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# Diversity and utilization of medicinal plants used in managing respiratory illnesses in Migori County, Kenya

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**Abstract**
Respiratory illnesses account for 19% of infection cases treated in Kenyan hospitals. Local communities in Kenya depend on medicinal plants to manage various respiratory ailments. This study assessed the diversity and utilization of medicinal plants used in the management of respiratory illnesses in Kuria West, Kuria East, and Suna East in Migori County, Kenya. Data on the utilization of medicinal plants was collected through structured questionnaires administered to purposively selected herbalists. Data on the diversity of medicinal plant species was collected by use of the transect-quadrat technique. Sampling was carried out in 10 m x 10 m quadrats along a transect at 20 m intervals. The Statistical Package for Social Sciences (SPSS) version 22 was used to analyze data from the questionnaires. Data on diversity was analyzed using the Shannon-Wiener Diversity Index. There were a total of 1032, 499, and 487 medicinal plants in Kuria East, Kuria West, and Suna East respectively. The diversity index was highest in Kuria West at 3.30 and least in Suna East at 2.71. In all three sites, the most dominant species was *Leucas aspera*. The most commonly utilized family was Asteraceae (16.1%), and Lamiaceae (8.9%). Plant parts that were commonly utilized were leaves (60.7%) followed by roots (25%).

**Keywords:** Herbalists, medicinal plants and exploitation

## Introduction
According to the World Health Organization (WHO, 2015), approximately 3 million deaths are caused by Chronic Respiratory Diseases globally [1]; more than 90% of these deaths take place in least-developed and middle-income countries. Both industrialized and developing nations continue to experience high rates of respiratory disease incidence and severity. According to the National Strategic Plan for the Prevention and Control of Non-Communicable Diseases, Chronic Obstructive Pulmonary Disease (COPD) poses a serious risk of death and is one of the most frequent diseases in the category of chronic respiratory illnesses [2]. The chronic respiratory diseases alone were responsible for around 1.7% of fatalities in Kenya [3]. In the Nyanza region, Pneumonia and tuberculosis accounted for 13.7% of all reported deaths [4]. Medical therapeutic preparations for both curative and preventive purposes, as well as a source of key bioactive components, can be derived from medicinal plants [5]. Medicinal plants, according to the WHO may be beneficial to one's health and immune system [6]. In Kenya, there is widespread use of medicinal plants among Kenyan communities [7]. For example, various communities like the Maasai [8], Kamba [9], and Luo [10] depend on locally available plant resources to manage common respiratory ailments.
However, medicinal plants are rapidly disappearing in Kenya due to indiscriminate harvesting and habitat destruction [11]. Overharvesting of medicinal plants poses a significant impact on their diversity and availability. Gradual loss of knowledge about medicinal plant species therefore necessitates an urgent response to preserve information before it is irreversibly lost. The lack of interest persons within emergent nations have in herbal medicines, poses a risk that traditional healers' expertise will be lost unless actions are taken to document the specific prescriptions involved [12]. This work was designed to document the diversity and utilization of medicinal flora in alleviating respiratory illnesses in Migori County, Kenya.

Systematic documentation of use would provide information that will inform decisions on management and conservation. This can also support research for novel drugs for contemporary health challenges like Covid-19.

## Materials and Methods

### Study area

The study was conducted in Migori County in South-Western Kenya (Figure 1). Migori County covers an area of approximately 2,596.5 km$^2$ and is located between latitude 1° 4' 7.9824" South and longitude 34° 28' 14.196" East. The population in this area is 1,116,436 according to the 2019 Kenya population count [13]. The area receives an annual rainfall that ranges from 700 to 1,800 mm with annual temperatures ranging from a minimum of 24 °C to a maximum 31 °C. The major economic activities of the populace include agriculture, fishing, manufacturing, and mining [14].

