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ETHNO-EPIDEMIOLOGICAL INFLUENCE ON *MORINGA OLEIFERA* NUTRITION SUPPLEMENTATION AMONG ADULT HIV PATIENTS ON DOLUTEGRAVIR-BASED TREATMENT IN ZAMBIA

Nosia Mhango Mwilai[1i],
Joe Likando[2],
Priscilla Nkonde Gardner[3],
Amit Kumar Singh[4],
Derick Hamakala[5],
Isaac Fwemba[6],
Aubrey C. Kalungia[7]
[1]University Teaching Hospital, Lusaka, Zambia
[2]Dr., Institute of Distance Education, University of Zambia, Zambia
[3]Zambia National Institute of Public Health, Zambia
[4]Dr., Texila American University, Lusaka, Zambia
[5]Texila American University, Lusaka, Zambia
[6]Dr., University of Zambia, Zambia
[7]Dr., University of Zambia School of Health Sciences, Zambia

Abstract:
Ethno-epidemiology, a field bridging culture and health, provides critical insights into how traditional beliefs and practices influence health behavior and the integration of biomedical and traditional health systems. This article examines the utilization of *Moringa oleifera* among adult HIV patients on Dolutegravir-based antiretroviral therapy (ART) in Zambia. Recognized for its nutritional and medicinal properties, *Moringa oleifera* has gained cultural acceptance as a complementary therapy. Using the Health Belief Model this study explores the role of cultural beliefs, community endorsement, and socio-

[i] Correspondence: email nosiamwila@gmail.com

structural factors in shaping health behaviors. The findings underscored the need for culturally sensitive healthcare strategies to safely integrate traditional remedies like *Moringa oleifera* into HIV management.

Keywords: ethno-epidemiology, antiretroviral therapy, Dolutegravir, HIV, *Moringa oleifera*, nutrition

1. Introduction

Epidemiology focuses on understanding health and disease within populations, but it often underestimates the profound impact of cultural practices on disease management. For instance, the influence of cultural practices on the outcome of antiretroviral therapy (ART). Ethno-epidemiology embraces intervention strategies that take cultural factors into account (Sy, 2017; Walker *et al*., 2024). Dahlgren and Whitehead, in 1991, developed a model composed of multiple layers of non-medical factors with a direct bearing on health outcomes. They included conditions in which people are born, grow, work, live, and age as well as cultural beliefs referred to as social determinants of health, beyond an individual's control (Dahlgren & Whitehead, 2021). Moreover, the World Health Organization (2023) described to a large extent how social determinants impact health more than commonly considered factors such as access and use of healthcare services (World Health Organization, 2023).

Ethno-epidemiology bridges the gap by analyzing how cultural norms, traditions, and beliefs influence health behavior and disease management. It also highlights how cultural frameworks categorize illness and how these frameworks interact with or diverge from, biomedical models. Furthermore, humans live within societies where beliefs, attitudes, and behaviors are shaped by interactions that are often governed by laws. Hence, health behaviors in the context of nutritional supplementation in ART in resource-constrained settings are deeply influenced by cultural norms and community dynamics (Sy, 2017).

Nutritional deficiencies during ART represent a profound public health crisis affecting 2 billion people globally and worsens with health disparities among vulnerable populations, especially in low-middle income countries (LMICs) of Sub-Saharan Africa (SSA). Social determinants of health contribute to the health status of populations, which have a direct bearing on health inequalities among populations (Perez-Escamilla, 2018). In Zambia, *Moringa oleifera* is a culturally endorsed remedy for its nutritional and perceived therapeutic benefits. Traditional medicine forms a crucial aspect of healthcare. Hence, ethno-epidemiology provides insights into the use of indigenous plants like *Moringa oleifera*.

Commonly known as the "miracle tree," *Moringa oleifera* has a long history in African traditional medicine. Its leaves, seeds, and pods are used for nutritional supplementation and treating ailments such as inflammation, infections, and chronic

diseases (Wardana *et al*., 2022). Among adult HIV patients, it is perceived as a natural immune supplement and a means of improving overall well-being, complementing ART like Dolutegravir-based ART. Ethno-epidemiology examines how cultural practices intersect with health and disease, providing a lens through which traditional health remedies like *Moringa oleifera* are understood and utilized (Walker *et al*., 2024).

The Health Belief Model further theorizes that health behavior is influenced by perceived susceptibility, severity, benefits, and barriers (Alamer, 2024). In the context of HIV management, patients may view *Moringa oleifera* as addressing gaps left by biomedical treatment, such as enhancing energy levels and preventing opportunistic infections. Communities play a pivotal role in health behaviors, particularly in LMICs where formal healthcare access is limited (Öztürk and Gezgin, 2024). However, the interplay between cultural acceptance, biomedical practices, and traditional beliefs about *Moringa oleifera* raises questions about its role in health outcomes. Hence, the exploration of the influence of ethno-epidemiology on the integration of *Moringa oleifera* in HIV management, emphasizing its influence on treatment adherence and health outcomes among adult HIV patients on Dolutegravir-based treatment in Zambia (de Almeida-Filho, 2020).

