



THE IMPACT OF HERBAL MEDICINES USE IN PATIENTS UNDER HIGHLY ACTIVE ANTIRETROVIRAL THERAPY IN RWANDA

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ABSTRACT

Background: Herbal medicine is widely used in many developing countries and its use is increasingly popular in western world. However, information regarding the extent of herbal medicine use among people living with HIV under highly active antiretroviral therapy (HAART) is limited in most settings in Sub-Saharan Africa. This study aimed to assess possible effects caused by concomitant use of antiretroviral drugs with herbal medicines and determine the frequently used plants among patients on antiretroviral therapy at Rango Health Center in Huye, the southern part of Rwanda.

Methods: A sample of 196 participants enrolled in HAART at Rango Health Center were selected using a simple random sampling. Using questionnaires, information that assessed exposures to herbal medicines before initiating antiretroviral therapy and while taking antiretrovirals were collected from consented participants. Data collected were analysed using SPSS v.16.

Results: The study showed that 68.36% (n=134) used herbal medicines either before or after starting antiretroviral therapy. The most used plant by our respondents was *Tetradenia riparia* (Umuravumba) at 24.76%, while 6.71% of all participants who have used traditional medicines reported undesirable adverse effects. The main adverse effects experienced were gastric irritation, severe nausea, diarrhea, and constipation. It is important to note that 85.93% of participants who used herbal medicines alongside antiretroviral drugs reported disease improvement.

Conclusion: The prevalence of herbal medicine use among our respondents on HAART was high. This is of clinical and pharmacological concerns; hence, the possibility of treatment change due to poor adherence because of the exacerbation of Antiretrovirals (ARVs) side effects.

Keywords: Antiretroviral drugs, Herbal medicines, Adverse effects, Traditional medicine, Complementary and Alternative Medicines (CAM), Herbal-drugs interactions.

INTRODUCTION

Globally, herbal medicine use is progressively becoming more prevalent [1]. Herbal medicines serve as the main

source of healthcare in most rural communities where access to orthodox medicines is limited. These medicines are often sold by individuals with little or no formal training. The scarcity of conventional training may be due

to the inability of herbal practitioners to answer questions regarding the efficacy and mechanism of action of herbal medicines either as a supplement to modern orthodox medicine or as a therapy to mitigate diseases. Knowledge of herbal medicine is passed from one generation to another generation with a sophisticated theory or system, which may partly affect the ability of herbal practitioners to answer questions regarding plant-based treatment [2,3,4].

The use of complementary and alternative medicine, including herbal therapy, is widespread globally. The World Health Organization (WHO) estimates that 4 billion people (80% of the World's population) use herbal medicines for some aspect of primary health care [5]. In the United States of America, 42% of the population has reported the use of complementary and alternative medicine [6]. Remarkable use of herbal remedies is evidenced in the Caribbean, where newer studies in Trinidad revealed a comparatively widespread use for symptomatic relief in asthma and treatment of diabetes mellitus [7,8].

Medicinal plants are an integral component of Chinese traditional medicine system where more than 500 medicinal herbs have been utilized in the treatment of various human diseases, amounting to approximately 20% of the entire Chinese pharmaceutical market [9]. Herbs homegrown in Japan were listed in the first pharmacopeia of Japanese traditional medicine in the 9th century [10]. The herbal medical system practiced in India for disease mitigation, treatment, and prevention is Ayurveda, which includes diet and herbal remedies with emphasis on the body, mind, and spirit [11].

The use of complementary and alternative medicine is not uncommon among HIV-infected patients. A study showed that 67% of HIV-infected patients receiving HAART were concomitantly taking a natural health product [12]. A significant reliance on herbal medicine by the more substantial proportion of the Sub-Saharan Africa population has led to its use as a form of treatment of HIV-related symptoms [13,14]. In Africa, traditional herbal medicines are often used as a primary treatment for Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/ AIDS) and HIV-related problems including dermatological disorders, nausea, depression, insomnia, and weakness [15]. The use of traditional herbal medicine by AIDS patients after HIV diagnosis was noted in a study conducted in Uganda [14].

