal is to address the complexity of factors that contribute to non-adherence by employing a comprehensive approach. Multicomponent interventions usually have large effect size and several studies (Bosworth et al., 2017; Kanters et al., 2017; Lejone et al., 2020; Vonbank et al., 2017) have drawn conclusions that multicomponent interventions are comparatively more effective than single interventions. For example, Kanters et al. (2017) conducted a systematic review and network meta-analysis of supportive interventions that aimed at improving ART adherence and concluded that the use of multiple intervention approach generally resulted in better adherence than a single intervention. Giving the complex and multifactorial nature of non-adherence behaviour among young persons living with HIV, multicomponent interventions have been

suggested as the optimum way of improving adherence (Depp et al., 2022). Despite the importance of this intervention approach, they are often costly and complex to implement (Depp et al., 2022).

2.11 Theoretical Position of the Study

A theory in research serves as a critical framework for understanding, explaining, and predicting phenomena. It offers a structured way to interpret relationships between variables and organize knowledge within a specific field (Grant & Osanloo, 2014; Lynch et al., 2024). A well-defined theoretical framework shapes research design by guiding the selection of variables, formulation of hypotheses, and interpretation of results. Theoretical foundation in research also helps explain relationships between variables and predict outcomes, making studies purposeful and generalizable (Lederman & Lederman, 2015). Grant and Osanloo (2014) describe the theoretical framework of a research dissertation as the "blueprint" of a house, using an architectural analogy. They emphasize that, like a blueprint guiding construction from foundation to finishing, the theoretical framework directs and shapes the research.

This study is based on both the Theory of Reasoned Action (TRA) and the Theory of Planned Behaviour (TPB), these are two widely recognized frameworks for understanding and predicting health behaviours. The TRA, initially proposed in 1967 and later refined by Ajzen and Fishbein in the 1970s, emphasizes that behaviour is primarily determined by an individual's intention to perform it, which is influenced by attitudes and subjective norms (Fishbein & Ajzen, 1977). Attitudes toward a behaviour are shaped by factors such as behavioural beliefs, evaluations of the outcomes of the behaviour, and motivation to comply with perceived social norms (Fishbein & Ajzen, 1977; Kalichman et al., 2007). If individuals believe the outcomes of a behaviour are positive, they are more likely to develop a favourable

attitude toward performing it. Similarly, subjective norms reflect the perceived social pressures to engage or not engage in a behaviour, further shaping behavioural intentions (Arafat & Ibrahim, 2018; Kalichman et al., 2007).

The TPB builds upon the TRA by introducing perceived behavioural control as an additional determinant of behaviour (Arafat & Ibrahim, 2018; Fan et al., 2018). The TPB acknowledges that intention alone is not always sufficient; an individual's perception of their ability to perform the behaviour also plays a significant role. According to the TPB, behaviour is guided by three key considerations: behavioural beliefs (perceptions of the likely outcomes of the behaviour), normative beliefs (perceptions of social expectations), and control beliefs (perceptions of factors that facilitate or hinder the behaviour) (Arafat & Ibrahim, 2018; Jemmott & Jemmott, 2007). These considerations lead to attitudes, subjective norms, and perceived behavioural control, respectively. When attitudes, norms, and perceived control are favourable, the individual's intention to engage in the behaviour is stronger (Arafat & Ibrahim, 2018; Fan et al., 2018).

Behavioural change interventions remain important in HIV/AIDS prevention, morbidity and mortality reduction strategies across the globe (De Vasconcelos et al., 2018). To describe the mental and social wellbeing of patients, several socio-behavioural models have been developed. Because medication adherence is a complicated socio-behavioural issue, including a behavioural intervention might help patients better manage their condition and obtain better clinical outcomes (viral suppression) (De Vasconcelos et al., 2018; Thirumurthy & Lester, 2012). Behavioural interventions are designed to influence an individual's behaviour in areas that are relevant to their daily lives. In the case of adherence, the goal is to change patients' treatment behaviours, i.e., to improve adherence (Arafat & Ibrahim, 2018).

With no vaccine available now for HIV/AIDS, it is important to shift more attention to behaviour change communication to help achieve local, national, regional and global HIV/AIDS targets and goals. The theories of TRA and TPB are founded on the principle that individuals make rational and deliberate decisions to engage in specific behaviors based on their evaluation of the information available to them (Arafat & Ibrahim, 2018; Kalichman et al., 2007; Ortega et al., 2012).

In this study, adolescents and young adults received support from their peers (home visits, support groups, phone calls, and short message service reminders to take their HIV medication). Studies have shown that people who are socially integrated and who experience supportive relationships have better health outcomes (Fiori & Denckla, 2012; Kelly et al., 2014; Lee et al., 2007; Turan et al., 2016).

2.12 Summary of Literature Review

Despite significant progress in the global response to HIV/AIDS, the disease remains a substantial public health challenge, particularly in Sub-Saharan Africa, where the burden is disproportionately high. Young people living with HIV face numerous challenges including psychological and adherence to ART worsening treatment outcomes. Adherence to ART among young people living with HIV remains suboptimal. This suboptimal adherence is influenced by a range of factors, including socio-demographic, therapy-related, disease-related, health system-related, and patient-related factors.

Often, non-adherence to ART is viewed primarily as a patient-related issue; however, it is important for healthcare providers to consider and address the multiple barriers that impact adherence to ART. These barriers include stigma, mental health challenges such as depression, internalized and perceived stigma, logistical difficulties in accessing healthcare, and challenges related to the complex medication regimens. To support YPLHIV, healthcare providers must

assess these multidimensional challenges and offer tailored interventions to improve adherence.

Among the interventions aimed at improving ART adherence, mHealth technology approaches such as SMS reminders and phone calls reminders have produced mixed results. While these interventions can be effective, the complexity of ART adherence requires a more comprehensive approach that addresses the various factors influencing adherence. One of such promising approach is the use of peer support interventions. Peer support interventions are based on the premise that individuals who share similar experiences, such as living with HIV, can offer valuable support, encouragement, motivation and coping strategies. Peers can provide practical advice on managing the disease, share personal experiences, and help reduce the sense of isolation that many YPLHIV face. Common components of peer support interventions include SMS reminders for medication adherence, phone calls to remind patients of appointments, monthly support group meetings, and home visits. These interventions can be implemented to meet the specific needs of young people living with HIV.

2.13 Systematic Review and Meta-analysis on adherence to ART

The first objective of the study was achieved by conducting a systematic review and meta-analysis to estimate the pooled level of adherence among people living with HIV. This part of the study is published with citation: [Boadu, I., Manu, A., Aryeetey, R. N. O., Kesse, K. A., Abdulai, M., Acheampong, E., & Akparibo, R. (2023). Adherence to antiretroviral therapy among HIV patients in Ghana: A systematic review and meta-analysis. *PLOS Global Public Health*, *3*(11)] (see appendix 1). In summary, the review found sub-optimal level of adherence among patients living with HIV in Ghana [70% (CI: 58-81%)] with adolescents and young adults having lower adherence level compared with adults (66% vs 70%). This finding from the review provided justification for the study intervention.

CHAPTER THREE

3.0 METHODS

Introduction

This chapter presents the detailed methods of the study. It includes the study setting and design, study population, sample size determination, sampling method, data collection tools, data collection procedure, quality assurance, ethical considerations and procedures employed in analyzing the data.

3.1 Study Design

The design of a study is the set of procedures for collecting, analysing, interpreting and reporting research data that logically fit together to understand a research problem (Creswell & Hirose, 2019). This research employed the quasi-experimental study design (non-equivalent group design) to examine the effects of using peers as treatment supporters to improve adherence, psychosocial wellbeing (reduce stigma and depression) and viral suppression among adolescents and young people living with HIV compared with standard of care (SOC).

Quasi-experimental study design, like true experiments, tests causal hypotheses (Maciejewski, 2020). However, unlike true experiments, there is a lack of randomization. Participants involved in this study were assigned to either the intervention (treatment) or control (no treatment) after baseline data collection to compare the main study outcome, adherence to ART. The comparison group was chosen to have similar baseline characteristics as the treatment group. This provides enough evidence of what would have happened in the absence of the intervention (counterfactual). Any observed difference in adherence to ART may be attributed to the implemented intervention (Cook & Campbell, 2007). In a quasi-experimental study, a comparison group can be done using different techniques, including propensity score matching (PSM) and regression discontinuity design (RDD) (Chang & Chung, 2017). These

are mainly employed to reduce bias (selection bias). Quasi-experimental methods are normally used when it is not possible to randomize participants and when there are ethical, political, and logistical constraints (UNICEF, 2014). Although randomized controlled trials (RCTs) are considered the gold standard for estimating intervention effects because randomization minimizes bias (de Vocht et al., 2021), this study adopted a quasi-experimental approach due to logistical, and feasibility constraints. RCTs are often costly, require longer follow-up, and demand larger sample sizes to adequately estimate intervention effects (Cook et al., 2002; de Vocht et al., 2021; Handley et al., 2018), which was not practical in the current study context. In addition, the small number of eligible participants, coupled with the risk of contamination between intervention and control groups if randomization occurred within the same clinics, made RCTs less feasible. Similar challenges in resource-limited settings have been reported, where quasi-experimental designs are recommended as pragmatic alternatives to RCTs when logistical barriers prevent randomization (Cook et al., 2002; Handley et al., 2018). Importantly, the quasi-experimental design in this study allowed for a robust evaluation of the intervention. By including both intervention and comparison groups and assessing outcomes before and after the intervention, the design minimized threats to validity and provided meaningful evidence on the effectiveness of peer-support in improving ART adherence.

The intervention was conducted in two district-level hospitals, Nkawie Government Hospital and Obuasi Government Hospital in the Ashanti Region. This facility-level intervention study lasted for 6 months (April to September, 2023) and started with quantitative data (implementation of the intervention) and qualitative data (focus group discussions) to understand participants' perspective on the benefits of the intervention (Figure 3.1). Data was integrated to provide a comprehensive understanding of the effect of the intervention.

Mixed Method Study

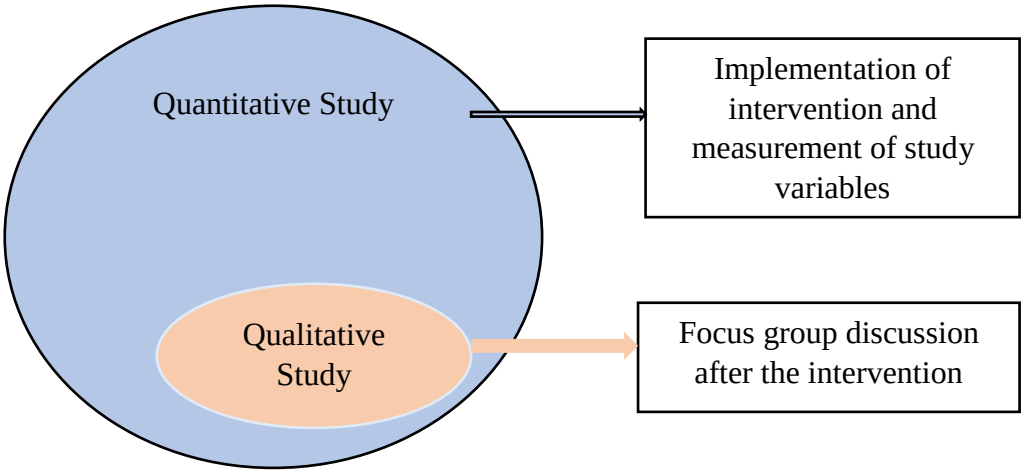

Figure 3.1 Diagram of the study design

3.2 Study area

This study was conducted in two selected district health facilities in the Ashanti Region of Ghana. The Ashanti Region, located in the southern part of Ghana occupies a total land area of 24,389 km^2 (10.2%) of Ghana. The Ashanti Region is located approximately between longitudes 0.15° E and 2.25° W and latitudes 5.50° N and 7.46° S. It is bordered to the north by the Bono East Region, the west by the Western Region, the east by the Eastern Region, and the south by the Central Region (GSS, 2021). Administratively, the Region is divided into 43 Metropolitan, Municipal, and District Assemblies (MMDAs). There is one Metropolis, eighteen Municipalities, and twenty-four Districts. In terms of population, the region is the second most populous area in Ghana, second to the Greater Accra region, with a population of 5,432,485 people, accounting for 17.1 percent of the country's total population according to the 2021 population and housing census (GSS, 2021). The Ashanti Region is well-known for gold production and cocoa and has Kumasi as the largest city and regional capital.

As of the end of 2020, the Region had the highest HIV population, with an estimated 73,245 people living with HIV (GAC, 2020). The prevalence of HIV among adults (15-49) years was 1.94% according to the Ghana AIDS Commission estimates in 2020 (GAC, 2020). This study was conducted at the ART clinics of two district-level hospitals (Fig 3.2). These hospitals were purposively selected due to the higher number of registered ART clients aged 15-24 years according to the national and regional estimates (GAC, 2020). This criterion ensured that the study targeted facilities with a substantial HIV-positive young people population to meet the sample size and allow for meaningful analysis to better answer the research questions. Again, these facilities had no ongoing intervention as of the time of the study, which is essential in minimizing potential confounding factors.

3.2.1 *Obuasi Government Hospital*

The ART clinic in Obuasi Hospital started in the year 2006 to provide ART services to clients in Obuasi and its surrounding communities. The clinic provides ART services to 1,624 clients with about 195 patients (12%) within the age of 15-24 years. Patients are scheduled to come for their medication every 3 months depending on their clinical needs. Clinics are held on Mondays, Wednesdays, and Thursdays. The clinic has six (6) health workers with two (2) nurses, two (2) peer models, one (1) case manager and one (1) paralegal officer. Medications are prescribed for patients by a registered staff nurse at initiation and follow-ups.

3.2.2 *Nkawie Government Hospital*

The Nkawie ART clinic, established in 2014, offers ART services to HIV patients in Nkawie and nearby communities. Currently, the clinic has over 1,200 registered clients, including approximately 187 patients aged (15.6%) 15-24 years. Although the clinic operates throughout the week, patient visits are primarily scheduled for Thursdays. The clinic has seven (7) health

care professionals with different cadres who provide comprehensive ART services to clients. Anti-retrovirals are prescribed to patients by a pharmacy technician at initiation and follow-up.

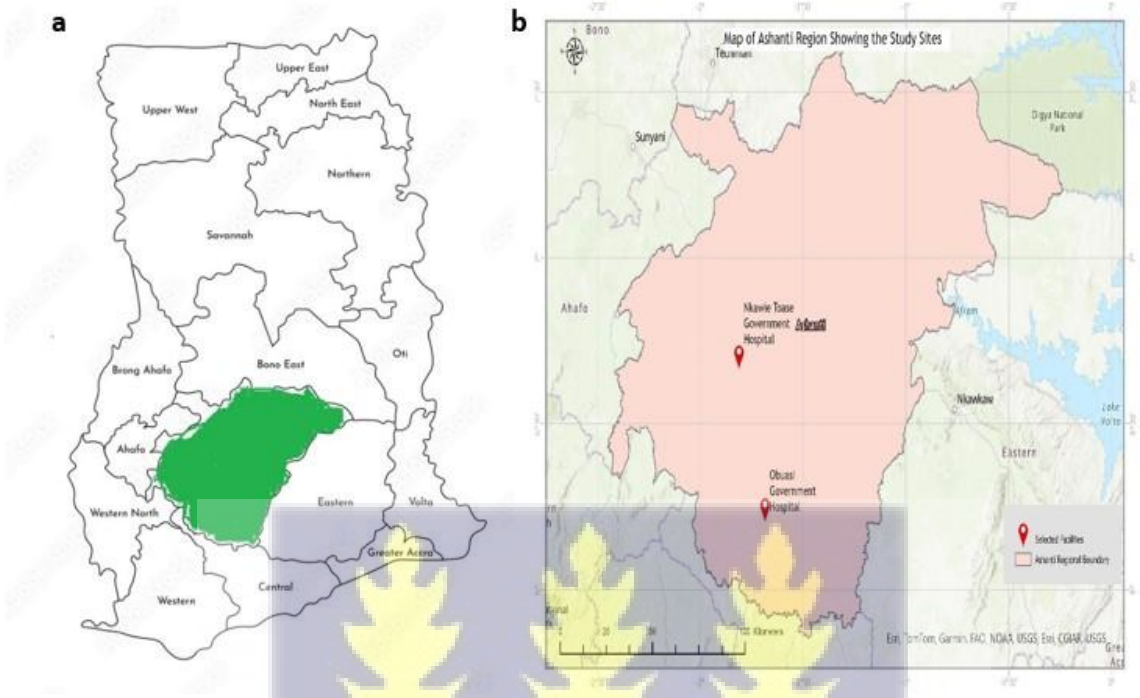

Figure 3.2 (a) *Map of Ghana showing the study region in green* **(b)** Map of Ashanti region showing the study sites.

3.3 Study Population

A study population represents a subset of the target population from which the participants of a study are selected (Creswell & Creswell, 2017). This study involved young people aged 15-24 years, diagnosed with HIV and were receiving ART services at two district-level health facilities in the Ashanti Region.

3.3.1 Inclusion criteria for study participants

Participants were recruited into the study if they met the following criteria: aged 15–24 years, confirmed HIV-positive, receiving antiretroviral treatment, owned a personal mobile phone for receiving text messages and phone calls, were not involved in another intervention, regularly

attended ART clinics at the study health facilities (attended at least 80% of scheduled visits in the past six months which was assessed through medical records with assistance from clinic staff), and were willing to receive HIV treatment support, including adherence guidance from a peer supporter.

3.3.2 Exclusion criteria

Participants were excluded if they had end-stage HIV infection (AIDS). Participants were also excluded if they had a significant ocular impairment precluding their ability to read text messages, and if their HIV status had not been disclosed to them, a situation that was common among younger participants due to parental or caregiver decisions to delay disclosure. This is often driven by concerns about the child's emotional readiness, fear of stigma, or the belief that disclosure could negatively impact their mental wellbeing.

3.4 Sample size calculation

The formula for calculating sample size between two groups when there is a binary outcome (adherence/non-adherence) as proposed by Singh (2012) was used.

$$n = \frac{\left\{Z_{\alpha/2}\sqrt{[2\bar{p}(1-\bar{p})]} + Z_{\beta}\sqrt{[p_1(1-p_1)+p_2(1-p_2)]}\right\}^2}{(p_1-p_2)^2}$$

Where:

n= required sample size for one group

$\bar{p} =$ Pooled proportion $= \frac{p_1+p_2}{2}$

P_1 = Proportion of HIV treatment outcome in group 1 (intervention)

P_2 = Proportion of HIV treatment outcome in group 2 (Control)

$Z_{1-\frac{\alpha}{2}}$ = confidence level at 95% (standard value of 1.96)

$Z_{1-\beta} = Z_{0.20}$ =0.84 at 80% power; to detect the difference of HIV treatment adherence between the groups.

Considering a baseline adherence level of 79% (Biney et al., 2021) and intervention effect of 16%, That is 95% proportion of HIV treatment adherence in the intervention group and 79% adherence in the control group, the sample size required was

n=85.4

Considering an equal sample size allocation ratio, for the intervention and the control group; the required sample size for both groups =85.4*2 = 171

Considering a 25% attrition rate from similar study (Willis et al., 2019), and using the drop rate formula by Kang (2021), $Nd = \frac{N}{1-d}$ where N and Nd are the calculated sample size before and after considering drop-out rate respectively, and d is the expected drop-out rate; approximately 228 participants were required for the study.

3.5 Sampling and enrolment

A purposive sampling approach was used in selecting the two health facilities. Participants were included in the study if they met the inclusion criteria and were willing to participate.

3.5.1 Facility selection

A purposive sampling method was employed to select the health facilities within the study setting. The selection was based on the high burden of young persons living with HIV in these facilities in the Ashanti Region. In addition, the facilities were chosen because there were no ongoing HIV-related interventions at the time of the study. This information was obtained from the Ashanti Regional Health Directorate and the National HIV/STI Control Program.

3.5.2 Recruitment of Study Participants

Similar to the study by Denison (2020) among young people (15-24 years) living with HIV in Zambia, a consecutive sampling approach was used in sampling the participants into the study. Participants who met the inclusion criteria and were willing to participate were included in the study till the required sample size was met. Once the health facilities were identified, a contact was made with the head of the ART clinics. The study protocol was well explained to them. With assistance from the ART clinic staff, potential eligible participants (meeting age criteria) at each health facility were determined by reviewing ART clinic records, manually and electronically.

Participants were contacted on the phone by the head of the ART clinics and informed about the research. Where a third party answered the phone call, a call-back was politely requested. They were invited to the ART clinic where the study protocol was explained, comprehensively, to their understanding. Participants were given time to ask questions and seek clarification of the study. All questions and concerns raised were addressed to participant's satisfaction. Of those contacted (296), 36 could not be reached, 18 declined with non-interest in the study, and two were found to be on admission. Details of study enrolment is provided in Figure 3.3. They were enrolled after providing written informed consent (for participants' ≥18 years). Consent and assent were sought from mothers of participants <18 years old. The recruitment of participants lasted for approximately 5 weeks.

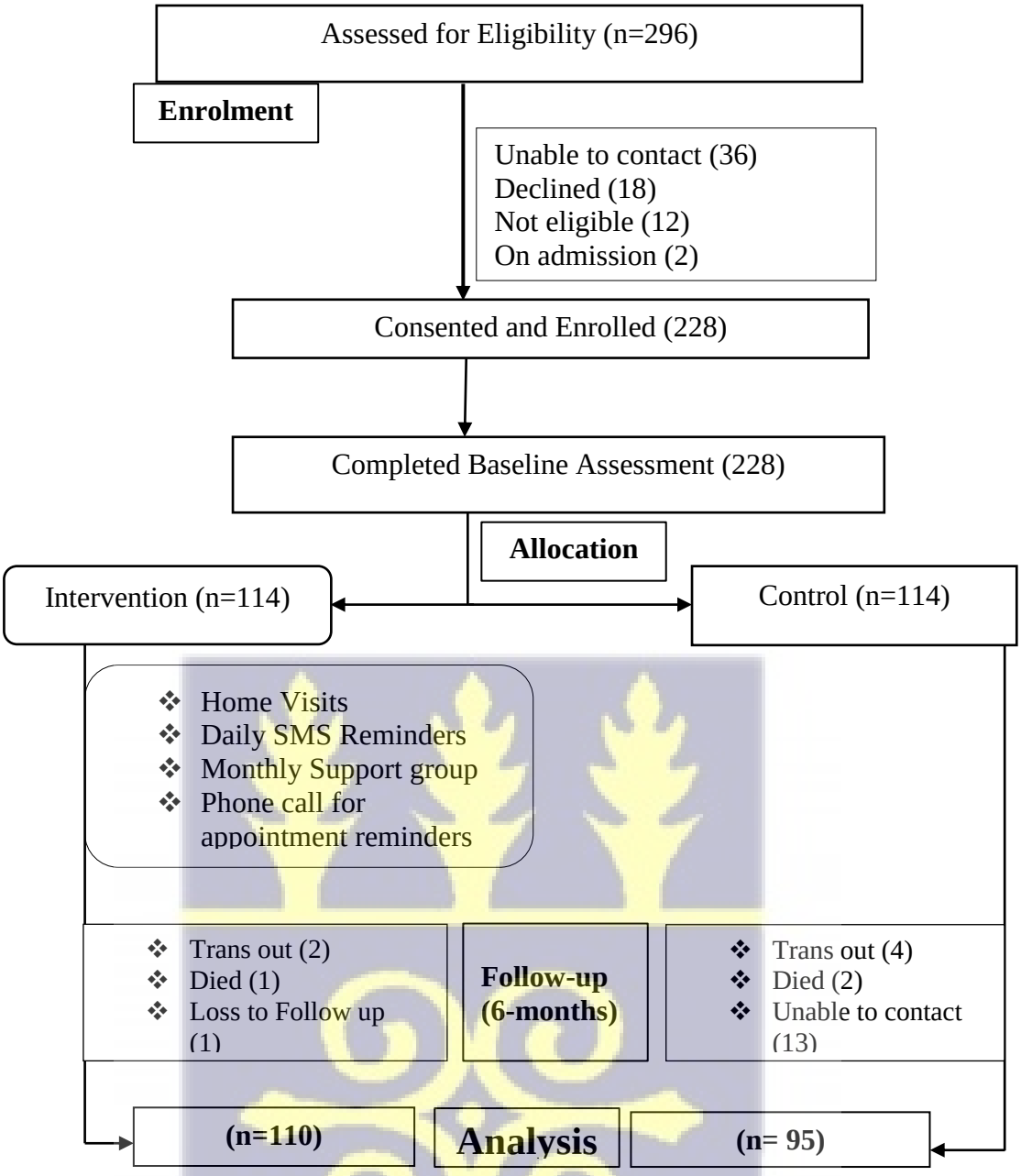

Figure 3.3. Flow chart of Participants Enrolment based on the Transparent Reporting of Evaluations with Non-Randomized Designs (TREND) (Des Jarlais, 2014).