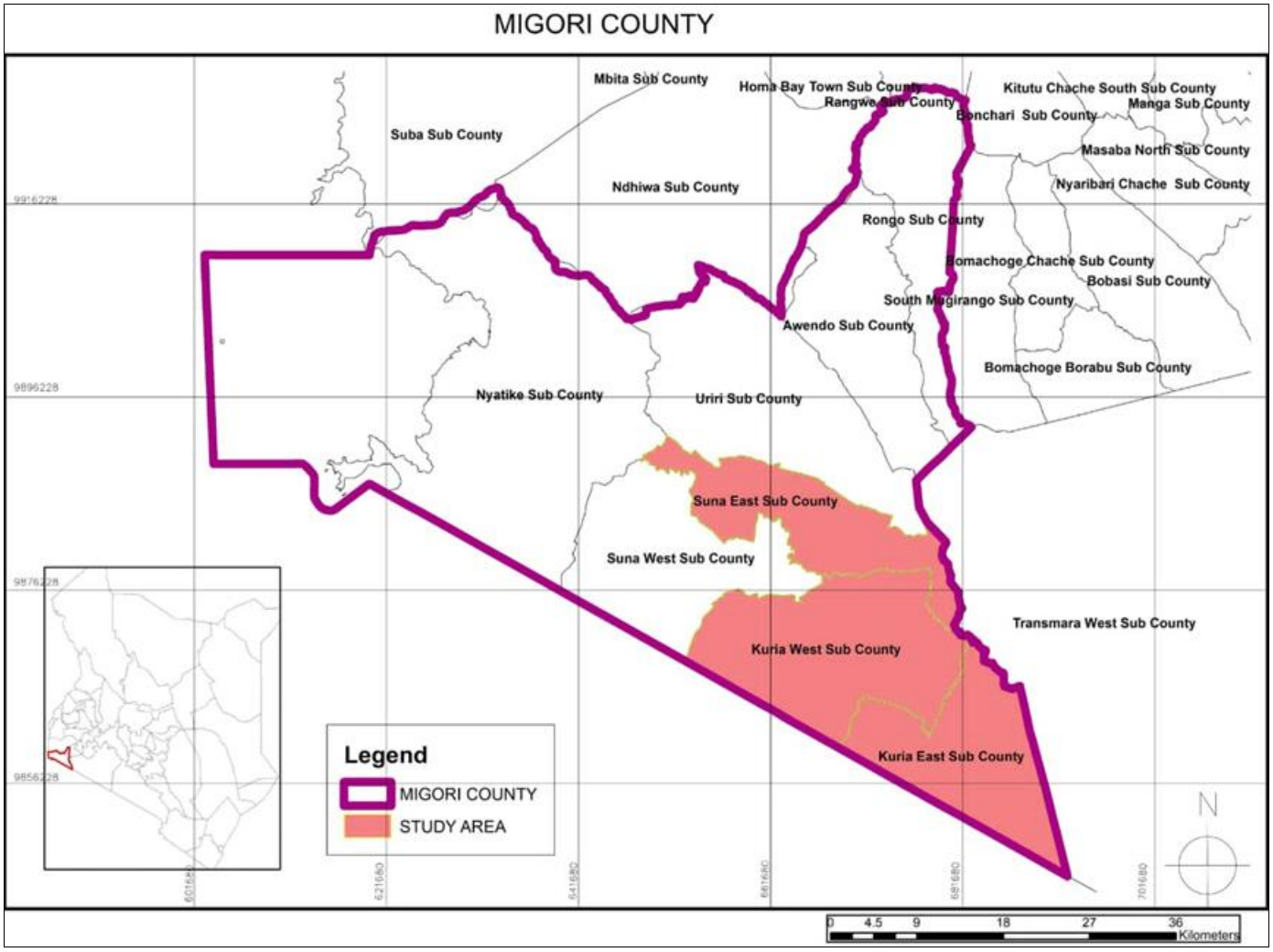


**Fig 1:** Map of Migori County showing the study areas. Sources: Esri, HERE, Garmin, Inter map, Increment P Corp

### Data collection and analysis

### Sampling design

Three study areas namely Kuria West, Kuria East and Suna East sub-counties were selected purposively. Snowball sampling was used to sample specialized herbalists who gave information on medicinal plants utilized in managing respiratory illnesses in the area. Structured questionnaires were administered to the herbalists and information on the local name of plants, their parts used and whether they are exotic or indigenous were noted. Selected herbalists accompanied researchers during transect walks to physically identify the plants mentioned during interviews.

