An ethnobotanical study of medicinal plants used in the coastal bushland of Lindi District, Southeast Tanzania

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Abstract

Background: An ethnomedicinal study was conducted to document the medicinal plants used for treating diseases in the coastal bushland of the Lindi Region in southeastern Tanzania.

Methods: Semistructured interviews were conducted between August 2016 and September 2018 to collect information regarding local medicinal plant names, the diseases that they were used to treat, and the plant organ used to prepare remedies. The data collected were compared with previous reports within Tanzania and elsewhere and counted and cross-tabulated when appropriate.

Results: A total of 108 species belonging to 49 families and 91 genera were reported. The most commonly used plant families were Caesalpiniaceae and Euphorbiaceae. The most commonly used plant types in the coastal bushland were trees and shrubs, and leaves were mostly used due to various reasons. The majority of the recorded plants were indigenous/natural, which included one newly identified and five endemic species. Most of the local names originated from the Mwera ethnic group. A total of 268 usage variations based on a combination of the plant organ used and disease treated were recorded for the species identified, including edibility. The documented diseases treated with medicinal plants included hernia, convulsion, stomachache, snake bites, skin parasites, abscesses, tinea capitis, malaria, and measles. Medicinal plants related to magic also constituted a significant proportion of uses. In this study, 64.9% of the plant species used to manage diseases were previously reported medicinal species. Moreover, 29.1% were used to manage a similar disease and 13.1% for the same disease, whereas 9.3% of the medicinal plants had the same organ used to treat the same disease as reported. Of the plants identified, 28.7% were edible. Within the study, new treatments that have not been previously reported in Tanzania were identified for 35.1% of the species.

Conclusions: The use of mostly native plants to manage diseases in the study area was validated through cross-checking uses at other locations, and the therapeutic claims of the interviewees were verified. Some of the new findings and new species utilized may provide a basis for new medicinal compounds and remedies in the future.

Background

Even with the progress of modern medicine, people worldwide continue to use herbal medicine as an affordable and familiar form of treatment. In addition, the World Health Organization (WHO) recognizes the importance and therapeutic value of herbal medicine and supports its facilitation [1, 2]. Relying on traditional medicine is also highly regarded and important for people's health in Tanzania, which caused the Tanzanian government to adopt a strategy supporting continued research on medicinal plant uses [3]. In a series of articles published from 1988 to 1993, 77 medicinal plants used in northeast and central-east Tanzania were reported, namely, the Coast, Dar es Salaam, Kilimanjaro, Morogoro, and Tanga [4–9]. In another three articles published in the period 2009–2012, 94, 33, and 49 ethnomedicinal plants used in the region of Kagera in northwestern Tanzania, respectively, were reported [10–12]. Other studies have identified 45 medicinal plants in the New Dabaga Ulongambi Forest Reserve in the Udzungwa Mountains [13], as well as 82 medicinal plants around the Kimboza Forest Reserve [14], both of which are in the region of Morogoro. These studies provided important information on the ethnomedicinal uses of plants, especially in northern and central-eastern Tanzania. However, the published information only covered a limited portion of the vast ethnomedicinal knowledge and did not even include medicinal plants used in southern Tanzania. Furthermore, since 2012, there has been a decrease in substantive ethnomedicinal research in Tanzania.

With the relatively large amount of rainfall and numerous forest reserves in the coastal bushland of Lindi District, southeast Tanzania has ample resources and knowledge of traditional medicine. In a previous study, a few useful plants from a single case study were reported in the Lindi Region [15] and compared to the knowledge of a set of plants compiled from villagers in Rutamba Village [16]. In addition, how interviewees share and withhold medicinal plant knowledge compared among those of the Dodoma Region, Tanga Region, Dar es Salaam, and Zanzibar has been analyzed [17]; how female users utilize medicinal plants in the Lindi Region, Dodoma Region and Zanzibar has been compared [18]; and basic useful plants that were identified in the Lindi Region have been disseminated in a picture book [19] in previous studies performed in Tanzania. However, the collected information has yet to be published as ethnomedicinal research and has not been compared with previous findings within Tanzania. In this research, information on the medicinal plants used in the coastal bushlands of Lindi District, Tanzania, is recorded and analyzed.