2. Statement of the Problem

The impact of HIV is keenly felt in Zambia, with a high prevalence of HIV (14.4%). Nutrition is part of the comprehensive care of ART. It is essential for optimizing the effectiveness of ART and the prevention of opportunistic infections (OIs). The current preferred first-line ART Dolutegrvir-based regimen composed of Tenofovir, Lamivudine and Dolutegravir (TLD) offers durable therapy owing to the high genetic barrier to resistance and high viral suppression rate (WHO, 2018). However, HIV alters the nutritional landscape by increasing energy expenditure and nutrient requirements. Hence, people living with HIV (PLHIV) in low-middle-income countries (LMICs) face nutritional deficiencies that may undermine the durability of TLD. This may contribute to viral replication and the risk of treatment failure if left unaddressed. Therefore, there is a pressing need for cost-effective and innovative nutritional interventions. Literature highlights Moringa as a natural plant rich in vitamins, minerals, proteins, and bioactive compounds with immune-modulatory properties (Gambo *et al*., 2021). This study evaluated the attributes of nutritional supplementation with Moringa to help fill the gaps in Ethno-epidemiology. Aligned with Sustainable Development Goals (SDG) target 3.3 promoting good health and wellbeing to end the AIDs epidemic by 2030 (UNAIDS, 2021)

2.1 Study Justification

HIV progression is influenced by both biological and social determinants of health. Therefore, a holistic understanding of HIV patients self-supplemented with Moringa during ART highlights the need for healthcare integration of locally tailored, accessible,

and culturally acceptable nutrition supplements (Edosa & Reshid, 2017). Therefore, ethno-epidemiology underscores the importance of cultural acceptance in health interventions. The use of *Moringa oleifera* reflects a synthesis of biomedical and traditional systems, with patients navigating both worlds to address their health needs. This duality presents opportunities for collaboration. Integrating culturally tailored messages about the benefits and risks of combining *Moringa oleifera* with ART can foster informed decision-making (Castleman *et al.*, 2017; Nkirote, 2021). This article explores how cultural perceptions, community endorsements, and biomedical frameworks influence the use of *Moringa oleifera* among HIV patients. It integrates insights from the Health Belief Model, which emphasizes individual perceptions of health risks and benefits). Furthermore, it shapes patient behavior and decision-making regarding Moringa nutrition supplementation with a broader epidemiological impact in reducing morbidity and mortality in HIV-positive populations (Gopalakrishnan *et al.*, 2016; Nyingchu *et al.*, 2023).

2.2 Main Research Objective

Exploring the influence of ethno-epidemiology on *Moringa oleifera* supplementation among adult HIV patients on Dolutegravir-based treatment in Zambia.

2.3 Specific Objective

To explore the cultural beliefs of adult HIV patients on TLD towards *Moringa oleifera* nutrition supplementation.

2.4 Ethical Considerations

Ethical clearance was obtained from Excellence Research Ethics and Science (ERES) Converge in Lusaka, Zambia. Additional permission to conduct the study was sought from the National Health Research Authority (NHRA) and University Teaching Hospital (Adult Hospital) management. Consent was obtained from participants, and they were allowed to withdraw at any time they felt uncomfortable. Confidentiality was achieved by putting a password restricting access to patient's information only to people who were involved in the study. In addition, the patient's personal identification information was replaced with serial numbers.

2.5 Theoretical Framework

The theoretical framework is based on the established model in the field of health behavior and health promotion. The Health Belief Model (Hochbaum, Rosenstock, 1950) states that people will not change their health behaviors unless they believe that there is a risk. Beliefs lead to attitudes, and attitudes, in turn, lead to intentions and so behavior. Incorporating this theory, the study will explore how various factors, including individual beliefs, perceptions, attitudes, behaviors within human action, contribute to *Moringa oleifera* utilization. The theory will provide useful information for predicting health behavior towards the implementation of the utilization of *Moringa oleifera*

nutritional supplementation in ART. Hence, it will highlight the determinants of health behaviors associated with the use of *Moringa oleifera* in ART. Aligning with UNAIDS targets for Strategic Development Goal 3.3 (SDGs) promoting 'Good Health and Wellbeing' with the aim to end AIDS epidemics by 2030 (UNAIDS, 2021).

3. Literature Review

Heidkamp *et al.* (2022; UNAIDS, 2022) that reports that HIV disease remains a critical concern in global public health. HIV is known to increase energy expenditure and nutrient requirements due to viral replication. Micronutrient deficiencies can compromise the effectiveness of ART, making PLHIV more susceptible to infections and opportunistic diseases. Therefore, good nutrition is crucial for maximizing the benefits of ART in terms of improving CD4 and reducing the viral load. A Dolutegravir-based regimen has demonstrated substantial promise with a high genetic barrier to resistance and reduction in viral load.

This prompts exploration of the utilization of nutritional supplementary intervention in ART with medicinal plants such as *Moringa oleifera* to optimize the treatment outcome of a Dolutegravir-based regimen (Wardana *et al.*, 2022). Therefore, this chapter will review the current state of knowledge and the gaps regarding the utilization and influence of *Moringa oleifera* on ART (Cai *et al.*, 2019). Articles will be reviewed in terms of the methodology, study design, findings, conclusion and recommendation. HIV affects nutritional status early in the course of the infection, even before other symptoms appear (Takarinda *et al.*, 2017; UNAIDS, 2022). Early and intensive dietary interventions should be a fundamental part of the management of HIV-infected individuals at the level of ART. Good nutrition prevents HIV disease progression by enhancing the body's ability to fight opportunistic infections. Several gaps exist in the current approaches, posing challenges to achieving optimal nutritional status and overall well-being for individuals living with HIV on ART (Gambo *et al.* 2022; Shifera *et al.*, 2022).

