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Ethnobotanical Study on Awareness of Medicinal Plants Used to Treat Urinary Tract Infection and Microbial Infections in Biharamulo District

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ABSTRACT

Medicinal plants have been interested in many researchers for overcoming a catastrophic disaster of antimicrobial resistance. This study aimed to identify medicinal plants for treating UTI through an ethnobotanical survey conducted in the Biharamulo district in the Kagera region in Tanzania. Semi-structured questionnaires were used to assess the awareness of society on UTIs and their medicinal plants. UTI herbs were collected and identified. The ethnobotanical data were analyzed using the Chi-square test in SPSS version 16. Participants' awareness was justified by the statistically significant difference of p-values < 0.05. The study found most participants to have an understanding of UTI and its herbs because they identified clinical signs (85.2%), mode of transmission and etiology (41%), UTI herbs (99.5%), and used herbs to treat UTI (92.8%). Out of the 42 medicinal plants identified for treating UTI, 29 (69%) had pharmacological supports for antimicrobial activities, which were attributed to their phytochemicals and ethno medical literature support for treating UTI and other related microbial infections; they belonged to 20 families whereby the dominant were Lamiaceae 17.2 %, and legumes are (10.3 %). This agreed with other studies that society knew UTIs and their medicinal plants. Ethno medical literature supported this study. The study results were significantly justified and supported the uses of identified medicinal plants for treating UTIs with antimicrobial efficacies, as traditional healers and herbalists claimed. Hence this study may provide a direction and scope for further discovery of new UTI drugs.

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INTRODUCTION

Medicinal plants possess therapeutic potentials with more significance than orthodox medications by having a wide range of efficiencies with sophisticated mechanisms for curing various illnesses. At the same time, some may become sources of nutrients, all of which enhance people's health. The holy bible depicted at most minuscule 30 medicinal plants, while Hippocrates gave over 400 herbs [1]. An ethnobotanical survey helps gather information about herbs from residents who belong to their traditions and beliefs [2]. Through an ethnobotanical survey, much-hidden information on medicinal plants can be obtained and become helpful in treat-

ing various diseases which slow down the development of the community. To effectively tackle antimicrobial illnesses, WHO associated folk and Western medicines with contemporary and alternative medications [3].

Urinary tract infection happens when microbes like bacteria and fungi colonize and infect parts of the urinary system. Previous studies showed that the prevalence of UTI is 30.9% among pregnant women at Bugando in Mwanza, Tanzania [4]. Bacteria and fungi cause UTIs, with *E. coli* being the leading microbe, accounting for more than 80% of the etiology [5]. The rest UTI causative agents are countered by *P. mirabilis*, *K. pneumonia*, *S. aureus*, *E. faecalis*, and fungi [6]. When UTI is accompanied by illnesses that deteriorate host immunity, it is regarded as a complicated UTI [3]. The disease is transmitted through genital organs to contact with infected agents like water from toilets and bathrooms, poor personal hygiene, the crossing of *E. coli* from the alimental canal to the urinary system, and sexual intercourse. Urinalysis and media-based microbial culture are the diagnostic tests for UTI [7]. Gave clinical indications of UTI as pains during urination, high rate of urination, fever, shivering, vomiting, and aches in the lower abdomen and back. Its side effects are associated with discomfort, deterioration of the reproductive system, body impairment, and promotes miscarriage in females. UTI is treated by using antibiotics, probiotics, and medicinal plants and equipping self and public person hygiene [8].

Biharamulo district has medicinal plants found in sub-equatorial climatic conditions. Within the district civilization, there are herbalists with extensive awareness gained via battling illnesses in daily life and from oral dissemination of traditional herbal knowledge and skills from nearby nations [9]. The majority of herb knowledge is passed down orally through informal education, which has resulted in the concealment of some necessary details about folk therapies among the communities and resulted into the prohibition of their accessibility of such information to the younger generation [2]. Herbal remedies were undermined and discredited throughout the colonial era in Africa, as inferior medical interventions, but later on, research into their phytochemicals had revealed that they possess pharmacological significance. Research is a crucial tool for taking what hearsays into consideration when putting theories into perspective in order to support what traditional healers have claimed and believed on herbal remedies for a long time [2].

To address the issue, an ethnobotanical survey was required to verify the information narrated by critical informants and traditional healers regarding using specific medicinal plants to treat UTIs. Finally, to document what is revealed for society's future health and prosperity. Therefore, this study identified and established medicinal plants for treating UTI and other related microbial infections.

2.0 Materials and Methods

2.1 Description of the study area

The research was conducted in Biharamulo district in the Kagera region, which is allocated to North Western part of Tanzania. Tropical-equatorial climatic conditions with bimodal rainfall characterize the area. Peasant agriculture is the economic backbone of society. Its dominant tribes are Subi, Ha, and Haya, who belong to Christians, Muslims, and paganism [5] . Five of the 17 wards, namely Biharamulo town, Kabindi, Kalenge, Nyarubungo, and Nyakahura wards, were selected for the study. Below is a map of the Biharamulo district indicating the study areaFigure 1 .