Methods

Study area

The study was carried out in six villages (Mchinga II, Michee, Rutamba, Kinyope, Milola, and Nndawa) within the Lindi Region of Lindi District located in southeastern Tanzania. Lindi District includes coastal lowlands at an altitude of 0–100 m with sandy soils and midlands at an altitude of 300–600 m with sandy-loamy soils [20]. The rural population of this district is 181,979 inhabitants [21]. The study locations were between a latitude of 09°43'–10°14'S and a longitude of 39°12'–39°43'E, as shown in Fig. 1. The altitudes were in the range of 12–411 m, with Mchinga II in the extreme northeast on the coast at the lowest altitude and Nndawa inland to the southwest at the highest attitude. The vicinity had various forest reserves, including Rondo, Litipo, Makangala, and Chitoa (Fig. 1).Various forest reserves differed in terms of species diversity and in terms of which tree species are most common. Rondo had the most diversity, e.g., Milicia excelsa, Albizia gummifera, Dombeya sp. among others followed by Chitoa (e.g., Scorodophloeus fischeri, Afzelia quanzesis, Manilkara sulcata, Milicia excelsa, and Euphorbia sp.), whereas Makangala (Brachystegia spiciformis, Pterocarpus angolensis, Manilkara sulcata, and Euphorbia sp.) and Litipo (Berlinia orientalis) had limited diversity with regard to common tree species [22].

Data collection

Ethnobotanical data were collected between August 2016 and September 2017 (August to September 2016, January to February 2017, and August to September 2017), on the basis of mainly semistructured interviews in Swahili with 13 interviewees (10 males, 3 females) who were either traditional healers or villagers who were considered knowledgeable with regard to medicinal plants. Of the interviewees, three were from Mchinga II, six from Rutamba and Michee (formally part of Rutamba), one from Kinyope, one from Milola, and two from Nndawa. Their ages ranged from 36 to 81. Among them, six significant interviewees from Rutamba, Milola, Kinyope, and Mchinga II each provided information on more than 10 medicinal plants. These interviewees were all males, and their average age was 56.8 years. Plant specimens were collected (along with GPS data and a photo), and plant type and habitat were documented as well as their local names. Which diseases were treated by each plant, the plant organs used, and their edibility information were also collected in the field. The methods of preparation and administration were also recorded; however, this information is proprietary and cannot be disclosed.

A total of 134 specimens of medicinal plants were collected from Lindi District. These specimens were identified by a taxonomist at the herbarium of the University of Dar es Salaam. The first voucher specimens were deposited at the herbarium, and additional samples were also deposited at the Institute of Traditional Medicine (ITM), the herbarium of Muhimbili University of Health and Allied Sciences (MUHAS), and Tochigi Museum. The scientific names of the identified samples were delivered to the key interviewees for their information, and their local information was reconfirmed with them from August to September in 2017 and 2018.

Analysis

Origin, distribution, and conservation status were determined for each identified species, which created the first data set of collected species (see Additional File 1). The second data set (see Additional File 2) categorizes the species by diseases treated and plant organ(s) used as well as the WHO International Classification of Diseases 11th Revision (ICD-11, Version 04/2019) [23]. Information on the collected species was referred to the confidential database of the ITM, MUHAS (hereafter MUHAS database). Previously published data on collection, disease, plant organ used, and location were retrieved and used to compare and evaluate the uniqueness and commonness of each identified species, supplemented with other unpublished previous research. Cross-tabulation analysis was performed for appropriate factors using SPSS (version 25). Pearson's chi-squared analysis was performed to test the significance when all categories had an expected count of five or more, whereas Fisher's exact test was used when the expected count was less than five.

Results

Medicinal plant diversity

A total of 108 plant species belonging to 91 genera and 49 families that are used for treating nearly 66 health problems/diseases as well as five other related uses were identified in the study (Tables 1 and 2). The most common plant family in the list of medicinal plants was Caesalpiniaceae with nine (8.3%) medicinal plant species, followed by Euphorbiaceae (6 species, 5.6%) and Rubiaceae (5 species, 4.6%). Families Caesalpiniaceae and Euphorbiaceae had the most represented genera (6 species, 6.6%). Within a genus, Cassia (family Caesalpiniaceae) and Ficus (family Moraceae) had the greatest number of represented species (3, 2.8%). The most commonly used plant species was Securidaca longipedunculata with nine treatments (3.3%, diseases and plant organs). Other species used frequently included Abrus precatorius (7 treatments, 2.6%), Buchnerodendron lasiocalyx (7 treatments, 2.6%), Senna occidentalis (6 treatments, 2.2%), Ocimum gratissimum (6 treatments, 2.2%), Rourea orientalis (6 treatments, 2.2%), and Rytigynia celastroides (6 treatments, 2.2%; see Additional file 3).