Similarly, Fathima *et al.* (2022) conducted a narrative review in Switzerland and looked at the nutritional aspects of People Living with HIV amidst COVID-19. Evidence was gathered by conducting a thorough search of the literature using the keywords: people living with HIV, nutritional habits, COVID-19, antiretroviral therapy and malnutrition. Literature and linguistic filters were used as criteria for selection. The narration included a large quantity of recent data, but old literature was also included based on relevance. HIV was found to have a deleterious impact on nutritional health by enhancing energy demands, lowering intake of food, and reducing nutrient absorption and metabolism. Cultural attitudes and food preferences were significant indicators of eating behaviors. Individuals maintaining nutritional status and treating or preventing malnutrition reduced unfavorable outcomes in PLHIV and benefited from a healthy diet. In conclusion, the study recommended nutritional intervention, such as the use of dietary supplements that could help prevent nutrient deficiencies, optimizing ART and

nutritional status of PLHIV. This prompts the exploration of *Moringa oleifera* as nutritional supplementation in ART (Fathima *et al.*, 2022).

Sub-Saharan Africa is home to some of the most nutritionally unsecured countries. Poor infrastructure and limited resources compounded with conflict, HIV, and poor access to health services are the factors that contribute to malnutrition and food insecurities. Fanzo *et al.* (2012), in a study on nutrition challenges in Sub-Saharan Africa (SSA), concluded that there was still room for research in developing the technical and scientific evidence underpinning nutritional interventions tailored towards what works on the ground. Similarly, Keats *et al.* (2019) conducted a systematic review with the aim to determine the real-world impact of key fortified micronutrients (vitamin A, iodine, iron, folic acid) on improving nutrition status in SSA. All applicable published and unpublished evidence was systematically retrieved and analyzed. Studies were not restricted by age or sex. Meta-analyses were performed for quantitative outcomes, and an age-specific effect of fortification was noted, with women (aged >18 years) attaining greater benefit. However, context and implementation factors were important when assessing programmatic sustainability and impact; however, data was quite limited in LMIC studies. Hence, the study recommended a coordination of various efforts to reduce micronutrient malnutrition. There is a need to address critical gaps in the evidence through further research, strengthening of existing programs, and implementation of additional programs across the globe. For instance, nutritional intervention with *Moringa oleifera* may effectively contribute to resolving nutritional deficits in a cost-effective manner (Keats *et al.*, 2019).

Similarly, a descriptive, prospective trial was performed at ARV roll-out centres in the Northern Cape Province of South Africa. Letegan *et al.* (2010) aimed to describe the nutritional status and determine the impact of current nutrition intervention strategies on weight changes in adult HIV-infected patients on ART. Participants' body mass index (BMI) was determined before and after a four-month intervention period of nutritional supplementation with an instant, enriched maize product. The study suggested that nutritional supplementation, in combination with ARVs, nutritionally benefited approximately half of the patients in the ARV program in the Northern Cape. Immunocompromised patients clearly needed both ARV therapy and nutritional support. The study recommended that more aggressive supplementation be investigated to increase the success rate in terms of weight gain. Hence, this study will investigate the influence of *Moringa oleifera* nutritional supplementation in ART to contribute to filling the gap (Letegan *et al.*, 2010).

Ewune *et al.* (2021) conducted a study that aimed to explore nutrition management challenges among people living with HIV on ART in primary health centers in Addis Ababa, Ethiopia. Hermeneutic (interpretive) phenomenological study design was engaged. The study used in-depth interviews to describe lived experiences among adult patients aged 18 and above. Participants were selected purposively until the saturation of the idea was reached. The data was analyzed through inductive thematic analysis.

Nutrition management challenges for HIV patients were described using six significant themes. The major themes were acceptance of the disease and the health status, facilitators and barriers to treatment adherence, behavioral changes in eating patterns, experience of food insecurity issues, nutrition knowledge, and support. The themes explained how patients using ART were challenged to manage nutrition ever since their diagnosis. Of all the challenges, food insecurity was found to be the core reason for poor nutrition management. Therefore this study investigates *Moringa oleifera* nutritional supplementation in ART. Cost-effective, rich in vitamins and minerals with the potential to improve the treatment outcome of ART, contributing to filling gaps (Ewune *et al.*, 2021).

Nutrition interventions increase compliance with treatment regimens and optimize the benefits of antiretroviral drugs. Mengie *et al.* (2018) also conducted a study in Ethiopia with the aim of assessing the nutritional knowledge, dietary practice and associated factors among adult PLWHA on anti-retroviral therapy (ART) in Felege Hiwot Referral Hospital in Ethiopia. It was a cross-sectional study involving a systematic random sampling technique and a semi-structured and pretested questionnaire. The study revealed that 30.4% of respondents had poor, average and good dietary practice scores, respectively. The study recommended nutrition education and counseling to be given by healthcare workers to patients on ART to improve their nutritional knowledge. The media should also strengthen its role in disseminating nutrition information. *Moringa oleifera* is rich in minerals and vitamins, potentially filling the gaps in addressing food security (Megie *et al.*, 2018).