Despite limited evidence on the efficacy and the possibility of side effects, some African ministries of health, such as South Africa, currently promote traditional medicines for the treatment of HIV and associated symptoms [16]. Two principal medicinal herbs used for HIV/AIDS treatment in Sub-Saharan Africa include *Hypoxis hemerocallidea* and

Sutherlandia, which are currently recommended by the South African Ministry of Health for HIV management [17]. Similarly, in Ontario, Canada, it was found that 77% of patients who are HIV infected reported herbal medicine use, with nearly all patients reporting using it in conjunction with HAART [18].

Even though there is no known prevalence of patients using herbal medicines concomitantly with HAART in Rwanda, it is estimated that some HIV infected patients use this kind of therapy among approximately 3% of people living with HIV in Rwanda [19]. This study assessed how herbal medicines use may affect the effectiveness of HAART among people living with HIV and the most frequently used plants in patients under HAART.

METHODS

We conducted a cross-sectional survey among HIV patients seeking care at a rural health center. A well-defined paper questionnaire consisting of close-ended and open-ended questions was used to obtain information from the respondents. Responses from the survey were exclusively used as the data source. The study was conducted in Rango Health Center in South Province from February 2014 to May 2014. The target population consisted of people under HAART who were exposed to herbal medicines before taking antiretrovirals or while taking antiretrovirals. We included male and female patients above 12 years of age and receiving HAART in Rango Health Center. We excluded patients who did not consent to participate in the study.

Using a simple random sampling method, we selected a sample of 196 patients to participate in the study. Questionnaires were administered to be answered individually by the consented respondents. Data collected were statistically analysed using SPSS v.16

ETHICAL CONSIDERATIONS

The research was conducted ensuring total compliance to ethical considerations. Authorization to conduct the study from respondents' institution (Rango Health Center) was obtained, and written informed consent was obtained from all patients at enrolment. We assured patients that the data provided would be treated with confidentiality. The Department of Pharmacy, University of Rwanda, also approved the study.

RESULTS

We enrolled a total of 196 participants in the study. The majority were females (57.7%). 45.4% of all participants were between 30 and 40 years old (Table 1).

The findings highlight that the majority (68.36%) of participants used traditional herbal medicine (Figure 1).

Table 1: Demographic characteristics of the patients enrolled in the study.

Variables	Frequency	Percentage (%)
Total	195	100%
Sex		
Female	113	57.7
Male	82	42.3
Age		
Between 12-20	1	0.5
Between 20-30	65	33.2
Between 30-40	89	45.4
Between 40 and above	40	20.4
Exposure time to traditional medicines		
1 to 3 days before treatment	12	8.96
4 to 7 days before treatment	7	5.22
1 to 2 week before treatment	29	21.64
Above 2 weeks before treatment	46	34.32
During ARV treatment	40	29.85
Herbal medicines use and disease improvement		
Yes	84	62.7
No	50	37.3
Herbal use with ART and related undesirable symptoms		
Herbal use with ART	Undesirable symptoms	
	Yes (n)	No (n)
Yes	6 (66.7%)	58 (46.4%)
No	3 (33/7%)	67 (53.6%)

Bar Chart

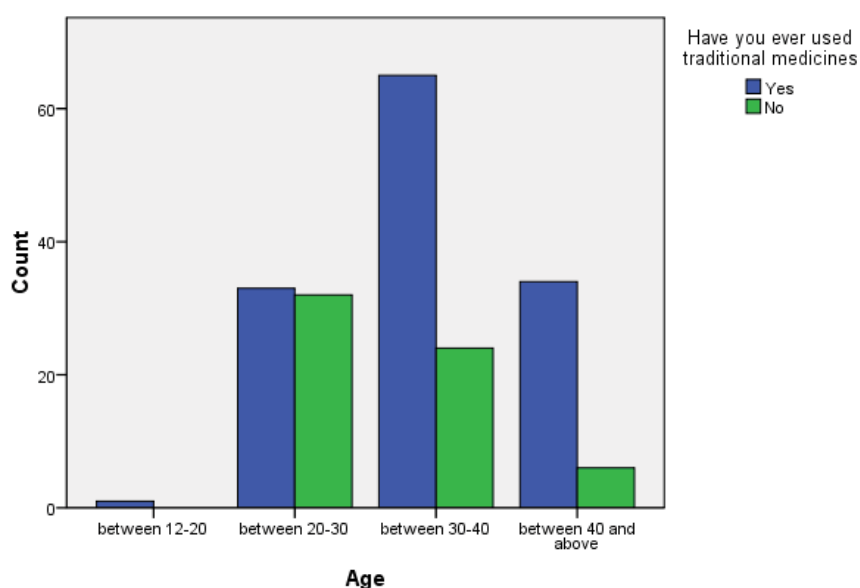


Figure 1: Traditional medicine use according to the study population.