### Plant species diversity

In each of the study areas data was obtained from forests and home gardens using random sampling utilizing the transect-quadrat approach. Plots were delineated along each transect, each measuring 10 m by 10 m with a 20 m gap along 100 m line transect. In every plot, plant species used in managing respiratory illnesses were identified, counted and recorded with the help of herbalists and an experienced taxonomist. Diversity of the species was estimated using Shannon-Wiener diversity index as per the equation below;

$$\text{Shannon Index} \quad -\sum_i \left(\frac{n_i}{N} \cdot \log_2\left(\frac{n_i}{N}\right)\right)$$

### Sample collection and identification

Research assistants, as well as herbalists, helped collect medicinal plants that were commonly used to treat respiratory illnesses highlighted during interviews. The plants were collected during transect walks. The plant's botanical name, native name, habit and part harvested were documented. Samples were properly labeled and voucher specimens collected for preservation. The plants were selected based on how frequent they were used and their level of threat. The label also included complete information about the plant's

location as well as characteristics of the plant that would not be observable in dried specimens, such as tree height.

**Data analysis**

Data collected was analyzed by use of both qualitative and quantitative statistical tools to obtain several measures of species diversity. Descriptive statistics such as percentage and frequency were employed to summarize the data and results were presented in figures, tables and charts. Data from questionnaires were run through Statistical Package for Social Science (SPSS) software Version 22. Species diversity was determined using Shannon-Wiener diversity index. The Berger-Parker dominance index was used to analyze the most dominant species.

## Results and Discussion

**Identification and sampling of the herbalists**

The herbalists were both male and female adults mainly of the ages above 50 years (59.4%). The youngest was 25 years and the oldest was 62 years. 87.5% of the herbalists were unmarried while 12.5% were married. 53.1% had primary education. In this study, the herbalists sampled were mainly from Kuria (40.6%) and Luo (31.3%) communities with a few from Gusii, Luhya, and Nandi ethnic groups. A major source of livelihood of the respondents was farming (62.5%) (Table1).

**Table 1**: Herbalists' demographic information

| Demography | Category | Frequency (n = 32) | Percentage (%) |
|---|---|---|---|
| Gender | Male | 17 | 53.1 |
| | Female | 15 | 46.9 |
| Ages (years) | Below 25 years | 0 | 0.0 |
| | 25 - 30 | 1 | 3.1 |
| | 31 - 35 | 1 | 3.1 |
| | 36 - 40 | 2 | 6.3 |
| | 41 - 45 | 4 | 12.5 |
| | 46 - 50 | 5 | 15.6 |
| | Above 50 years | 19 | 59.4 |
| Marital status | Single | 28 | 87.5 |
| | Married | 4 | 12.5 |
| Highest level of education | Primary | 17 | 53.1 |
| | Secondary | 8 | 25.0 |
| | College | 1 | 3.1 |
| | University | 1 | 3.1 |
| | No formal education | 5 | 15.6 |
| Ethnicity | Gusii | 1 | 3.1 |
| | Kuria | 13 | 40.6 |
| | Luo | 10 | 31.3 |
| | Luhya | 1 | 3.1 |
| | Nandi | 1 | 3.1 |
| Source of livelihood | Farming | 20 | 62.5 |
| | Herb seller | 7 | 21.9 |
| | Business | 5 | 15.7 |

**Diversity of selected medicinal plant species**

The most commonly used indigenous plant families were Fabaceae, Asteraceae, Euphorbiaceae, and Lamiaceae. In the exotic plants category, the most commonly used families were; Asteraceae, Myrtaceae, Verbanaceae, and Lamiaceae.

In Kuria East, a total of 1,032 medicinal plants were sampled. These plants were found to belong to 22 species. This gave a diversity index of 3.21. Kuria West had a total of 499 medicinal plants sampled. These were grouped into 21 plant species. This gave a diversity index of 3.29. In Suna East, there were 487 medicinal plants sampled. These plants were found to belong to 19 species. The computed diversity index of the plants in Suna East was therefore 2.71. In the three study areas, however, the most dominant species was *Leucas aspera*. In Kuria East, the Berger-Parker dominance index for this species was 0.29. The Berger-Parker dominance index obtained for this species in Kuria West was 0.20 while in Suna East was 0.41.