Ghana may face challenges in achieving the SDG targets 3.3 and 3.4 targets, stopping the AIDS epidemic and preventing premature deaths from malnutrition by 2030. Nanewortor *et al.* (2021) conducted a descriptive cross-sectional study and examined the nutritional status and associated factors among HIV-positive clients accessing Highly Active Anti-Retroviral Therapy (HAART) at a public hospital in Ghana. Data were analyzed using SPSS 22.0, and descriptive and analytical statistics comprising frequency, percentage, and binary logistic regression were adopted. About 74% -79% of the clients had good nutrition knowledge and attitude, respectively, and 42% were malnourished. There was a high prevalence of malnutrition among the clients working against progress towards achieving SDGs target.

Although nutrition-related knowledge and attitudes among PLWHA were good, they did not correspond to the high prevalence of malnutrition. This finding implied that most PLWHA are at risk of deteriorating immunity as a result of poor nutrition. Potentially, increasing the risk of exposure to opportunistic infections reduces survival rates and quality of life. In order for Ghana to achieve the targets of the SDGs, there was a need for innovative approaches to nutritional education and counselling for PLWHA. Additionally, social support focuses on assisting PLWHIV in ensuring food security for individuals with low socio-economic status. Hence, the findings justify the need for the

implementation of innovative interventions such as *Moringa oleifera* to improve the nutritional status of people living with the disease (Naneworter *et al*., 2021).

Saka *et al.* (2023) also conducted a comparative cohort study in Ghana, assessing dietary habits and determining nutritional status. The study showed that macro and micronutrient intakes, especially among PLWH, were not adequately met by all groups. The type of HAART used by respondents had no significant effect on serum concentrations of Se, Zn and Cu. Patients on AZT+3TC+NVP had lower Zn concentrations compared to the respondents on other medications. Dietary intake of Se, Zn and Cu were highest among the controls and least among the HAART treatment naïve group. Although serum concentrations were significantly lower, the respondents required general dietary counselling to assist in improving their nutritional status, especially for PLWH, since they were more vulnerable and at risk of high morbidity and mortality. More controlled intervention studies were needed to investigate the effect of HAART on serum concentration of Se, Cu and Zn for PLWHA. This prompts the exploration of *Moringa oleifera* as nutritional supplementation in the current study to fill in the gaps in ART (Saka *et al*., 2023).

Moramarco *et al.* (2016) conducted a retrospective study on Zambian malnourished children. Nutritional status was evaluated according to WHO methodology, and the program outcomes met international standards. The finding suggested that early detection of HIV with adequate antiretroviral treatment and extending the duration of feeding supplementation improved weight gain and prevention of deterioration in severe acute malnutrition. Nutritional supplementation is crucial for ensuring full recovery and lowering mortality rates in malnourished Zambian children. Hence, *Moringa oleifera* may contribute to sealing the gaps (Moramarco, *et al*., 2016).

A phase III trial was conducted in Zambia and Tanzania by Filteau *et al*. (2015) on the effects of nutrition on malnourished adult HIV patients on ART. High-dose vitamin and mineral supplementation in lipid-based nutritional supplements (LNS), compared to LNS alone, did not decrease mortality in malnourished African adults initiating ART but improved CD4 count. The intervention did not decrease mortality, although it did benefit a secondary outcome, CD4 count. Nevertheless, the benefit of CD4 count in the large trial, added to previous information from smaller trials of micronutrient supplements for HIV patients, suggests that micronutrient supplementation should be pursued. The study recommended that the addition of micronutrient supplements to ART could provide clinical benefits in ART patients. Further research is needed to address how to improve compliance with similar nutritional interventions.

Literature on nutritional deficiencies in ART reveals several gaps requiring intervention. Resource limitations in healthcare settings, especially in low-income regions, hinder the implementation of comprehensive nutritional support programs. Adequate supplementation and dietary support may be challenging to provide consistently. *Moringa oleifera* supplementation is rich in micro and macronutrients and

cost-effective; hence, it may help bridge the gaps. Therefore, it may enhance the nutritional well-being of adult HIV patients on ART and improve their overall health outcomes in terms of nutrition status and clinical outcome, signifying the need for the current study (Fuseini *et al*., 2021).

Ewetola *et al.* (2019) also noted that *Moringa oleifera* leaves contain magnesium, Vitamin C, and Calcium. Other nutritional properties include potassium and iron, as well as numerous phytochemicals, including carotenoids and phenolic acid. Oyepata & Tosin, (2021) further underscored that the plant is a good source of proteins and amino acids. Similarly, a study involving elemental and chemical analysis of powdered, solid, and liquid samples of *Moringa oleifera* dried leaves produced a total of 35 elements (14 macroelements and 21 microelements). The macroelements in the powdered leaf samples included S, Ca, K, Mg, Na, P, Si, Cl, Al, Fe, and Mn. The minor elements produced by the analyses in decreasing order were V, Ba, Cr, Y, Ba, Zn, Rb, Ce, La, Cu, Cs, Sn, Co, Ni, and Zr. The concentrations of all the elements were within the recommended daily allowance (RDA) limits (Chapter *et al*., 2017).