2.2 Study designs

It employed a cross-sectional study design. The cross-sectional study design involved interviewing ethnobotanical surveys among five wards of Biharamulo district.

2.3 Sample Size and sampling techniques

Snowball sampling technique was used to recruit 400 participants in an interview by using semi-structured questionnaires during an ethnobotanical survey in Biharamulo district; it involved five wards, namely Biharamulo town, Kabindi, Kalenge, Nyarubungo, and Nyakahura. According to sample size was calculated from Yamane's formula: -

n=N/ (1+Ne2)

n=124 368/ (1+124 368*0.052)

Where n = desired sample size, e= acceptable error (5%), N =124 368 people as the known population from the census 2012 in 5 wards of Biharamulo district. Therefore, the sample size was 399 participants.

2.4 Ethnobotanical Survey and Identification of medicinal plants

In the ethnobotanical survey, villagers, traditional healers, and key informants in 5 wards of Biharamulo district were interviewed using semi-structured questionnaires with open and closed-ended questions. Information on medicinal

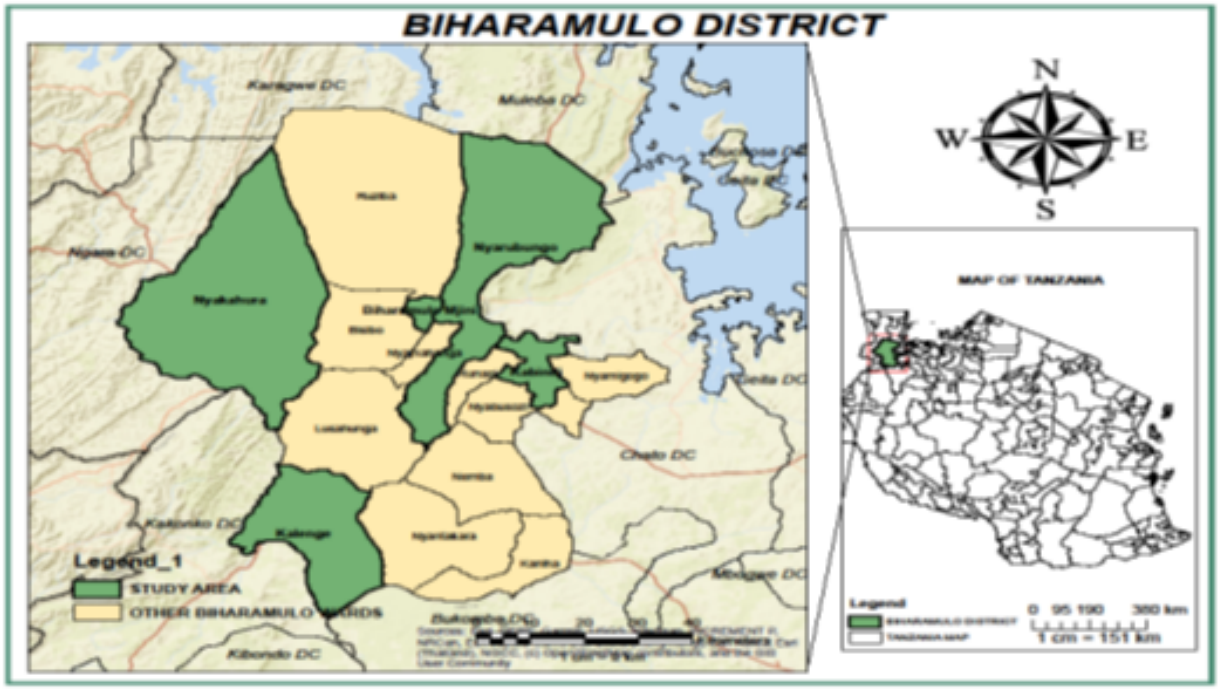

Figure 1: A map of Biharamulo district in Kagera. Source:Created by GIS program (2021)

plants vernacular names or morphology helped to identify the plants by matching their pictures with those in plant net identification software and confirmed through the literature [10] .

2.5 Method of data analysis

The ethnobotanical survey data were compiled by using Microsoft Excel in Windows 2016. Version 16 of the Statistical Package for Social Sciences (SPSS) software was used to analyze the data using the Chi-square test [11] . Statistically significant differences between interviews' awareness of UTIs and their medicinal plants were determined from the Chi-square test at the p-values < 0.05.