3.6 Study Intervention

This was a multicomponent peer support intervention. A multicomponent intervention approach was used due to the complexity of adherence to ART which some single interventions such as SMS reminders have failed (Kanters et al., 2017). The study used four main approaches including daily SMS reminders, monthly home visits, monthly support meetings and phone call for appointment reminders. The primary focus of the intervention is to assist the young people to gain the necessary information, attitudes, and skills for positive behavioural modification that are important in the HIV treatment process. This is important to improve adherence to ART and their psychosocial wellbeing (reduce stigma, and depression).

3.6.1 Pre-intervention

Prior to the intervention, all eligible participants were invited to the health facility (Obuasi government hospital). This was important for group formation and participant participation in the development of the content of the daily text messages.

Group formation

At the clinic, eleven (11) support groups were formed with one peer support leader. Peer support leaders were nominated by group members with the support of ART health care staff based on pre-determined eligibility criteria. Support group formation applied age-matching to enable participants to freely share their experiences and concerns as recommended in a similar study at Komfo Anokye Teaching Hospital (Barker et al., 2019). A peer supporter was assigned to 10 intervention participants.

3.6.2 Peer supporters' selection

Participants who were nominated as peer leaders were assessed for eligibility as outlined in the Paediatric Adolescent Treatment Africa programme Handbook[1] (PATA). These include their willingness to lead their peers in the intervention, accept the peer leaders' responsibilities, agree not to relocate for the next six months, not defaulters from care (this was done with assistance from ART nurse), and were able to read and write.

3.6.2.1 Peer Leaders training and responsibilities

Peer leaders received a comprehensive two-day training focusing on their primary responsibilities within the intervention. The training equipped them with current information about HIV, communication and counseling skills, and self-confidence. These competencies are necessary for effective support and motivation of their assigned HIV-positive peers. The training sessions were conducted by an expert from the National AIDS/STI Control Programme (NACP). The training consisted of role plays and interactive sessions on knowledge of HIV, including mode of transmission, prevention and management, adherence to treatment, dealing with depression and stigma, and sexual and reproductive decisions. The training adopted materials from the USAID document entitled "Positive Connections: Leading Information and Support Groups for Adolescents Living with HIV" (USAID, 2013) and the Paediatric Adolescent Treatment Africa (PATA) peer supporter porgramme handbook.

The USAID guide provided a framework for young people to understand their HIV status and treatment. It outlined strategies for living a healthy lifestyle including physical activity, avoidance of drugs and alcohol, adherence to treatment, and information to enable them make informed decisions about sexual and reproductive health. Sexual and reproductive health information included prevention of viral transmission and ways of dealing with HIV-related

[1] www.teampata.org/wp-content/uploads/2017/10/PATA-Peer-Supporter-Handbook-review-2017_Final.pdf

stigma and depression[2]. This was complemented by the PATA peer support programme handbook content on code of conduct of peer supporters, as well as how to commit to carrying out assigned peer support duties. Peer leaders were briefed on the importance of maintaining strict confidentiality regarding the information of their group members. To maintain fidelity, peer supporters were equipped with a training manual and session guide to standardize delivery. They were supervised through regular debriefing meetings, monthly feedback sessions, and activity log reviews.

The peer leader's main duties in working with HIV-positive young people were to:

1. Facilitate monthly support group sessions.
2. Perform monthly home visits.
3. Send daily SMS reminders.
4. Call and remind participants of their clinic appointments.

They were reminded that their roles should not affect their treatment. Peer leaders were to act as role models in providing support to their peers in an empathic and non-judgemental manner. As motivation for their role, each peer leader received a monthly allowance of GHS400 (approximately $33).

3.6.3 Monthly support group meetings

A monthly support session were held for participants in the intervention arm for six months. This was led by the peer supporters. Prior to each group meeting, the researcher with assistance from a health care provider discussed with the group leader what information needs to be shared and discussed with participants. The table below provides more details on topics that were covered during the group sessions.

[2] www.fhi360.org/sites/default/files/media/documents/positive-connections-2013.pdf

Table 1. Topics discussed during monthly support sessions

Meeting	Topic covered	Content
1	Adherence	Peer leaders talked about medication schedule; the importance of taking medications at the same time each day and how this consistency contributes to the effectiveness of the treatment. They explained how consistency in medication taking as prescribed (adherence) helps to achieve and maintain viral suppression, leading to better health outcomes and reducing the risk of opportunistic infections and transmission to partners. They discussed on the key barriers to adherence (mainly on medication side effects, forgetfulness) and the need to keep in contact health care providers to help address these barriers. The peer leaders shared success stories of adherence, illustrating how adherence positively influenced the health and wellbeing of individuals living with HIV. They used themselves as an example of their current health status due to good adherence.
2	Depression	The peer leaders explained depression and the need to avoid it in HIV treatment. Participants were encouraged to understand that depression is more than just feeling sad; it is a mental health condition that affects thoughts, feelings, and daily functioning. Some signs of depression include having trouble concentrating on an activity, loss of interest in doing things etc. Peer leaders encouraged participants to seek help from health care providers if needed.
3	Stigma	Stigma was explained as negative beliefs, attitudes and behaviours directed towards people living with HIV. Stigma may present as discrimination or social exclusion. Stigma was

		also explained in terms of participants applying the negative societal beliefs, attitudes, and behaviours to themselves (self-stigma) which often leads to shame, anxiety, and depression. Participants were advised to have a deep understanding of HIV because stigma often arises from ignorance and misinformation about HIV and were encouraged to seek help from health care providers when necessary.
4	Disclosure	The peer leaders discussed importance of disclosing their HIV status. They reminded participants that disclosure is a personal choice but can foster support, reduce stigma, and create opportunities for shared experiences. Peer leaders mentioned that while disclosure seem difficult and often a problem for younger people, they should consider the bigger picture of its importance. They discussed the importance of choosing the right time and place for disclosure and encouraged participants to plan and consider the potential impact on their relationships. It was also highlighted that they should disclose their HIV status to persons they trust (e.g. friends, family) to avoid stigma and discrimination.
5	Sexual and Reproductive Health	Peer leaders provided education on sexual and reproductive health. These included the need to use condoms during sexual intercourse, and the need to disclose their status to their sexual partners. They were also reminded to frequently take their medication to avoid the transmission of the virus to their partners. Peer leaders highlighted the concept of "U=U", undetectable viral load translate to untransmittable. They were made to understand that having HIV does not prevent them from having children as far as they adhere to their medication.

6	Nutrition and Physical Activity	Peer leaders advised participants on the need to have adequate nutrition for optimum immune function. They were also advised on the need to have regular exercise such as walking, dancing, or engaging in sports as young people living with HIV which is important for their mental health or as coping strategies to deal with mental health issues such as depression.

3.6.3.1 Support group sessions

At each meeting, peer leaders reminded participants of the purpose of their meeting (to provide information and create a supportive environment for their HIV treatment), assured participants of the confidentiality of the information they share within the group and the need to respect each other's views. This created an environment where they felt secure discussing their experiences. The peer leaders engaged participants and led the discussion on predetermined topics (Table 1). In the sessions, participants were asked to share their experiences as well as coping strategies on some of the topics discussed, particularly stigma, depression, adherence, and disclosure. All communication during the support group meetings were in the local language (Twi), the predominant language in the study setting. The meetings were held at convenient locations and days agreed by members of the groups; typically they were Saturdays or Sundays at a school compound or at the ART clinic. Staff from the ART clinic were often present at these meetings, but they did not interfere with the discussions. Their role was simply to ensure that the meetings took place as scheduled. Each group session lasted for a minimum of 45 minutes and a maximum of 60 minutes depending on the topic discussed.

3.6.4 Home visits

Home visit is an integral component of comprehensive patient-centered care and treatment service delivery for patients with chronic diseases such as HIV/AIDS. Home visits/support were done by peer leaders once a month to encourage and motivate participants to take their medications, and to remind them to attend their scheduled clinic appointments. Peer leaders also asked participants whether they were facing any health challenges with respect to their HIV treatment and if any, provided advice on seeking care from a health facility. A home visit was only done by peer leaders when participants had agreed to a visit and when the visit should occur.

3.6.5 Short Message Services (SMS)

A one-way message was developed by the participants themselves and personalized to reflect content that was meaningful to them. The messages were developed such that it did not reveal participant's HIV status and/or mention ARVs. Participants agreed that the number "8" be sent to them by their peer leaders as reminders since majority mentioned taking their medication at 8:00 pm. Participants were advised to delete the messages after taking their medication to avoid accidental disclosure. Messages were sent by peer leaders daily.

3.6.6 Phone calls for appointment reminders

Peer leaders maintained records of their group members' upcoming clinic appointments and called to remind them one or two days before their scheduled clinic appointment. The call was typically in the evenings. If a participant did not answer or could not be reached, a follow-up call was made early in the morning on the day of the appointment.

3.7 Intervention compliance

The researcher, with support from the ART clinic staff, randomly called 10 participants daily to verify whether they had received the messages. This process was repeated monthly for home visit follow-ups. In addition, a form was created for each peer leader, which included participants' unique identification, age, place of residence, phone contact and a section to indicate whether the messages had been sent. Peer leaders were required to complete this form daily for messages sent to their group members, as well as for the monthly support group meetings and home visits. They also provided a brief report on each meeting, which was shared with the researcher every month.

3.8 Control Group

The control group received HIV standard of care and treatment from the health facility as per the guidelines of the Ghana National AIDS/STI control programme (NACP). These included the provision of ARVs at clinic visits, management of opportunistic infections, often by the administration of cotrimoxazole prophylaxis and adherence counselling (NACP, 2019).

3.9 Outcome Measures

The primary outcome of the study was the proportion of participants who adhered to their medication (ART) after the intervention. Adherence to ART was assessed using the MMAS-8 and the Pill count method as used in a previous study among adolescents and young adults population in Ghana (Biney et al., 2021).

The secondary outcomes of the study were, stigma, and depressive symptoms, HIV status disclosure, viral load of the participants in the intervention group compared with the control group.

3.10 Data Collection

3.10.1 Questionnaire

A questionnaire was designed to collect data from participants at enrolment (baseline) and six (6) months after the intervention began. This includes demographic characteristics of the participants, HIV and other clinical characteristics, comprehensive knowledge of HIV/AIDS, adherence, stigma, depression, and viral load (if available) (see appendix 1).

3.10.1.1 Demographic data

The questionnaire included demographic data such as the patient's sex, age, religion, educational status, occupation, marital status, living arrangements, status of parents and health insurance status.

3.10.1.2 HIV and Clinical Information

This section of the questionnaire captured information on date and place of diagnosis of HIV, age of diagnosis, belief of their infection, duration on using HIV treatment after diagnoses, type of currently used HAART drug(s), side effects of HAART, duration of HAART treatment, whether a participant is taking other medication to treat HIV, disclosure information, sexual relationship of the participant, history of opportunistic infection, clinic visits and recent viral load if available.

3.10.1.3 Knowledge of HIV infection and Anti-retroviral therapy (ART)

Comprehensive knowledge of HIV infection and treatment was assessed among the study participants. Six questions were used to assess knowledge on the transmission pathways of the virus. These included whether "one can get infected with HIV through witchcraft, one can reduce the risk of getting HIV by always using condoms during sex, one can reduce the risk of getting HIV by having only one sexual partner, one can get HIV from mosquito bites, a person can get infected with HIV by sharing food with a person who has HIV/AIDS, a healthy looking

person can have HIV". In addition, participant's knowledge of antiretroviral therapy was assessed using 8 questions with responses of "agree, disagree and don't know". These questions were adopted from the study by Nachega et al. (2005) in South Africa.

3.10.2 Measurement of study Outcomes

3.10.2.1 Adherence

Adherence, the primary outcome was measured using the MMAS-8 and the pill count method. The MMAS-8 is an eight-item self-report tool designed to assess medication-taking behaviour (Aguiar et al., 2020). The tool has proved to be a valuable resource to address adherence concerns, such as forgetting to take medications or discontinuing medications without guidance. Prior to using this tool, written permission was obtained from Dr. Donald Morisky.

Participants were asked to come to the clinic with their pill bottles. Pill count was completed using the method described by Basu and Garg (2017). To calculate the number of pills taken, the number of pills remaining was subtracted from the total dispensed at the previous visit. The adherence rate was then determined by dividing the number of pills consumed by the number of days since the last dispensation, and multiplying the result by 100.

$$\text{Pill count} = \frac{\text{number of pills taken}}{\text{nuber of days elapsed since last dispense}} * 100$$

3.10.2.2 Measurement of Depression

Depression was measured using the Patient Health Questionnaire (PHQ-9), which employs a 4-point Likert scale with responses ranging from "not at all" to "nearly every day" (Kroenke et al., 2001). The PHQ-9 measures the frequency of depressive symptoms by asking whether individuals have experienced certain symptoms within the past two weeks. It helps screen for depression and measures its severity. This scale has been used previously in sub-Saharan African populations to assess depression among AYPLHIV (Willis et al., 2019).

3.10.2.3 HIV-Related Stigma

Internal (self) experienced stigma was measured by asking participants a series of questions regarding how they perceive themselves after being diagnosed with HIV. The internal stigma scale measured participant's actual emotions or experiences related to having HIV. *(eg, "I feel ashamed that I am HIV positive*"). This was adapted from the Internalized AIDS-Related Stigma Scale (IA-RSS) (Kalichman et al., 2009). Similarly, perceived stigma (externalized) required the participants to think of the feelings or behaviors of others (eg, "People I know would treat someone with HIV as an outcast"). These measures have also been used in previous studies in Ghana (Barker et al., 2019). The two measures consisted of 12 questions, each containing 6 items on a four-point Likert scale, with response options ranging from 1 (Strongly disagree) to 4 (Strongly agree) to indicate the participant's level of agreement.

3.10.2.4 Viral Load

Viral load data before and after the intervention were extracted from participants medical records, if available. Participants were classified as virally suppressed if they had HIV RNA <1000 copies/ml (Tapera et al., 2019). Viral load testing at both health facilities is carried out at the Komfo Anokye Teaching Hospital, which serves as the regional referral center.

3.11 Qualitative Data

Focus group discussions were held at the end of the study with participants from the intervention group to understand their experiences with the peer support intervention. Participants in the intervention arm were purposely selected from each group to participate in the focus group discussion. This was done to reflect diversity in-terms of age and sex identity. They were asked to share their experiences regarding their involvement in the study, mainly on the benefits and the challenges as well as perspectives for similar future interventions. The interview lasted for a minimum of 45 minutes and maximum of 60 minutes.

The focus group discussion was carried out in a serene environment preferred by participants, which enabled them to feel comfortable to express their views and share their experiences. The interviews were conducted in Twi, the predominant local language of the study participants. With permission from participants, each of the focus group discussions was audio recorded for transcription and analysis. Participation in the discussion was mainly voluntary and confidential and they were reimbursed their cost of transportation. Participants were grouped into two categories according to their age, group A, between 15 -19 years and group B, between 20-24 years and taking into account their sex (males and females separately in a group). In total, five focus group discussions were conducted to achieve data saturation.

3.12 Quality Control Measure

To ensure trust, confidentiality and accurate responses, peer leaders and research assistants were adequately trained. Four research assistants (two males and two females) with tertiary education backgrounds received two days of training. They were educated about HIV/AIDS and the importance of maintaining optimal adherence to treatment. Additionally, the research assistants were trained on how to properly administer the study questionnaires to participants and the importance of maintaining confidentiality. To minimize social desirability bias during the data collection process, healthcare workers were not involved in data collection. The questionnaire was pretested with twenty (20) respondents (HIV-positive adolescents and young adults) at an ART clinic in Kumasi, Ashanti region. This was important to ensure clarity, logical flow, identify where skip patterns were needed and also ensure easy understanding of the study questionnaire. Interviews were conducted in the local languages of participants. The Kobo Collect data collection tool was used to design the questionnaire and data collection. This made it easy to check the completeness of responses each day and to correct any error (s) where necessary.

3.13 Intervention fidelity

Measures were taken to minimize potential contamination of the intervention, as contamination can reduce the estimated effect size of an intervention and lead to inaccurate conclusions (Torgerson, 2001). The two selected health facilities are geographically distant from each other (~82.8 km) reducing the likelihood of interaction between participants from the intervention and control groups. In addition, during end line data collection, participants in the control group were explicitly asked about their exposure to similar intervention (peer group meetings, SMS reminders, home visits) and none reported receiving any components of the intervention.

3.14 Data Analyses

3.14.1 Quantitative Data

Data was downloaded from the KoboCollect server to Microsoft Excel prior to analyses. Data were cleaned and analyses were performed using STATA version 17.0 for Windows. Age of participants was summarized using the mean and standard deviation, as well as frequency and percentages. Other demographic characteristics such as sex of participants, educational attainment, employment status, religious affiliations, marital status and place of residence were summarized in frequencies and percentages.

Adherence was assessed on the Morisky Medication Adherence Scale, ranging from 1 to 8. A higher score indicate good adherence. Similar to the study in Ghana by Biney et al. (2021) and the study by Tan et al. 2014, this study classified participants as having good adherence when the total score is (6-8) while less than 6 was classified as non-adherent. Using the pill count method, adherence was classified as having taken at least 95% of medication. Depression was scored from "Not at all" (0) to "Nearly every day" (3), with a total score of 27. The higher the score, the higher the depressive symptoms. Participants were categorized as "depressed" when their total score was more than 4; scores from 0-4 represented "No depression" (Duko et al., 2018).

Internal and perceived HIV-related stigma were scored from 1 (Strongly disagree) to 4 (strongly agree) with a total score of 24. A higher score indicated a high degree of stigma. Stigma scores were treated as continuous variable and presented in means and standard deviations.

Six questions with responses of "No" and "Yes" were used to determine participants' comprehensive knowledge of HIV. A correct response was scored as 1 while an incorrect response was scored as 0. A composite knowledge score was created by summing correct responses across the six items. Participants' scores ranged from 0 (minimum) to 6 (maximum). Responses to "one can get infected with HIV through witchcraft or supernatural means", "One can get HIV from mosquito bites" and "a person can get infected with HIV by sharing food with a person who has HIV/AIDS" were reversed coded. Participants were classified as knowledgeable of HIV when they provided a correct response to all the questions and not knowledgeable when they answered incorrectly at least one of the questions (Teshale et al., 2022).

Baseline characteristics were tested for differences between control and experimental groups with independent *t* tests for the continuous variable, i.e. stigma. Test for normality (Skewness/Kurtosis) was examined prior to testing for group differences (intervention vs control). Chi-square test was used to assess whether there were statistically significant differences in adherence between the intervention and control groups across different demographic variables. A binary logistic regression analysis was conducted to identify factors associated with adherence to ART. This was done to examine the relationship between various independent variables, such as socio-demographic factors and clinical factors, and the likelihood of being adherent to ART.

To assess the effect of the peer support intervention on the study's primary and secondary outcomes, a Difference-in-Difference (DiD) regression analysis was conducted. This approach

estimates the average treatment effect (ATE) by comparing changes in outcomes over time between the intervention and control groups. The parallel trend was assumption was taken into account prior to analyses. The parallel trend assumption states that, in the absence of the intervention, the average change in the study outcomes for the intervention and control group would have followed similar trend over time (Gibson & Zimmerman, 2021).

The DiD analysis was conducted using the diff command in STATA, which accommodates both continuous and categorical outcomes and allows for the inclusion of covariates. Potential confounding was addressed analytically using the difference-in-differences (DiD) approach, which controlled for baseline differences between intervention and comparison groups and accounted for time trends. In addition, multivariable logistic regression model was fitted to adjust for key covariates that were significantly associated with adherence in the bivariate analyses. These included belief in HIV status, current smoking status, current alcohol use, depression, stigma, age, and sex. Statistical significance was considered at p-value less than 0.05.

3.14.2 Qualitative data analysis

Thematic framework analysis was employed to analyze the qualitative data, following Braun and Clarke (2006) six-step approach to thematic analysis. These steps included: (a) familiarization with the data; (b) generation of initial codes; (c) searching for themes; (d) reviewing themes; (e) defining and naming themes; and (f) producing the final report.

Audio recordings from the focus group discussions (FGDs) were transcribed verbatim into English using Microsoft Word to maintain the accuracy and meaning of participants' responses. The researcher repeatedly listened to the recordings and reviewed the field notes to enhance familiarity and contextual understanding of the data. Field notes were integrated into the transcripts to capture non-verbal cues, group dynamics, and contextual details.

Coding was conducted using both inductive and deductive approaches. The deductive approach was informed by the study objectives and the socio-ecological framework, while the inductive approach allowed for the identification of new, emerging themes directly from the data. Initial codes were generated line-by-line to capture relevant ideas and patterns.

Following coding, similar codes were collated and grouped into potential themes and subthemes. Themes were then reviewed and refined by examining coherence within themes and distinctions between themes. To enhance credibility, the coding and thematic structure were discussed among members of the research team until consensus was reached. Reflexivity was maintained throughout the analysis process through the use of analytic memos, reflections, and possible biases that could influence interpretation.

The final themes were clearly defined and supported with verbatim quotations from participants to illustrate key findings and provide a rich, contextualized understanding of their experiences in the study intervention. The analysis was carried out using NVivo for Windows, version 12.0.

3.15 Ethical Considerations

1. Ethical approval for the study was obtained from the Ghana Health Service Ethical Review Committee (GHS-ERC) with approval number, GHS-ERC 019/09/22 (see appendix 3).

2. An introductory letter was obtained from the Ashanti Regional Health Directorate and presented to the facilities before the commencement of the study (see appendix 4). All the necessary permissions were also obtained from the health facilities.

3. Permission was also obtained from Dr. Donald Morisky to use the Morisky Medication Adherence Scale (MMAS-8).

4. Informed consent was obtained from all participants after the study had been explained to them with the aid of participant information sheet (see appendix 2). Participants were given the voluntary agreement sheet to complete and sign to certify that they had understood and agreed to be part of the study. Parents/guardians of participants less than 18 years were taken through the informed consent process and assent was obtained from their children to participate in their study.

5. Participants were informed about confidentiality, anonymity, potential risks and benefits, and their right to participate voluntarily or withdraw from the study at any time without facing any negative consequences.

6. Throughout the study, individual participants were given unique codes to maintain anonymity and to ensure confidentiality. Participants were assured that the study's findings could lead to the development of policies and interventions that may benefit them both directly and indirectly.

CHAPTER FOUR

4.0 RESULTS

This chapter presents the findings of the study. The chapter focuses on the demographic information of participants, adherence level to ART, factors associated with adherence, prevalence of depression, stigma and viral load information. In addition, differences in the study outcomes (adherence, depression, stigma, viral load) over time between the study groups are also presented.

4.1 Socio-demographic Characteristics of Study Participants

Shown in table 1 is the socio-demographic information of the participants. The study involved 228 young people between the ages of 15-24 years living with HIV. The majority (79.0%) of the participants were between the ages of 20-24 years, with a mean age of 21.4±2.8 (Mean ± SD). Most of the participants were females (68.4%). Less than one-tenth (7.9%) indicated having no formal education; less than half (37.7%) had education up to senior high school or higher. Slightly more than a quarter (25.4%) of the participants were students and approximately one-third (32.5%) had been employed. Forty-two percent (42%) of the participants indicated not being engaged in any employment activity. More than half (61.8%) of the participants had never married; 16.7% were married. The majority (82.4%) of the participants were Akans, and were Christians (80.7%). Only a few of the participants indicated not belonging to any religion (4.4%).