Nigeria conducted a number of studies on *Moringa oleifera*, and Aproku et al. (2022) investigated the beneficial role of *Moringa oleifera* supplementation in HIV-positive patients receiving antiretroviral drugs. Adult HIV-positive individuals attending the medical outpatient clinic in a tertiary health institution in Nigeria receiving highly active anti-retroviral therapies (HAARTs) were recruited in a randomized fashion for the study. Half of the subjects received a Moringa supplement, while the others received only HAART and represented the control group. All participants were monitored for 3 months, during which their immunological status. Baseline levels of CD4 increased in the Moringa-supplemented groups ($p<0.01$). In addition, baseline haematological abnormalities such as anaemia, thrombocytopenia, leucopenia, lymphopenia, and neutropenia improved most significantly in the Moringa-supplemented participants. The conclusion was that *Moringa oleifera* had beneficial properties and improved CD4 count and haematological abnormalities in HIV-positive individuals receiving antiretroviral therapy. However, the study did not look at the influence of *Moring oleifera* on viral load, leaving a gap (Aprioku *et al*., 2022).

Dietary diversity and impact of *Moringa oleifera Lam*. leaves supplementation was investigated in another study in Nigeria. It was a double-blind, randomized trial on the impact of nutritional status on patients receiving antiretroviral therapy. The study revealed poor dietary diversity amongst PLHIV. Supplementation of regular diet with *Moringa oleifera Lam*. leaves did not have an influence on nutritional status but could improve the immune response of HIV-positive adults (Gambo *et al*., 2022). Another study in Nigeria looked at other aspects, the impact of *Moringa oleifera* on the quality of life of people living with HIV in a double-blind randomized controlled trial. The findings revealed that supplementation with *Moringa oleifera* leaves during ART improved the quality of life domains of physical and psychological, level of independence, and social

relationships. Both studies did not establish the influence of *Moringa oleifera* supplementation on viral load and BMI, leaving gaps (Gambo, *et al.*, 2021).

Similarly, another study on CD4 patterns in people living with HIV on HAART exposed to *Moringa oleifera* leaf powder was conducted. The study concluded that *Moringa oleifera* had the potential to improve the CD4 count of HIV patients on HAART, translating to better treatment outcomes. However, the study did not look at the influence of *Moringa oleifera* on viral load (Njonge *et al.*, 2019).

Amlogu *et al.* (2016) assessed the short- and long-term effects of a nutrition-sensitive intervention to delay the progression of human immune-deficiency virus (HIV) to AIDS among people living with HIV in Abuja, Nigeria. Evidence indicated that the prevalence of macro and micronutrient deficiencies (particularly magnesium, selenium, zinc, and vitamin C) had a negative impact on optimal immune function through the progressive depletion of CD4 T-lymphocyte cells, thereby increasing susceptibility to morbidity and mortality among PLWH. The results suggested that a prolonged consumption of nutrition intervention is suitable for sustaining the improvements in CD4 count and the anthropometric and biochemical indices of PLWHIV. The study findings signified the need for *Moringa oleifera* in ART to improve CD4 and BMI but did not look at viral load, hence the gap (Amlogu *et al.*, 2016).

Nworu *et al*. (2013) conducted a study on *Moringa oleifera Lam* in Nigeria. Leaf extracts revealed selective inhibition of HIV-1 infectivity and hence could serve as a source of antiretroviral lead molecule. The outcome of the investigation could partly explain the antiviral benefits claimed in the use of extracts of M. oleifera in the management/treatment of People Living with HIV/AIDS in African Traditional Medicine. (Nworu *et al.*, 2013). Nkirote *et al.* (2021) also carried out a study on determinants of use and antiviral activity of *Moringa oleifera* extracts among people living with HIV and AIDS attending comprehensive care clinics at referral hospitals in Kenya. The study demonstrated that specific phytochemicals are responsible for antiviral activity against HSV-1 in aqueous and methanol extracts and further investigation for anti-HSV-1 activity in vivo (Nkirote, 2021).

Similarly, a study done in Carolina, USA, on *Moringa oleifera* demonstrated an increase in CD4 T-cell numbers in patients on ART. The study established that Moringa *oleifera* had the potential to remediate the immune suppressive effects of malnutrition but did not establish the effects on viral load (Pilotos, *et al.*, 2020). A study conducted in Indonesia revealed the molecular mechanism of compounds from *Moringa oleifera* with antiviral effects for HIV-1 through a bioinformatics approach. Kaempferitrin and β-sitosterol from *Moringa oleifera* were predicted to be HIV-1 antiviral agents. Both compounds could produce more negative binding affinity and weak bond interactions, indicating the stability of the binding interaction that triggers the inhibitory activity (Murtadlo *et al.*, 2022).

Minutolo *et al.* (2021) in Italy also carried out a study on plant microRNA from *Moringa oleifera* associated with immune response and HIV infection. The study revealed

that plant microRNAs from *Moringa oleifera* may restore the immune system and reduce the replication of HIV infection. The study also recommended that *Moringa oleifera* to be used as a standard in HIV treatment to contribute to the long-term control of the disease). The two studies by Murtadlo, Minutolo *et al.* signified the potential antiviral effects of *Moringa oleifera* on viral load that needs further exploration to fill in the gap (Minutolo *et al.*, 2021).

On the other hand, Biswas *et al.* (2020) in India conducted an article review and revealed that several studies reported regarding the medicinal activity of the *Moringa oleifera* plant, a pronounced bio-prospective aspirant. In African traditional medicine, the plant was popularly used against AIDS and related secondary infections associated with HIV. Study findings showed significant activities against viruses, including HIV. In some cases, authors documented active molecules with modes of action. However, a number of studies have not reported on lead compounds or the relevant mechanisms regarding the viral inhibitory activities of crude plant extract. The recommendations were that immense studies should be going on to resolve those unanswered motifs along with well-planned studies of clinical application of already discovered potent phytochemicals (Biswas *et al.*, 2020).