3.0 Results

3.1 Demographic characteristics of participants inwards of Biharamulo district, Kagera

The ethnobotanical survey on medicinal plants for treating UTI was conducted in Biharamulo district, whereby 400 respondents were interviewed using semi-structured questionnaires to assess the effects of medicinal plants used for treating urinary tract infections in humans. Female respondents were more (65%) than males. In age, most respondents were youth (60.5%), followed by adulthood (28%) and elders (11.5%). Of the occupations that participated, most of them were nondominant occupations (45.2%) like teachers, medical service providers, homemakers, and motorcycle riders, followed by farmers (34.8%), businessmen (11.8%), and traditional healers (8.2%). Most participants attained secondary and primary education by 43.5% and 41.8%, respectively. In tribals, Ha participated with high frequencies (39.2%), followed by Subi (26.2%), other less dominant tribes (19.5%), Haya (11%), and finally, Hangaza (4%)Table 1

3.2 Correct responses on awareness of UTI and its medicinal pants

Awareness of UTI among 400 interviews indicated that people already diagnosed or heard patients with UTI (98.2%), those able to give causes and mode of transmission (41%), and those said UTI could be treated by using medicinal plants (53.5%). For awareness of UTI medicinal plants, those mentioned at least one medicinal plant (99.5%), those who used the herbs (92.8%), those who know herbs locations (93.5%), understanding herbs safety (85%), people sold medicinal plants (13.8%), those able to mentioned medicinal plants for treating other related microbial infections like typhoid, gonorrhea, and syphilis (15%) and participants appreciated medicinal plants for treating UTI (68.8%)Table 2

3.3 Awareness of UTI and its medicinal plants according to the sexes of participants

In assessing awareness of UTI and its medicinal plants, females had a good understanding (72.3%) compared to males (66.6%). On the other hand,

Table 1: Demographic characteristics of respondents

	N = 400 interviews	
Characteristics	Frequencies	Percentage (%)
Sex		
Male	140	35
Female	260	65
Age		
Youth age: 18 - 35 years old	242	60.5
Middle age: 36 - 55 years old	112	28
Old age: 56 years and above	46	11.5
Occupations		
Farmer	139	34.8
Businessmen	47	11.8
Traditional healer	33	8.2
Others	181	45.2
Education level		
Informal education	20	5
Primary education (std 1 - 7)	167	41.8
Secondary education (std 9 - 12)	174	43.5
Tertiary education (above std 12)	39	9.8
Tribes		
Subi	105	26.2
Ha	157	39.2
Haya	44	11
Hangaza	16	4
Sukuma	43	10.8
Others	35	8.8

Source: Field data (2022).

Table 2: Correct responses on awareness of UTI and itsmedicinal pants

Characteristics	N=400	
	Frequencies	Percentage
People diagnosed or heard of UTI patients in the society	393	98.2
Awareness of UTI clinical signs	341	85.2
Understanding UTI mode of transmission	167	41.8
Understanding UTI etiology	164	41.0
People said UTIs could be treated by using medicinal plants	214	53.5
People can mention medicinal plants for treating UTI	398	99.5
People treated UTIs by using medicinal plants	371	92.8
People said UTI medicinal plants to be available	374	93.5
People said UTI medicinal plants are safe for the health	340	85
People selling medicinal plants	55	13.8
Knowing herbs to treat related microbial infections	60	15
People appreciated medicinal plants to cure UTI	275	68.8

Source: Field data (2022)

females were more knowledgeable in using medicinal plants than males as most of them agreed for UTI to be treated by medicinal plants, used their surrounding medicinal plants to treat UTI in daily life, and had a positive attitude toward medicinal plants by appreciating them than male respondents at a significant difference p-value < 0.05Table 3

3.4 Awareness of UTI and its medicinal plants according to age groups of participants

In assessing awareness of UTI and its medicinal plants, old and middle-aged people had a good understanding (76%) compared to youth (68.7%). On the other hand, old and middle-aged people were more knowledgeable about treating UTIs and other related microbial infections by using medicinal plants. They sold experienced safety or nontoxic medicinal plants, including traditional healers, then youth age respondents at a significant p-value of < 0.05Table 4

3.5 Awareness of UTI and its medicinal plants according to wards of respondents

Participants from Biharamulo town were awarded in knowing UTI patients, clinical signs, medicinal plants' use, the availability of herbs, insurance of s safety to users, and understanding medicinal plants treat UTI and other microbial infections. They appreciated medicinal plants compared to other wards at a significant difference p-value of < 0.05 [Table 5]. Awareness of UTI and its medicinal plants indicated that Biharamulo town ward had a good understanding (77.71%, followed by, Nyakahura (72.19%), Nyarubungo (68.85%), Kabindi (63.13%), and finally Kalenge ward (60.10%).Table 5

3.6 Awareness of UTI and its medicinal plants according to education level

Tertiary education has good awareness of UTI etiology, transmission, and treatments compared to other levels. Based on education level, tertiary education level had more understanding (75%) than primary (71.2%), informal (70.4%), and lastly secondary educated members (62.4%). In contrast, conversational education level followed by primary levels were most aware of how to use medicinal plants, sell medicinal plants, their availability locations, and herbs for treating other microbial infections compared to different groups at a significant difference p-value of < 0.05Table 6

3.7 Awareness of UTI and its medicinal plants among Participant occupations

Among participant occupations, traditional healers had good awareness (85.7%) compared to business people (72.7%), farmers (70.9%), and lastly, other less dominant occupations (65%). On the other hand, traditional healers had an excellent awareness of UTI causes and transmission, using the medicinal plant in treatments, equipped with psychomotor skills in the preparation and selling of UTI herbs, their side effects and safety, and understanding of medicinal plants able to treat UTI and other related microbial infections like gonorrhea and syphilis, with high appreciation to medicinal plants compared to other occupations at the significant difference of p-values of < 0.05Table 7