Participants from urban centers (65.4%) were more than the rural participants (34.6%). Slightly more than half of the participants (54%) lived with their immediate family (father, mother, spouse, and siblings); few (10.9%) were living alone. About 13% of the participants reported currently consuming alcohol, and 3% identified as current smokers. Majority (91.4%) of the participants indicated having good relationship with their health care providers. All the

demographic information of the participants did not differ significantly between the study groups except place of residence ($p<0.05$).

Table 4.1 Demographic Characteristics of Respondents (N=228)

Variable		Overall sample (N=228)	Intervention group (n=114)	Control group (n=114)	p-value
Age group		21.4±2.8	21.0 ± 3.0	21.7 ± 2.5	0.066
	15-19	48 (21.1)	29 (25.4)	19 (16.7)	0.104
	20-24	180 (79.0)	85 (74.6)	95 (83.3)	
Sex					
	Male	72 (31.6)	42 (36.8)	30 (26.3)	0.087
	Female	156 (68.4)	72 (63.2)	84 (73.7)	
Educational level					
	None	18 (7.9)	13 (11.4)	5 (4.4)	0.339
	Primary	20 (8.8)	11 (9.7)	9 (7.9)	
	JSS/JHS	104 (45.6)	49 (42.9)	55 (48.3)	
	Secondary/vocation school	75 (32.9)	35 (30.7)	40 (35.1)	
	Tertiary	11 (4.8)	6 (5.3)	5 (4.4)	
Occupation					
	Employed	74 (32.5)	35 (30.7)	39 (34.2)	0.314
	Unemployed	96 (42.1)	45 (39.5)	51 (44.7)	
	Student	58 (25.4)	34 (29.8)	24 ((21.1)	
Marital Status					
	Never married	141 (61.8)	80 (70.2)	61 (53.5)	0.069
	Married	38 (16.7)	16 (14.04)	22 (19.3)	
	Cohabiting	42 (18.4)	15 (13.2)	27 (23.7)	
	Divorced/Separated	7 (3.07)	3 (2.6)	4 (3.5)	
Ethnicity					
	Akan	192 (84.2)	97 (85.1)	95 (83.3)	0.924
	Ewe	20 (8.8)	9 (7.9)	11 (9.7)	

Ga/Dangme	9 (4.0)	4 (3.5)	5 (4.4)	
Other*	7 (3.1)	4 (3.5)	3 (2.6)	
Religion				
Christian	184 (80.7)	89 (78.1)	95 (83.3)	0.587
Islam	34 (14.9)	19 (16.7)	15 (13.2)	
No religion	10 (4.4)	6 (5.3)	4 (3.5)	
Place of Residence				
Urban	149 (65.4)	89 (78.1)	60 (52.6)	0.000
Rural	79 (34.6)	25 (21.9)	54 (47.4)	
Living arrangement				
Live with immediate Family	123 (54.0)	64 (56.1)	59 (51.8)	0.506
Live with extended Family	80 (35.1)	36 (31.6)	44 (38.6)	
Live alone	25 (10.9)	14 (12.3)	11 (9.6)	
Time to Reach ART Centre				
<30 mins	171 (75)	83 (72.8)	88 (77.2)	0.444
≥ 30 mins	57 (25)	31 (27.2)	26 (22.8)	
Currently drink alcohol				
Yes	30 (13.2)	14 (12.3)	16 (14.0)	0.695
No	198 (86.8)	100 (87.7)	98 (86.0)	
Currently smoke				
Yes	7 (3.1)	2 (1.8)	5 (4.4)	0.249
No	221 (96.9)	112 (98.2)	109 (95.6)	
Relationship with Health care Providers				
Poor	22 (9.6)	13 (11.4)	9 (9.7)	0.370
Good	206 (90.4)	101 (88.6)	206 (90.4)	

JHS/JSS: Junior High School/ Junior Secondary School; Other Ethnic group include Grusi, Gurma, and Mole-Dagbani; immediate family include father, mother, spouse, and siblings; extended family include Grandparents, uncles, Aunties etc.

4.2 Participants' HIV, Sexual and Clinical Characteristics

Presented in table 4.2 is the Sexual, HIV, and clinical characteristics of the participants. The variables assessed included beliefs about HIV status, sexual activity, condom use, current sexual relationships, duration on antiretroviral therapy (ART), side effects experienced from ART, methods for medication reminders, storage of antiretroviral drugs (ARVs), and lifetime adherence to ART. The majority (85.1%) of the participants believed and accepted their HIV diagnosis. At baseline, belief of HIV status did not differ significantly between the intervention and control arm ($p>0.05$). Among the participants, 67.5% reported being in a sexual relationship, 73.3% indicated they had ever had sexual intercourse. Among those who had ever had sex, 29.9% reported using a condom during their last sexual encounter. Sexual behaviour (sexual relationship, ever had sex, condom use at last sex) differed significantly between the intervention and control arms at baseline ($p<0.05$).

About two-thirds (67.5%) had been on ART for more than two years and indicated that they experienced side effects (71.8%). Majority of the participants kept their ARVs in a bag (82.5%). Various methods were used as reminders in takings their ARVs. These include using a phone with an alarm (22.8%), watches/wall clocks (14.0%) and a pill box (12.3%). Less than half of the participants (43.0%) indicated using nothing to remind themselves of taking their ARVs. A statistically significant difference was observed between the intervention and control arm on the medication reminding methods used by participants at baseline. When participants were asked whether they had ever missed taking their ARVs since they initiated ART, majority (80.3%) indicated having ever missed their medication. At baseline, viral load information which was retrieved from their medical records was available for 205 participants. Although close to two-thirds (63.4%) had their viral load suppressed (≤ 1000 copies/mL), slightly more than a quarter (25.9%) had unsuppressed viral load (>1000 copies/ml).

Table 4.2 HIV, Sexual and Other Clinical Characteristics of Respondents

Variable	Overall sample (N=228)	Intervention group (n=114)	Control group (n=114)	p-value
Believed HIV Status	194 (85.1)	99 (86.8)	95 (83.3)	0.457
Ever had sex	167 (73.3)	72 (63.2)	95 (83.3)	0.001
Used Condom at last sexual intercourse	50 (29.9)	34 (47.2)	16 (16.8)	0.000
Currently in sexual relationship	154 (67.5)	68 (59.7)	86 (75.4)	
Duration on ART				
Less than 1 year	20 (8.8)	6 (5.3)	14 (12.3)	0.049
1-2 years	54 (23.7)	23 (20.2)	31 (27.2)	
More than 2 years	154 (67.5)	85 (74.6)	69 (60.5)	
Experienced side effects of ART	166 (71.8)	89 (78.1)	77 (67.5)	0.074
Medication Reminders				
Nothing	98 (43.0)	53 (46.5)	45 (39.5)	0.003
Phone with alarm	52 (22.8)	15 (13.2)	37 (32.5)	
Pill box	28 (12.3)	18 (15.8)	10 (8.8)	
Watches/Wall clock	32 (14.0)	15 (13.2)	17 (14.9)	
Other	18 (1.9)	13 (11.4)	5 (4.4)	
Where ARVs are Kept				
Bag	188 (82.5)	95 (83.3)	93 (81.6)	0.776
Drawers	8 (3.5)	3 (2.6)	5 (4.4)	
On the Bed	10 (4.4)	6 (5.3)	4 (3.5)	
Under pillow	22 (9.7)	10 (8.8)	12 (10.5)	
Viral Load*				
Suppressed	130 (63.4)	66 (64.7)	64 (62.2)	0.680
Unsuppressed	53 (25.9)	27 (26.5)	26 (25.3)	
Results pending	22 (10.7)	9 (8.8)	13 (12.6)	
Lifetime adherence to ART	45 (19.7)	18 (15.8)	27 (23.7)	0.134

*Other: included bedtime and family reminder (mother, father, grandparent, Uncle etc); * viral load information was available for 205 participants. The unavailable information were due to failed results for reasons due to low sample, clotting, missing sample and incorrect sample labels.*

4.3 Adherence to Anti-Retroviral Therapy at Baseline

Adherence to ART was measured using the MMAS-8 and the Pill count method. Adherence to ART was found to be 71.9% and 63.6% using the MMAS-8 and the Pill count method respectively. Adherence did not differ significantly between the study groups at baseline. Details are presented in Figures 4.1 and 4.2 below.

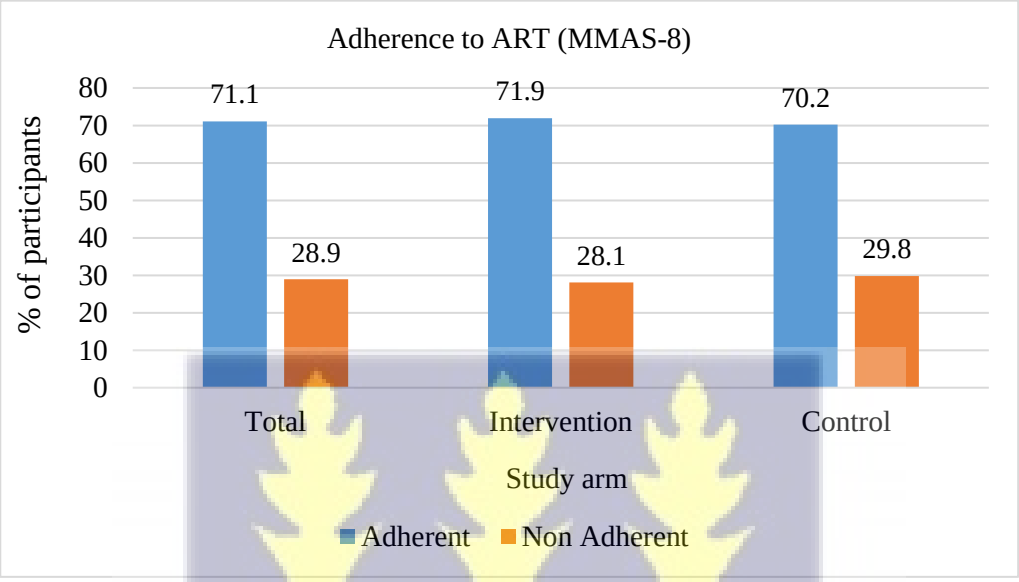

Figure 4.1 Prevalence of Adherence among the study participants at Baseline (MMAS-8)

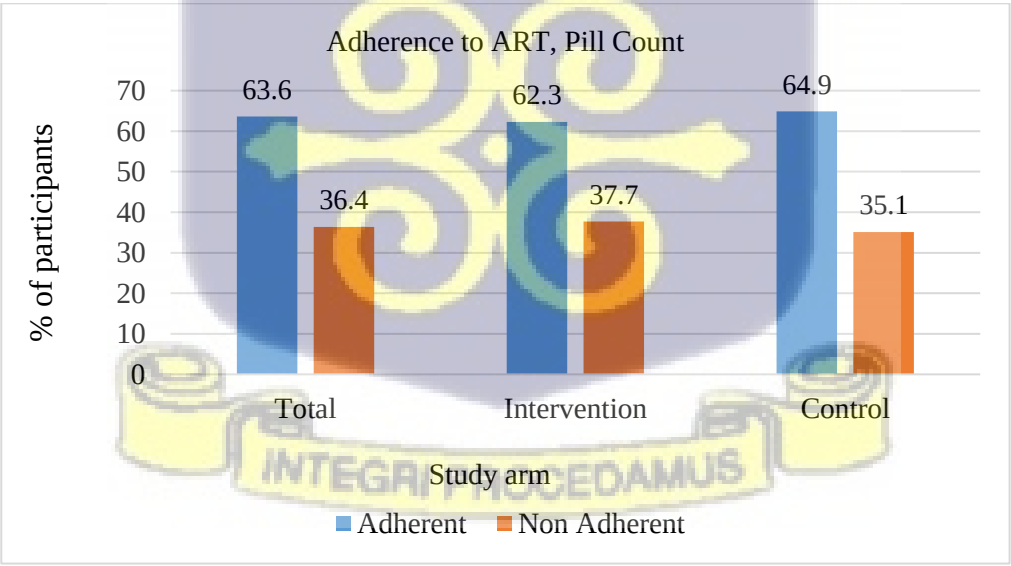

Figure 4.2 Prevalence of adherence among the study participants at Baseline (Pill count method)

4.4 Prevalence of Depression among the study participants at Baseline

Almost a third (31.6%) of the participants expressed experience of depressive symptoms. The prevalence of depression did not differ significantly between the intervention and control groups ($p>0.05$) at baseline. Details are presented in Figure 4.3. Shown in Table 4.3 is the distribution of responses to the nine (9) statements on depression. The total mean (SD) depressive score was 3.47 (2.67). The statements with the highest mean score were *participants indicating having poor appetite or overeating* (3.21±0.59) and *feeling bad about themselves* (3.16 ± 0.64) over the past two weeks.

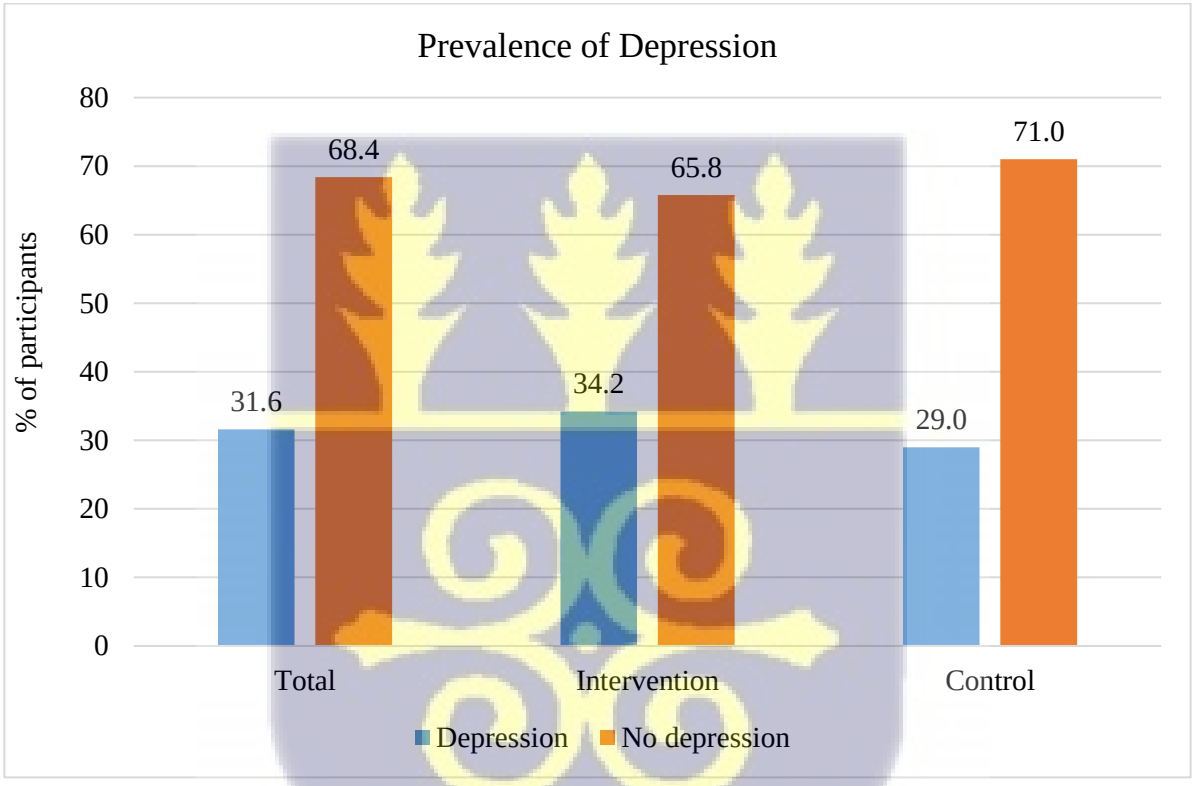

Figure 4.3 Prevalence of depression among the study participants

Table 4.3 Distribution of responses to depression statements among the study participants

Depressive symptoms in the last two weeks	Total score Mean (SD)	Intervention Mean (SD)	Control Mean (SD)	p-value
1. Little interest or pleasure in doing things	2.17 ± 0.47	2.11 ± 0.43	2.25 ±0.51	0.025
2. Feeling down, depressed, or hopeless	3.15 ±0.89	3.18 ± 0.86	3.13 ± 0.93	0.713
3. Trouble falling or staying asleep, or sleeping too much	3.05± 0.87	3.01±0.96	3.09 ± 0.77	0.495
4. Feeling tired or having little energy	3.14±0.83	3.09±0.98	3.19± 0.83	0.422
5. Poor appetite or overeating	3.21±0.59	3.23±0.56	3.19±0.622	0.656
6. Feeling bad about yourself or that you are a failure	3.16 ± 0.64	3.23±0.62	3.09±0.64	0.097
7. Trouble concentrating on things, such as reading the newspaper or watching television	3.15 ± 0.47	3.17 ± 0.44	3.14±0.418	0643
8. Moving or speaking so slowly that other people could have noticed?	3.06 ±0.33	3.07±0.344	3.05±0.321	0.692
9. Thoughts that you would be better off dead or of hurting yourself	2.07±0.36	2.05±0.39	2.09±0.33	0.361
Total	3.47 ±2.67	3.54 ± 2.43	3.39±2.89	0.674

4.5 Experience of Stigma among participants

All the participants affirmed ≥ 1 of the stigma statements with a mean score of 12.82 and 9.59 for internal and perceived stigma, respectively. With internal stigma, the statement with the highest score (2.67) was participants *finding it difficult to tell people about their HIV status* and *having the thought that having HIV made them unclean* (2.18). Regarding perceived stigma, the statement of *People I know would not want someone with HIV around*

their children (1.71) and *People I know would reject someone with HIV* (1.79). The overall stigma scores did not differ significantly between the intervention group and control group at baseline for internal and perceived stigma (p>0.05). Details of the stigma scores is presented in Table 4.4 below:

Table 4.4 Internal and Perceived Stigma experience among the study Participants

Internal Stigma				
	Total score Mean (SD)	Intervention Mean (SD)	Control Mean (SD)	p-value
It is difficult to tell people about my HIV infection	2.67 ± 1.07	2.71 ± 1.20	2.62 ± 0.93	0.538
Having HIV makes me feel unclean	2.18 ± 1.08	2.08 ± 1.11	2.27 ± 1.04	0.178
I feel guilty that I am HIV positive	1.88 ± 1.05	1.84 ± 1.08	1.91 ± 1.02	0.615
I am ashamed that I am HIV positive	1.90 ± 0.95	1.79 ± 0.88	2.02 ± 1.01	0.069
I sometimes feel worthless because I am HIV positive	2.07 ± 0.98	1.99 ± 0.89	2.14 ± 1.05	0.249
I hide my HIV status from others	2.14 ± 0.06	2.19 ± 0.99	2.08± 1.07	0.406
Total Score	12.82 ± 3.32	12.61 ± 3.27	13.04 ± 3.36	0.319
Perceived Stigma				
	Total score Mean (SD)	Intervention Mean (SD)	Control Mean (SD)	p-value
People I know would treat someone with HIV as an outcast	1.54 ± 0.05	1.47 ±0.06	1.61 ± 0.08	0.19
People I know would be uncomfortable around someone with HIV	1.55 ± 0.79	1.54 ±0.07	1.56 ± 0.08	0.87
People I know believe that a person with HIV is dirty	1.58 ± 0.05	1.58±0.07	1.59 ± 0.08	0.93
People I know would reject someone with HIV	1.72 ± 0.06	1.60 ± 0.07	1.84 ± 0.09	0.03
People I know would not want someone with HIV around their children	1.79 ± 0.05	1.71 ± 0.05	1.87 ± 0.09	0.13
People I know think that a person with HIV is disgusting	1.40 ± 0.05	1.40 ±0.68	1.42 ± 0.77	0.71
Total	9.59 ± 0.19	9.29 ±0.24	9.89± 0.32	0.94

4.6 Knowledge of HIV and ART among the study participants

A composite score was developed from the six (6) HIV questions that spans knowledge of HIV transmission, management and treatment. Figure 4.4 shows that more than half (59.2%) of the participants were knowledgeable of HIV infection. At baseline, knowledge of HIV did not differ significantly among the intervention and control groups (p=0.346).

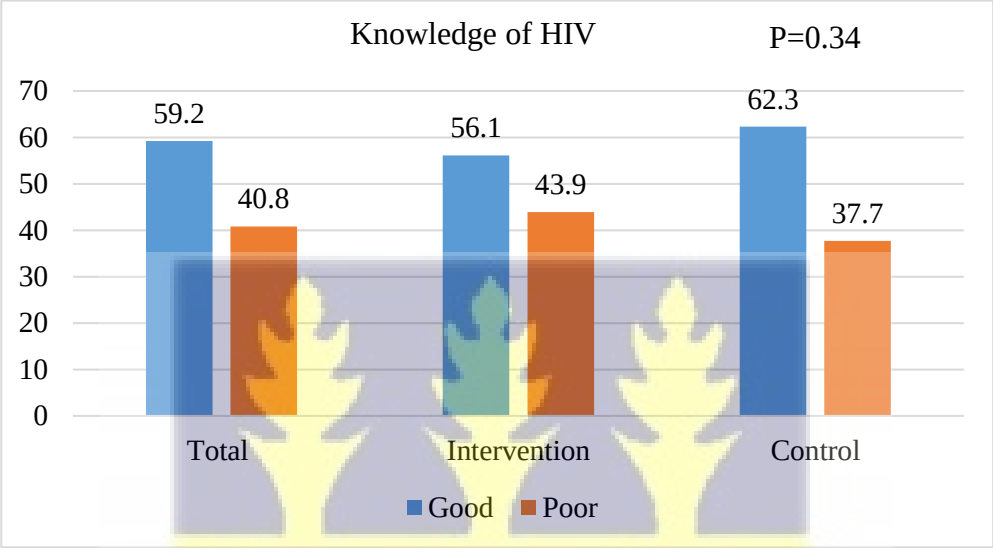

Figure 4.4 Knowledge of participants on HIV Infection

Knowledge of antiretroviral treatment was assessed among the participants using eight (8) questions. These questions were within the domain of perceived benefits or side effects and the importance of adherence to ART. Each correct response was scored 1, and a score of 0 for an incorrect response. Scores ranged from 0-8. The majority (93.4%) of the participants agreed that HIV can be managed by ART, can prevent mother to child transmission (88.6%), taking ART can prevent HIV from progressing (92.5%), missing doses of ART increases the risk of HIV transmission (93.4%) and disagreed that patients can stop taking ART when viral suppression is achieved. Generally, the majority of the participants demonstrated good knowledge of ART with a mean (SD) score of 6.38 (1.28). Knowledge of ART score did not

differ significantly between the intervention and control group at baseline (p>0.05). Details of knowledge of ART among the study participants is shown in Table 4.5.

Table 4.5 Knowledge ART among the study participants

KNOWLEDGE OF ART				
	Correct responses n (%)			
	Overall	**Intervention**	**Control**	**p-value**
ART prevent mother-to-child HIV transmission	202 (88.6)	106 (92.9)	96 (84.2)	0.037
HIV can be controlled by ART	213 (93.4)	101 (88.6)	112 (98.3)	0.003
HIV can be prevented by ART after rape	109 (47.8)	55 (48.3)	54 (47.4)	0.895
HIV can be cured by ART	138 (60.5)	71 (62.3)	67 (58.8)	0.588
Taking ART prevents HIV disease progression	211 (92.5)	106 (92.9)	105 (92.1)	0.801
Not starting ART when indicated can make you sick	205 (89.9)	105 (92.1)	100 (87.7)	0.272
Missing doses of ART increases risk of transmitting HIV	213 (93.4)	110 (96.5)	10.3 (90.4)	0.06
HIV patient can stop taking ART when viral suppression is achieved	159 (69.7)	74 (64.9)	85 (74.6)	0.113
Total score (Mean±SD)	6.38 ± 1.28	6.46± 1.09	6.27± 1.43	0.254

4.7 HIV Status Disclosure at Baseline

Participants were asked who knew about their HIV diagnosis or whom they had disclosed their HIV status to. Figure 4.5 shows that most participants (57.9%) had not disclosed their HIV status to anyone. Among those who had disclosed their status (42.1%), the disclosure was made often made parents and other family members such as, siblings, uncles, and

grandparents. Few participants disclosed their status to their friends. A chi-square test showed no significant difference between the intervention and control group ($p>0.05$) on HIV status disclosure.