The age category that has the highest number of participants included in this study was those aged 30–40 years, while those aged 12-20 years had the least number of participants included in this study (Figure 2).

A total of 68.36% (n=134) participants reported the use of herbal medicines, with 70.14% of them having used traditional herbal medicine before starting antiretroviral therapy, whereas 29.85% used herbal remedies along with antiretroviral drugs.

We found that 8.96% of participants used traditional herbal medicines 1 to 3 days before starting antiretroviral therapy, and 5.22% used traditional medicine 4-7 days before starting antiretroviral treatment. Twenty-nine participants (21.64%) used traditional medicines 1-2 weeks before starting antiretroviral, while 46 participants (34.32%) used plant-based medicines above two weeks before starting antiretroviral drugs (Table 1).

Among 134 patients who were exposed to traditional

medicines, 84 (62.7%) reported an alleviation in different opportunistic diseases such as cough, diarrhea, worms, malaria, fever, worms and vomiting, and asthenia (Table 1).

Even though recovery from reported conditions (such as cough, diarrhea, among others) has been observed, some participants experienced adverse effects, in addition to treatment change. 6.71% of participants who used traditional therapy reported undesirable effects. The majority of them (66.6%) were using herbals along with ART. The experienced adverse effects were gastric

irritation, severe nausea, diarrhea, constipation, lack of appetite, worsening of disease status, generalized body weakness (general unwell-being), and ARVs treatment change (Table 1).

A total number of 37 plant types have been used by participants mostly for cough, diarrhea, asthenia, malaria, and worms management. The common plants used were *Tetradenia riparia*, *Vernonia amygdalina*, *Ocimum suave*, *Aloe sp*, *Leonitisne ptaefolia*, *Psidium guajava* leaves, *Vernonia lasiopopus*, *Eucalyptus sp*, and *Trapaelum*

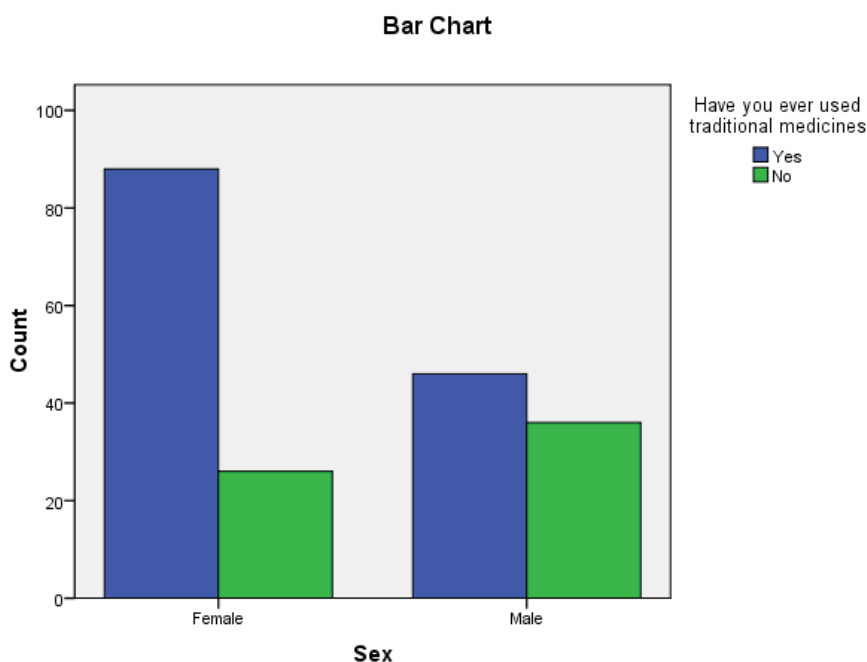


Figure 2: Traditional medicines use vs. age group.

Table 2: Plant type used their frequency and their intended uses.