Table 1
Medicinal plant families included in the study with the corresponding number of genera and species

Families	Number of genera	Number of species
Caesalpiniaceae	6	9
Euphorbiaceae	6	6
Rubiaceae	5	5
Capparidaceae	4	4
Papilionaceae	4	4
Apocynaceae	3	4
Tiliaceae	3	4
Moraceae	2	4
Anacardiaceae	3	3
Annonaceae	2	3
Celasteaceae	2	3
Combretaceae	2	3
Compositae	2	3
Ebenaceae	2	3
Flacourtiaceae	2	3
Laminaceae	2	3
Olacaceae	2	2
Acanthaceae	2	2
Bignoniaceae	2	2
Boraginaceae	2	2
Nyctaginaceae	2	2
Passifloraceae	2	2
Vitaceae	2	2
Asparagaceae	1	2
Connaraceae	1	2
Dioscoreaceae	1	2
Aloaceae	1	1
Caricaceae	1	1
Cucurbitaceae	1	1
Cypraceae	1	1
Dichapetalaceae	1	1
Dilleniaceae	1	1
Lauraceae	1	1
Loganiaceae	1	1
Meliaceae	1	1
Mimosaceae	1	1
Moringaceae	1	1
Musaceae	1	1
Myrtaceae	1	1
Oleaceae	1	1

Families	Number of genera	Number of species
Palmae	1	1
Pedaliaceae	1	1
Polygalaceae	1	1
Sapindaceae	1	1
Solanaceae	1	1
Sterculiceae	1	1
Taccaceae	1	1
Ulmaceae	1	1
Umbelliferae	1	1
Verbenaceae	1	1
Total: 49	91	108

Table 2

Number of treatments by category with reference to the ICD-11 (WHO, https://icd.who.int/en)

ICD-11 for Mortality and Morbidity Statistics Chapters		#	ICD	#	ICD	Major Diseases	#
1	Certain infectious or parasitic diseases	31	B	7	B75	Abscess	6
			F	17	F 3	Measles	5
					F28	Tinea capitis	6
					F40	Malaria	6
			G		G 0Z	Skin parasites	7
2	Neoplasms	1				Cancer	1
3	Diseases of the blood or blood-forming organs	4	A	4	A 0	Anemia	4
4	Diseases of the immune system	4				Strengthen body	4
5	Endocrine, nutritional or metabolic diseases	1				Diabetes	1
6	Mental, behavioral or neurodevelopmental disorders	5	B	4	B 0	Phobia from fear	4
9	Diseases of the visual system	15	C	4	C20.2	Abscess of eye	4
			D	4	D 0	Near-sightedness	3
					D40	Disability of eye	1
(21)					(MC18)	Pain in eye	1
						Eye	5
						Poison in eye	1
10	Diseases of the ear or mastoid process	3				Ear	3
11	Diseases of the circulatory system	1			BA 0	Blood pressure	1
12	Diseases of the respiratory system	8			CA 0	Cold	2
					CA23	Asthma	2
					CA40	Pneumonia	1
					CA 0F	Tonsils	1
					MD11	Breath	1
					MD11A	Sneeze	1
13	Diseases of the digestive system	34	DA	5	DA 8	Teeth	4
			DB	4	DA 7Y	Ulcer	1
					DB31.2	Rectal prolapse	4
			DD	17	DD50	Hernia (diaphragmatic)	5
			DD	17	DD 5Z	Hernia	12
			ME	13	ME5.0	Constipation	3
					ME5.1	Diarrhea	4
14	Diseases of the skin	3	EE	3	EE 0	Sweaty feet	3
15	Diseases of the musculoskeletal system or connective tissue	4			FB56.6	Swollen leg	2
16	Diseases of the genitourinary system	9	GA	7	GA30	Getting pregnant	3
					GA34	Menstrual pain	4
			GB	2	GB20	Breast	2
17	Conditions related to sexual health	5	HA	6	HA1.1	Increase men's strength	5
18	Pregnancy, childbirth or the puerperium	6	JA	1	JA 0	Abortion	1
			JB	3		Facilitate birth	
			MF	3	MF34	Stomachache of pregnant women	2