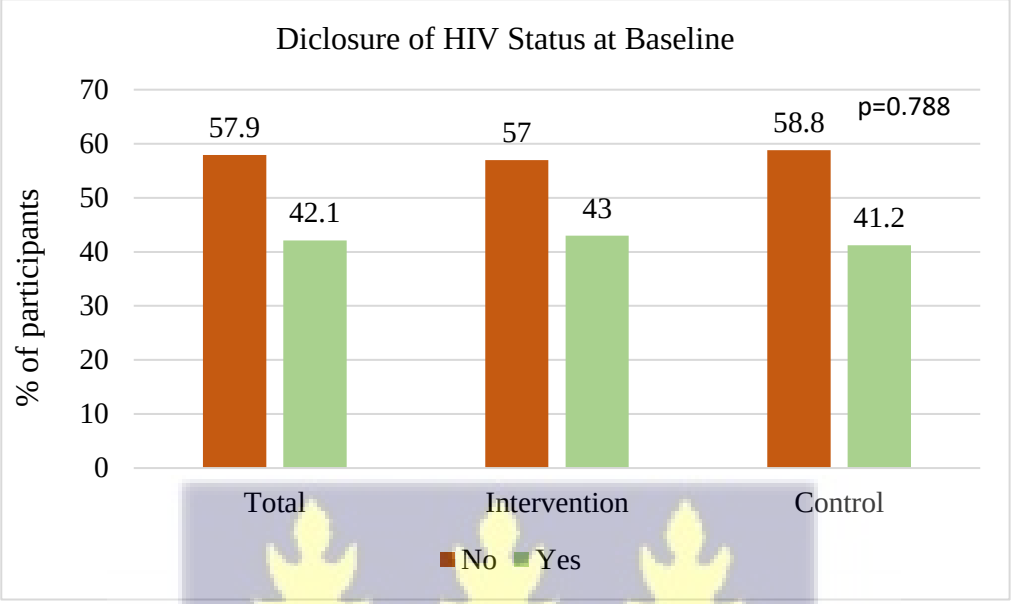

Figure 4.5 HIV Disclosure information of study participants

4.8 Factors associated with Adherence to ART among the study participants at Baseline

Factors identified to be significantly associated with adherence to ART by the two measurement methods include current alcohol intake and smoking, participants' belief of their HIV status, depression, stigma and viral load ($p<0.05$). Most of the demographic variables were not significantly associated with adherence to ART. Details are presented in Table 4.6.

Table 4.6: Factors associated with adherence to ART at Baseline

	MMAS-8			Pill count		
Variable	Adherent	Non- Adherent	p-value	Adherent	Non- Adherent	p-value
Sex						
Male	47 (29.1)	25 (37.9)	0.191	43 (29.7)	29 (34.9)	0.409
Female	115 (70.9)	41 (62.1)		102 (70.3)	54 (65.1)	
Age , years						
15-19	30 (18.5)	18 (27.3)	0.141	27 (18.6)	118 (81.4)	0.234
20-24	132 (81.5)	48 (72.7)		21 (25.3)	62 (74.7)	
Marital status						
Never married	102 (63.0)	39 (59.1)	0.241	92 (63.5)	49 (59.1)	0.479
Married	24 (14.8)	14 (21.2)		22 (15.2)	16 (19.3)	
Cohabiting	29 (17.9)	13 (19.7)		25 (17.3)	17 (20.5)	
Divorced/separated	0 (0.0)	7 (4.3)				
Ethnicity						
Akan	138 (85.2)	54 (81.8)	0.272	122 (84.2)	70 (84.4)	0.136
Ewes	14 (8.7)	6 (9.1)		12 (8.3)	8 (9.6)	
Ga/Dangme	4((2.5)	5 (7.6)		4 (2.8)	5 (6.0)	
Other	6 (3.7)	1 (1.5)		7 (4.8)	0 (0.0)	
Education						
None	10 (6.2)	8 (12.1)	0.061	9 (6.2)	9 (10.8)	0.220
Primary	11 (6.8)	9 (13.6)		10 (12.1)	10 (6.9)	
JHS	72 (44.4)	32 (48.5)		65 (44.8)	39 (47.0)	
SHS	59 (36.4)	16 (24.5)		52 (35.9)	23 (27.7)	
Tertiary	10 (6.2)	1 (1.5)		9 (6.2)	2 (2.4)	
Living arrangement						
Immediate family	90 (55.6)	33 (50.0)	0.416	79 (54.5)	44 (53.0)	0.079
Extended family	57 (35.2)	23 (34.9)		55 (37.9)	25 (30.1)	
Live alone	15 (9.3)	10 (15.2)		11 (7.6)	14 (16.9)	
Occupation						
Employed	51 (31.5)	23 (34.9)	0.522	47 (32.4)	27 (32.5)	0.804
Unemployed	72 (44.5)	24 (36.4)		63 (43.5)	33 (39.8)	

Student	39 (24.1)	19 (28.8)		35 (24.2)	23 (27.7)	
Current take alcohol						
Yes	15 (9.3)	16 (24.2)	**0.003**	12 (8.3)	19 (22.9)	**0.002**
No	147 (90.7)	50 (75.8)		133 (91.7)	64 (77.1)	
Currently Smoke						
Yes	2 (1.2)	5 (7.6)	**0.012**	1 (0.7)	6 (7.2)	**0.006**
No	160 (98.8)	61 (92.4)		144 (99.3)	77 (95.8)	
Believe of HIV Status						
Yes	154 (95.1)	40 (60.6)	**<0.001**	138 (95.2)	56 (67.5)	**<0.001**
No	8 (4.9)	26 (39.4)		7 (7.8)	27 (32.5)	
Disclosure of HIV Status						
Yes	73 (45.1)	23 (34.9)	0.157	65 (44.8)	31 (37.4)	0.271
No	89 (54.9)	43 (65.1)		80 (55.2)	52 (62.6)	
Depression						
Depressed	35 (21.6)	37 (56.1)	**<0.001**	31 (21.4)	41 (49.4)	**<0.001**
No depression	127 (78.4)	29 (43.9)		114 (78.6)	42 (50.6)	
Viral load						
Suppressed	110 (88.7)	20 (33.9)	**<0.001**	106 (89.1)	24 (37.5)	**<0.001**
Unsuppressed	14 (11.3)	39 (66.1)		13 (10.9)	40 (62.5)	
Stigma (mean ± SD)	12.41 ± 3.56	13.85 ± 3.56	**0.003**	12.40±3.24	13.57±3.34	**0.010**

JHS/JSS: Junior High School/Junior Secondary School

4.9 Predictors of adherence to ART among the study participants

In a multivariable logistic regression analysis, age was a significant predictor of adherence to ART. Participants aged 20-24 were 3.66 times more likely to be adherent compared to those aged 15-19 using the MMAS-8 method, and 2.88 times more likely using the pill count measurement method. Male participants were 1.26 times more likely to be adherent than female participants using the pill count method. Participants who did not believe their HIV status were 8% less likely to be adherent by MMAS-8 and 9% less likely by pill count method. Depression also significantly predicted adherence, with participants with depressive symptoms being 26% less likely to be adherent using the MMAS-8 and 34% less likely by the pill count method. Overall, both crude and adjusted analyses showed that higher levels of internal stigma were significantly associated with lower odds of adherence to ART. Specifically, for each one-unit increase in stigma, the odds of adherence decreased by 15% using the MMAS-8 method and by 11% using the pill count method. Participants with unsuppressed viral load were 9% and 7% less likely to be adherent by the MMAS-8 and Pill count method, respectively. Details of factors predicting adherence to ART is presented in Table 4.7

Table 4.7 Multivariable analysis of Predictors of adherence to ART among the study participants

	Adherence (MMAS-8)		**Adherence (Pill count)**	
Variable	cOR (95%CI)	aOR (95% CI)	cOR (95%CI)	aOR (95% CI)
Age				
15-19	1	1	1	1
20-24	1.65 (0.84-3.23)	3.66 (1.55-8.66)**	1.48 (0.77-2.83)	2.88 (1.32-6.31)**
Sex				
Male	0.67 (0.37-1.22)	1.08 (0.49-2.38)	0.78 (0.44-1.39)	1.26 (0.61-2.60)**
Female	1	1	1	1
Current Alcohol intake				
No	1	1	1	1
Yes	0.32 (0.15-0.69)**	0.51 (0.17-1.53)	0.30 (0.14-0.66)**	0.45 (0.17-1.22)
Currently smoke				
No	**1**	1	1	1
Yes	0.15 (0.03-0.81)*	0.41 (0.03-4.95)*	0.09 (0.01-0.75)*	0.17 (0.01-2.21)
Believe of HIV Status				
Yes	**1**	1	1	1
No	0.08 (0.03-0.19)**	0.09 (0.03-0.23)**	0.11 (0.04-0.26)**	0.13 (0.05-0.35)**
Depression				
No depression	1	1	1	1
Depressed	0.22 (0.12-0.40)**	0.26 (0.13-0.53)**	0.28 (0.16-0.50)**	0.34 (0.18-0.66)**
Stigma (internal)	0.88 (0.80-0.96)**	0.85 (0.77-0.95)**	0.89 (0.82-0.98)*	0.89 (0.81-0.98)**
Viral load				
Suppressed	1	1	1	1
Unsuppressed	0.07 (0.03-0.14)**	0.09 (0.03-0.22)**	0.08 (0.03-0.23)**	0.07 (0.03-0.16)**

Dependent variable=Adherence to Antiretroviral therapy measured by MMAS-8 or Pill count. 1= Reference category. cOR= Crude Odds ratio, aOR= adjusted Odss Ratio; *P-value less than 0.05, ** p-value less than 0.01

4.10 Average treatment effect of peer support intervention on adherence to ART

Table 4.8 shows the difference in adherence to antiretroviral therapy (ART) between baseline and end line assessments for the intervention and control groups, measured using the Morisky Medication Adherence Scale-8 (MMAS-8) and pill counts. At baseline, adherence rates were similar for both groups (71.9 vs 70.2%); however, by the end of the study, the intervention group showed a statistically significant increase in adherence (from 71.9 to 88.2%), while the control group experienced a slight decrease in adherence (from 70.2 % to 67.4%). The difference in difference (DID) analysis showed a 19.1% difference in adherence between the groups using MMAS-8 (p=0.022). For the pill count adherence, the intervention group also showed a significant increase from baseline to end line (from 62.3% to 85.5%), while the control group's adherence decreased (from 64.9% to 57.9%). The DID estimate for pill count adherence was 30.2%, with a significant improvement (p<0.001) in the intervention group. Generally, the intervention group showed significant improvements in ART adherence levels from baseline to end line, both in terms of MMAS-8 scores and pill counts, compared to the control group.

Table 4.8 Difference in Adherence level at Baseline and End line of the study

Study group	Baseline		End line	
MMAS-8				
	Adherence	p-value	Adherence	P-value
Intervention	82 (71.9)[a]	0.770	97 (88.2)	0.001**
Control	80 (70.2)		64 (67.4)	
Difference (T-C)[1]	1.7		20.8	
DID[2]			19.1	0.022*
Pill Count				
Intervention	62.3	0.664	85.5	0.001**
Control	64.9		57.9	
Difference (T-C)	-2.6		27.6	
DID			30.2	0.001**

*[a]: n(%); [1]T-C: Treatment –Control; [2] DID: Difference in difference, ** p<0.01; * p<0.05. covariates included in the model include age, sex, alcohol intake, smoking, believe in HIV status, stigma, and depression*

Findings from the focus group discussion also showed how the intervention helped to improve adherence. The presence of reminders and encouragement from peers played an important role in enhancing adherence. Some participants noted that before the intervention, they often forgot to take their medication and indicated how the intervention improved on adherence.

"*The programme [intervention] helped me to take my medication. Because at first, I sometimes sleep and forget to take my medication. But when I got involved in the programme, the messages that were sent every day were a reminder for me to take my medication on time*" *[Male, 24 years]*.

"When I receive a visit from him [Peer leader], I am motivated and encouraged to take my medication because it makes me think someone loves and thinks about me. That alone motivates me to take my medication every day" [Female, 21 years].

4.11 Logistic regression model to determine the odds of Adherence

Presented in Table 4.9 is a multivariable binary logistic regression model, to estimate the odds of adherence over time between the intervention and control group. The odds of adherence did not differ significantly between groups at baseline. However, after the intervention, participants in the intervention group were about three times more likely to be adherent compared to those in the control group (aOR=2.93, 95%CI: 1.09-7.88).

Table 4.9 Logistic regression model to estimate the odds of adherence

	Adherence (MMAS-8)		Adherence (Pill count)	
	aOR (95% CI)	p-value	aOR (95% CI)	p-value
Intervention exposure				
Control	1		1	
Intervention	1.07(0.58-1.96)	0.839	0.87 (0.49-1.54)	0.630
Timeline				
Baseline	1		1	
End line	0.94 (0.50-1.77)	0.855	0.79 (0.43-1.41)	0.422
Changes in Odds of adherence (Time*treatment)	2.93 (1.09-7.88)	0.033	4.17(1.67-10.36)	0.002
Sex				
Female	1		1	
Male	0.91 (0.53-1.57)	0.747	0.79 (-0.48-1.31)	0.36
Age				
15-19	1		1	
20-24	1.94 (1.06-3.57)	0.032	1.67 (0.95-2.96)	0.076
Internal stigma	0.92 (0.86-0.98)	0.015	0.90 (0.85-0.97)	0.002
Current alcohol consumption				
No	1		1	
Yes	0.82 (0.39-1.73)	0.609	0.57 (0.29-1.12)	0.105
Currently smoke				
No	1		1	
Yes	0.96 (0.26-3.51)	0.945	1.09 (0.29-3.99)	0.892
Believe in HIV status				
No	1		1	
Yes	5.10 (2.73-9.54)	0.000	3.10 (1.68-5.73)	0.892

aOR (adjusted odd ratio); 1 (reference category); 95% CI (95% Confidence interval).

4.12 Average treatment effect of peer support intervention on depression

Table 4.10 shows the effect of the peer support intervention on depression levels. At baseline, there was no statistically significant difference in depression between the study groups, (34.2% in the intervention group and 28.9% in the control group). At end line, there was a significant reduction in depression among participants in the intervention group (34.2% to 11.8%), whereas in the control group, depression increased to 32.6%. The difference in difference (DID) estimate between groups was -26.1%, indicating a significant decrease in depression for the intervention group compared to the control group (p=0.002).

This suggests that the peer support intervention significantly reduced depression among participants.

Table 4.10 Effect of peer support intervention on depression

Study arm	Baseline		End line	
Outcome	Depression	p-value	Depression	P-value
Intervention	39 (34.2)[a]	0.362	13 (11.8)	0.001
Control	33 (28.9)		31 (32.6)	
Difference (T-C)[1]	5.3		-20.8	
DID[2]			-26.1	0.002

[a]: n(%); [1]T-C: Treatment –Control; [2] DID: Difference in difference, covariates included in the model include age, sex, alcohol intake, believe in HIV status, and internal stigma

The results of the focus group discussion affirm how the intervention helped reduce depression among the study participants. Some participants acknowledged that they now know they were not alone in their struggles with HIV, and their involvement in the monthly group meetings was an opportunity to be part of a family they can trust.

"Before meeting these people (peers), I used to think about HIV almost every day, but now I am okay, I am now a senior woman… laughs" [Female, 24 years].

"As my dear sister mentioned, we are now a family. When we meet at the end of the month, we talk about health... Now I know I have a small family I can rely on and share anything bothering me on HIV" [Female, 23 years].

"At some point, I wanted to kill myself, to be sincere, I wanted to kill myself because I kept asking myself why it is me that have HIV. But the support we receive from our peers here has really helped me a lot." [Male, 22 years].

4.13 Average treatment effect of peer support intervention on Internal Stigma

Table 4.11 summarizes the average treatment effect of the peer support intervention on internal stigma among participants at baseline and end line. At baseline, internal stigma scores did not differ significantly between the intervention group (12.61 ± 3.27) and the control group (13.04 ± 3.36), (p-value = 0.318). By end line, the intervention group showed

a statistically significant reduction in average internal stigma score from 12.61 to 10.56 (p-value < 0.01), while the control group experienced a slight increase in stigma score from 13.04 to 13.60. The difference-in-difference (DID) analysis showed a statistically significant reduction of 2.61 points in internal stigma in the intervention group compared to the control group (p-value < 0.01). This finding suggests that the peer support intervention effectively reduced internal stigma among participants. The model accounted for characteristics such as age, sex, alcohol intake, smoking, belief in HIV status, and depression, which were included to control for their potential impact on internal stigma.

Table 4.11 Effect of the peer support intervention on internal stigma

Study arm	Baseline		End line	
Outcome	Stigma	p-value	Stigma	P-value
Intervention	12.61 ± 3.27[a]	0.318	10.56 ± 3.21	<0.01
Control	13.04 ± 3.36		13.60 ± 3.42	
Difference (T-C)[1]	-0.44		-3.05	
DID[2]			-2.61	<0.01

[a]: mean and standard deviation; [1]T-C: Treatment –Control; [2]DID: Difference-in-differences, covariates included in the model include age, sex, alcohol intake, smoking, believe in HIV status, knowledge of HIV and depression.

Findings from the focus group discussion showed that some participants through connecting with others in similar situations, gained a sense of belonging and self-worth. The realized that they were not the only people infected and seeing others thriving helped them overcome feelings of inferiority and self-doubt.

"At first, when I visit the facility I cry, but meeting my peers, I am now ok. I am not alone. I saw beautiful ones more than me, so I have stopped looking down on myself" [Female, 20 years].

4.14 Average treatment effect of peer support intervention on HIV Disclosure

Table 4.12 shows the effect of the peer support intervention on HIV disclosure status. At baseline, HIV disclosure was similar between the intervention group (43.0%) and the control group (41.2%), with no significant difference (p = 0.788). At end line, disclosure increased to 52.7% in the intervention group and 50.5% in the control group, but was not statistically significant (p = 0.753). The Difference-in-Differences analysis showed an effect estimate of 0.4 with a p-value of 0.963, indicating no statistically significant effect of the intervention on HIV disclosure.

4.12 Effect of the peer support intervention on Disclosure of HIV Status

Study arm	Baseline		End line	
Outcome	Disclosure	p-value	Disclosure	P-value
Intervention	49 (43.0)[a]	0.788	58 (52.7)	0.753
Control	47 (41.2)		48 (50.5)	
Difference (T-C)[1]	1.8		2.2	
DID[2]			0.4	0.963

[a]: n(%); [1]T-C: Treatment –Control; [2]DID: Difference in differences, covariates included in the model include age, sex, living arrangement, and believe in HIV status.

Disclosure of HIV status remains a significant challenge for many participants due to fear of stigma and discrimination. While some participants expressed concerns about how others would perceive them if they disclosed their status, others pointed to the need to protect their partners for fear of potential stigma or rejection. Some participants also noted that disbelief from family members discouraged them from disclosing their status to others.

"I have not told anyone about my status because when you tell them about your status, they will see you in a different way (bad person)" [Male, 24 years].

"When it comes to my partner, I always try and protect him by telling him to use a condom. I have not informed him" [Female, 23 years].

"Last two weeks, when I told my mother about my status she thought I was joking about it and said she cancel it in the name of Jesus! She advised I should take my mind off it. Since then. I have not tried to tell anyone (Female, 24 years].

4.15 Average treatment effect of peer support intervention on viral suppression

Presented in Table 4.13 is the effect of the peer support intervention on viral suppression. At baseline, viral suppression did not differ statistically between the intervention and control group (p=0.982). Although at end line the number of participants who were virally suppressed increased in both groups, this did not differ significantly (p=0167). The difference-in-difference analysis showed an effect estimate of 9.5 with a p-value of 0.300, indicating that the observed improvement in viral suppression due to the intervention was not statistically significant.

Table 4.13 Effect of peer support intervention on viral suppression

Study arm	Baseline		End line	
Outcome	Viral suppression	p-value	Viral suppression	P-value
Intervention	66 (71.0)[a]	0.982	73 (86.9)	0.167
Control	64 (71.1)		55 (77.5)	
Difference (T-C)[1]	-0.1		9.4	
DID[2]			9.5	0.300

[a]: n(%); [1]T-C: Treatment –Control; [2]DID: Difference in differences, covariates included in the model include age, sex, alcohol intake, smoking, depression, believe in HIV status, and internal stigma

CHAPTER FIVE

5.0 Discussion

This chapter presents the discussion of the study findings. In addition to the demographic and clinical characteristics, the findings of each of the objective are discussed. This includes adherence level of the study participants, depressive symptoms and stigma, factors associated with adherence and the effect of the peer support intervention on adherence, depression, stigma, disclosure, and viral suppression. The chapter also includes the strengths and limitations of the study, the contribution of the study to knowledge as well as implications for research, policy and practice.

5.1 Socio-demographic and clinical characteristics of participants

The socio-demographic characteristics of the participants in this study provide insights into the profile of young people living with HIV. Understanding of these factors is important for examining how characteristics such as age, gender, and lifestyle habits influence adherence to antiretroviral therapy. In this study, the majority of the participants were between the ages of 20-24 years. This agrees with the findings of other studies (Agaba et al., 2016; Gouws et al., 2008; Rangel et al., 2006) that highlight the vulnerability of this age group to HIV infection. Young adults are more likely to engage in risky sexual behaviours placing them at risk of sexually transmitted diseases including HIV (Manu et al., 2022). For instance, during interviews, some young adults (20-24 years) reported engaging in anal sex after taking alcohol and smoking prior to their HIV diagnosis. Additionally, the effectiveness of antiretroviral therapy (ART) has allowed individuals with horizontally acquired HIV to live into adulthood, potentially contributing to the higher representation of this age group in the study. This finding is different from that of Biney et al. (2021) who reported a higher proportion of adolescents (14-19 years) compared to young adults (20-24 years) in their

study. Their study population included adolescents and young adults aged 14-24 years, while the present study focused on participants aged 15-24 years.

Although there was relatively low prevalence of current alcohol consumption (13%) and smoking (3%) among participants, substance use has been reported to increase the risk of sexual behaviour among youths (Hlahla et al., 2024). The prevalence of alcohol consumption is similar to a study in Kenya that reported 13% of alcohol use among HIV positive young people aged 18-24 years (Nyongesa et al., 2021a). Individuals under the influence of alcohol may be less likely to engage in safe sex practices, such as using condoms, which can lead to higher rates of HIV transmission (Hlahla et al., 2024).

In this study, some participants (14.9%) did not believe of their HIV diagnosis. The stigma surrounding HIV can lead to denial, as individuals fear discrimination and social repercussions. The absence of immediate symptoms can also lead to skepticism about the diagnosis, with many feeling healthy and questioning test accuracy. For instance, during interviews, a participant expressed disbelief in her HIV diagnosis, stating she only feels compelled to take antiretroviral therapy (ART) when she sees visible signs of illness, like blood under her skin, which reinforces her doubt about being positive.

Although participants were aware of their HIV status, condom use at last sexual intercourse was low (29.9%). This may increase viral transmission if viral suppression is not achieved. This finding emphasizes the need to maintain optimal adherence. Risky sexual behaviours such as engaging in unprotected sex are common among young people in Ghana (Manu et al., 2022). The low prevalence of condom use at last sexual intercourse is consistent with findings from other studies, though some report slightly higher rates. For instance, a study conducted in Uganda among HIV-positive youth aged 15-24 reported condom use prevalence of 24% at last sexual intercourse (Beyeza-Kashesya et al., 2011). Similarly,

research in South Africa found that 77% of sexually active HIV-positive youth used condoms during their last sexual encounter (Thurman et al., 2024). Several factors may contribute to the reluctance to use condoms among young people living with HIV. Fear of stigma and discrimination can prevent disclosure of their status, hindering discussions about safe sex (Thurman et al., 2024). Insufficient knowledge about the importance of condom use for preventing other sexually transmitted infections (STIs) such as syphilis, hepatitis etc. may also lead to non-use. Additionally, some young individuals underestimate their risk of transmission, particularly if they believe their viral load is undetectable due to antiretroviral therapy. In intimate relationships, especially with HIV-negative partners, there may be pressure to forgo condoms to enhance intimacy or based on perceived trust (Thurman et al., 2024).