Scientific names	Frequency use	%	Cough	Asthenia	Diarrhoea	ARV adverse effect	No effect of ARV	others
<i>Tetradenia riparia</i>	79	24.7	70	5	13	0	0	24
<i>vernonia amygdalina</i>	53	16.6	32	1	17	0	0	29
<i>Ocimum suave</i>	39	12.2	38	4	5	0	0	12
<i>aloes. Sp</i>	12	3.7	8	1	1	0	0	11
<i>Coleus kilimandschari</i>	9	2.8	7	0	5	0	0	4
<i>Gürke Leonitisneptaefolia</i>	8	2.5	6	0	0	0	0	7
<i>psidium guajava</i>	7	2.19	5	0	3	0	0	4
<i>Vernonia lasiopopus O.Hoffm</i>	7	2.19	5	0	3	0	0	4
<i>Eucalyptus cinerea, Eucalyptus maidenii</i>	7	2.19	5	2	0	0	0	4
<i>Lithonia diversifolia</i>	6	1.8	3	3	2	0	0	4
<i>Trapaelum majus</i>	6	1.8	6	0	2	0	0	2
<i>Trimeria grandifolia subsp. tropica Sleumer</i>	6	1.8	1	0	4	0	0	2
<i>Indigofera arrecta</i>	6	1.8	0	1	0	0	0	3
<i>Lantana trifolia L.</i>	5	1.5	4	0	1	0	0	2
<i>magnifera indica</i>	4	1.2	2	2	0	0	0	4
<i>citrus medica</i>	4	1.2	2	0	0	0	0	2
<i>Indigofera arrecta</i>	6	1.8	0	0	0	0	0	6
<i>Cajanus cajan (L.) Millsp.</i>	3	0.9	0	0	0	0	0	3

<i>Zehneria scabra (L.f.)</i>	3	0.9	1	0	1	0	0	2
<i>Momordica foetida Schum</i>	2	0.6	2	0	0	0	0	2
<i>Clutia abyssinica.</i>	2	0.6	0	0	2	0	0	0
<i>Rumex bequaertii De Wild</i>	2	0.6	1	1	0	0	0	1
<i>Orthosiphonsuffrutescens</i>	2	0.6	2	0	1	0	0	0
<i>Ludwigia abyssinica A. Rich.</i>	2	0.6	1	0	0	0	0	1
<i>Carica papaya</i>	2	0.6	0	0	0	0	0	2
<i>Dracaena steudneri Engl</i>	1	0.31	1	0	0	0	0	0
<i>leucas martinicensis</i>	1	0.31	1	0	1	0	0	1
<i>Passiflora edulis</i>	1	0.31	1	0	0	0	0	1
<i>Urtica massaica Mild Br, Urtica massaica</i>	1	0.31	0	0	0	0	0	1
<i>Rumex abyssinicus Jacq</i>	1	0.31	1	0	0	0	0	1
<i>Polygala luteo-viridis Choda</i>	1	0.31	1	0	0	0	0	1
<i>Sporobolus pyramidalis P.</i>	1	0.31	0	0	0	0	0	1
<i>Clematis hirsuta Perrotte et Guill</i>	1	0.31	0	0	0	0	0	1
<i>Chenopodium ugandae Aellen</i>	1	0.31	0	0	0	0	0	1
<i>Cinchona pubescens</i>	1	0.31	0	0	0	0	0	1
<i>Myrica kandtiana Engl.</i>	1	0.31	0	0	1	0	0	0
<i>Musa acuminata Colla</i>	1	0.31	0	0	0	0	0	1
<i>Cajanus cajan (L.)</i>	1	0.31	0	1	0	0	0	1

majus. (Table 2).

Of 16.61% who used *Vernonia amygdalina*, 77.35% reported disease improvement, while 9.43% were triggered to change treatment. Table 3 illustrates the most used plants, their relevance in HIV infection, and the impact on antiretroviral therapy. Among patients who used *Tetradenia riparia*, 7 reported adverse effects occurrence, 5 confirmed gastric irritation, one affirmed nausea, and three accounted for diarrhea (Table 4).

DISCUSSION

The prevalence of traditional herbal medicine use among patients on HAART at Rango Health Center in South Province was high, with 68.36% of patients using herbal medicine alongside HAART. However, this prevalence may be an underestimation of the actual situation since herbal medicine is usually discouraged by healthcare providers. Patients are regularly sensitized about the dangers of combining conventional drugs like HAART with traditional herbal medicine and followed up to monitor progress.