While specific research on the influence of *Moringa oleifera* on CD4 count and viral load in the context of Dolutegravir-based regimen in Lusaka may be limited, the above studies provide insights into the potential effects of *Moringa oleifera* on CD4 count and viral load in people living with HIV. The studies do not directly address the specific context of Dolutegravir-based regimens in Lusaka but provide valuable information that acts as a basis for exploring the impact of *Moringa oleifera* supplementation on CD4 counts and viral load in the target population. Moreover, there are still gaps in the limited scientifically robust studies specifically focusing on the influence of *Moringa oleifera* on viral load, the standard monitoring parameter of HIV disease progression (Sztam *et al.*, 2013; Gambo, 2021).

Despite the potential benefits of *Moringa oleifera* supplementation, adaptability to different climates and considerable economic importance, its utilization among adult patients on Dolutegravir-based regimen in Lusaka remains a subject of limited exploration. Existing studies show gaps in our understanding of why patients choose to use or not use *Moringa oleifera* in ART. This could be attributed to the fact that the barriers to utilization differ in different regions, which warrants comprehensive investigation. Understanding the factors is crucial to optimize the potential benefits, address barriers and improve healthcare practices involving *Moringa oleifera* (Crop *et al.*, 2018; Gandji *et al.*, 2018; Stevens *et al.*, 2015, 2015; Velasco & Canada, 2022).

Similarly, a study examined households‘ perceptions, awareness, and willingness to pay for *Moringa oleifera* powder for nutrition supplementation. The findings revealed that the level of education, age, marital status, price of moringa, level of awareness, occupation and gender were statistically significant factors affecting households' willingness to pay for *Moringa oleifera*. The study revealed a positive correlation between

the level of awareness and households' willingness to pay for *Moringa oleifera* supplements. The study recommended that efforts were to be made to ensure that Moringa was made available and accessible. Governments, NGO's and corporate bodies to create awareness for the general public (Famuyide & Adio, 2014).

Oke *et al.* (2020) also conducted a study in Nigeria that revealed that age, membership in the Moringa farmers' association, non-farm income, and access to extension and involvement in agroforestry practices were significant factors influencing the adoption of *Moringa oleifera*. The study emphasized awareness of the benefits of Moringa in order to increase demand for its product in order to have access (Oke, *et al.*, 2020). In the Philippines, a study conducted on determinants of willingness to cultivate *Moringa oleifera*, also revealed that lack of awareness was the main contributing factors (Valasco *et al.*, 2022; Gandji & Assogbadjo, 2018).

Michela *et al.*, 2018) reviewed that, in Zambia, the acceptability and the safety of dietary supplementation with MO powder in malnourished children for 30 days. A daily dose of 14 g daily was safe and well-accepted. Therefore, its regular use in local populations' menus and ART may be a viable proposition. Therefore, conditioned situations of factors contributing to the underutilization of *Moringa oleifera* in Zambia must be analysed using a Bayesian Network Model (Puga *et al.*, 2015; Repaka *et al.*, 2019). A probability statistical tool that would address the problem objectively and more effectively. Moreover, it brings out new knowledge from conditioned situations to help optimize and maintain TLD as the current preferred first line in ART (Ganapathy *et al.*, 2023; Stap *et al.*, 2022).

4. Methodology

4.1 Study Design

A case study design was used to generate data through semi-structured interviews. The data described the cultural beliefs and utilization of *Moringa oleifera* among adult HIV patients on a Dolutegravir-based regimen. Participants were selected using purposive sampling (homogenous and snowball), and the sample size of 15 participants was arrived at after reaching saturation.

4.2 Data Generation

Data was generated using a semi-structured interview guide on the influence of cultural beliefs on the utilization of *Moringa oleifera* among HIV patients on TLD.

4.3 Qualitative Data Analysis

Reflexive thematic analysis was used to analyze qualitative data obtained through semi-structured interviews.

4.4 Study Site

This study was conducted at University Teaching Hospitals in Lusaka, Zambia, the largest tertiary referral public hospital in Zambia, providing a high chance of obtaining the required sample size.

4.5 Target Population

Adult male and female HIV patients initiated on TLD regimen self-supplemented with *Moringa oleifera* in the community and those not on any supplements meeting the criteria.

5. Findings

Concerning cultural belief, the following codes, themes and sub-themes were generated:

5.1 Cultural Influence on Moringa Utilization in ART

In the research conducted, it was discovered that families of individuals undergoing antiretroviral therapy (ART) incorporated Moringa into their health practices for a wide range of health issues beyond those related to HIV. The first participant emphasized the alignment of Moringa use with cultural beliefs, noting that a majority of individuals using moringa hail from families that place their trust in traditional herbal remedies. They recounted their first encounter with Moringa, recounting how their sister boiled the leaves and administered it, asserting that it would expedite recovery and provide a substantial energy boost. Moreover, families of ART patients believed in the broad healing properties of Moringa, extending beyond HIV-related conditions.

Participant 1 said,

> *"I learnt about moringa for the first time from my sister. She boiled the leaves and gave me to take, saying I was going to recover quickly, and it gave me much energy."*

Participant 2 emphasized,

> *"Moringa use is aligned with my cultural beliefs; my family trusts in traditional herbal remedies, and my family used herbs more than conventional medicines."*

Families of ART patients believed in the broad healing properties of moringa, extending beyond HIV-related conditions. Participant 3 shared their experience of learning about moringa while visiting Chirundu,

> "*…when I visited Chiriundu I found that the community often prepared Moringa as a relish with groundnuts.*"

They also experimented with Moringa tea, although discontinued due to its adverse effect of causing diarrhoea. Participant number 2 acquired knowledge about moringa from their aunt in the village, who used it for preventative health measures, and they have since incorporated it into their health regimen.