5.2 Adherence level of participants

Sustained adherence to ART is important to achieve viral suppression, decrease viral transmission, improve health-related quality of life and reduce morbidity and mortality among patients with HIV (Casale et al., 2019; Griffee et al., 2022). However, adherence to ART is challenging among people living with HIV especially among youths (15-24) years. In this study, adherence at baseline using both the Morisky Medication Adherence Scale (MMAS-8) and the pill count method, was 71.1 and 63.6%, respectively. These findings reflect a moderate level of adherence but are still below the optimal adherence threshold of at least 95%, which is important for achieving viral suppression, preventing drug resistance, and improving clinical outcomes (WHO, 2003, 2016a). The adherence rates reported in this study are consistent with findings from other studies conducted in Ghana, though there are some slight variations. For instance, Biney et al. (2021) found a slightly higher adherence rate of 78.7% among adolescents and young adults (14-20 years) at a teaching hospital in Ghana using the MMAS-8. Similarly, Anokye-Kumatia et al. (2018) reported an adherence

rate of 76.4% among adolescents and young adults aged 10-20 years at the Komfo Anokye Teaching Hospital using the same scale. The slightly lower adherence rates observed in the current study could be attributed to disparities in healthcare provision. These studies were not only conducted in the capital cities of the study regions; urban area (Accra and Kumasi) but also in a teaching hospital where there is the possibility of improved care and better knowledge of participants on adherence.

The adherence level in this study by the pill count method (63.6%) is similar to the findings of Afrane et al. (2017) who reported an adherence rate of 61.6% using the same measurement method among adolescents and young adults with HIV in Accra. This poor adherence rate recorded is also in agreement with the findings from the sub-group analysis of the systematic review of adherence in Ghana (66.0%). Although the prevalence of ART adherence among young people living with HIV varies across studies due to differences in measurement methods, the overall findings consistently indicate poor adherence levels, highlighting the urgent need for intervention. Low adherence rates have significant health implications for both individual health outcomes and public health. This include the potential for increased viral transmission, the development of drug-resistant strains, and increased vulnerability to opportunistic infections such as tuberculosis, pneumonia and ocular infections leading to increased morbidity and mortality within this age group (Reif et al., 2020). Adherence level measured by the MMAS-8 was higher than the pill count method. A possible reason for this observation is that, the MMAS-8 is a self-reported scale that assesses adherence based on patients' responses, which can sometimes lead to over-reporting due to social desirability bias (patients wanting to appear compliant) while the pill count method involves counting the remaining medication, which is more objective (Aguiar et al., 2020; Achieng et al., 2013).

5.3 Predictors of adherence to ART among youth living with HIV

Several factors such as age, side effects of medication, gender among others have been reported to influence adherence to ART (Hudelson & Cluver, 2015; Kim et al., 2017; Letta et al., 2015). In this study, an interplay of demographic, psychological, behavioral, and clinical factors was found to predict adherence to ART among young people living with HIV. These included age, stigma, belief in HIV status and viral suppression. Participants aged 20-24 years were about two times (pill count) and three times (MMAS-8) more likely to adhere to ART compared to those aged 15-19 years. This finding could be due to the fact that older youths may have developed better coping mechanisms, greater maturity, and better understanding of the importance of adherence. Similar findings have been reported in other studies. For example, Kim et al. (2015) in South Africa found that older adolescents and young adults had higher adherence rates compared to younger adolescents. Murphy et al. (2001) in the United States also observed that adherence improved with age among HIV-positive youth. In addition, Hudelson and Cluver (2015) noted better adherence among older adolescents in a review of studies conducted in low- and middle-income countries.

Belief in one's HIV status was found to predict ART adherence in this study. Participants who doubted their diagnosis were significantly less likely to adhere to treatment, emphasizing the importance of psychological acceptance. This finding aligns with the study by Langebeek et al., (2014) which identified disbelief in one's HIV status and belief about the use of ART as a barrier to adherence.

Depression was a significant predictor of non-adherence across both models. Individuals with depression were less likely to adhere to ART. The link between depression and non-adherence is well-established. Uthman et al. (2014) found that depression was associated with lower adherence to ART. This association is explained by the impact of depression on

motivation, cognitive function, and the ability to manage daily routines (Uthman et al., 2014).

Internal stigma was found to be inversely associated with adherence in both models. Higher levels of stigma were associated with lower adherence, highlighting the adverse effect of internalized stigma on treatment adherence. Stigma has long been identified as a key barrier to adherence in sub-Saharan Africa (Hudelson & Cluver, 2015). A study in Cameroon among HIV positive adolescents found internal stigma as a significant predictor of adherence (Bongfen et al., 2020). Similarly, in Kenya, a study by Mugo et al. (2022) found stigma to be associated with non-adherence as well as detectable viral load among young people aged 15-24 years living with HIV. Internalized stigma can lead to feelings of shame, isolation, and fear of disclosure, all of which affect patient's adherence behaviour (Kip et al., 2022; Rao et al., 2007).

Viral suppression was strongly associated with adherence. Individuals with unsuppressed viral loads were significantly less likely to adhere, reinforcing the importance of adherence in achieving and maintaining viral suppression. Several studies have reported a linkage of viral suppression with medication adherence (Biney et al., 2021; Kahana et al., 2013; Nachega et al., 2009). This direct relationship underscores the importance of adherence to achieving optimal health outcomes, including viral suppression, and reducing the risk of HIV transmission.

5.4 Prevalence of depression among participants

Depression is a common comorbidity among young people living with HIV (Nutor et al., 2023; Willis et al., 2018). This can have an important implications for HIV care and management. Depression can negatively impact adherence to antiretroviral therapy (ART), through low motivation, and a sense of hopelessness, making it difficult for individuals to

maintain the routine of taking medications consistently compromising viral suppression and increasing the risk of HIV transmission (Ayano et al., 2021). It can also negatively impact quality of life and increase the stigma associated with living with HIV (Ayano et al., 2021). A study in Ghana showed that half (52.0%) of youth (18-24 years) living with HIV were in fear or worried about their condition (Tarantino et al., 2024). In this study, the prevalence of depressive symptoms among the youth living with HIV was 31.6%. This is in agreement with other findings in similar populations. In Ethiopia, Abebe et al. (2019) found 35.5% prevalence of depression among youth (15-24 years) living with HIV. Similarly, (Nyongesa et al., 2021b) reported 29% prevalence of depressive symptoms among young people living with HIV in Kenya. The prevalence of depression in this study is lower than other studies conducted among HIV positive youths in Uganda, 46% (Kemigisha et al., 2019), Zimbabwe, 63% (Willis et al., 2013) and Nigeria, 39.9% (Sale & Gadanya, 2008). Possible reasons for these variations could be due to the data collection tool used to assess depression, difference in stigma level, social support and poor adherence to treatment resulting in comorbidities (Abebe et al., 2019). For example, the study by Kemigisha et al., (2019) used the centre for Epidemiological studies'depression scale and the study by Sale and Gadanya (2008) used the hospital anxiety and depression scale compared with the PHQ-9 used in this study. Nonetheless, these findings suggest that depression is a prevalent issue among HIV-positive youth which can be attributed to social stigma associated with HIV, and the emotional toll of living with a chronic illness (Abebe et al., 2019).

5.5 Stigma among study participants

Stigma in HIV care among youth presents significant challenges, negatively impacting their health and wellbeing (Small et al., 2022). Youth living with HIV often experience multiple forms of stigma including internalized, social/perceived, and institutional that affect their access to care and adherence to treatment. In this study, all the participant responded positively to at least one of the stigma questions; internalized stigma was high among youth, with a mean score of 12.8 out of 24, indicating significant internalized stigma. This is consistent with findings from Zimbabwe, where all participants reported HIV-related self-stigma (Rich et al., 2022). Internalized stigma can lead to shame, guilt, psychological distress, and reluctance to engage in care, ultimately affecting health outcomes (Hudelson & Cluver, 2015). Although perceived stigma was lower, with a mean score of 9.59 out of 24, it still indicates notable stigma. Perceived stigma involves negative attitudes and discrimination from others, which can be particularly damaging for youth, leading to isolation, depression, and disengagement from healthcare. Stigma in HIV care does not only undermines the mental and physical health of youth but also poses broader public health challenges by increasing the risk of HIV transmission (Small et al., 2022).

5.6 Effect of Peer Support intervention on study outcomes

Early initiation of antiretroviral therapy (ART) has been shown to significantly reduce morbidity and mortality among people living with HIV (Ford et al., 2010). In line with this, the World Health Organization recommends early ART initiation for all diagnosed HIV patients (WHO, 2016). However, the success of ART depends on sustained adherence. Young people living with HIV face numerous challenges as they navigate the complexities of life alongside the burden of disease (Hlophe et al., 2023). As the potent effects of ART allow more children to survive into adolescence and young adulthood, it becomes important

to develop evidence-based, context-specific interventions tailored to their unique needs for optimal health outcomes (Willis et al., 2019).

Peer support is recognized as a vital source of social support and information for adolescents and young adults living with HIV (Mavhu et al., 2020; WHO, 2016a; Willis et al., 2019). Youth-specific support groups and educational activities provide valuable opportunities for young people to cultivate supportive networks, enhance their knowledge about HIV, and develop essential self-management skills (Denison et al., 2020). These interactions not only foster a sense of community but also empower youth by equipping them with the tools necessary to navigate their health challenges effectively (Okonji et al., 2020).

In this study, the peer support intervention which consisted of monthly peer support meetings, home visits by trained peers, daily SMS for medication reminders, and phone calls to remind patients of appointments improved adherence to antiretroviral therapy (ART) among youths living with HIV in the two districts. Participants in the intervention group were about three or four times more likely to be adherent to ART compared with the control participants. Although there are limited peer support intervention to improve adherence and other health outcomes among young people living with HIV in Africa (Okonji et al., 2020; Reif et al., 2020), the few implemented interventions (Abiodun et al., 2021; Denison et al., 2020; Willis et al., 2019) have demonstrated promise of improving adherence and other health outcomes such as retention in care, psychosocial wellbeing, disclosure, viral suppression and quality of life.

The finding of improved adherence in this study is similar to an intervention in Zimbabwe where young people living with HIV involved in a peer support intervention were about four times (3.9) more likely to be adherent to ART (Willis et al., 2019). Adherence was

likely enhanced through the structured peer support intervention, which included monthly group meetings and home visits by peer supporters. These interactions may have facilitated a better understanding of the importance of adherence by providing opportunities for participants to engage in discussions about treatment experiences and the benefits of consistent ART use. Observing others successfully managing their treatment could have acted as a positive reinforcement, creating a sense of responsibility and motivation to adhere to treatment (Willis et al., 2019).

The intervention addressed common adherence barriers, such as forgetfulness (Biney et al., 2021), which can be exacerbated by personal challenges like limited social support, financial strain, and relationship difficulties. The use of daily SMS reminders provided consistent cues for medication-taking behaviour. Furthermore, the intervention tackled the fear of clinic visits due to potential negative treatment by healthcare providers when appointments were missed. The reminder calls to ensure attendance at scheduled clinic visits likely prevented interruptions in medication access, which is important for sustained adherence.

In this study, there was a statistically significant reduction in depression and internal stigma among participants in the intervention arm compared to the control arm. Participants in the intervention arm were about 16% less likely to be depressed. Several explanations could account for the observed improvement. First, young people living with HIV often experience isolation, stigma, and psychological distress, which can hinder their adherence to ART (Kip et al., 2022; Mavhu, et al., 2018).

Peer support provides an opportunity for participants to connect with others facing similar challenges, creating a sense of belonging and reducing feelings of isolation. As evidence from some participants in the focus group discussion that, they now feel happy belonging

to a small family who they can share anything bothering them on their HIV care and treatment. This emotional support helps reduce depression and internalized stigma, as participants receive encouragement, empathy, and motivation from their peers (Wogrin et al., 2021). WHO recommends the integration of mental health services for all HIV patients (WHO, 2016). While studies have shown promise of using lay cadres in delivering mental health services (Chibanda et al., 2016), there is paucity of information on how peer supporters can be leveraged to deliver mental health services to young people living with HIV; this warrant further investigation.

Although there was improvement in adherence and psychosocial wellbeing, the intervention did not significantly improve disclosure and viral suppression. HIV status disclosure is an important aspect of managing HIV, both for individual wellbeing and public health. Disclosure to trusted individuals, such as partners or family members, can provide emotional and practical support that encourages better adherence to antiretroviral therapy (ART) (Gabbidon et al., 2020). However, HIV status disclosure is very difficult especially to sexual partners and this challenges prevention efforts (Weintraub et al., 2017).

Disclosure plays a key role in preventing the spread of HIV. When individuals share their status with sexual partners, it facilitates open communication about safer sex practices, including consistent condom use which can significantly reduce the risk of HIV transmission (Gabbidon et al., 2020; Grainger, 2017). Given that the study population involved young people who are often in casual relationships, the fear of rejection or losing their partners if they disclosed their status could account for the reluctance in disclosing their HIV status. Research shows that young people, especially those in unstable or informal relationships, may hesitate to disclose their HIV status due to fear of ruining their relationships (Grainger, 2017).

Stigma related to HIV further exacerbates this issue. Anecdotally, within the Ghanaian context, HIV is associated with sexual promiscuity or moral judgment, individuals fear social exclusion or discrimination, making disclosure difficult. Studies from countries like Uganda and Kenya have highlighted that fear of stigma and discrimination as a significant barrier to disclosure among young people living with HIV (Kavuma et al., 2023; Ngeno et al., 2019).

The finding of no effect on viral suppression is in contrast with the study by Mavhu et al. (2020) who reported improved viral suppression in their study cohort. This could be due to the duration of the study. While this study was implemented in 24 weeks the authors measured their study outcomes in 96 weeks. Viral suppression often requires sustained adherence to antiretroviral therapy (ART) over an extended period (Byrd et al., 2019b). The six-month intervention duration may not have been adequate to achieve significant improvements in viral suppression. Again, at end line, viral suppression data were available for only a few participants, which may have limited the statistical power to detect any observed differences. While adherence to ART improved in this study, it did not reach the recommended threshold of at least 95% required for achieving viral suppression.

5.7 Strengths and Limitations of the Study

A key strength of this study is the use of a multicomponent intervention to improve ART adherence, addressing the various barriers such as forgetfulness, stigma, and depression faced by young people living with HIV. Additionally, adherence was assessed using two different methods, which complemented each other and strengthened the evaluation. However, some limitations should be acknowledged. First, mode of HIV transmission was not included in the analysis due to limited data, as many participants were unwilling to disclose how they acquired the infection. Including this variable could have provided deeper

insights into potential differences in adherence between perinatally and horizontally infected participants. Again, the use of quasi-experimental design in this study may have introduced some level of bias compared to a randomized controlled trial. Finally, the purposive sampling of facilities and consecutive sampling of participants rather than a probability sampling approach may have led to selection bias, potentially affecting the generalizability of the findings.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

This chapter provides a summary of the major findings from the study based on the objectives. It also highlights the study's contribution to knowledge as well as recommendations for policy, clinical practice and research.

6.1 Conclusions

The following conclusions are made based on the study objectives in relation to the findings.

1. The review showed a suboptimal level of adherence to ART among people living with HIV in Ghana, particularly among young people.
2. Similarly, the study participants also demonstrated suboptimal level of adherence to ART prior to the implementation of the peer support intervention.
3. Depressive symptoms and stigma was common among the study participants.
4. Participants aged 20-24 years were more likely to be adherent compared with those aged 15-19 years. Denial of HIV status, depression, and internal stigma were negatively associated with adherence.
5. The peer support intervention improved adherence to ART using the adherence assessment methods. Participants in the intervention group were about three or four times more likely to be adherent to ART. In addition, the intervention significantly reduced depression and internal stigma. However, the intervention had no effect on viral suppression and HIV status disclosure among the participants.

6.2 Recommendations

Based on the findings of the study, the following recommendations are suggested for research, policy, practice.

6.2.1 Research

1. The findings provide a foundation for future research on the long-term effects of peer support on ART adherence, as well as its influence on viral suppression and HIV status disclosure among young people. `
2. Future studies should involve larger samples from different health facilities in various regions to enhance the power and generalizability of the findings.
3. It will be important to explore the barriers faced by young people living with HIV in terms of HIV status disclosure for appropriate intervention.

6.2.2 Practice

1. When patients miss appointments, healthcare professionals at ART clinics should listen to their concerns and offer the appropriate support to help them stay in care to improve adherence.
2. It is also essential for healthcare providers to continually assess barriers to adherence and offer counseling at each clinic appointment.

6.2.3 Policy

1. The Ghana AIDS Commission, in collaboration with HIV program implementers such as the Ghana AIDS/STI Control Programme, should allocate human and financial resources to integrate mental health services as part of comprehensive care.
2. Regular monitoring and training will also be important to strengthen healthcare workers' capacity to handle the barriers of adherence among young people living with HIV.

3. Quarterly and annual HIV program reports should include adherence data across different demographic groups. This is important to track program success.
4. Currently, there are few health facilities in Ghana with differentiated service delivery for young people living with HIV. There is the need to prioritize and expand differentiated service delivery (DSD) models and youth-friendly services across health facilities to enhance clinic attendance and improve treatment outcomes among young people living with HIV.

6.3 Contribution to knowledge

1. The study highlights suboptimal ART adherence among young people living with HIV and contributes to the limited adherence interventions in Ghana and sub-Saharan Africa, providing further evidence of the effectiveness of peer support in improving adherence.
2. This study demonstrates how key factors such as denial of HIV diagnosis, depression and stigma present significant barriers to treatment adherence in this population.

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Appendices 1: Objective 1- To synthesize available evidence on adherence to ART among HIV patients in Ghana

PLOS GLOBAL PUBLIC HEALTH

RESEARCH ARTICLE

Adherence to antiretroviral therapy among HIV patients in Ghana: A systematic review and meta-analysis

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Abstract

Maintaining a high level of adherence to antiretroviral therapy (ART) is critical to limiting rapid viral replication, drug resistance, and viral transmission. However, ART adherence remains a major challenge in HIV/AIDS treatment success. This systematic review and meta-analysis was aimed to synthesize available evidence on adherence to ART among HIV/AIDS patients in Ghana.This review followed the preferred reporting item for systematic review and meta-analysis (PRISMA) criteria. A comprehensive literature search was done using five online databases (PubMed, Google Scholar, Medline, Africa Index Medicus, and Willey Online Library) from 25th- 30th April 2023 to identify potential studies. In addition, references of related articles were manually searched to further identify relevant studies. Search records were managed in Endnote library where duplicates were removed prior to screening. Studies were eligible for inclusion if they were conducted in Ghana, designed as an observational or experimental study, and explicitly measured adherence to ART, either as a primary or secondary outcome. Studies were excluded if the proportion or prevalence of adherence to ART was not reported.A total number of 126 potential studies were identified from the literature search. Of these, 14 met the inclusion criteria and were included in the Meta-analysis. The studies involved a total number of 4,436 participants. The pooled estimate of adherence to ART was 70% (CI: 58–81%). In subgroup analysis, adolescents and young adults had a lower adherence rate (66%, CI: 46–84%) compared with adults (70%; CI: 58–81%). Publication bias was not observed among studies. The pooled estimate of optimal adherence to ART among HIV patients in Ghana was lower than is recommended (≥95%) to achieve viral suppression. Adherence was lower among young persons living with HIV/AIDS. To achieve the United Nation's Sustainable development goals and the UNAIDS "95-95-95" targets, there is a need to focus on improving adherence interventions among persons living with HIV/AIDS, especially among the younger cohort.

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Introduction

HIV/AIDS remains a significant global public health problem, having claimed more than 40 million lives, since its emergence over 40 years ago [1]. Globally, an estimated 38 million people were living with HIV (PLHIV) at the end of 2021 with 1.5 million new infections and about 650 thousand HIV-related deaths [1,2]. The HIV/AIDS burden is having a disproportionally higher impact on sub-Saharan Africa, where over two-thirds of all people living with HIV reside [2,3].

In Ghana, there has been modest progress in managing HIV/AIDS. In 2020, the national prevalence of HIV among adults in Ghana was estimated at 1.68% compared to 2.5% in 2002 including 22, 611 new infections [4].

The number of PLHIV, globally, continues to increase due to the effectiveness of ART in increasing survival and improving quality of life [5]. Early initiation of ART has been linked with reduced mortality and morbidity among PLHIV [5,6]. As a result, ART is recommended for all PLHIV, including children and adolescents. PLHIV should be put on ART as soon as possible, irrespective of the number of viral load [7].

In 2016, Ghana adopted and is implementing nationwide, the WHO's 'TREAT ALL' policy on the use of ART for the treatment and prevention of HIV infection [4,8]. As a result, ART treatment coverage has improved significantly; coverage was estimated at 96% in 2020 [4]. Although Ghana is striving to meet national and global targets for treatment, the overall achievement of increasing testing, reducing new infections and mortality has been minimal. HIV-related deaths was estimated to be 13,616 in 2020 and 79% of PLHIV knew their serostatus at the end of 2022 [4].

Medication adherence is defined as the taking of all medications at the appropriate time and dosage as recommended by a physician [9,10]. Optimal adherence is important to ensure the efficacy of ART (achieve viral suppression), prevent drug resistance, lower opportunistic infections, reduce disease transmission, hospitality, morbidity and mortality, and ensure the well-being of PLHIV [11].

In the literature, several factors have been associated with adherence to ART. These include patient behavior and lifestyle factors (eg. forgetfulness, being busy, poor understanding of the regimen, self-stigma, etc.), treatment-related factors (side effects, polypharmacy), healthcare or provider factors (eg. waiting time, the attitude of health care providers) and socio-cultural factors (eg. use of traditional medicine, and spiritual beliefs) [12–17].

With a focus on achieving viral suppression, the joint United Nations Programme on HIV/AIDS (UNAIDS) launched the 95-95-95 initiative in 2020. This initiative seeks to achieve viral suppression among 95% of persons on ART [18]. Because adherence serves as a proxy for viral suppression [19], there is a need for focused attention to achieve this ambitious target.

Medication adherence of at least 95% is recommended as effective in achieving treatment success [20]. However, adherence to ART is low in sub-Saharan African countries (77%) [21]. For example, a systematic review in Ethiopia on adherence to highly active ART among children reported 88.7% of patients adhering to treatment on a 7-day recall [22]. In Ghana, several empirical studies have reported sub-optimal adherence among diverse HIV populations [23–30]. Biney et al. [26] reported an adherence level of 78.7% among adolescents and young adults in the Greater Accra region. Similarly, Obirikorang et al. [28] Sefah et al. [31] and Adu et al. [24] have reported adherence levels of 62.2, 42.9, and 53.1% among PLHIV, respectively. There is paucity of evidence on pooled adherence to ART to better understand HIV program success. This review, therefore, aims to report on pooled adherence rate of ART among persons living with HIV in Ghana and report on age-group adherence proportions. The review sought to address the following research questions: 1). What is the pooled adherence to ART

among persons living with HIV/AIDS in Ghana?. 2). Are there differences in adherence level to ART among adults and young people living with HIV/AIDS in Ghana?.

Methods

Ethics statement

The study required no ethical approval.

Search strategy

This review was registered in PROSPERO (Reg ID: CRD42023417543), and conducted following the preferred reporting item for systematic review and Meta-Analyses (PRISMA) guidelines [32]. A protocol for this review was prepared prior to the manuscript development. An extensive literature search was performed in Medline, PubMed, Africa Index Medicus (AIM), Google Scholar, and Wiley Online Library. We searched for published papers using the combination of free texts and medical subject headings (MeSH) terms, e.g. "Adherence" "non-adherence" "Compliance" "non-compliance" "ART" "HAART" "Highly active" "Antiretroviral therapy" "HIV/AIDS" and "Ghana". We used the PICO framework for systematic reviews to structure the search using Boolean operator combinations. Supplemental searches were carried out by reviewing the references of the included papers, as well as follow-up searches of citations to identify additional papers that reported on medication adherence in Ghana but which were not identified through the electronic database searches. All searches were conducted from April 25 to 30, 2023.