Most of the literature reports Complementary and Alternative Medicine among HIV patients with traditional herbal medicine being just a part of Complementary and Alternative Medicine [20]. The prevalence of herbal medicine use in our study is significant compared to that reported in other studies. In British Columbia, the prevalence of herbal medicine use among HIV patients was 19% [21], while in the USA, 67% of HIV patients

were taking herbs, 20% were taking Chinese herbs [20]. In Canada, 30% of HIV outpatients reported the use of herbal medicines [22]. The general lower prevalence of herbal medicine use among HIV patients in the developed world is reflected by the low prevalence (14%) of herbal/supplement use in the population [18,20,23].

The study shows that the prevalence of herbal medicine use among women was higher than that of men. A research carried out in TASO (The Aids Support Organisation) treatment centers, Uganda, obtained similar results. In this study, the prevalence of herbal medicine among women was 36.4% compared to 27.3% by men [24]. A related trend has been observed in extensive surveys in the USA [18,20,23]. However, this study did not assess the relationship between gender and prevalence of traditional herbal medicine use among patients on HAART.

The study revealed that (70%) of patients were exposed to herbal medicines before starting HAART; moreover, individuals were on herbal medicine for a relatively short period before starting antiretroviral drugs. This finding is in contrast to a study by Agnoletto et al., where patients with a longer duration on HAART are more likely to use Complementary and Alternative Medicine [25]. This difference could be explained by a difference in patients' understanding of the concomitant use of herbal medicines with HAART.

Our study also demonstrated that HIV-related symptoms were the main reasons for herbal medicine use, where 62.7%

Table 3: Most used plants, their relevance in HIV infection and the impact on antiretroviral therapy.

Plant	Family	Treatment change	Other symptoms	Disease improvement
<i>Tetradenia riparia</i>	Lamiaceae	7 (8.86)	7 (8.86%)	42 (53.16%)
<i>Vernonia amygdalina</i>	Asteraceae	5 (9.43%)	2 (3.7%)	41 (77.35%)
<i>Ocimum suave</i>		6 (15.38%)	5 (12.82%)	23 (59%)
<i>Aloes</i>	Liliaceae	1 (8.3%)	0	11 (91.6%)
<i>Leonotis nepetaefolia</i>	Lamiaceae	0	4 (44.4%)	8 (88.8%)
<i>Psidium guajava leaves</i>		3 (37.5%)	0	8 (100%)
<i>Vernonia lasiopis</i>		2 (28.6%)	2 (28.6%)	7 (100%)
<i>Eucalyptus</i>	Myrtaceae	2 (28.6%)	0	6 (85.7%)
<i>Trapaelum majus</i>		0	2 (33.3%)	4 (66.6%)

Table 4: Plants and linked adverse effects.

Plant used	Frequency of adverse effects occurrence	Gastric irritation	severe nausea	diarrhoea	constipation	General unwell being
<i>Tetradenia riparia</i>	7	5	1	3		0
<i>Vernonia amygdalina</i>	2	2	1	0		0
<i>Ocimum suave</i>	5	2	0	0		3
<i>Leonitis napaefolia</i>	4	0	1	3		1
<i>Vernonia lasiopis</i>	2	0	0	0		2
<i>Trapaelum majus</i>	2				1	1

(n=84) reported experiencing relief from opportunistic diseases. This usage is possibly due to the perception that herbal medicine is natural without any toxic element that gives excellent comfort if taken in reasonable quantities.

Some patients experienced adverse effects, most notably those who used traditional herbal medicines along with antiretroviral therapy (ART) and patients who have been exposed to traditional medicines 1-3 days before beginning antiretroviral drugs. Findings are comparable with a study done on interactions between natural heal products and antiretroviral drugs, which shows an increasing proof of the interactions of herbs/supplement and ART with potential for serious adverse effects [26,27]. Some herbs (e.g., germander, comfrey, pennyroyal) have well-documented toxic effects [28].

Herbals and HAART may share similar adverse effects. Patients using both therapies may wrongly attribute their harmful effects to the antiretroviral. Interactions of this type may result in increased toxicity and decrease the efficacy of both herbal medicine and HAART [29].