**Utilization of medicinal plant species**

A total of 56 medicinal plants from 27 families were used by the herbalists for the management of respiratory illnesses in Migori County. The data demonstrated that Asteraceae and Lamiaceae were the most utilized families with 16.1% and 8.9% respectively (Figure 2). Most of the medicinal plants were shrubs (38.3%) followed by trees (33.9%), herbaceous (21.4%) and the least habits were climbers (7.1%).

Most plant parts were utilized in the formulation of remedies for the treatment of respiratory illnesses in the study area. The parts included rhizomes, barks, fruits, leaves, roots, and whole plants in case of an herb. Leaves were predominantly used by the herbalists (60.7%) followed by roots (25%) and bark (14.3%) (Figure 3). In the Lamiaceae family, leaves, roots, and bark were used. The herbalists either used the bark and leaves, leaves alone, roots or roots and leaves when preparing the concoctions. In Lamiaceae, Acanthaceae, Arecaceae, Meliaceae, and Solanaceae families, only plant leaves were used. The herbalists used only plant bark from Anacardiaceae, Bignoniaceae, and Moraceae families. In the family of Apiaceae and Asteraceae whole plant were used. Both bark and leaves of Canellaceae family were used. Fabaceae plant leaves and roots were used. In Rutaceae, both fruits and roots were used. Euphorbiaceae leaves and sap were used. In Cucurbitaceae leaves and roots were used (Table2). Breathing difficulty was the most common sign of respiratory illness managed by the medicinal plants (39%) followed by cough (32%). The least was blocked nose (16%) (Figure 4).