Eligibility criteria and selection criteria

Studies were included if (1) they were conducted in Ghana (2) used observational or experimental designs that explicitly measured adherence to ART, either as a primary or secondary outcome; For experimental studies, baseline adherence was considered; (3) mixed method studies that reported on the prevalence of adherence were also included. Consistent with a similar review [33], where more than one method was used to measure adherence, the more objective method used was reported. To give a wider scope of studies included, we did not limit the year of publication nor the age of study participants; we included published dissertations that met the inclusion criteria. Studies were excluded if they did not indicate evidence of prevalence of adherence to ART or did not meet the inclusion criteria 1, 2, and 3 described above.

All citations of identified documents were imported into EndNote 13 reference manager [34] and screened for relevance. Screening was carried out at three levels: title, abstract, and full text. At title and abstract levels, three reviewers (IB, MA, and KKA) independently applied a predetermined inclusion criteria to screen all titles and abstracts of the identified studies after duplicates were removed. Full texts of the potentially eligible abstracts were downloaded, read, and subsequently screened to ascertain their relevance with respect to the inclusion criteria. To eliminate any selection bias, a second reviewer (EA) screened 10% each of the included and excluded abstract and full texts. Any discrepancies were addressed between reviewers. The PRISMA flow chart (Fig 1) provides a summary description of the screening and selection process.

Data extraction

Both text and statistical data were extracted from each of the articles meeting the inclusion criteria by two reviewers (IB and KKA). A third reviewer (MA) cross-checked the extraction for

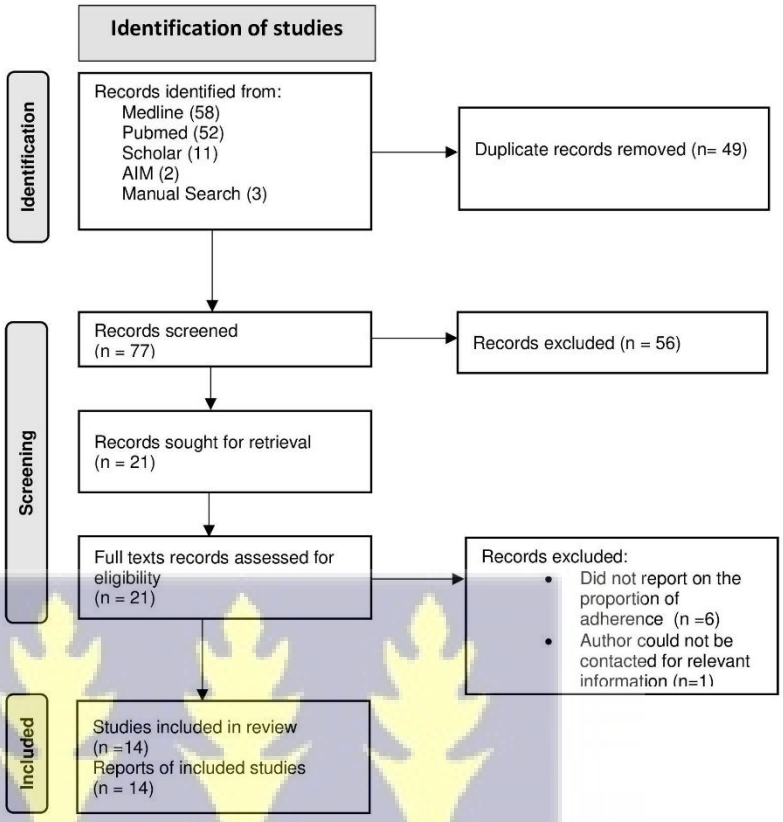

Fig 1. Flow chart showing study selection process [35]. For more information, visit: http://www.prisma-statement.org/.

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quality. Key information extracted included author detail, year of publication, study setting, study design, sample size, sampling method, the method used to measure adherence and proportion of adherence to ART. The authors of two studies [28,36] were contacted for additional relevant information we missed during the data extraction process.

Quality assessment

Quality assessment of the included studies was done using the revised Joanna Briggs Institute (JBI) Critical Appraisal tools for systematic reviews [37]. This appraisal tool assesses the methodological quality of a study and determines the extent to which the study has addressed the possibility of bias in its design, data collection, and analysis [37]. Two authors (KKA and IB) carried out the quality assessment independently and graded the studies as low (>70%), medium (50–70%), and high (<50%) [37,38]. Discrepancies in the assessment and scoring were resolved through discussion and consensus.

Statistical analysis

The extracted data were imported into R statistical software for analysis. Freeman-Tukey double arcsine transformation and inverse variance methods were used to calculate the pooled estimates of adherence to ART. The weighted random effects model was considered rather than the common effects due to the large statistical heterogeneity across studies [39–41]. As asserted by Fletcher [41], significant large heterogeneity can be handled in two ways; narrative synthesis or meta-analysis using random effects. The latter was used consistent with earlier studies [42,43] as included studies essentially measured the same outcome, that is, adherence to ART.

Documents were categorized by research participant's age group: 'adolescents and young adults' (10–24 years) versus 'adults' (18+). This classification was based on WHO's classification of young people [44]. Where there is age overlap, we used the reported mean to classify a study under these categories. Thus, when the reported mean age is greater than 24 years, the study was classified as an adult study or otherwise. We used the Chi^2 Q test and I^2 statistic to identify heterogeneity; an I^2 estimate greater than 50% indicated significant heterogeneity [45]. Potential sources of heterogeneity were assessed using sensitivity and subgroup analyses. We performed exploratory analyses of heterogeneity using meta-regression based on the sample size of the studies and the quality scores of individual studies. Potential publication bias was evaluated using Egger's and Begg's tests. The R software package '*metafor*' was used to perform the analysis. All statistical analyses were 2-sided and statistical significance was considered at p-value < 0.05.

Results

Search outcome and study characteristics

A total of 126 records were retrieved from the databases and supplementary searches. Of these, 49 duplicates were identified and removed. We excluded 56 records after screening titles and abstracts. Twenty-one full-texts were assessed for eligibility, and 14 met our inclusion criteria and were subjected to review. These 14 studies were conducted between 2013 and 2022. The PRISMA flowchart shows the document selection process [Fig 1].

Shown in Table 1 are the characteristics of the 14 studies included in the meta-analyses. A total of 4,436 HIV-positive patients were studied across the 14 studies to ascertain their adherence to ART with sample sizes ranging from 25 [36] to 683 [30]. Diverse measurement methods were used to assess adherence to ART. These included studies that used self-reported questionnaires [24–26,28,30,46–48], pill count [31,36], Patient Attendance-based Defaulting (PAD) [49], and a combination of other methods [27,50] to determine adherence. Study designs used include surveys [23–26,28,30,31,36,47–49], randomized control trials [27,50], and a prospective cohort [46]. The studies were predominantly conducted in health facilities in the Ashanti (4/14; 28.6%) [24,25,46,49] and Greater Accra (4/14; 28.6%) [23,26,36,50] regions of Ghana. Other regions included Central [47], Eastern [31], Upper West [28]; a few were conducted in multiple regions [27,30,48]. Of the 14 studies, 10 (71.4%) were conducted among adults while 4 (28.6%) were among adolescents and young adults.

Adherence to antiretroviral therapy

The prevalence of adherence among the study participants ranged from 43% (95% CI; 36.0–50.0%) to 98% (95% CI; 96%-99.0%). The pooled estimate of adherence to ART was 70% (95% CI: 58.0–81.0) using a weighted-random effects model with significant heterogeneity (I^2 = 99%, p< 0.001) [Fig 2]. This obvious heterogeneity was further supported by the drapery plot

Table 1. Characteristics of the included studies on adherence to antiretroviral therapy in Ghana.

Author (s)	Year	Study Title	Study Location	Study design	Study Population	Sample size	Sampling method	Adherence Assessment	Prevalence Adherence
Biney et.al [26]	2021	Antiretroviral therapy adherence and viral suppression among HIV-infected adolescents and young adults at a tertiary hospital in Ghana	Greater Accra	Cross-sectional	Adolescents and young adults	136	Purposive	MMAS-8	78.67
Anokye-Kumatia et al. [25]	2018	Highly active antiretroviral therapy adherence among perinatally infected HIV adolescents at a teaching hospital in Ghana	Ashanti region	Cross-sectional	Adolescents and young adults	106	Random	MMAS-8	76.4
Addo et.al [23]	2022	Factors influencing adherence to antiretroviral therapy among HIV/AIDS patients in the Ga West Municipality, Ghana	Greater Accra	Cross-sectional	Adults	397	Purposive and systematic random	Self-report question	44.6
Nichols et al. [27]	2019	High prevalence of non-adherence to antiretroviral therapy among undisclosed HIV-infected children in Ghana	Ashanti region/ Greater Accra	Randomized clinical trial	children and adolescents	440	Random	Pharmacy refill, caregiver or child 3-day recall	47.5
Sefah et al. [31]	2022	Barriers and facilitators of adherence to antiretroviral treatment at a public health facility in Ghana: a mixed method study	Eastern region	Cross-sectional	Adults	231	Random	Pill count	42.9
Prah et al. [47]	2018	Factors affecting adherence to antiretroviral therapy among HIV/AIDS patients in Cape Coast Metropolis, Ghana	Central region	Cross-sectional	Adults	381	Systematic	Self-report (Life time adherence question)	73
Obirikorang et al. [28]	2013	Predictors of Adherence to Antiretroviral Therapy among HIV/AIDS Patients in the Upper West Region of Ghana	Upper west region	Cross-sectional	Adults	201	Convenience	Life time adherence question	62.2
Adu et al. [24]	2022	Socio-demographic factors associated with medication adherence among People Living with HIV in the Kumasi Metropolis, Ghana	Ashanti region	Cross-sectional	Adults	420	simple random	MMAS-8	53.1
Afrane et al. [36]	2021	HIV virological non-suppression and its associated factors in children on antiretroviral therapy at a major treatment centre in Southern Ghana: a cross-sectional study	Greater Accra	Cross-sectional	children and adolescents	25	consecutive	Pill count	61.6
Boateng and Kumah [49]	2021	Assessing the rate of antiretroviral therapy adherence among people living with HIV/aids in the Atwima Nwabiagya Municipal—Ashanti region	Ashanti region	Cross-sectional	adults	450	convenience	Patient Attendance-based Defaulting (PAD)	47.8
Adam et al. [48]	2022	Impact of antiretroviral therapy regimens adherence on perceived health and wellbeing status among adults living with HIV in Ghana	Volta and Oti Region	Cross-sectional	Adults	301	convenience	Self-report (Life time adherence question)	97.3
Annison et al. [46]	2013	The Immunological response of HIV-Positive patients initiating HAART at the Komfo Anokye Teaching Hospital, Kumasi, Ghana.	Ashanti region	follow up (prospective)	Adults	303	convenience	self-report (no treatment interruption)	86.5
Dzansi [50]	2017	Integrated mobile phone interventions for adherence to Antiretroviral treatment in clients with HIV infection in Accra, Ghana	Greater Accra	Randomized clinical trial	Adults	362	Random	Self-report, Pill count, VAS	75

(*Continued*)

Table 1. (Continued)

Author (s)	Year	Study Title	Study Location	Study design	Study Population	Sample size	Sampling method	Adherence Assessment	Prevalence Adherence
Ohene et al. [30]	2013	Evaluation of antiretroviral therapy (ART) provision in an early cohort of patients initiating ART in Ghana	Eastern and Greater Accra region	Cross-sectional	Adults	683	Purposive	Self-report, (missed dose in the past 3 months)	78.6

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[51] for all the studies in the meta-analysis [S1 Fig]. In the drapery plot, the prediction region (light grey) is broader than the p-value curve of the pooled estimates, showing significant heterogeneity [S1 Fig].

Sensitivity analysis

Sensitivity analysis was carried out to identify studies that contributed substantially to the pooled estimate and add to the overall heterogeneity of the meta-analysis. The baujat plot in S2A Fig shows that five studies—in the following order: Dzansi [50], Adam et al. [48] Nichols et al. [27] Addo et al. [23] and Boateng and Kumah [8] have a large impact on the pooled estimates and add considerably to the heterogeneity. Further sensitivity analysis was performed by omitting one study each at a time. As shown in S2B Fig, heterogeneity measured by I^2 is ranked from low to high. The plot shows that omitting the study by Dzansi [50] and Adam et al. [48] resulted in I^2 value of 98%. The weighted pooled adherence rate and heterogeneity I^2 reduced after these five studies were excluded from the meta-analysis, falling to 69% (95% CI: 58.6–78.0) and 94% ($p < 0.01$), respectively.

Subgroup analysis of the prevalence of adherence to ART among HIV patients

Subgroup analyses were performed with respect to the age of study participants (adolescents and young adults, versus adults) to determine the prevalence of adherence rate. Findings

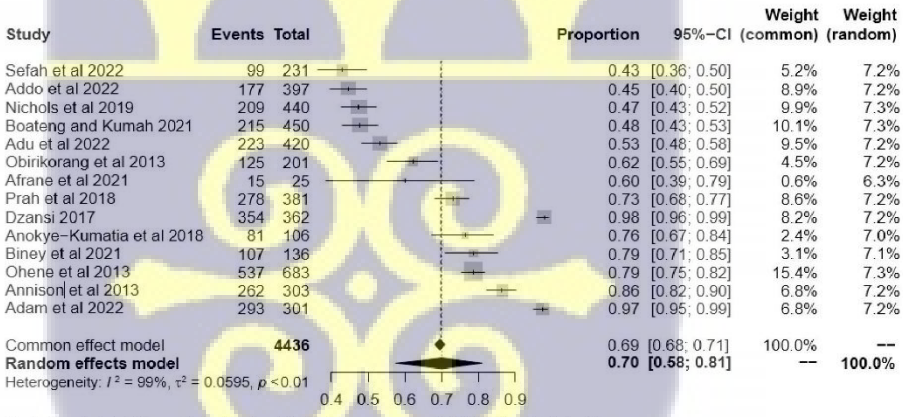

Fig 2. Forest plot of the pooled estimate of ART adherence among HIV/AIDS patients in Ghana.

https://doi.org/10.1371/journal.pgph.0002448.g002

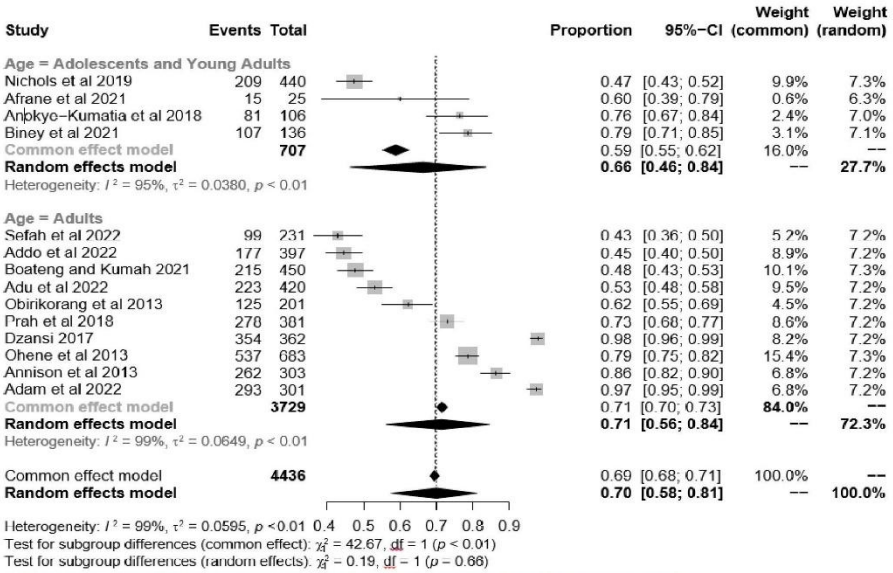

Fig 3. Forest plot showing age subgroup analysis of the prevalence of adherence to ART among HIV/AIDS patients in Ghana. The horizontal line represents 95% CI, and the diamonds correspond to the pooled estimate and CI. We used the random effect model.

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showed that adolescents and young adults had the lowest adherence rate compared to adults [66% (95% CI: 46.0–84.0) vs. 71% (95% CI: 58.0–84.0), p = 0.66] [Fig 3]. Results of the meta-regression showed estimated regression weights for sample size and quality scores to be -0.0001 (p = 0.90) and -0.011 (p = 0.81), respectively. This means that for every unit increase in sample size and quality score, the pooled adherence of the studies is expected to decrease by 0.0001 and 0.011 respectively. The test of moderators for sample size (QM = 0.02; p = 0.90) and quality scores (QM = 0.06, p = 0.81) had no effect on adherence (S3 Fig). This implies that neither sample size nor quality score could significantly predict the observed adherence estimate in the study.

Quality of included studies

The mean quality score of the studies was 6.7 out of a maximum score of 8. The lowest and highest score was three and eight respectively. Of the studies that were included in the review; 11 [23–28,31,36,47,48,50], 2 [30,49], and 1 [46] were found to have a low, moderate, and high risk of bias respectively. Half of the studies, (50%) [23,27,28,30,46–48] scored "No" on question related to whether the outcome was measured in valid and reliable way. Three of the studies [25,46,49] did not clearly state criteria of inclusion of participants and were conducted in the Ashanti region with two employing convenience sampling [46,49] and the other random sampling [25].

Publication bias

The Begg and Egger funnel plot for prevalence of ART adherence showed a skewed pattern, with several studies at the top of the funnel plot, indicating the presence of studies with large

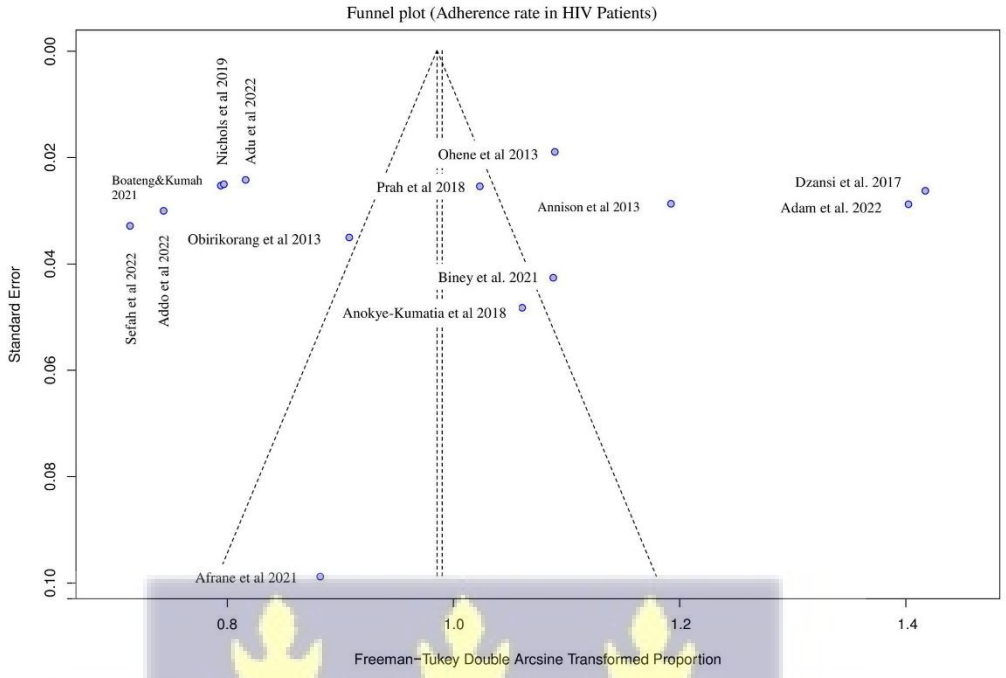

Fig 4. Assessment of publication bias. Begg's funnel plot with a 95% confidence interval for adherence to ART.

https://doi.org/10.1371/journal.pgph.0002448.g004

sample sizes [Fig 4]. There was no publication bias as Egger's test did not indicate the presence of funnel plot asymmetry (p = 0.86).

Discussion

Adherence to medication remains a cornerstone to achieving better health outcomes among chronic diseases such as HIV/AIDS. Findings from this meta-analysis have shown a pooled adherence rate of 70% among HIV/AIDS patients in Ghana. This pooled adherence estimate is far below the recommended ≥95% required to achieve viral suppression [52–54]. This means critical attention and interventions are needed to prevent a higher likelihood of ART drug resistance, new transmissions, hospitalization, morbidity, and mortality among this population.

Our finding of 70% adherence rate is similar to the average adherence score of 72.9% reported by Heestermans et al. [55] in their review study in sub-Saharan Africa. However, the 70% adherence level in this study is slightly lower than the results reported by Mills et al. [21] in their review of published studies in Africa. Those authors reported a slightly higher adherence rate of 77% (95% CI, 68%-85%; I^2, 98.4%) among HIV/AIDS patients taking ART in Africa. The findings of 70% adherence level is also far lower than the adherence estimate of 93.7% among HIV/AIDS children in Ethiopia [22]. The difference in these adherence rates could be due to the different methods used to assess adherence and the different populations

studied. For instance, the study in Ethiopia focused on children less than 15 years whereas our study involved adolescents and the adult population [22]. These different population groups are likely to exhibit different medication adherence behaviors. The higher adherence rate in children could be due to the fact their parents provide support to adhere to their medication plan. Reporting bias and caregivers' overestimation of self-reports [56,57] of adherence studies among children could lead to higher levels of adherence. Meeting the UN Sustainable development goal 3 of "ensuring good health for all at all ages" implies a needed focus on strategies and interventions for better health outcomes among HIV patients on anti-retroviral therapy.

In our sub-group analyses, adolescents and young adults had a lower adherence rate (66%) compared with adults (71%). This is similar to the studies by Kim et al. [58] where 62% of adolescents were reported to be adherent to ART. Several barriers have been identified related to ARV intake among young people living with HIV. Adolescents and youth often deny their HIV status, do not disclose their HIV status, and have the false perception that they feel better, leading to a lower perceived need for taking their medication [59–61]. They also feel stigmatized coming to the clinic for medication; this leads to frequent interruptions in adherence [62–64].

A common barrier to adherence to ART reported was forgetfulness. Forgetfulness is a well-documented barrier to adherence to ART [65–68] and several interventions including daily reminder messages have been implemented to address this barrier [69–72].

This study has both strengths and limitations. In terms of strengths, this is the first comprehensive review that has focused on the prevalence of adherence to ART among HIV patients in Ghana. A systematic search of the literature using strict inclusion criteria was conducted to ensure wider coverage and depth of the evidence that is available about ART adherence in Ghana. Furthermore, the methodological quality and strength of the evidence were critically appraised using tools recommended for critical appraisal of the literature. This makes our findings reliable and critical for use by policymakers to inform decisions. However, we acknowledge some limitations of the review. Of the 14 studies included in the review, two were not peer reviewed and this may raise concern about the quality of evidence produced as well as the credibility of the study outcomes reported. Furthermore, although we used a random effect model to account for the observed large heterogeneity from our meta-analysis, we could not significantly identify the potential source of the large heterogeneity in our meta-regression as only a few covariates were used. For example, covariates such as gender which has been reported to significantly explain the variation of adherence in similar studies [33] were not included in our data. Gender-specific information on adherence to ART was not reported in most of the included studies.

In resource-limited settings such as Ghana, self-report assessment of adherence is popular and widely used due to its ease of use in busy settings, affordability, and low staff requirements [73–75]. Over 60% of the included studies used self-report as opposed to objective measurements such as medication event monitoring system (MEMS), drug levels, or viral load outcomes to assess adherence. This method is subject to social desirability bias [76] and has been reported to overestimate adherence [74] and may affect the pooled adherence rate documented in this study. Notwithstanding these limitations, the findings of this meta-analysis can guide the research potential of strategic interventions to improve adherence to ART among PLHIV.