O = Other uses not including in the ICD1

ICD-11 for Mortality and Morbidity Statistics Chapters		#	ICD	#	ICD	Major Diseases	#
20	Developmental anomalies	2	LA	2	LA 2Z	Hernia, spinal	2
21	Symptoms, signs or clinical findings, not elsewhere classified	49	MB	30	MB23	Small children crying from fear	1
					MB44.2	A child having problems of walking	3
					MB48	Dizziness	3
					MB46Y	Convulsion	18
					MB 6Y	Headache	1
					MB84Z	Backache	3
			MD	19	MD12	Cough	3
					MD81.1	Stomachache	11
					MD90	Vomiting	2
22	Injury, poisoning or certain other consequences of external causes	11	ND	6	ND56.1	Cut	6
			NE	5	NE 6	Antidote for poison	3
					NE 2Z	Burn	2
26	Supplementary Chapter Traditional Medicine Conditions - Module I	49			SD82	Depression disorder	2
					QA46.2	Twins	1
					SD92	Severe vomiting Related to witchcraft	1 19
						Bless children	9
						Solve problem	5
						Bless food	5
						Good luck	4
						Relationship with partner	3
X	Extension Codes	11	J	2	J 9NV	Bruise	2
			M	9	M18Y9	Snake-bite	9
O	Insecticide, poison	7				Mosquito repellant	2
						Other insect repellant	4
						Snake repellant	1
	Poison	1				Poison	4
	Animal disease	1				Sickness of chicken	1
O = Other uses not including in the ICD1							

The most common plant types of medicinal plants were trees (41, 38%), shrubs (32, 29.6%), and herbs (20, 16.8%), whereas other types were climbing plants (8, 7.4%), climbing shrubs or trees (3, 2.8), lianas (2, 1.9%), parasitic plants (1, 0.9%), and sedges (1, 0.9%). Most of the plants were indigenous (93, 86.1%), but some were exotic (15, 13.9%). The majority of medicinal plants were natural/wild (90, 83.3%), whereas 14 (13.0%) were planted/cultivated and four (3.7%) were found both naturally and cultivated. Most of the indigenous plants occurred naturally, whereas the exotic plants were cultivated with the exception of two cultivated indigenous species (*Markhamia zanzibarica* and *Ficus natalensis*), as well as one naturalized exotic species (*Senna siamea*). Most of the medicinal plants were widely distributed. Furthermore, one identified plant was a rare new species (family Tiliaceae, *Microcos* sp. nov.), and five plants were endemic (*Xylotheca tettensis*, *Aloe lateritia*, *Uvaria leptocladon*, *Euclea racemosa*, and *Lantana viburnoides*). The conservation status of all five endemic plants was designated as “Least Concern,” and the new rare species has not yet been assessed. Additionally, among the 108 species, 31 (28.7%) were edible. Of the cultivated species, 9.3% were edible, whereas 8.3% of the exotic plants were edible.

The majority of the local names (see Additional file 3) derived from the Mwera ethnic group (84, 77.8%) and Swahili (36, 33.3%), but some local names also originated from Yao (4, 3.7%) and Makonde (2, 1.9%). Some plants had names in both Mwera and Swahili.

Plant Organ Utilized

A total of 268 usage variations based on the plant organ used and disease treated were recorded for the reported medicinal plant species. The plant organs used for making traditional medicine included leaves, roots, bark, fruit, branches, sap, gel, seeds, flowers, tubers, and thorns. Leaves (105, 39.2%) and roots (88, 32.8%) were the most frequently used organs, followed by bark (25, 9.3%), fruit (11, 4.1%), tree branches/stems (11, 4.1%), sap (8, 3.0%), gel (5, 1.9%), seeds (4,

1.5%), flowers (2, 0.7%), tubers (2, 0.7), the whole plant (2, 0.7%), and thorns (1, 0.4%). Within the species used for sap, three produced a water-like liquid, two a white liquid, and one gum. For nine treatments (5%), “rope” was made from the plants.

Leaves were the most frequently used part in families Lamiaceae (8, 3.0%) and Caesalpiniaceae (8, 3.0%), followed by Euphorbiaceae (7, 2.6%) and Papilionaceae (6, 2.2%). Roots were the most frequently used part in family Rubiaceae (12, 4.5%), followed by Flacourtiaceae (7, 2.6%), Caesalpiniaceae (6, 2.2%), and Papilionaceae (6, 2.2%). Bark was the most used part in family Caesalpiniaceae (9, 3.4%) (see Additional file 3).