Curative effect of plants reported by participants

The study showed an improvement in overall health status using herbal medicine before and after enrolling in ART. This could be explained by using HAART, in addition to the care and support received from counselors and clinicians at the treatment center. Nevertheless, as reported by Edward Mills [30] "It is not unreasonable to suggest that some herbal products may have therapeutic benefits." For example, in our study, all the participants

who used *Psidium guajava* leaves' extract report significant improvement and recovery from cough and diarrhea. Evidence has shown that *P. guajava* leaves have a broad spectrum of antimicrobial action (as anti-giardial and antiretroviral activity) that could be effective in controlling diarrhea due to a wide range of pathogens. The antimicrobial activity can be linked to the presence of flavonoids extracted from guajava leaves [31]. Guava leaves' extract has anti-cough effects and has an inhibition impact on HIV reverse transcriptase [32]. Participants also reported a treatment change at 37.5% because there was a failure with the previously used treatment, and no other adverse effects had been reported. This treatment failure may be linked to a decrease in drug concentration caused by saponins constituents in *Guajava* leaves [33,34]. *Guajava* leaves contain amino acids, triterpenes, steroids, acids, phenols, saponins, and carotenes. The presence of saponins may interact with antiretrovirals absorption by forming a thin viscous layer on the gastrointestinal mucosa hence a decrease in drug efficiency [35,36].

In our study, participants who used *Vernonia lasiopis* reported recovery from diarrhea and abdominal pain. Results correspond with a study done by Julius in 2009 [37]. The study noted that *V. lasiopis* is used to treat fever, abdominal pain, diarrhea, ascariasis, and other ailments.

Our study accounted for 28.6% of patients who confirmed treatment change due to a failure in the previously used treatment. Severe general body tiredness was reported, which is one of the undesirable adverse effects linked to ARVs [38]. Further research is still needed to evaluate

phytochemical constituents of *Vernonia lasiopus*, which may interact with antiretroviral drugs.

Additionally, 91.6% of patients who used Aloe reported a good improvement from diarrhea, asthenia, cough, malaria, skin acne, and worms. No adverse effects have been noted, but 8.3% attest treatment change after failure with the previous treatment. This result agrees with a study done by Smith et al. [39] which states that Aloes exacerbate several chronic conditions and interact with many drugs; hence its oral use is not recommended. It is most specially advised not to use aloe with azidothymidine (AZT), one of the antiretroviral drugs. These findings were similar to another study by Laitinen et al., who affirmed that aloe could promote changes in the ARVs absorption by increasing the rate of gastric emptying. The anthraquinones present in aloe can increase the peristaltic movements; therefore, reducing the bioavailability of antiretroviral medicines. The decrease in ARVs concentration could result in an increased therapeutic failure [40].

Participants have used *Leonotis naptaefolia* for diarrhea management. 88.8% of them reported diarrhea improvement, while 44.4% reported having severe diarrhea as adverse effects. No participant experienced treatment change. Though one of the HIV medication side effects includes diarrhea, there is no research to conclude that having severe diarrhea after *Leonotis naptaefolia* use is linked to an increase in antiretrovirals blood concentration.

Eucalyptus is a plant that has been indicated by traditional healers in the treatment of respiratory tract infections, bronchial infections, asthma, and cough [41]. 85.7% of study participants who used eucalyptus reported recovery from cough and flu, while 28.6% reported treatment change due to non-adherence with the previous treatment. It has been noted that cineole contained in eucalyptus is a relevant chemical inhibitor of CYP3A4 enzymes, and this may cause an increase in drug concentration, which might lead to an increase in adverse effects [42].

Quercetin, widely found in nature and present in *Eucalyptus globulus*, binds to the plasma proteins (98%) and when administered with other medicine with high affinity for plasma protein, may lead to a pharmacological competition, and this interaction may form both a dislocated drug and a dislocating drug [43]. Thus, herbal medicines or large amounts of food containing onion or eucalyptus when used concomitantly with efavirenz, which presents binding percentage to the plasma protein higher than 99% [44] may promote competition for this binding, which can exacerbate its excitability symptoms in the central nervous system.