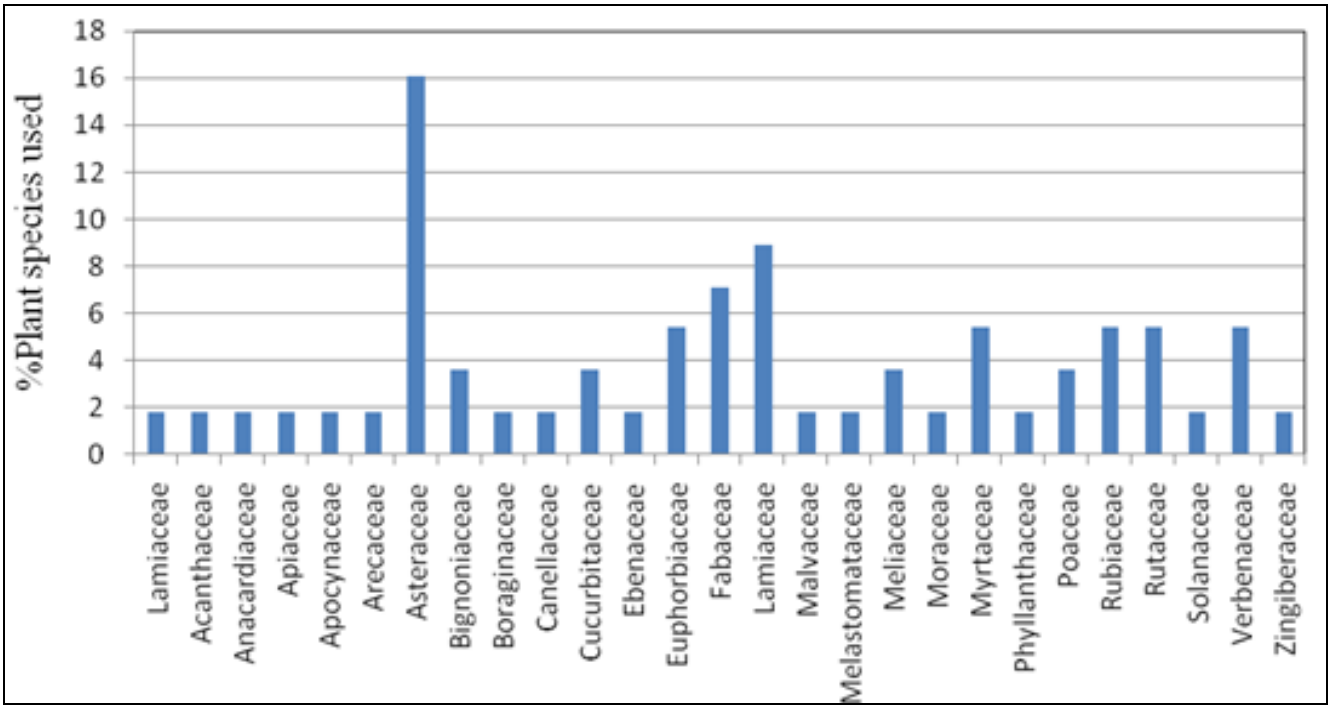


**Fig 2:** The percentage frequency of plant families used in the management of respiratory illnesses

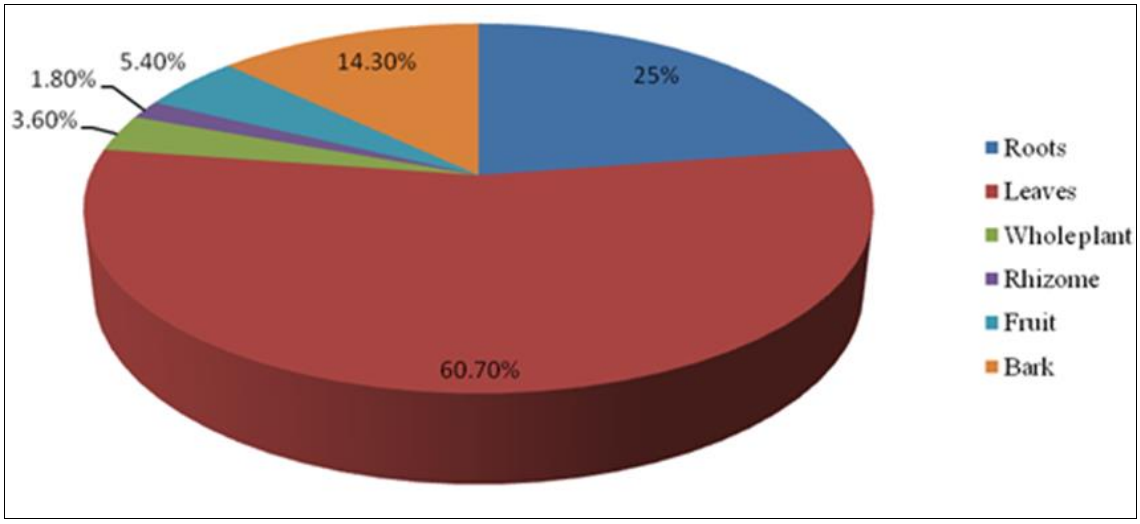


**Fig 3:** Plant parts used

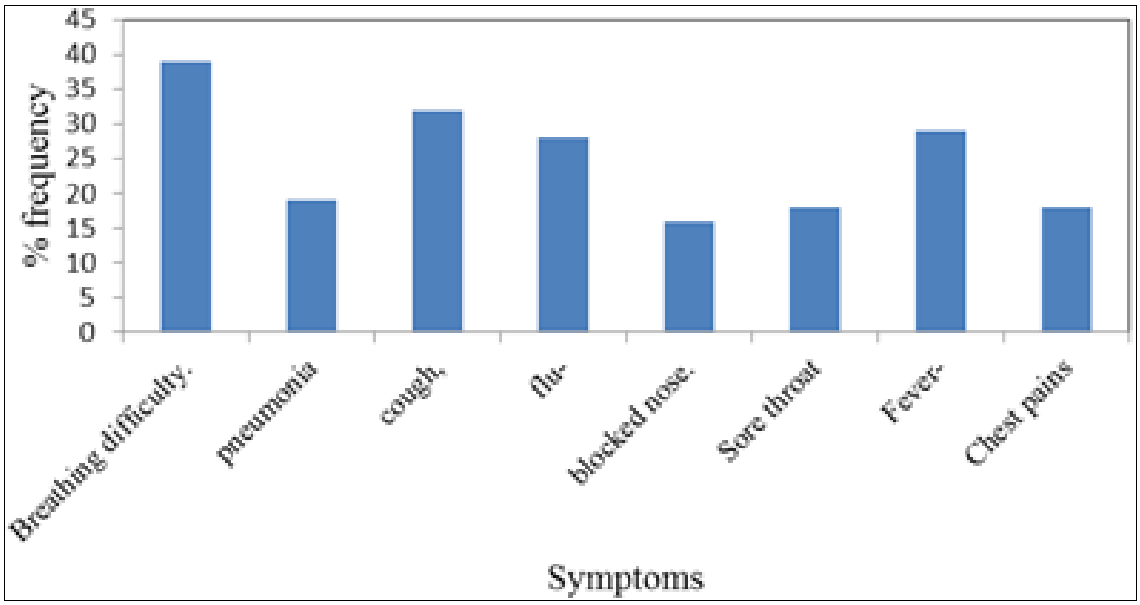


**Fig 4:** The most common symptom of respiratory illness managed by herbal concoctions

**Table 2**. Commonly utilized medicinal plants by herbalists

| S.no | Botanical Name | Family Name | Local Name | Part Used | Habit | Diseases Treated |
|---|---|---|---|---|---|---|
| 1 | *Warburgia ugandensis* | Canellaceae | Esoko | Bark/Leaves | Tree | Cough, breathing difficulty, chest pains |
| 2 | *Toddalia asiatica* | Rutaceae | Orunisia | Roots | Shrub | Cough, blocked nose, flu, breathing difficulty, chest pains |
| 3 | *Clerodendrum myricoides* | Lamiaceae | Irihililia | leaves | Shrub | breathing difficulty, Sore throat, cough, Flu, |
| 4 | *Kedrostis foetidissima* | Cucurbitaceae | Ang'we | Leaves | Climber | Sore throat, chest pains, cough, Pneumonia |
| 5 | *Rhus vulgaris* | Anacardiaceae | Omosangora | Bark | Shrub | severe headache, chest pains, sore throat |
| 6 | *Erythrina abyssinica* | Fabaceae | Omotembe | Leaves | Tree | Cough |
| 7 | *Fuerstia africana* | Lamiaceae | Ikibunga bare | Roots/leaves | Herb | chest pains, cough, breathing difficulty, fever |
| 8 | *Psidium guajava* | Myrtaceae | Omopera | Leaves | Tree/Shrub | Flu, Cough |