There were several commonly used medicinal species with regard to each plant organ type. Leaves from Azadirachta indica (Meliaceae), Croton sylvaticus (Euphorbiaceae), and Ocimum basilicum (Lamiaceae) were each used in four treatments, making them the most commonly used leaf species. The roots of Buchnerodendron lasiocalyx (Flacourtiaceae) were used in five treatments, whereas those of Securidaca longipedunculata (Polygalaceae), Rytigynia celastroides (Rubiaceae), and Chassalia umbraticola (Rubiaceae) were each used in four treatments. In addition, the most commonly used bark was that of Cassia agnes (Caesalpiniaceae), which was used in three treatments.

Maladies Remedied

The diseases and maladies treated using traditional medicine were classified according to the WHO ICD-11 (Table 2). The most frequent classification fell under “21: Symptoms or signs … not elsewhere classified” with 52 treatments (19.4%), including convulsion (18, 6.7%) and stomachache (11, 4.1%). This classification was followed by the new “26: Supplementary Chapter Traditional Medicine Conditions” with 49 treatments (18.3%); however, a total of 45 (16.8%) treatments were related to magic and the traditional belief system, including witchcraft, which did not fit any of the descriptions well. Furthermore, 34 treatments (12.7%) were classified as “13: Disease of the digestive system,” 31 (11.6%) as “1: Certain infectious or parasitic diseases,” and 15 (5.6%) as “9: Disease of the visual system.” Specific severe diseases with a documented treatment were hernia (19, 7.1%), convulsion (18, 6.7%), stomachache (11, 4.1%), snake bites (9, 3.4%), skin parasites (7, 2.6%), abscesses (6, 2.2%), tinea capitis (6, 2.2%), malaria (6, 2.2%), and measles (5, 1.9%).

There were some diseases in the categories of “1: Certain infectious or parasitic diseases,” “13: Diseases of the digestive system,” “21: Symptoms or signs … not elsewhere classified,” and “26: Supplementary Chapter Traditional Medicine Conditions” that had a limited number of plant species used for their treatment, which are listed in Table 2. As for the diversity of treatments, family Caesalpiniaceae had treatments categorized under nine ICD classifications, followed by family Euphorbiaceae with eight classifications. Croton sylvaticus (Euphorbiaceae) and Reissantia indica (Celastraceae) both had treatments within five classifications each, whereas Ehretia amoena (Boraginaceae) had four and Senna occidentalis (Caesalpiniaceae) had four as well as other uses.

Whether the medicinal plants were exotic/indigenous, naturally occurring/cultivated, or edible/nonedible varied greatly among the different disease classifications. For example, diseases classified as “1: Certain infectious or parasitic diseases” had the highest use of exotic plants (6, 2.2%) and planted/cultivated plants (8, 3.0%) in treatments. Conversely, uses related to “26: Traditional medicine” used the most indigenous (47, 17.5%) and natural (47, 17.5%) plants, followed by “21: Other symptoms” with 47 (17.5%) and 46 (17.2%), respectively. Furthermore, of the plants used to treat diseases classified as “1: Certain infectious or parasitic diseases,” “26: Traditional medicine,” and “21: Other symptoms,” 4.4% (11), 6.0% (16), and 5.6% (15), respectively, were edible, whereas some classifications such as “9: Disease of the visual system” were only comprised of 0.7% (2) edible plants. There were also differences among classifications in the frequency of the plant organs used to prepare treatments, as shown in Table 2.

Comparison with medicinal uses in other parts of Tanzania

The species identified in this study were compared to reports from other regions of Tanzania in the MUHAS database and supplemented with other references [24–28] (see Additional file 3).

The MUHAS database included information on about half of the species collected (56, 51.9%) and the treatments (142, 53.0%) reported. Among the species with information in MUHAS, 20.1% (54 species) had a similar usage (e.g., in the same ICD-11 category as in this study). Within similar disease classifications, 8.9% (24) used the same plant organ, 7.5% (20) were treatments for exactly the same disease, and 2.6% (7) used the same plant to treat the same disease. When supplemented with other previous information, species for 64.9% (174) of the uses were verified, 29.1% (78) were used to treat a similar disease, 16.8% (45) used the same plant organ, and 13.1% (35) were used to treat the same disease. Many of the common treatments were from central-eastern Tanzania (9, 3.4%), followed by East Africa (5, 1.9%) in accordance with the availability of information of the species in central-east Tanzania (97, 36.2%) and East Africa (11, 4.1%). On the other hand, 35.1% (94) of the treatments did not have published ethnomedicinal information on the species and were novel species. The plant organs found to be most commonly used in this study and previous research for the same or similar disease with the same species were leaves (18, 6.7%) and roots (16, 6.0%), followed by bark (6, 2.2%).