3.8 Awareness of UTI and its medicinal plants among tribes of participant

In awareness of UTI and its herbs, Hangaza was more knowledgeable compared to other tribes as they encountered (80.2%,) followed by Subi (70.2%), Haya 69%), Ha (66.4%), and finally, a mixture of other tribes (63.3%). Based on statistical significance, Hangaza, followed by Subi, possessed good awareness of UTI and its medicinal plants in diagnosis and hearing patients, UTI transmissions, treatments of UTI by using medicinal plants, identification of UTI herbs, use of herbs to treat UTI, the safety of UTI herbs and herbs to treat related microbial infections compared to other tribes at a significant difference p-value of < 0.05Table 8

3.9 Information dissemination on UTI and its medicinal plants in Baramulo's societies

Information dissemination on UTI and its medicinal plants among Biharamulo societies was distributed by villagers among themselves (49.5%), followed by medical experts and public health extension educators (18.8%), parents (11.8%), traditional healers (5.5%), from other occupations (2.3%) and lastly, those who did not remember where they acquired UTI information (0.8%). These indicated a need for further provision of UTI information by responsible institutions, as most of the education was provided by villages that were less knowledgeable about UTI Figure 2

3.1 Medicinal plants and their information

Based on interview information in the ethnobotanical survey, among the 42 medicinal plants identified, only 29 (69%) were supported by literature to have pharmacological significance in treating UTIs. Furthermore, their vernacular and botanical names, families, parts, usable states, preparation methods, and diseases treated were documented, whereby among the active 29 herbs, pharmacologically treated UTI (96.5%), typhoid (48.3%), malaria (34.5%), anthelmintic (24.1%), STDs (20.9%), cough (17.2%), worm infections (11.9%), wounds and ulcers (17.2%), fungal infec-

Table 3: Awareness of UTI and its medicinal plantsaccording to the sexes of participants

Awareness in:	Sexes' answer frequencies (%)		P-value
	Male	Female	
	n = 140 (35)	n = 260 (65)	
People diagnosed or heard UTI patients	138 (34.5)	255 (63.8)	0.532
Mentioning UTI clinical signs	116 (29.0)	225 (56.2)	0.199
Understanding of UTI mode of transmission	56 (14.0)	111 (27.8)	0.34
Understanding of UTI etiology	59 (14.8)	105 (26.2)	0.407
Treatment of UTI by medicinal plants	62 (15.5)	152 (38.0)	0.001
Identification of UTI medicinal plants	139 (34.8)	259 (64.8)	0.578
Use of medicinal plants to treat UTI	121 (30.2)	250 (62.5)	0.002
Selling UTI medicinal plants	17 (4.2)	43 (10.8)	0.152
Availability of UTI medicinal plants	127 (31.8)	247 (61.8)	0.221
Safety of UTI medicinal plants	112 (28.0)	228 (57.0)	0.120
Knowing Herbs to treat other related microbes	86 (21.5)	162 (40.5)	0.473
Appreciation for UTI medicinal plants	85 (21.2)	190 (47.5)	0.053
Total percentages of items (%)	(66.6)	(72.3)	

Significant p-values (<0.05) according to the Chi-square test; Source: Field data (2022).

Table 4: Awareness of UTI and its medicinal plants accordingto age groups of participants

Characteristics	Age groups in years			Chi-square
	Youth (18-35) n = 242 (60.5)	Adulthood (36-55) n = 112 (28)	Old age (55 +) n = 46 (11.5)	P-value
People diagnosed or heard UTI patients	237 (59.2)	110 (27.5)	46 (11.5)	0.619
Mentioning UTI clinical signs	204 (51.0)	99 (24.8)	38 (9.5)	0.520
Understand UTI transmission	101 (25.2)	49 (12.2)	17 (4.2)	0.734
Understanding of UTI etiology	101 (25.2)	47 (11.8)	16 (4.0)	0.660
Treatment of UTI by medicinal plants	108 (27.0)	74 (18.5)	32 (8.0)	0.000
Identification of UTI medicinal plants	240 (60)	112 (28.0)	46 (11.5)	0.519
Use of medicinal plants to treat UTI	218 (54.5)	107 (26.8)	46 (11.5)	0.114
Selling UTI medicinal plants	28 (7.0)	18 (4.5)	14 (3.5)	0.004
Availability of UTI medicinal plants	220 (55)	108 (27.0)	46 (11.5)	0.52
Safety of UTI medicinal plants	191 (47.8)	104 (26.0)	45 (11.2)	0.000
Knowing Herbs to treat other microbes	76 (19.0)	54 (13.5)	22 (5.5)	0.003
Appreciation for UTI medicinal plants	155 (38.8)	88 (22)	32 (8.0)	0.209
Knowing UTI expertise with evidence	117 (29.2)	60 (15.0)	24 (6.0)	0.634
Total percentages of items (%)	68.7	76.6	76.8	