| 9 | *Euphorbia candelabrum* | Euphorbiaceae | Engoto | Sap | Tree | Flu, breathing difficult, sore throat, pneumonia |
| 10 | *Vernonia amygdalina* | Asteraceae | Omorurarua | Leaves | Shrub | breathing difficulty |
| 11 | *Momordica foetida* | Cucurbitaceae | Omobora | Roots | Climber | Pneumonia |
| 12 | *Abrus precatorius* | Fabaceae | Ombulu | Leaves | Climber | breathing difficulty |
| 13 | *Canthium gueinzii* | Rubiaceae | Atego | Root/Bark | | Flu, cough, Breathing difficulty |
| 14 | *Kigelia africana* | Bignoniaceae | Omoriba | Bark | Tree | Sore throat, flu, Breathing difficulty, blocked nose, pneumonia, fever |
| 15 | *Vangueria madagascariensis* | Rubiaceae | Omokomorio | Roots/Bark | Shrub | Chest pains, pneumonia, flu, Breathing difficulty |
| 16 | *Tithonia diversifolia* | Asteraceae | Akech | Leaves | Herb/Shrub | Flu |
| 17 | *Citrus limon* | Rutaceae | Ndimu | Fruit | Tree | Cough, flu, Sore throat |

*Warburgia ugandensis* leaves and bark were used to prepare a concoction that was used to relieve cough, chest pain, and difficulty breathing. *Toddalia asiatica* roots were used by the herbalists to alleviate cough, blocked nose, flu, difficulty breathing, and chest pains (Table 2). *Clerodendrum myricoides* leaves on the other hand were used by the herbalists to prepare a concoction that manages breathing difficulty, Sore throat, cough, and flu. Other plant species utilized by the herbalists are also listed in Table 2.