The findings suggest that cultural belief contributed to self-supplementation with Moringa. The cultural value of patients on ART self-supplemented with moringa was rooted in herbal use (non-conversion medicines). Herbal medicines were considered to be safer compared to conventional medicines. This was attributed to various factors, e.g., Moringa provided extra strength and was cheap and easy to access. Patients' experiences with ART highlight the significance of healthcare providers in providing medical advice, considering that there is a lack of knowledge among the patients self-supplemented with Moringa. In the research conducted, it was discovered that families of individuals undergoing ART incorporated Moringa in their health practices for a wide range of health issues beyond those related to HIV. Cultural factors had an influence on behavior in terms of perception and attitude towards the use of Moringa.

4.1 Community Influence

Moringa oleifera was appreciated as a multipurpose herb by patients on ART; Moringa provided energy and boosted appetite.

Participant 1 acquired knowledge about moringa from their aunt in the village, who used it for preventative health measures:

> *"I first learnt about Moringa from my auntie in the village, and it is abundant in my neighbourhood. I easily access the plant from the community where I stay, and I do not spend any money at all."*

Participant 2 affirmed,

> "*From the time I started taking Moringa, I have not easily gotten sick; hence, I am motivated to use it regularly. Moringa prevents minor illnesses associated with low immunity."*

Participant 3 said,

> *"Moringa provides energy for carrying out daily activities. That is why I am motivated to take it on a regular basis". Individuals taking moringa while on ART experience limited side effects. The benefits of Moringa outweigh the risks, hence the growing interest in the community."*

Moringa is really appreciated by members of the community.

4.2 *Moringa Oleifera* Affordable and Easily Accessed by Patients on ART

The findings indicate that the Moringa plant is grown in homes, easily accessed without spending money, and can survive with little watering. The four participants gave their experiences, and it was easy to grasp the meaning of their experiences as they answered that *Moringa oleifera* was affordable and easily accessible. One participant stated that the powder and capsules on sale in the community are easily accessed.

Participant 1 mentioned,

> *"Moringa is easy to access. I have five plants at my home; I dry the leaves in the shed and come up with powder, which I mix when taking other foods. I also boil fresh leaves directly from the plant to make tea."*

The other findings indicate that the growth of Moringa was simple and that it did not cause much stress or difficulties for the farmers.

Participant 2 said,

> *"Moringa can easily grow with little water; hence, it is easy to sustain and very affordable. I have Moringa plants at my home."*

The understanding is that certain medicine related to HIV involves costs to travel to and from the hospital and clinics but the use of Moringa is faster if it is able to be accessed on the street or in markets. The finding shows that Moringa beneficiaries are very comfortable with its effects.

Participant 3 affirmed,

> *"I access Moringa powder in the community it is sold on the street and very affordable. I view Moringa as a substance that sustains my life because it is nutritious. As a result, I take it for the well-being of my life."*

Additionally, the fourth participant brought up the aspect of price, stating that accessing the medicine was very cheap and it was affordable to handle and administer the medicine. Underprivileged families or those coming from the lower class easily accessed Moringa compared to other drugs.

Participant 4 argued that,

> *"Moringa is everywhere in the neighbourhood I easily access the plant from the community where I stay; I do not spend any money, I also use it as relish very cheap. I grow it at home, and I learnt that it improves health hence, I continue to use it."*

Participant 5 declared,

"Moringa provides energy for carrying out daily activities, motivating patients on ART to take it regularly. It prevents illnesses associated with low immunity, and there are no concerns or reservations about its use while on ART, considering that the majority experience no side effects while on ART. The benefits of moringa outweigh the risks, hence the growing interest by the community."

The study noticed that through the use of Moringa, some participants were able to acknowledge its importance in health, such as providing energy and boosting appetite to be able to have meals.

4.4 The Benefits of Moringa to Patients on ART

The findings show clearly that *Moringa oleifera* is a natural nutrition supplement that improves health in ART patients. Participants benefited, and there were no signs of quitting the use of the product. Moringa is very effective in preventing different illnesses.

Participant 1 complemented that,

"Moringa is naturally given by God, I take it because it frees me from minor illnesses because it can cure 99 diseases and gives strength to the body to fight diseases."

There are many reasons why patients are motivated to take Moringa. One of the prominent issues that arose from the interview was that taking Moringa gave patients energy, especially when they felt weak.

Participant 2 mentioned,

"When I take Moringa, it provides me with energy to carry out my daily activities, and it is a natural energizer. I take it all the time."

Some books and literature that have been read about moringa and the experiences proved correctly in the field. There were similarities when it came to what moringa does to the body.

Participant 3 argued,

"I take it to naturally cleanse toxins from the blood to keep my body in good shape, and when I take it at night, I sleep peacefully like a baby."

When it came to the dosage of the use of Moringa, the findings show that patients on ART who use the product face several challenges. There is no cultural dosage in using Moringa even if they take moringa excessively. Some face diarrhoea, headache and body pains. However, others said it was fine and that they did not face problems using Moringa.