Significant p-values (<0.05) according to the Chi-square test
Source: Field data (2022)

Table 5: Awareness of UTI and its medicinal plantsaccording towards

	Wards' answer frequencies and (%)					P-value
	Bihara-mulo	Kabindi	Kalenge	Nyakahura	Nyarubungo	
UTI awareness in:	n = 80 (20)	n = 80	n =80	n = 80	n = 80	
Diagnosed or heard UTI patients	80 (20.0)	77 (19.2)	79 (19.8)	78 (19.5)	79 (19.8)	0.437
UTI clinical signs	73 (18.2)	68 (17.0)	59 (14.8)	73 (18.2)	68 (17.0)	0.011
Understanding spread	43 (10.8)	31 (7.8)	27 (6.8)	36 (9.0)	30 (7.5)	0.089
Understanding etiology	40 (10.0)	29 (7.2)	32 (8.0)	34 (8.5)	29 (7.2)	0.370
Treatment by herbs	52 (13.0)	29 (7.2)	28 (7.0)	48 (12.0)	57 (14.2)	0.000
Identification of herbs	80 (20.0)	80 (20.0)	79 (19.8)	79 (19.8	80 (20.0)	0.555
Use of UTI herbs	80 (20)	70 (17.5	66 (16.5)	77 (19.2)	78 (19.5)	0.000
Selling UTI herbs	17 (4.2)	10 (2.5)	12 (3.0)	8 (2.0)	13 (3.20	0.341
Availability of herbs	78 (19.5)	70 (17.5)	71 (17.8)	79 (19.8)	76 (19.0)	0.029
Safety of UTI herbs	77 (19.2)	62 (15.5)	50 (12.5)	74 (18.5)	77 (19.2)	0.000
Herbs for microbes	57 (14.2)	21 (5.2)	30 (7.5)	20 (5.0)	24 (6.0)	0.000
Appreciation of herbs	69 (17.2)	59 (14.8)	44 (11.0)	53 (13.2)	50 (12.5)	0.000
Total percentages (%)	(77.7)	(63.1)	(60.1)	(72.2)	(68.8)	

Significant p-values (<0.05) according to the Chi-square test
Source: Field data (2022).

Table 6: Awareness of UTI and its medicinal plants amongeducation levels of participants

Awareness of UTI and its medicinal plants in:	Education level answer frequencies and (%)				P-value
	Informal n = 20	Primary n = 167	Secondary n = 174	Tertiary n = 39	
Diagnosed or heard UTI patients	19 (4.8)	166 (41.5)	169 (42.2)	39 (9.8)	0.213
Mentioning UTI clinical signs	17 (4.2)	141 (35.2)	146 (36.5)	37 (9.2)	0.360
Understanding the mode of transmission	5 (1.2)	67 (16.8)	66 (16.5)	29 (7.2)	0.000
Understanding UTI etiology	6 (1.5)	61 (15.2)	71 (17.8)	26 (6.5)	0.005
Treatment of UTI by medicinal plants	15 (3.8)	113 (28.2)	67 (16.8)	19 (4.8)	0.000
Identification of UTI medicinal plants	20 (5.0)	167 (41.8)	173 (43.2)	38 (9.5)	0.231
Use of medicinal plants to treat UTI	20 (5.0)	164 (41.0	151 (37.8)	36 (9.0)	0.003
Selling UTI medicinal plants	7 (1.8)	28 (7.0)	19 (4.8)	6 (1.5)	0.030
Availability of UTI medicinal plants	19 (4.8)	165 (41.2)	153 (38.2)	37 (9.2)	0.007
Safety of UTI medicinal plants	17 (4.2)	163 (40.8)	127 (31.8)	33 (8.2)	0.000
Knowing Herbs for related microbes	9 (2.2)	64 (16.0)	54 (13.5)	25(6.20)	0.002
Appreciation for UTI medicinal plants	15 (3.8)	128 (32.0)	106 (26.5)	26 (6.5)	0.214
Total percentages of items (%)	(70.4)	(71.2)	(62.4)	(75.0)	

Significant p-values (<0.05) according to the Chi-square test
Source: Field data (2022).