## Discussion

Analysis of medicinal plant families in this study showed that there were 27 plant families used by herbalists. The most utilized family by herbalists was Asteraceae. A similar study found that Asteraceae was also the most represented family used to treat respiratory diseases in Tuba, Cameroon [15]. Additionally, Studies have shown that members of the family Asteraceae produce a wide variety of secondary plant products, including terpenes and sesquiterpenes, which give them their therapeutic characteristics and thus able to treat a variety of illnesses, including respiratory problems [16-20]. Bremer and Anderberg, (1994) [21], also pointed out that members of the family Asteraceae contain potent bioactive compounds [21]. Therefore, the importance of this family in traditional medicine is primarily due to these secondary metabolites and the enormous number of species.

The medicinal plants used to manage respiratory illnesses in the study area were both indigenous and exotic. This is consistent with a study by Bussmann and Glenn in Peru which showed that medicinal plants used to manage respiratory illnesses were both indigenous and exotic [22]. The communities having interacted with indigenous plants for a very long time have deep knowledge about such species. However, exotic species depend on knowledge about their use from their regions of origin.

*Psidium guajava* has been used to cure coughs in Zimbabwe [23], South Africa [24], Uganda [25-26] and Pakistan [27]. A study by Gutierrez *et al.*, *(*2008) [28] further pointed out that *Psidium guajava* contains bioactive substances, vitamin C, and trace minerals that are beneficial for boosting the immune system [28]. *Citrus limon* has an abundance of bioactive substances. Due to the major flavonoids, anti-inflammatory and anti-allergic properties, *Citrus limon* is seen as helpful in respiratory conditions like bronchitis and asthma [29]. On the other hand, various components of *Kigelia africana* contain a wide range of bioactive substances [30-33]. The Shona people of Southern Africa, use the bark or root of *Kigelia africana* to treat pneumonia [34]. According to Amira and Okubadejo, (2007) [35], tonics made from extracts of *Vernonia amygdalina* have been effective in treating fevers and coughs in Nigeria [35]. A study in India also showed that *Abrus precatorius* leaves are used to treat colds and coughs [36]. In South Africa, the stem bark of *Warburgia ugandensis* has been used to cure tuberculosis [37].

The plant parts majorly used by the herbalists were leaves. This corroborates findings from studies done elsewhere [38]. Research has also shown that leaves are mostly used because they are easier to collect and are also more than other plant parts [39]. Furthermore, the use of leaves also has advantages for the survival of mother plants and they are thought to store up medicinal substances like alkaloids and tannins by photosynthetic pigments. On the contrary, in arid areas as pointed out by Almeida *et al.*, 2000 [40], the plant part utilized most is the bark since it is constantly available. This is because plants in these areas are subjected to prolonged dryness and lose their leaves, hence bark and roots are more frequently employed.

The most utilized plant habit from the study was the shrubs (38.3%). This concurs with a study done elsewhere which pointed out that shrubs were the most used plant types because they are more resilient to drought than other plant types and can be harvested all year round [41]. The future treatment of respiratory ailments may therefore heavily rely on plant-based indigenous remedies [10].

## Conclusion

This study examined the diversity and utilization of medicinal plants in the management of respiratory illnesses in Migori, Kenya. The diversity of medicinal plants was highest in Kuria West. However, the most dominant species in the study sites was *Leucas aspera*. From the Berger-Parker dominance index, its dominance was higher in Suna East than the other two study areas. The results from the study recorded 56 plant species as used by herbalists to treat respiratory illnesses. The family that was most utilized by the herbalists was Asteraceae. This was major because of their large number of

species and also due to their possession of potent bioactive compounds. Shrubs were the most utilized plant habit as they could be harvested all year round due to their resilience to drought than other habits. Eight different respiratory symptoms were managed by the herbalists that is; breathing difficulty, pneumonia, cough, flu, blocked nose, sore throat, fever, and chest pain. The plant parts used included; rhizomes, barks, fruits, leaves, and roots. Consequently, pharmacological research on these plants may result in useful herbal treatments for a variety of respiratory illnesses.

**Competing interests**

The authors declare that they have no competing interests.

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