Implications of findings

Findings from our review could be used by the Ghana National AIDS/STI Control programme (NACP) and the Ghana Health Service (GHS) to optimize ART clinical services and adherence support within the current healthcare systems. The sup-optimal ART adherence rate in this

study implies a need for attention to design and implement integrated interventions (patient-friendly services, peer support, home visits, community support) and strategies to achieve viral suppression. The implementation of the interventions will also be important to reduce drug resistance, reduce new infections and reduce HIV-related morbidity and mortality among PLHIV, especially among adolescents and young adults who have increased risk of treatment failure due to sub-optimal adherence to ART. Healthcare professionals need to strengthen their capacity for counseling services during regular follow-up visits by PLHIV. There is also the need for implementation research that targets the several domains of the barriers to adherence to ART.

Conclusion

A pooled adherence estimate of 70% was found among persons living with HIV/AIDS on anti-retroviral therapy. Adherence was lower among young people compared with adults. A comprehensive approach in the form of a multi-component intervention in the domain of education, peer support, home visit, and daily reminder messages will be necessary to address the multi-dimensional complexities of adhering to ART for better treatment outcomes.

Supporting information

S1 Fig. Drapery plot showing p-value curves for adherence to ART among HIV/AIDS patients. Studies are represented by gray curves and weighted random effect models are represented on a grayscale. Studies with higher weights are shown in dark gray and those with low weights in light gray. Dashed horizontal lines are used to detect Confidence intervals for common alpha levels.
(DOCX)

S2 Fig. Sensitivity analysis of the prevalence of adherence to ART. (A) Baujat plots to detect studies contributing to heterogeneity in the meta-analysis. **(B)** Plot for Leave-One-Out meta-analysis by omitting each study in turn.
(DOCX)

S3 Fig. Meta-regression analysis plot to investigate the patterns of heterogeneity in our data based on sample size **(A)** and quality scores **(B)** of the studies.
(DOCX)

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Appendix 1- Study Questionnaire

STUDY QUESTIONNAIRE (BASELINE)

EFFECTS OF PEER SUPPORT INTERVENTIONS ON ADHERENCE TO ANTI-RETROVIRAL THERAPY AMONG HIV-POSITIVE ADOLESCENTS AND YOUNG ADULTS IN TWO DISTRICTS IN THE ASHANTI REGION, GHANA.

Date:
Stating time:
Ending time:
Patient ID:
Questionnaire ID:
Interviewer ID:
Facility Code:

My name is ……I am working with a research team from the Department of Population, Family and Reproductive Health, School of Public Health, University of Ghana. The research is a PhD thesis that seeks to assess the effectiveness of peer led support intervention on HIV treatment adherence among HIV-positive adolescents and young adults in the Ashanti region. This is hoped to improve HIV treatment among adolescents and young adults living with HIV. We assure you that any information collected will be kept confidential. Findings from this research will be analyzed anonymously and published in a research Journal without any identification. Importantly, no personal or identifiable information will be present in the research findings. The interview will ask questions about your HIV status including how it was acquired, diagnosed, and how you manage and cope with the disease.

Finally, the interview will ask about your treatment routine, perceived stigma, disclosure and your mood. This interview is expected to last for about 45 minutes and will be conducted in a language you understand. You are free to ask for any clarification about this research. Your response to each question is voluntary (you are not obliged to answer all questions) and you are free to pause or withdraw from the interview at any point without explanation. We assure you that your withdrawal will not affect the treatment or benefit you receive at the health facility.

Thank you for your time and support for this research.

SECTION A: SOCIO- DEMOGRAPHIC CHARACTERISTICS

Kindly circle the number corresponding to the responses where appropriate

I.	Sex of participant	Male Female	1 2
II.	What is your age (years) at your last birthday?	Age in years _____	
III.	What is your marital status?	Never married Married/Cohabiting Divorced/Separated Widowed	1 2 3 4
IV.	Which ethnic group do you belong to?	Akan Ga/Dangme Ewe Guan Mole-Dagbani Other (Specify)	1 2 3 4 5 6
V.	What is your religion?	Christian Muslim Traditional Other (Specify) None	1 2 3 4 5
VI.	Are you currently in school?	Yes No	1 2
VII.	If No, why are you not in school?	Completed JHS Completed SHS Dropped out of school due to ill health Do not have money for school fees Other, (specify) _____	1 2 3 4 5
VIII.	What is your current educational qualification?	None Primary JHS SHS Tertiary	1 2 3 4 5
IX.	What is your occupation?	Employed Unemployed Student Other, (specify)	1 2 3 4
X.	What is the status of your parents?	Both parents are alive Mother alive, father dead Father alive, Mother dead Both parents dead Not known	1 2 3 4 5
XI.	Whom do you live with?	Mother Father Both parents Sister Aunty	1 2 3 4 5

		Other, (specify)	6
XII.	Do you have someone who supports in taking your ARVs?	Yes No	1 2
XIII.	If yes, who supports you to take your drugs?	Mother Father Both parents Sister Aunty Other, (specify)……	1 2 3 4 5 6
XIV.	Do you currently take Alcohol?	Yes No	1 2
XV.	Have you ever taken alcohol?	Yes No	1 2
XVI.	Do you currently smoke?	Yes No	1 2
XVII.	Have you ever smoked?	Yes No	1 2
VIII.	Do you have Health Insurance?	Yes No	1 2
XIX.	Do you have your own mobile phone?	Yes No	1 2
XX.	Are you currently ill?	Yes No	1 2
XXI.	If yes, what do you think is wrong with you?	……	
XXII.	ART Currently taking	……	

SECTION B – HIV, SEXUAL AND OTHER CLINICAL CHARACTERISTICS

1.	How did you get infected with HIV?	Perinatally (mother to child by birth) Horizontally (by sex) Blood transfusion Don't know Other (specify)……	1 2 3 4 5
2.	Do you believe you have HIV?	Yes No	1 2
3.	If No, why don't you believe?	_____	
4.	At what age were you diagnosed of HIV? (Please obtain information from records)	....	
5.	Where were you diagnosed of HIV	In this facility Another facility	1 2

6. After your diagnosis, how long did it take you to be put on treatment (ART)?	within a week more than a month more than two months more than 3 months don't remember	1 2 3 4 5
7. How long have you been on ART treatment?	In Months _____ In Years_____ Don't remember …….	1 2 3
8. Apart from ARV, are you taking any other medication to treat HIV?	Yes No	1 2
9. If yes, which medication?	.....	
10. Have you ever used traditional therapies for treatment?	Yes No	1 2
11. Have you missed any ART dose in the last 30 days?	Yes No	1 2
12. If yes, what was the cause?	……	
13. Have you ever had any side effect of ARVs?	Yes No Don't know	1 2 3
14. Do you know of any HIV infected family member?	Yes No Don't know	1 2 3
15. Are you suffering from other disease apart from HIV?	Yes No Don't know	1 2 3
16. If Yes, which disease condition? (Please confirm from medical records)	……	
17. Have you disclosed your HIV status to anyone?	Yes No	1 2
18. If yes, to whom?	……..	
19. How do you currently perceive your health status since initiation of ART	Worse …… Stable …… Better ……	1 2 3
Are you currently in sexual relationship?	Yes No	1 2
If you are in a sexual relationship, does your partner know your status?	Yes No	1 2
Have you ever had sex?	Yes No	1 2
If yes, age of sexual debut (age at first sex)?	……	
In your last sex, did you use condom?	Yes No Don't remember	1 2 3

SECTION C- ATTITUDES AND KNOWLEDGE OF ART

Kindly tick as appropriate

Questions	Response			
	A Little	Not at all	somewhat	very
ATTITUDES OF ART				
1. Are you worried about ART side effects?				
2. Are you worried about ART ineffectiveness?				
3. Are you worried about having to take ART?				
4. Are you worried about friends finding out you are on ART?				
5. Are you worried about family finding out you are on ART?				
6. Are you worried about your sexual partner finding out you are on ART?				
KNOWLEDGE ON ART				
Question	**Agree**		**Disagree**	**Don't know**
7. ART prevent mother-to-child HIV transmission				
8. HIV can be controlled by ART				
9. HIV can be prevented by ART after rape				
10. HIV can be cured by ART				
11. Taking ART prevents HIV disease progression				
12. Not starting ART when indicated can make you sick				
13. Missing doses of ART increases risk of transmitting HIV				
14. HIV patient can stop taking ART when viral suppression is achieved				

SECTION D – MEASUREMENT OF ADHERENCE USING MORISKY MEDICATION ADHERENCE SCALE (MMAS-8)

Kindly tick the responses as appropriate

Question	Yes	No
1. Do you sometimes forget to take your medicine?		
2. Over the past two weeks, were there any days you did not take your medicine?		
3. Have you ever stopped your medicine without telling your doctor?		
4. When you travel, do you sometimes forget to bring your medicine?		
5. Did you take all your medicine yesterday?		
6. When you feel your symptoms are under control, do you sometimes stop taking medicine?		
7. Taking medicines every day is a real inconvenience for some people. Do you ever feel stressed about sticking to your treatment plan?		

8. How often do you have difficulty remembering to take all your medications? 1. Never/rarely ☐ 2. Once a while ☐3. Sometimes ☐4. Usually ☐ 5. All the time ☐		

SECTION E- ASSESSMENT OF DEPRESSION (PHQ-9)

These questions ask how the **last 2 weeks**, how often have you been bothered by any of the following problems? Please answer all the questions. If you are unsure about which response to give to a question, please choose the one that appears most appropriate. This can often be your first response. Please keep in mind your standards, hopes, pleasures and concerns.

Over the last 2 weeks, how often have you been bothered by any of the following problems? *(Use "✓" to indicate your answer)*	Not at all	Several days	More than half the days	Nearly every day
10. Little interest or pleasure in doing things				
11. Feeling down, depressed, or hopeless				
12. Trouble falling or staying asleep, or sleeping too much				
13. Feeling tired or having little energy				
14. Poor appetite or overeating				
15. Feeling bad about yourself — or that you are a failure or have let yourself or your family down				
16. Trouble concentrating on things, such as reading the newspaper or watching television				
17. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so restless that you have been moving around a lot more than usual				
18. Thoughts that you would be better off dead or of hurting yourself in some way				

SECTION F- HIV-related Stigma

This is a 12-item scale assessing internalized stigma and perceived external stigma.

Kindly tick the responses as appropriate

	Strongly disagree	Disagree	Agree	Strongly Agree
Internal Stigma				
1. It is difficult to tell people about my HIV infection				
2. Having HIV makes me feel unclean				
3. I feel guilty that I am HIV positive				
4. I am ashamed that I am HIV positive				
5. I sometimes feel worthless because I am HIV positive				
6. I hide my HIV status from others				
Perceive External Stigma				
7. People I know would treat someone with HIV as an outcast				
8. People I know would be uncomfortable around someone with HIV				
9. People I know believe that a person with HIV is dirty				
10. People I know would reject someone with HIV				
11. People I know would not want someone with HIV around their children				
12. People I know think that a person with HIV is disgusting				

SECTION G: CONCERNS ABOUT DISCLOSURE

Kindly tick the responses as appropriate

	Strongly disagree	Disagree	Agree	Strongly Agree
1. I am very careful who I tell that I have HIV				
2. I don't feel the need to hide the fact that I have HIV				
3. I worry that people may judge me when they learn I have HIV				
4. Telling someone I have HIV is risky				
5. Since knowing I have HIV, I worry about people discriminating against me				

6. It is easier to avoid new friendships than worry about telling someone that I have HIV				
7. I work hard to keep my HIV status a secret				

SECTION : H

Pill Count
(……/100)

SECTION I:

HIV Viral Load
Record participant's viral load from medical records if available

Viral load (copies/ml)		
Viral Load	Suppressed (< 1000) Non-suppressed (≥1000) Not available	1 2 3

Thank you!

STUDY QUESTIONNAIRE (ENDLINE)

EFFECTS OF PEER SUPPORT INTERVENTIONS ON ADHERENCE TO ANTI-RETROVIRAL THERAPY AMONG HIV-POSITIVE ADOLESCENTS AND YOUNG ADULTS IN TWO DISTRICTS IN THE ASHANTI REGION, GHANA

Date:
Stating time:
Ending time:
Patient ID:
Questionnaire ID:
Interviewer ID:
Facility Code:

My name is ……I am working with a research team from the Department of Population, Family and Reproductive Health, School of Public Health, University of Ghana. The research is a PhD thesis that seeks to assess the effectiveness of peer led support interventions on HIV treatment adherence among HIV-positive adolescents and young adults in two districts in the Ashanti region. This is hoped to improve HIV treatment among adolescents and young adults living with HIV. We assure you that any information collected will be kept confidential. Findings from this research will be analyzed anonymously and published in a research Journal without any identification. Importantly, no personal or identifiable information will be present in the research findings. The interview will ask questions about your HIV status including how it was acquired, diagnosed, and how you manage and cope with the disease. Finally, the interview will ask also you about your treatment routine, perceived stigma, disclosure and your mood. This interview is expected to last for about 45 minutes and will be conducted in a language you understand. You are free to ask for any clarification about this research. Your response to each question is voluntary (you are not obliged to answer all questions) and you are free to pause or withdraw from the interview at any point without explanation. We assure you that your withdrawal will not affect the treatment or benefit you receive at the health facility.

Thank you for your time and support for this research.

SECTION A – HIV AND CLINICAL CHARACTERISTICS

i.	Apart from ARV, are you taking any other medication to treat HIV?	Yes No	1 2
ii.	If yes, which medication?	.....	
iii.	Have you missed any dose in the past 30 days?	Yes No	1 2
iv.	Is there any day you have missed taking your HIV medication?	Yes No	1 2
v.	If yes, what was the cause?	……	
vi.	Have you ever had any side effect of ARVs?	Yes No Don't know	1 2 3
vii.	Do you know of any HIV infected family member?	Yes No Don't know	1 2 3
viii.	Are you suffering from other disease apart from HIV?	Yes No Don't know	1 2 3
ix. **x.**	If Yes, which disease condition? **(Please confirm from records)**	……	
xi.	Have you disclosed your HIV status to anyone?	Yes No	1 2
xii.	If yes, to whom?	…….	
xiii.	Does your partner or any relation know your HIV status?	Yes No	1 2
xiv.	How do you currently perceive your health status since initiation of ART	Worse Stable Better	1 2 3
xv.	Have you ever had sex?	Yes No	1 2
xvi.	If yes, age of sexual debut (age at first sex)?	……	
xvii.	Are you currently in sexual relationship?	Yes No	1 2
xviii.	If yes, do you use condom in your sexual relationship?	Yes No Sometimes	1 2 3
xix.	In your last sex, did you use condom?	Yes No Don't remember	1 2 3 4
xx.	If you are in a relationship, does your partner know your status?	Yes No	1 2

SECTION B- KNOWLEDGE AND ATTITUDES OF ART

Kindly tick as appropriate

Questions	Response			
	A Little	Not at all	somewhat	very
ATTITUDES OF ART				
1. Are you worried about ART side effects?				
2. Are you worried about ART ineffectiveness?				
3. Are you worried about having to take ART?				
4. Are you worried about friends finding out you are on ART?				
5. Are you worried about family finding out you are on ART?				
6. Are you worried about your sexual partner finding out you are on ART?				
KNOWLEDGE OF ART				
Question	**Agree**		**Disagree**	**Don't know**
7. ART prevent mother-to-child HIV transmission				
8. HIV can be controlled by ART				
9. HIV can be prevented by ART after rape				
10. HIV can be cured by ART				
11. Taking ART prevents HIV disease progression				
12. Not starting ART when indicated can make you sick				
13. Missing doses of ART increases risk of transmitting HIV				
14. HIV patients can stop taking ART when viral suppression is achieved				

SECTION D – MEASUREMENT OF ADHERENCE USING MORISKY MEDICATION ADHERENCE SCALE (MMAS-8)

Kindly tick the responses as appropriate

Question	Yes	No
9. Do you sometimes forget to take your medicine?		
10. Over the past two weeks, were there any days you did not take your medicine?		
11. Have you ever stopped your medicine without telling your doctor?		
12. When you travel, do you sometimes forget to bring your medicine?		
13. Did you take all your medicine yesterday?		
14. When you feel your symptoms are under control, do you sometimes stop taking medicine?		
15. Taking medicines every day is a real inconvenience for some people. Do you ever feel stressed about sticking to your treatment plan?		

16. How often do you have difficulty remembering to take all your medications? 1. Never/rarely ☐ 2. Once a while ☐3. Sometimes ☐4. Usually ☐ 5. All the time ☐		

SECTION E- ASSESSMENT OF DEPRESSION (PHQ-9)

These questions ask how the **last 2 weeks**, how often have you been bothered by any of the following problems? Please answer all the questions. If you are unsure about which response to give to a question, please choose the one that appears most appropriate. This can often be your first response. Please keep in mind your standards, hopes, pleasures and concerns.

Over the last 2 weeks, how often have you been bothered by any of the following problems? *(Use "✓" to indicate your answer)*	Not at all	Several days	More than half the days	Nearly every day
19. Little interest or pleasure in doing things				
20. Feeling down, depressed, or hopeless				
21. Trouble falling or staying asleep, or sleeping too much				
22. Feeling tired or having little energy				
23. Poor appetite or overeating				
24. Feeling bad about yourself — or that you are a failure or have let yourself or your family down				
25. Trouble concentrating on things, such as reading the newspaper or watching television				
26. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so restless that you have been moving around a lot more than usual				
27. Thoughts that you would be better off dead or of hurting yourself in some way				

SECTION F- HIV-related Stigma

This scale assessing internalized stigma

Kindly tick the responses as appropriate

	Strongly disagree	Disagree	Agree	Strongly Agree
Internal Stigma				
13. It is difficult to tell people about my HIV infection				
14. Having HIV makes me feel unclean				
15. I feel guilty that I am HIV positive				
16. I am ashamed that I am HIV positive				
17. I sometimes feel worthless because I am HIV positive				
18. I hide my HIV status from others				

SECTION G: CONCERNS ABOUT DISCLOSURE

Kindly tick the responses as appropriate

	Strongly disagree	Disagree	Agree	Strongly Agree
8. I am very careful who I tell that I have HIV				
9. I don't feel the need to hide the fact that I have HIV				
10. I worry that people may judge me when they learn I have HIV				
11. Telling someone I have HIV is risky				
12. Since knowing I have HIV, I worry about people discriminating against me				
13. It is easier to avoid new friendships than worry about telling someone that I have HIV				
14. I work hard to keep my HIV status a secret				

SECTION : H

Pill Count
(……/100)

SECTION I:

HIV Viral Load
Record participant's viral load from medical records if available

Viral load (copies/ml)		
Viral Load	Suppressed (< 1000) Non-suppressed (≥1000) Not available	1 2 3

Thank you!

Appendix 2a: PARTICIPANTS INFORMATION SHEET- 18+Yrs (PARTICIPANTS)

Title of Study: EFFECTS OF PEER SUPPORT INTERVENTIONS ON ADHERENCE TO ANTI-RETROVIRAL THERAPY AMONG HIV-POSITIVE ADOLESCENTS AND YOUNG ADULTS IN TWO DISTRICTS IN THE ASHANTI REGION, GHANA

Principal Investigator:

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P.O.Box LG 13.

Email:isaacboadu62@gmail.com; mobile: 0243881993

PART 1: Information Sheet

Hello, my name is _____; I am a research assistant working for the department of Population, Family and Reproductive Health at the University of Ghana. You are invited to volunteer for a study that we are doing. Mr. Isaac Boadu is the principal investigator responsible for the study. This study seeks to assess how effective peer support interventions will help improve adherence to anti-retroviral among adolescents and young adults living with HIV. It also seeks to assess how the peer support intervention will help reduce the HIV virus in your body, reduce how you see yourself in a negative way, reduce the persistent feeling of sadness and low mood and help you remain in hospital care. Before you decide to join the study, I will like you to understand why the research is being done, and what will be required of you should you decide to participate.

I am going to give you information on the study and you will also be given a copy of the study information sheet for you to read or for someone to read for you. Please take some time to read this information carefully and feel free to ask any question (s) about any part of the study you do not understand. If there are words you do not understand, please feel free to stop me as we go through the information sheet and I will be glad to explain to you. You do not have to decide now on whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research, including any of the ART clinic staff or other staff where you receive care. Your participation is completely voluntary and you are free to decline to participate. If you choose not to participate, this will not affect you negatively in any way whatsoever. You are free to withdraw from the study at any point, even if you have already agreed to participate.

Purpose of research: The purpose of the study is to determine adherence rate and also assess how peer support intervention can be used to improve adherence among young persons aged 15-24 years living with HIV in the Ashanti region. We believe that involving peers to provide support to individuals of similar age and characteristics will be an optimum strategy to improve adherence to ART and treatment outcomes such as reduce the HIV virus in your body, improve low mood, help HIV patients remain in hospital care and reduce how you see yourself in a negative way. We believe that involving peers to provide support to individuals of similar age

and characteristics will be an optimum strategy to improve adherence to ART and treatment outcomes such as reduce the HIV virus in the body, low mood, helps patients remain in care and reduce how you see yourself in a negative way.

Nature of research: This is an intervention study among 235 HIV positive adolescents and young adults (15-24 years) at Obuasi government hospital and Nkawie-Toase government hospital. **There will be no random allocation of participants to the study groups**. Participants that will be recruited from Obuasi government hospital will serve as the study intervention group and those from Nkawie-Toase hospital will serve as the control. Allocation of participants to the study intervention is because of the proximity of Obuasi government hospital to the researcher.

The research will be in two parts; a quantitative and a qualitative study. The first part will be quantitative and will involve training HIV peer supporters to deliver the study intervention. This will include the peer supporters facilitating monthly support group meetings, providing adherence counseling through monthly home visits and sending of daily SMS messages to participants. They will also be involved in calling participants to remind them of their clinic appointments. The qualitative part will explore the experiences of participants in a focus group discussion on their involvement in the intervention after the study.

Participant's involvement: If you agree to participate in the study, you be will be interviewed at two different times, at enrolment and at the end of the study (six months after the intervention). If you agree to participate in the research, you will be required to sign a consent form. At enrolment, you will be interviewed about your background characteristics such as age, level of education, marital status, whom you currently live with, past and current smoking and drinking history. In addition, we will ask you about how you are managing your HIV positive status, access to and use of Anti-retroviral therapy (ART) The interview will be conducted at a convenient time and place for you. Each interview is expected to last approximately 45 minutes.

Depending on which of the study groups you will be assigned to (intervention/control), if you are assigned to the intervention group, you will be put into a group (maximum 11 people per group) to receive peer support interventions. Your group will nominate a peer leader who will be responsible for coordinating monthly support group meetings. The support group meetings will involve a discussion about the importance of adherence to HIV medication and the best way of managing with the disease. Meetings will be held at appropriate time and place agreed by all of you in the group.

The peer leaders will be visiting your homes once a month to provide adherence counseling as well counseling on the best way of living with HIV. The peers will also send to you daily SMS messages (messages will be what you have all agreed on as a group). These activities (home visits, monthly support meetings and daily SMS reminders to take your medication) will continue for six months if you are assigned to the intervention group.

Potential Risks: We do not foresee any potential risk associated with your participation in this study. However, we do appreciate that you will be asked to share with us some very personal

and confidential information, and you may feel uncomfortable talking about some of the topics. You are not obliged to answer all the questions, and you do not have to give us any reason for not responding to any question, or for refusing to take part in the interview. During the interviews, a face mask and sanitizers will be provided to you and the interviewer to minimize the risk of coronavirus infection.

Benefits: There are no direct benefits from participating in this study. However, your participation in the study will help us to understand whether trained peer supporters can be used to improve on ART adherence and HIV treatment outcomes This will be useful in making possible recommendations to people and institutions who are interested in improving the health outcomes among young persons (15-24 years) living with HIV.

Costs: There are no costs to you in terms of money for participating in the study. Your time will be appreciated by providing you with snack during the interviews.

Compensation: You will not receive any compensation for your participation in this study. However, you will be provided with an average amount of GHS 40 for transportation to attend the interviews. Monthly SMS credits worth GHS 15 will be provided to you if you are assigned to the study intervention group.