Table 7: Awareness of UTI and its medicinal plants amongparticipant occupations

Awareness of UTI and its medicinal plant in:	Correct answer frequencies and (%)				P-value
	Farmers n = 139	Business n = 47	Healer n = 33	Others n = 181	
Diagnosed or heard UTI patients	137 (34.2)	47 (11.8)	33 (8.2)	176 (44)	0.598
Mentioning UTI clinical signs	115 (28.8)	43 (10.8)	29 (7.2)	154 (38.5)	0.547
Understanding the mode of transmission	44 (11.0)	24 (6.0)	17 (4.2)	82 (20.5)	0.044
Understanding UTI etiology	44 (11.0)	23 (5.8)	16 (4.0)	80 (20.3)	0.088
Treatment of UTI by medicinal plants	89 (22.2)	30 (7.5)	25 (6.2)	70 (17.5)	0.000
Identification of UTI medicinal plants	139 (34.8)	47 (11.8)	33 (8.2)	179 (44.8)	0.639
Use of medicinal plants to treat UTI	134 (33.5)	44 (11.0)	33 (8.2)	160 (40)	0.134
Selling UTI medicinal plants	9 (2.2)	3 (0.80	30 (7.5)	18 (4.5)	0.000
Availability of UTI medicinal plants	136 (34.0)	44 (11.0)	33 (8.2)	161 (40.2)	0.071
Safety of UTI medicinal plants	133 (33.2)	45 (11.2)	29 (7.2)	113 (33.2)	0.000
Knowing Herbs for related microbes	46 (11.5)	13 (3.2)	19 (4.8)	74 (18.6)	0.021
Appreciation for UTI medicinal plants	102 (25.5)	36 (9.0)	30 (7.5)	107 (26.8)	0.036
Total percentages of items (%)	(67.63)	(70.74)	(82.58)	(63.26)	

Significant p-values (<0.05) according to the Chi-square test
Source: Field data (2022).

Table 8: Awareness of UTI and its medicinal plants amongtribes of participants

Demographic information	Tribal answer frequencies and (%)					P-value
	Subi	Ha	Haya	Hangaza	Others	
Awareness in:	n = 105	n = 157	n = 44	n = 16 (4)	n = 78	
Diagnosed or heard UTI	104 (26.0)	156 (39.0)	43 (10.7)	16 (4.0)	74 (18.5)	0.017
Mentioning UTI signs	88 (22.0)	128 (32.0)	39 (9.8)	15 (3.8)	71 (17.8)	0.118
Understand transmission	39 (9.8)	60 (15.0)	17 (4.3)	12 (3.0)	39 (9.8)	0.019
Understanding etiology	39 (9.8)	57 (14.2)	19 (4.8)	11 (2.8)	38 (9.4)	0.098
Treatments by using herbs	70 (17.5)	86 (21.5)	25 (6.2)	9 (2.2)	24 (6.0)	0.001
Identification of UTI herbs	105 (26.2)	157 (39.2)	44 (10.4)	16 (4.0)	76 (19.0)	0.002
Use of herbs to treat UTI	103 (25.8)	148 (37.0)	42 (10.6)	16 (4.0)	62 (15.5)	0.02
Selling UTI herbs	21 (5.2)	21 (5.2)	6 (1.4)	5 (1.2)	7 (1.7)	0.188
Availability of UTI herbs	101 (25.2)	148 (37.0)	43 (10.8)	16 (4.0)	66 (16.5)	0.26
Safety of UTI herbs	93 (23.2)	136 (34.0)	38 (9.5)	15 (3.8)	58 (14.5)	0.005
Herbs related microbes	44 (11.0)	54 (13.5)	22 (5.4)	11 (2.8)	21 (5.2)	0.021
Appreciation for herbs	77 (19.2)	100 (25.0)	30 (7.5)	12 (3.0)	56 (14)	0.833
Total percentages (%)	(70.2)	(66.4)	(69.7)	(80.2)	(63.3)	0.135

Significant p-values (<0.05) according to the Chi-square test
Source: Field data (2022)

tions (13.7%), anemia (10.3%), diabetes, cancer, and toothache were each represented by cancer (6.9%), measles, cardiovascular diseases, and yellow fever were each represented once by (3.4%) (Table 2.9).

The 29 medicinal plants belonged to 20 families, whereby the dominant were Lamiaceae (17.24%), Asteraceae, Rutaceae, and Myrtaceae each accounted (6.9%), while the rest appeared once as 3.45%Table 9

4.0 Discussion

This study revealed that society must be aware of UTI, their medicinal plants, and other microbiological infections like typhoid, gonorrhea, and syphilis. In sex, females were more knowledgeable about UTI and its medicinal plants compared to males, it was attributed to the fact that women have genital anatomical structures that expose them to susceptibility to UTI infections compared to males, and they also maintain the health status of their families. Sup-