Participant 4, when asked about the use of Moringa, stated that,

> *When I take more than twice in a day or more than two tablespoons of Moringa, I feel bad, I vomit,* and *develop diarrhoea and headache."*

5. Discussion

The significant findings of this study were that patients on ART were alternatively using Moringa without proper health guidelines as it is taken to be an everyday nutritional supplement for their health.

Cultural beliefs and community endorsement significantly shaped the perception of nutritional supplementation with Moringa. Similar to the findings of Gandji *et al.* (2019), who revealed that ART patients often saw herbs as part of their cultural heritage, contributing to their preference over conventional medicines. The cultural acceptability of Moringa, combined with perceived energy-boosting properties, increased its popularity among ART patients in line with the Health Belief Model. Further discussed by Minutolo *et al.* (2017), communities play a pivotal role in shaping health behaviors, particularly LMICs where access to formal healthcare is limited.

Plants like *Moringa oleifera* are central to their practices due to their accessibility, affordability, and perceived efficacy. (Crop *et al.*, 2018; Kekana *et al.*, 2021). In ethno-epidemiological terms, *Moringa oleifera* represents a culturally congruent intervention, aligning with local health theories that emphasize restoring balance and enhancing vitality. Many HIV patients view *Moringa oleifera* as a "natural medicine" that complements ART. Evidence from interviews indicates that patients attribute improvements in energy levels, reduced symptoms of fatigue, and fewer opportunistic infections to *Moringa oleifera*. HIV patients on Dolutegravir-based ART often integrate *Moringa oleifera* into their daily routines, perceiving it as both therapeutic and preventive. The cultural acceptability of *Moringa oleifera*, coupled with its perceived health benefits, reinforces its popularity as a complementary therapy (Gandji & Assogbadjo, 2018).

The study further found that it was so easy and accessible for patients to use moringa and the major factor was that there is a cultural belief that moringa heals all diseases in communities. Findings show that moringa has become part of food such as tea and vegetables. Despite the high level of awareness of the importance of nutritional intake, most of the study participants on ART consume moringa healthy foods without proper dosage. (Aprioku *et al.*, 2022) add that even though there is evidence to support *Moringa oleifera's* health benefits and nutritional value, little is known about the effects

when taken in conjunction with conventional medical therapies such as antiretroviral drugs. When herbs are taken concomitantly with antiretroviral drugs, there is a potential for clinically significant interactions (Praygod *et al*., 2018).

Furthermore, there was a need to support patients, families, and communities in appreciating the importance of moringa. As it stands, the findings show that much has not been done to promote the multipurpose nutrition product. However, (Gharsallah *et al*., 2021; Velasco & Canada, 2022) studies on *Moringa oleifera* in South Africa reviewed its production, growing conditions and consumption as a food source, his findings showed that "*even though moringa is fast becoming a cultivated crop in South Africa, perceptions about, and uses of, this plant are relatively undocumented and lack of policy formulation which guides the beneficiaries in Zambia."* This could be due to a lack of awareness and media sensitization about the medicinal values of Moringa. The slow increase of Moringa tree farmers from the yards and meals could also be a plausible cause for a lack of interest and awareness about its medicinal values. This is supported by the study by Velasco & Canada (2022), who stated that, despite the abundant benefits of this plant, it seems that "*there is a lack of awareness and/or an unwillingness to exploit it*".

6. Conclusion

Moringa is beneficial as adjunctive therapy during ART. Health behaviors toward Moring utilization were influenced by beliefs, attitudes, and interactions governed by cultural norms. Moringa nutritional supplementation in ART was driven by cultural values rather than medical guidance. Moringa is cost-effective and has easy access that is suitable for LMICs. However, patients lacked an understanding of its benefits in ART. Some patients distrusted biomedical treatments, relying on *Moringa oleifera* as their primary intervention, which could jeopardize ART adherence. The unregulated use of traditional remedies poses risks, as dosages and preparations vary widely. Collaboration between traditional and biomedical systems can ensure that cultural relevance and scientific rigor coexist in healthcare strategies.

7. Recommendations

1) Healthcare providers should receive training in cultural competence, enabling them to respect patients' beliefs while guiding them toward safe and effective treatment choices.
2) Community Engagement can build trust and improve health outcomes.
3) The Ministry of Health in Zambia **e**stablishing policy frameworks for the use of traditional remedies in conjunction with ART can ensure patient safety.
4) There should be active promotion and increased planting of *Moringa oleifera* trees. Working with the Ministry of Agriculture to encourage large-scale planting of

Moringa oleifera trees would ensure a steady supply of seeds that will help our patients on ARTs.

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Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relations that could be construed as a potential conflict or competing interests.

About the Author(s)

Nosia Mhango Mwila is a Pharmacist and Clinical Pharmacologist at the University Teaching Hospital in Lusaka, Zambia.
Dr. Joe Likando, Institute of Distance Education University of Zambia.
Priscilla Nkonde Gardner, Zambia National Institute of Public Health, Zambia.
Dr. Amit Kumar Singh is a Dean at Texila American University in Lusaka, Zambia.
Derick Hamakala, Academic Manager, Texila American University in Lusaka, Zambia.
Dr. Isaac Fwemba is a Biostatistician and research specialist at the University of Zambia, Zambia.
Dr. Aubrey C. Kalungia is a Pharmacist and an Assistant Dean at the University of Zambia School of Health Sciences, Zambia.

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