Discussion

This study was able to elucidate the plants that were most frequently used to treat diseases and other maladies in the coastal bushlands of Tanzania. The most utilized plant family was Caesalpiniaceae; species within Caesalpiniaceae have also frequently been classified as Fabaceae in central-east [14] and northwest [11] Tanzania. Medicinal plants within Euphorbiaceae have also frequently been used and found in other research in northeastern and central-eastern Tanzania [4–9, 14], as well as northwestern Tanzania [11–12]. Rubiaceae was also frequently found in the study in northeastern Tanzania [5–9].

In this study, the most frequent plant types used in medicinal treatments were trees followed by shrubs. As previous research in northwestern Tanzania has shown, being near forests provides an opportunity to utilize trees for medicinal purposes and increases the likelihood of their use [3]. The region included in

this study area is also in the vicinity of forests, and the forested areas may have contributed to the medicinal species used in these regions for treatment, and ultimate collection by in this research.

Leaves and roots were the most commonly used plant organs in the preparation of medicine in this region of Tanzania; however, in previous research, roots were the most commonly used plant organ in northeastern and central-eastern Tanzania [4–9, 13], whereas leaves were most commonly used in the northwest [10–12] and central east [14]. In this study, leaves were used more frequently followed by roots. The possible frequent use of leaves is as follows: Firstly, all plant habits included in the study (e.g., trees, shrubs, herbs, grasses etc.) may have influenced the frequent use of leaves. Generally, the only commonly available organ of the plants for medicine is leaves when all the plant habits are involved. The roots or barks of herbs and grasses are rarely recorded. Second, the study included experts as well as non-experts as informants. Leaves make infusion easy, and consequently are used by majority even by non-experts in traditional medicine. Third, the frequent use of leaves may be a result of the villages within the research area utilizing several tree species in neighboring forest reserves [10]. The use of leaves as opposed to roots may have a positive consequence on the conservation of the species as the use of leaves is less likely to severely damage the plant and threaten plant survival in comparison to roots. However, it should also be noted that medicinal plants have other uses that may lead to their over exploitation, threatening their continuous survival in the area [29]

Analyses of ethnomedicinal claims from southeastern Tanzania were performed, and 9.3% of the treatments were identical in terms of species, disease remedied, and plant organ(s) used. Claims concerning the plants are listed in Table 3.

Table 3
Medicinal plants with similar uses in the coastal bushlands and southeastern Tanzania

Medicinal species	Plant organ	Area treated, uses
Abrus precatorius	Leaves	Eye issues
Alchornea laxiflora	Leaves	Hernia
Aloe lateritia	Gel	Tinea capitis, burns
Annona senegalensis	Bark	Boils
Azadirachta indica	Leaves	Malaria, insecticide
Cajanus cajan	Leaves	Ward against witchcraft
Croton sylvaticus	Leaves	Malaria
Deinbollia borbonica	Leaves	Convulsion
Ehretia amoena	Leaves	Convulsion
Grewia forbesii	Roots	Stomachache
Ocimum gratissimum	Leaves	Convulsion
Piliostigma thonningii	Bark	Cough and cold
P. thonningii	Leaves	Stomachache
Psidium guajava	Leaves	Diarrhea
Sclerocarya birrea ssp. caffra	Bark	Blood in stool
Securidaca longipedunculata	Roots	Snake bites
Senna occidentalis	Roots	Hernia, stomachache
Tamarindus indica	Bark	Diarrhea
T. indica	Roots	Cough
Trichodesma zeylanicum	Roots	Wounds
Xylotheca tettensis	Leaves	Stomachache

Previous research indicated that the identical uses of medicinal plants used by different people from different areas support the notion that the plant may have curative properties [11, 30]. On the other hand, some plant organs are known to be poisonous. The seeds of Abrus precatorius [25], the bark of Securidaca longipedunculata, and the roots of Vernonia amygdalina [24] are established as toxic, and their use can be dangerous. Meanwhile, some species such as Annona senegalensis, Azadirachta indica, Cassia occidentalis (Senna occidentalis), Moringa oleifera, and Psidium guajava, also included in this study, are considered to have good toxicological profiles [31]. Furthermore, the edibility of the plant organ is another sign of established usage, and 28.7% of the species in these studies were edible. Analysis also showed that edible plants were used more frequently to treat infectious or parasitic diseases.