Table 9: Medicinal plants of Biharamulo district used totreat diseases

S/N	Botanical names (family)	Local name	Parts used	Frequency	Preparation	Disease Treated	Supporting literature for biomedical significance
1	Aloe vera (Asphodelaceae)	Shubiri (Swahili)	Leaves	101	Maceration and infusion	UTI, typhoid, and malaria	Antibacterial and antifungal[12]
2	Azadirachta indica (Meliaceae)	Mwarobain (Swahili)	Leaves	108	Infusion	UTI, typhoid, and malaria	Antimicrobial activity [13]
3	Bidens pilosa (L) (Asteraceae)	Shanda (Subi)	Leaves	60	Decoction and infusion	UTI and anemia, and ulcers	Antimicrobial activities [14,15]
4	Cinnamomum verum (Lauraceae)	Mdalasini (Swahili)	Barks	1	Maceration and decoction	UTI and ulcers	Antimicrobial [14]
6	Clematis terniflora (Ranunculales)	Bukakara (Subi)	Whole	17	Infusion and decoction	UTI, gonorrhea, wounds, and yellow fever	Antimicrobial [16]
7	Clerodendrum trichotomum (Lamiaceae)	Kiseke (Subi)	Leaves	1	Decoction and infusion	UTI, malaria, and worms	Antimicrobial [17]
8	Cymbopogan citratus (Poaceae)	Mchaichai (Swahili)	Whole	205	Maceration and decoction	UTI, ant allergic, antifungal, antibacterial	Antimicrobial [18,19]
9	Erythrina abyssinica (Leguminosae)	Omlinzi (Subi)	Barks	40	Maceration and decoction	UTI, gonorrhea, and typhoid	Antimicrobial [20]
10	Ipomoea cairica (L) (Comnvulvulaceae)	Kalandarugo (Haya)	Whole	93	Concoction and decoction	UTI and typhoid	Antibacterial [21]
11	Jacaranda mimosifolia (Bignoniaceae)	Mmea (Subi)	Whole	3	Maceration and decoction	UTI and typhoid	Antimicrobial [22]
12	Jatropha curcas L. (Euphorbiaceae)	Mbono (Ha)	Whole	19	Maceration and decoction	UTI, wounds, gonorrhea, cough, and toothache	Antimicrobial [23]
13	Kleinia fulgens (L.) (Asteraceae)	Kanyoro (Haya)	Roots	3	Maceration and decoction	UTI, syphilis, and gonorrhea	Antimicrobial [24]
14	Lantana camara (L.) (Verbenaceae)	Nyanunda (Subi)	Leaves	4	Concoction and infusion	UTI	Antibacterial [25]
15	Leonotis leonurus (L) (Lamiaceae)	Kitatelante (Subi)	Leaves	5	Infusion and decoction	UTI, anthelmintic and anti-malaria	Antimicrobial [26,27]
16	Moringa oleifera (Moringaceae)	Mlonge (Swahili)	Whole	26	maceration and decoction	UTI, typhoid, B. P, malaria, diabetes, and cancer	Antimicrobial activity [14]
17	N. macrophylla (Chrysobalanaceae)	Omnazi (Swahili)	Roots	7	Maceration and decoction	UTI and typhoid	Antimicrobial [28]
18	Ocimum sanctum (Lamiaceae)	Kashwagara	Leaves	156	Tisane and decoction	UTI and typhoid, and malaria	Antimicrobial activity [14,29]
19	Physalis peruviana (L) (Solanaceae)	Ntuntunya (Subi)	Leaves	69	Infusion and decoction	UTI and typhoid	Antimicrobial [17]

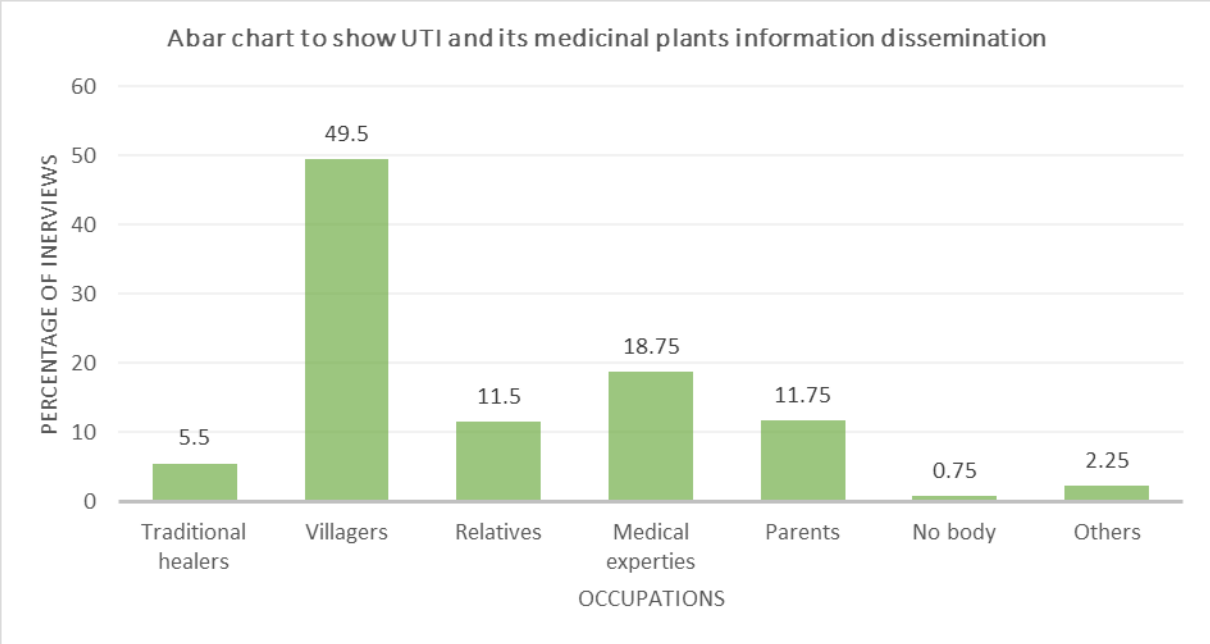

Figure 2: A bar chart for UTI information dissemination; Source: Field data (2022)

port for the same argument came from and who realized that women had the primary responsibility of providing healthcare in a family. This circumstance sparked their interest in researching accessible and effective medicinal plants against nosocomial infections, including UTIs.