Moreover, the majority (77.35%) of respondents who used *Vernonia amygdalina* reported recovery from cough,

asthenia, diarrhea, and a general unwell-being. This is linked to *Vernonia amygdalina* properties of acting as an immunostimulant in Human Immunodeficiency Virus (HIV) infection [45]. Another study reports that *Vernonia amygdalina* has an immunological effect through transient and early maturation of cells and hindrance of all destruction. Hence, it could be used as nutritional supplements in immunocompromised conditions as HIV infection to a less extent [46]. There is a strong belief in the scientific community that the active agent that could successfully combat HIV/AIDS might be contained in medicinal plants, including *Vernonia amygdalina* [45,46].

Although this plant has a significant role in combating HIV opportunistic diseases, 3.7% of participants declared that it might cause gastric irritation as an undesirable adverse effect. Gastric irritation might be associated with the plant itself. Phytochemical analysis of *V. amygdalina* leaves revealed the presence of saponins [47], which have been reported as potent hemolytic agents that irritate the gastrointestinal tract and the mucous membrane [48]. The gastric irritation, in turn, impairs drugs' absorption [49] and causes a pyloric spasm, which in turn may delay drug absorption and reduce bioavailability. This reduced bioavailability may lead to treatment failure leading to a change in therapy, as reported by 9.43% of the study population.

Respondents used *Trapaelum majus* for cough management and diarrhea, of whom 66% reported recovery from respiratory diseases and diarrhea, 33.3% reported experiencing constipation and a general body un-wellbeing as adverse effects; however, no treatment change had been reported. There is no evidence to conclude that the reported adverse effects are attributable to the increased antiretrovirals blood concentration resulting from their concomitant use with *Trapaelum majus*. Further researches are recommended to determine the possible interactions of *Trapaelum majus* with modern ARV.

Fifty-nine percent of participants who used *Ocimum suave* reported recovery from cough, asthenia, and diarrhea. Gastric irritation and severe nausea as undesirable effects have been reported. The adverse effects could not be linked to the phytochemical composition of the plant itself as it has been proved that *Ocimum suave* has gastric cytoprotective action [50]. The experienced adverse effects among participants who used *Ocimum suave* could be explained by an increase in ARVs concentration resulting from herbal-ARVs interaction as anti-HIV medication may cause upset stomach (nausea), stomach pain, vomiting, and reduced appetite as side effects. An increase in antiretrovirals' blood concentration may worsen their undesirable effects [51].

Tetradenia riparia is one of the most popular medicinal plants in Rwanda. Several new substances that exhibit significant antimicrobial activity against several bacteria and fungi have been isolated from the leaves of this plant, including diterpene diol, and a racopimaradiene-7 alpha,18-diol [52]. Our study found that 53.16% of participants who used *Tetradenia riparia* reported recovery from cough, asthenia, diarrhea, worm infection, and 54.68% of patients used *Tetradenia riparia* along with antiretroviral drugs. Patients that had used *Tetradenia riparia* reported gastric irritation as adverse effects and severe diarrhea. Although no treatment change caused by a failure in the previously used treatment had been reported, the impact of reduced bioavailability may lead to treatment failure hence treatment change. Reported adverse effects may be linked to an increase in ARVs concentration as they are signs of hepatotoxicity, an adverse effect related to ARVs. Signs and symptoms of hepatotoxicity vary depending on how badly the liver is damaged [53]. Symptoms of liver damage include: nausea, vomiting, abdominal pain, loss of appetite, diarrhea, and all FDA-approved nucleoside reverse transcriptase inhibitors (NRTIs), non-nucleoside reverse transcriptase inhibitors (NNRTIs), and Protease inhibitors (PIs) are associated with hepatotoxicity increase in those drugs' concentration is associated with adverse effects worsening. Additionally, in the era of antimicrobial resistance, prudent use of antimicrobials is advocated for [54].

CONCLUSION

There is a widespread use of traditional herbal medicines concurrently with antiretroviral drugs among the participants. Undesirable adverse effects linked to herbal medicine use were found, which may affect the clinical efficacy of ARVs. Some plants displayed a positive impact on patients under ARVs by acting as an immune stimulant and producing desirable antimicrobial effects. There is a need to develop more studies for herbal therapy to examine individual plant constituents and to determine how plants interact with drugs and food. It is also important to have a study on significant pharmacokinetic and pharmacodynamic interactions of herbal medicines and antiretrovirals, to ensure that ARV efficacy is maintained in patients that use traditional medicines.

AUTHORS' CONTRIBUTIONS

All the authors participated in the research drafting, design, analysis of data, and conceptualization.

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