Some plants in this study were used for the treatment of multiple diseases. A possible reason might be that plants contain various secondary metabolites that could have different pharmacological activities that can treat different diseases. Securidaca longipedunculata was the most used among nine plant organ–malady combinations (i.e., combinations of bark, roots, and leaves were used for constipation, spinal hernia, convulsion strike, and snake bites). Using roots to

treat snake bites is also common in Nigeria, and this species has been well studied there. Its bark is known to be toxic, and aqueous stem bark extracts have been shown to be slightly toxic [32]. However, another study indicated that the bark served an antibacterial function, which supports its use in the management of bacterial diseases [33]. The evaluation of its leaf and root extracts indicated that the roots have a high antimicrobial activity [34].

Abrus precatorius was used in seven plant organ–malady combinations (i.e., combinations of seeds, leaves, and roots for the treatment of eyes, pregnancy, birth, and blood in urine). The use of leaves to treat issues with the eyes occurs in nearby African regions, but the leaves are also known to be toxic. Previous research has indicated that the leaves contain various substances with potential therapeutic effects [35].

There were also discrepancies in the literature regarding the geographical generalization of Tamarindus indica, well-known edible species. Previous research indicated that the bark is used in West Africa, whereas the leaves are used in East Africa to treat diarrhea [26]. However, this study shows that that bark is also used to treat diarrhea in East Africa.

This study has a few limitations. First, information on the preparation, dosage, and route of administration of medicinal plants is proprietary and, therefore, limits the capability of direct comparisons of previous and future ethnomedicinal research. Second, the study is limited to defining uses in the given research area and is not representative of common usage. However, the diversity of knowledge and usage between areas, even within the same ethnic group, has been argued elsewhere [16, 17].

Conclusions

In this study, a large number of medicinal plants were shown to be used for treating different diseases in the coastal bushlands of Tanzania. Altogether, 108 plant species belonging to 49 families and 91 genera have been identified as medicinal plants used by traditional healers or villagers in Lindi District, Lindi Region, southeast Tanzania. Most of the medicinal plants were sourced from the wild, and the majority of the local names originated from the Mwera ethnic group and Swahili. In addition to their medicinal uses, some of these plants had other reported uses. Leaves were used more than any other plant organ, indicating that the traditional medicine culture in the area should not pose a significant threat to biological diversity. Although medicinal plants related to magic were reported, which constituted some portion of the study, their efficacy is beyond the verification of science. Many other treatments for symptoms have also been reported in other published studies in other areas, providing evidence to support the villagers' claims. The study also indicated new treatments not yet reported, providing future potential sources of novel medicine. This research provides valuable information for further phytochemical and biological activity studies leveraging cultural knowledge of indigenous plants.

List Of Abbreviations

ICD, International Classification of Diseases;

ITM, Institute of Traditional Medicine;

MUHAS, Muhimbili University of Health and Allied Sciences;

WHO, World Health Organization

Declarations

Consent to participate

The objective/design of the research was explained to the interviewees, and written consent was obtained before the start of the study after understanding the research. This research was approved by the Ethical Committee of Utsunomiya University (H15-0049).

Consent for publication

Consent for the publication of the provided information was confirmed with each interviewee at the start of the study and also reconfirmed after data collection.

Availability of data and materials

The data used for this article is provided in the supplement. Plant specimens are deposited at the herbarium of the University of Dar es Salaam, the herbarium of ITM MUHAS, and Tochigi Prefectural Museum.

Competing interests

The authors declare they have no competing interests in this subject matter.

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Authors’ contributions

KS collected, organized, and analyzed the information and drafted the initial version of the article and also edited and finalized it. JNO advised on the data to be collected, provided previous ethical consent forms, facilitated agreements between Utsunomiya University and ITM, edited and commented on the manuscript, and contributed to the discussion. ICK retrieved information from the MUHAS database and contributed to information about common tree species. FMM partly participated in the data collection, identified the families and species, and collected information on plant types and distributions. All the authors reviewed the manuscript and agreed on the final draft.