Confidentiality: We assure you that any information collected from you will be handled with the strictest confidentiality and will not be disclosed to any other person. The information will be used only for the purpose of this study. Your name or any personal identifiers will not be linked to the data. We request you not to share or disclose the information of other participants with anyo**ne.** All hard copies of the questionnaire will locked in a safe cabinet with the key accessible only by the Principal Investigator. Soft copies will be kept on password protected hard drive, with password known only by the principal investigator. All collected and kept data will completely be destroyed after 5 years.

Voluntary participation/withdrawal: Your participation is in this study is voluntary. You are free to refuse to participate, and you may withdraw your consent or discontinue participation at any time. Your refusal to participate will not result in any penalty or loss of benefits. You are free to skip any questions you do not want to answer. All the research data will be under the care of the principal investigation. If you decide to withdraw from the study at any point, your data will not be used in this study.

Outcome and Feedback: The principal investigator and supervisors will be responsible for the secure storage, transfer and safe use of the data. All the questionnaires will be entered electronically and kept under a cloud backup and storage device, accessible only to the research team. The hard copies will be kept in a secure locker accessible only to the PI. You will receive all the information needed after the completion of the study through online platforms.

Funding information: This study is funded by the World Health Organization Human Reproduction Program (WHO/HRP) Alliance through the University of Ghana School of Public Health, under the WHO/HRP Alliance in research capacity strengthening in Sexual and Reproductive Health.

Sharing of participants Information/Data: By consenting to participate in this study, you are also allowing us to use the data you will share with us to inform future research and other initiatives in the field of HIV among adolescents and young adults**.** Outcome of the data will be shared through seminars, workshops and conferences. Data sharing will take into consideration anonymity.

Provision of Information and Consent for participants: A copy of the Information sheet and Consent for will be given to you after it has been signed or thumb-printed to keep.

Who to Contact for Further Clarification/Questions: For further clarification of the study, please contact the PI, Mr. Isaac Boadu (isaacboadu62@gmail.com); 0243881993 or Dr. Adom Manu (amanu@ug.edu.gh) or Professor Richmond Nii Okai Aryeetey (026112 8506) all of the Department of Population, Family and Reproductive Health). If you require any further clarification on this consent, you are free to contact the administrator of the Ghana Health Service Ethics Review Committee, Nana Abena Apatu (0503539896) responsible for approving the research study.

Appendix 2b: PARTICIPANTS INFORMATION SHEET- Child (<18 yrs)

Title of Study: EFFECTS OF PEER SUPPORT INTERVENTIONS ON ADHERENCE TO ANTI-RETROVIRAL THERAPY AMONG HIV-POSITIVE ADOLESCENTS AND YOUNG ADULTS IN TWO DISTRICTS IN THE ASHANTI REGION, GHANA

Principal Investigator:

Isaac Boadu, MPhil, MSc. PhDc.

Department of Population Family & Reproductive Health

School of Public Health, University of Ghana-Legon.

P.O.Box LG 13.

Email:isaacboadu62@gmail.com; mobile: 0243881993

PART 1: Information Sheet

Hello, my name is _____; I am a research assistant working for the department of Population, Family and Reproductive Health at the University of Ghana. You are invited to volunteer for a study that we are doing. Mr. Isaac Boadu is the principal investigator responsible for the study. This study seeks to assess how effective peer support interventions will help improve adherence to anti-retroviral among adolescents and young adults living with HIV. It also seeks to assess how the peer support intervention will help reduce the HIV virus in your body, reduce how you see yourself in a negative way, reduce the persistent feeling of sadness and low mood and help you remain in hospital care. Before you decide to join the study, I will like you to understand why the research is being done, and what will be required of you should you decide to participate.

I am going to give you information on the study and you will also be given a copy of the study information sheet for you to read or for someone to read for you. Please take some time to read this information carefully and feel free to ask any question (s) about any part of the study you do not understand. If there are words you do not understand, please feel free to stop me as we go through the information and I will be glad to explain to you. You do not have to decide now on whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research, including any of the ART clinic staff or other staff where you receive care. Your participation is completely voluntary and you are free to decline to participate. If you choose not to participate, this will not affect you negatively in any way whatsoever. You are free to withdraw from the study at any point, even if you have already agreed to participate.

We have discussed this research with your parent (s)/guardian and asked if him/her/them if we may ask you to participate in the study. If you do not wish to participate in the research, you do not have to, even if your parents have agreed.

Purpose of research: The purpose of the study is to determine adherence rate and also assess how peer support intervention can be used to improve adherence among young persons aged 15-24 years living with HIV in the Ashanti region. We believe that involving peers to provide support to individuals of similar age and characteristics will be an optimum strategy to improve adherence to ART and treatment outcomes such as reduce the HIV virus in your body, improve

low mood, help HIV patients remain in hospital care and reduce how you see yourself in a negative way. We believe that involving peers to provide support to individuals of similar age and characteristics will be an optimum strategy to improve adherence to ART and treatment outcomes such as reduce the HIV virus in the body, low mood, helps patients remain in care and reduce how you see yourself in a negative way.

Nature of research: This is an intervention study among 235 HIV positive adolescents and young adults (15-24 years) at Obuasi government hospital and Nkawie-Toase government hospital. **There will be no random allocation of the study participants to the intervention and control groups**. Participants that will be recruited from Obuasi government hospital will serve as the study intervention group and those from Nkawie-Toase hospital will serve as the control. Allocation of participants to the study intervention is because of the proximity of Obuasi government hospital to the researcher.

This research will be in two parts; a quantitative and a qualitative study. The first part will be quantitative and will involve training HIV peer supporters to deliver the study intervention. This will include the peer supporters facilitating monthly support group meetings, providing adherence counseling through monthly home visits and sending of daily SMS messages to participants. They will also be involved in calling participants to remind them of their clinic appointments. The qualitative part will explore the experiences of participants in a focus group discussion on their involvement in the intervention after the study.

Participant's involvement: If you agree to participate in the study, you be will be interviewed at two different times, at enrolment and at the end of the study (six months after the intervention). If you agree to participate in the research, you will be required to sign a consent form. At enrolment, you will be interviewed about your background characteristics such as age, level of education, marital status, whom you currently live with, past and current smoking and drinking history. In addition, we will ask you about how you are managing your HIV positive status, access to and use of Anti-retroviral therapy (ART) The interview will be conducted at a convenient time and place for you. Each interview is expected to last approximately 45 minutes.

Depending on which of the study groups you will be assigned to, if you are assigned to the intervention group, you will be put into a group (maximum 11 people per group) to receive peer support intervention. Your group will nominate a peer leader who will be responsible for coordinating monthly support group meetings. The support group meetings will involve a discussion about the importance of adherence to HIV medication and the best way of managing with the disease. Meetings will be held at appropriate time and place agreed by all of you in the group.

The peer leaders will be visiting your homes once a month to provide adherence counseling as well counseling on the best way of living with HIV. The peers will also send to you daily SMS messages (messages will be what you have all agreed on as a group). These activities (home visits, monthly support meetings and daily SMS reminders to take your medication) will continue for six months if you are assigned to the intervention group.

Potential Risks: We do not foresee any potential risk associated with your participation in this study. However, we do appreciate that you will be asked to share with us some very personal and confidential information, and you may feel uncomfortable talking about some of the topics. You are not obliged to answer all the questions, and you do not have to give us any reason for not responding to any question, or for refusing to take part in the interview. During the interviews, a face mask and sanitizers will be provided to you and the interviewer to minimize the risk of coronavirus infection.

Benefits: There are no direct benefits from participating in this study. However, your participation in the study will help us to understand whether trained peer supporters can be used to improve on ART adherence and HIV treatment outcomes This will be useful in making possible recommendations to people and institutions who are interested in improving the health outcomes among young persons (15-24 years) living with HIV.

Costs: There are no costs to you for letting your child participate in this study. Snack will be provided during the interviews.

Compensation: You will not receive any compensation for your participation in this study. However, you will be provided with an average amount of GHS 40 for transportation to attend the interviews. Monthly SMS credits worth GHS 15 will be provided to you if you are assigned to the study intervention group.

Confidentiality: We assure you that any information collected from you will be handled with the strictest confidentiality and will not be disclosed to any other person. The information will be used only for the purpose of this study. Your name or any personal identifiers will not be linked to the data. **We request you not to share or disclose the information of other participants with anyone**. All hard copies of the questionnaire will locked in a safe cabinet with the key accessible only by the Principal Investigator. Soft copies will be kept on password protected hard drive, with password known only by the principal investigator. All collected and kept data will completely be destroyed after 5 years.

Voluntary participation/withdrawal: Your participation is in this study is voluntary. You are free to refuse to participate, and you may withdraw your consent or discontinue participation at any time. Your refusal to participate will not result in any penalty or loss of benefits. You are free to skip any questions you do not want to answer. All the research data will be under the care of the principal investigation. If you decide to withdraw from the study at any point, your data will not be used in this study.

Outcome and Feedback: The principal investigator and supervisors will be responsible for the secure storage, transfer and safe use of the data. All the questionnaires will be entered electronically and kept under a cloud backup and storage device, accessible only to the research team. The hard copies will be kept in a secure locker accessible only to the PI. You will receive all the information needed after the completion of the study through online platforms.

Funding information: This study is funded by the World Health Organization Human Reproduction Program (WHO/HRP) Alliance through the University of Ghana School of

Public Health, under the WHO/HRP Alliance in research capacity strengthening in Sexual and Reproductive Health.

Sharing of participants Information/Data: By consenting to participate in this study, you are also allowing us to use the data shared with us to inform future research and other initiatives in the field of HIV among adolescents and young adults**.** Outcome of the data will be shared through seminars, workshops and conferences. Data sharing will take into consideration anonymity.

Provision of Information and Consent for participants: A copy of the Information sheet and Consent for will be given to you after it has been signed or thumb-printed to keep.

Who to Contact for Further Clarification/Questions: For further clarification of the study, please contact the PI, Mr. Isaac Boadu (isaacboadu62@gmail.com); 0243881993 or Dr. Adom Manu (amanu@ug.edu.gh) or Professor Richmond Nii Okai Aryeetey (026112 8506) all of the Department of Population, Family and Reproductive Health). If you require any further clarification on this consent, you are free to contact the administrator of the Ghana Health Service Ethics Review Committee, Nana Abena Apatu (0503539896) responsible for approving the research study.

Appendix 2c: PARTICIPANTS INFORMATION SHEET- PARENT/GUARDIAN

Title of Study: EFFECTS OF PEER SUPPORT INTERVENTIONS ON ADHERENCE TO ANTI-RETROVIRAL THERAPY AMONG HIV-POSITIVE ADOLESCENTS AND YOUNG ADULTS IN TWO DISTRICTS IN THE ASHANTI REGION, GHANA

Principal Investigator:

Isaac Boadu, MPhil, MSc. PhDc.

Department of Population Family & Reproductive Health

School of Public Health, University of Ghana-Legon.

P.O.Box LG 13.

Email:isaacboadu62@gmail.com; mobile: 0243881993

PART 1: Information Sheet

Hello, my name is _____; I am a research assistant working for the department of Population, Family and Reproductive Health at the University of Ghana. We are inviting your child to volunteer for a study that we are doing. Mr. Isaac Boadu is the principal investigator responsible for the study. This study seeks to assess how effective peer support interventions will help improve adherence to anti-retroviral among adolescents and young adults living with HIV. It also seeks to assess how the peer support intervention will help reduce the HIV virus in your body, reduce how you see yourself in a negative way, reduce the persistent feeling of sadness and low mood and help you remain in hospital care. Before you decide that your child join the study, I will like you to understand why the research is being done, and what will be required of him/her should you decide to let him/her participate.

I am going to give you information on the study and you will also be given a copy of the study information sheet for you to read or for someone to read for you. Please take some time to read this information carefully and feel free to ask any question (s) about any part of the study you do not understand. If there are words you do not understand, please feel free to stop me as we go through the information and I will be glad to explain to you. You do not have to decide now on whether or not you will allow him/her participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research, including any of the ART clinic staff or other staff where your child receive care. Participation in this study is completely voluntary and you are free to let your child decline to participate. If you choose not to participate, this will not affect the way your child receive care at the health facility whatsoever. You are free to let him/her withdraw from the study at any point, even if you have already agreed to participate.

Purpose of research: The purpose of the study is to determine adherence rate and also assess how peer support intervention can be used to improve adherence among young persons aged 15-24 years living with HIV in the Ashanti region. We believe that involving peers to provide support to individuals of similar age and characteristics will be an optimum strategy to improve adherence to ART and treatment outcomes such as reduce the HIV virus in your body, improve

low mood, help HIV patients remain in hospital care and reduce how you see yourself in a negative way. We believe that involving peers to provide support to individuals of similar age and characteristics will be an optimum strategy to improve adherence to ART and treatment outcomes such as reduce the HIV virus in the body, low mood, helps patients remain in care and reduce how you see yourself in a negative way.

Nature of research: This is an intervention study among 235 HIV positive adolescents and young adults (15-24 years) at Obuasi government hospital and Nkawie-Toase government hospital. **There will be no random allocation of participants to the study groups.** Participants that will be recruited from Obuasi government hospital will serve as the study intervention group and those from Nkawie-Toase hospital will serve as the control. Allocation of participants to the study intervention is because of the proximity of Obuasi government hospital to the researcher.

The research will be in two parts. The first part will be quantitative and will involve training HIV peer supporters to deliver the study intervention. This will include the peer supporters facilitating monthly support group meetings, providing adherence counseling through monthly home visits and sending of daily SMS messages to participants. They will also be involved in calling participants to remind them of their clinic appointments. The qualitative part will explore the experiences of participants in a focus group discussion on their involvement in the intervention after the study

Participant's involvement: If you agree to let your child participate in the study, he/she will be interviewed at two different times, at enrolment and at the end of the study (six months after the intervention). If you agree to let him/her participate in the research, you will be required to sign a consent form. At enrolment, he/she will be asked about his/her background characteristics such as age, level of education, religion, who he/she currently lives with, past and current smoking and drinking history, and who support him/her to take his/her HIV medication. In addition we will ask him/her about how he/she is managing his/her HIV positive status, access to and use of Anti-retroviral therapy (ART). The interview will be conducted at a convenient time and place for him/her. Each interview is expected to last approximately 45 minutes.

Depending on which of the study group he/she is assigned to (intervention or control), he/she will be put into a group (maximum 11 people per group) to receive peer support interventions. The group will nominate a peer leader who will be responsible for coordinating monthly support group meetings. The support group meetings will discuss about the importance of adherence to HIV medication and the best way of managing with the disease. Meetings will be held at appropriate time and place agreed by all of members in the group.

The peer leader will be visiting homes of participants once a month to provide adherence counseling as well counseling on the best way of living with HIV. The peers will also send daily SMS messages (messages will be what they have all agreed on as a group). These activities (home visits, monthly support meetings and daily SMS reminders to take your medication) will continue for six months if you with the intervention group.

Potential Risks: We do not foresee any potential risk associated with your child's participation in this study. However, we do appreciate that he/she will be sharing with us some very personal

and confidential information, and he/she may feel uncomfortable talking about some of the topics. He/she is not obliged to answer all the questions, and he/she do not have to give us any reason for not responding to any question, or for refusing to take part in the interview. During the interviews, a face mask and sanitizers will be provided to you and the interviewer to minimize the risk of coronavirus infection.

Benefits: There are no direct benefits to you or your child from participating in this study. However, your child's participation in the study will help us to understand whether trained peer supporters can be used to improve on ART adherence and HIV treatment outcomes. This will be useful in making possible recommendations to people and institutions who are interested in improving the health outcomes among young persons (15-24 years) living with HIV.

Costs: There are no costs to you in terms of money for participating in the study. Your time will be appreciated by providing you with snack during the interviews.

Compensation: He/she will not receive any compensation for participating in this study except for transportation costs incurred in relation to participating in scheduled interviews. An average amount of GHS 40 will be given as reimbursement to cover for incidental expenses to attend the interview. In addition, snacks will be provided during interviews. Monthly SMS credits worth GHS 15 will be provided should he/she be in the study intervention group.

Confidentiality: We assure you that the information collected will be handled with the strictest confidentiality. Any information provided in the questionnaire will not be disclosed to anyone and will be used only for the purpose of this study. No names will be taken on the questionnaire, only numbers or codes will be assigned to each respondent. We request you not to share or disclose the information of other participants with anyone. The information you provide will be kept in our data base, coded and will not be used for any other purpose. The code will only be known by the researcher. The collected data will only be accessible to the research team. All collected and kept data will completely be destroyed after 5 years.

Voluntary participation/withdrawal: Your child's participation in this study is voluntary. He/she is free to refuse to participate, and you may withdraw your consent or discontinue participation at any time. The refusal to participate will not results in any penalty or loss of benefits. He or she is free to skip any questions he/she does not want to answer. All the research data will be under the care of the principal investigation. If you decide to withdraw from the study, all data collected from him/her will be not be used.

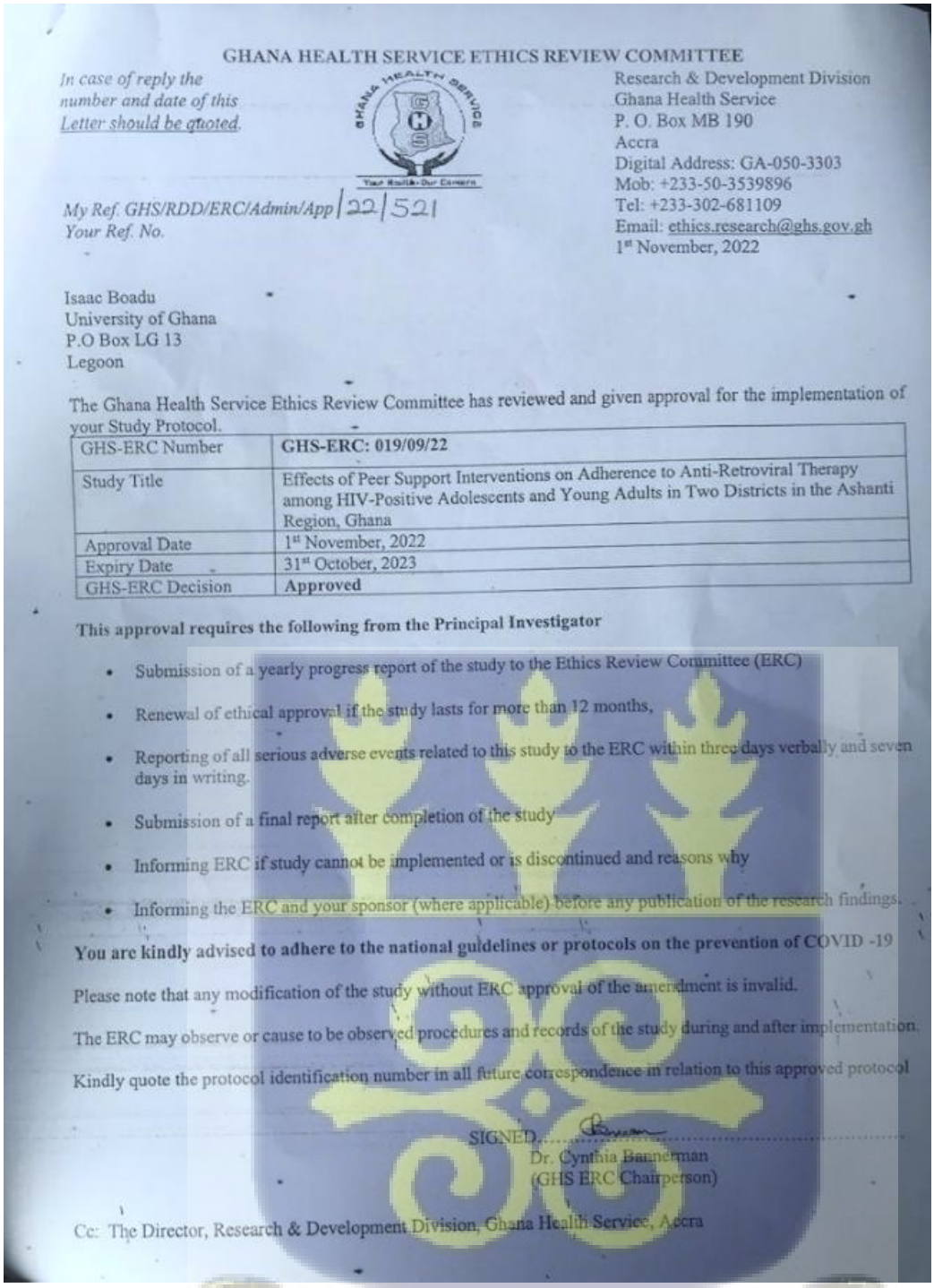
Outcome and Feedback: The principal investigator and supervisors will be responsible for the secure storage, transfer and safe use of the data. All the questionnaires will be entered electronically and kept under a cloud backup and storage device, accessible only to the research team. The hard copies will be kept in a secure locker accessible only to the PI. You will receive all the information needed after the completion of the study through online platforms.

Funding information: This study is funded by the World Health Organization Human Reproduction Program (WHO/HRP) Alliance through the University of Ghana School of Public Health, under the WHO/HRP Alliance in research capacity strengthening in Sexual and Reproductive Health.

Sharing of participants Information/Data: By consenting to participate in this study, you are also allowing us to use the data your ward will share with us to inform future initiatives in the field of HIV among adolescents and young adults**.** Outcome of the data will be shared through seminars, workshops and conferences. Data sharing will take into consideration anonymity.

Provision of Information and Consent for participants: A copy of the Information sheet and Consent form will be given to you after it has been signed or thumb-printed to keep.

Who to Contact for Further Clarification/Questions: For further clarification of the study, please contact the PI, Mr. Isaac Boadu (isaacboadu62@gmail.com); 0243881993 or Dr. Adom Manu (amanu@ug.edu.gh) or Professor Richmond Nii Okai Aryeetey (026112 8506) all of the Department of Population, Family and Reproductive Health). If you require any further clarification on this study and consent, you are free to contact the administrator of the Ghana Health Service Ethics Review Committee, Nana Abena Apatu (0503539896) responsible for approving the research study.



GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Digital Address: GA-050-3303
Mob: +233-50-3539896
Tel: +233-302-681109
Email: ethics.research@ghs.gov.gh

My Ref. GHS/RDD/ERC/Admin/App/22/521
Your Ref. No.

1st November, 2022

Isaac Boadu
University of Ghana
P.O Box LG 13
Legoon

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	**GHS-ERC: 019/09/22**
Study Title	Effects of Peer Support Interventions on Adherence to Anti-Retroviral Therapy among HIV-Positive Adolescents and Young Adults in Two Districts in the Ashanti Region, Ghana
Approval Date	1st November, 2022
Expiry Date	31st October, 2023
GHS-ERC Decision	**Approved**

This approval requires the following from the Principal Investigator

- Submission of a yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report after completion of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.

You are kindly advised to adhere to the national guidelines or protocols on the prevention of COVID -19

Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
Dr. Cynthia Banneman
(GHS ERC Chairperson)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra

In case of reply the number and the date of this letter should be quoted

My Ref. No: GHS/ASH/INTRO

Your Ref. No:

Email: rdhs.ar@ghsmail.org
Tel: 233-0320-22089/23651
Fax: 233-0320-26219

GHANA HEALTH SERVICE
Your Health · Our Concern

GHANA HEALTH SERVICE
REGIONAL HEALTH DIRECTORATE
P. O. BOX 1908
KUMASI

30TH November 2022.

THE MEDICAL SUPERITENDENT
GHANA HEALTH SERVICE
ASHANTI.

INTRODUCTORY LETTER

This is to introduce to you Isaac Boadu, a Ph.D. candidate from the School of Public Health, University of Ghana.

He has been given permission to conduct a study titled **"Effects of peer support interventions on adherence to anti-retroviral therapy among HIV positive adolescents and young adults in two districts in the Ashanti Region, Ghana"** in your facility.

Ethical approval (GHS-ERC:019/09/22) has been obtained from the Ghana Health Service Ethics Review Committee.

Kindly provide him with the support he needs to undertake this study.

Thank You

DR. EMMANUEL K. TINKORANG
REGIONAL DIRECTOR OF HEALTH SERVICES
ASHANTI REGION

Cc: Obuasi Government Hospital
Nkawie-Toase Government Hospital
Isaac Boadu (Principal Investigator)
Tel: 0243881993