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Additional File Information

Additional File Information

File name: Additional file 1

File format: xlsx

Title: Data set by Plants

Description: Data set

File name: Additional file 2

File format:.xlsx

Title: Data set by use

Description: Data set

File name: Additional file 3

File format:.xlsx

Title: Medicinal plants from the study in coastal bushland of Lindi District, Lindi Region compared to uses in other regions

Figures

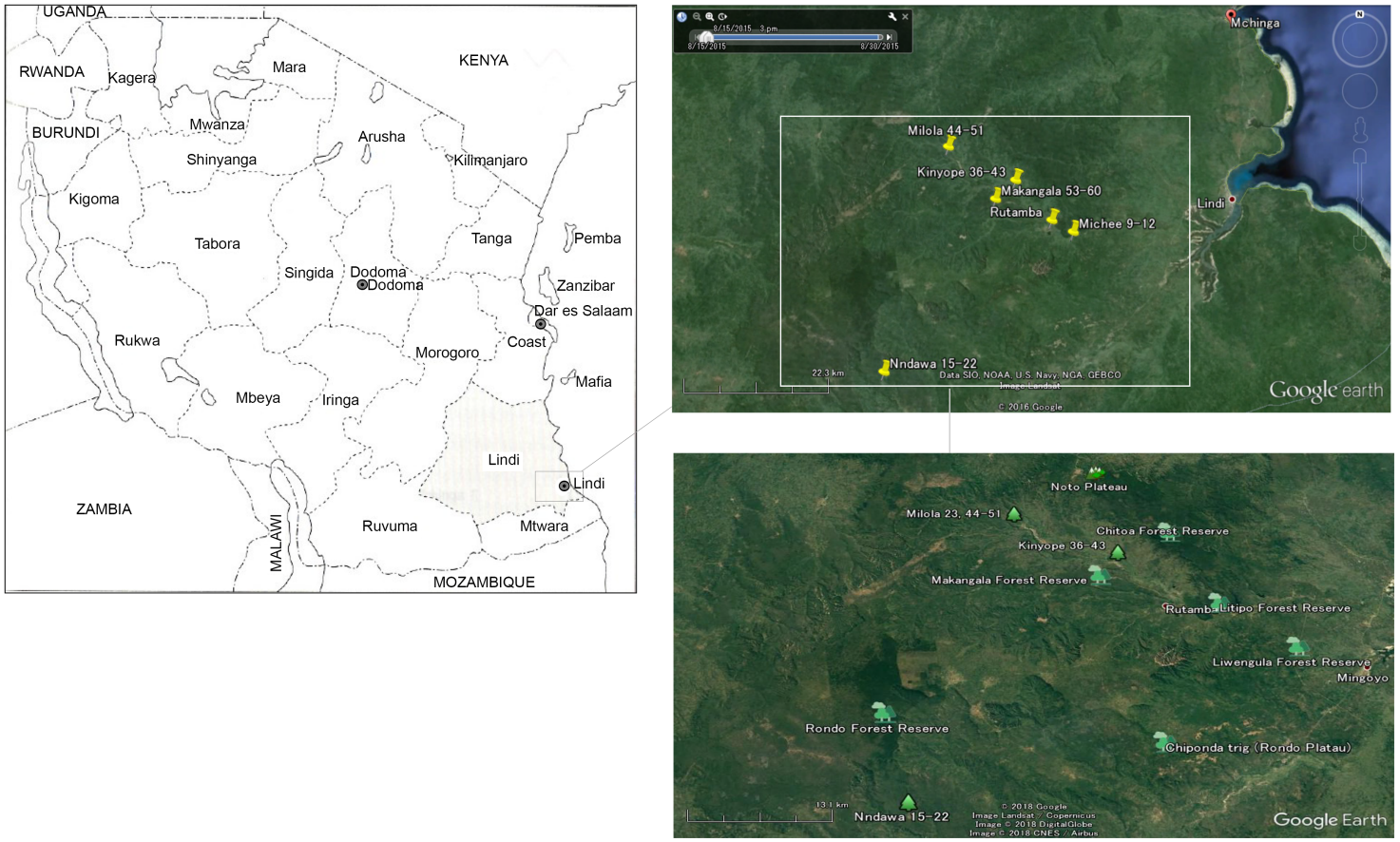

Figure 1

Location of the study area in the Lindi Region and forest reserves

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