The age groups were associated with acquiring knowledge of UTI medicinal plants. The Old age group was more knowledgeable, followed by the middle and finally, the youth age. This was linked to older people's prolonged exposure to herbs against ailments, especially traditional healers, who acquire herbal knowledge and experiences throughout their lifetime. Gave a similar finding that the level of understanding of herbs and experiences in a community varies directly in proportion to seniority, provided that senescence had not deteriorated the mental activities. The same ideal was observed by who argued that youths' irritation with medicinal plants was associated with seniors' concealment in herbs and youth preferences for orthodox over herbal remedies.

Biharamulo town wards were more knowledgeable in UTI and its medicinal plants due to extensive connection with individuals who brought their ancestral herbal knowledge from rural to urban areas, as opposed to other rural wards with few tribes fixed to a limited number of herbs. The previous studies from Lagos and proved that about 66% of urban inhabitants recognized and used medicinal plants for contagious infectious ailments like UTIs at affordable expenses.

Participants with higher educational levels had more heightened awareness of UTI but were less knowledgeable in its medicinal plants as most used antibiotics and ignored medicinal plants. Vice versa was accurate at the informal and primary levels, where most of them were aware of medicinal plants compared to higher levels of education [Table 6]. Similar findings from indicated a negative relationship between attained education and knowledge of folk medicine, with the argument being that as education levels ri, it initiates the loss of interest in folk medicine. They supported the argument by providing evidence that the uneducated exemplified more herbs than scholars.

Compared to other professions, traditional healers had a better understanding of UTI and its medicinal plants as they treated many patients and marketed herbs as commodities, giving them much experience with antimicrobial plants.

Hangaza tribes were more aware of medicinal plants for treating UTI than other tribes due to their proximity to neighboring nations like Burundi and Rwanda, which have historically swapped information about herbs dating back to the colonial era.In addition, people could participate by disclosing the details of UTI medicinal plants. This could account for Haya, who were suspected of knowing many medicinal plants but mentioned a small number of UTI medicinal plants. According to popular belief, healers keep secret in disseminating herbal information.

As a result of their accessibility and commitment

to plant protection, most participants from Biharamulo applied leaf decoctions and infusions as preparation methods for UTI treatments. This scenario was in line with a previous study conducted by who credited for the accessibility and consistency of leaves throughout the year except for a few arid climate zones. Furthermore, appreciated people from Kagera for utilizing leaves in medicinal plants.

Information dissemination on UTI and its medicinal plants within Biharamulo's societies was enhanced by less than 50% among villagers. Public health extension educators, traditional healers, and parents have educated the community on UTIs to a small extent, which is why most respondents did not understand the causes and transmission of UTIs. Comparative research from Kenya by shows that non-traditional healers, particularly older women are the best sources of herbal information for over 50%, while traditional healers hinder the herbal details. These signified a need for further provision of UTI information to the majority where villages provide UTI education. Regarding African folk medicine innovation has been hampered by the absence of reliable and secure supervision, inconsistent dosage, toxicity assessment, and recordkeeping. Herbalists are urged to adhere to these restrictions.

Biomedical justification for UTI herbal efficiencies. The literature review confirmed that all 42 medicinal plants possess tannins, phenols, and flavonoids with different extinctions of phytochemicals as described below; It has been ascertained that the Combretaceae family, which includes *Terminalia mollis*, contains resins and combrela tannins that kill microorganisms by precipitating their amino acids in cell walls. Myrtaceae (*S. guineense, and S. cordatum*) reported that anticancer have antimicrobial, hypoglycaemic, anthelmintic, and virucidal activities [46]. On the other hand, it was contended that members of the Olacaceae family, notably *X. caffra*, had antimicrobial, anticarcinogenic, and antiparasitic properties. Inulin found in the Asteraceae was reported by to have antimicrobial properties, including UTI. Many plants in the Lamiaceae family, but some of them, like *S. hispanica*, *P. barbatus*, and *H. opposite*, had poor antibacterial activity reported in the literature.

According to rutaceae family (*C. limon* and *Z. album*) contain limonoids, carbazole, benzylisoquinolines, and anthranilate, all of which have antimicrobial, antitumour, and anti-HIV. *Kleinia* sp had oleanolic acid, which accounts for antimicrobial activities. Family Solanaceae (*P. peruviana*) was reported by to comprise solanine, solasonine, and solamargine, which enhances antibacterial, anticancer, and cardiac impairments. Family Lauraceae (*C. verum*) contains aroma, Benzylisoquinoline, cinnamaldehyde, benzyl benzoate, and terpenoids, which elicit antimicrobial activities, antidiabetic and antiulcer potentials. Iridoids, quinones, and phenylpropanoids were reported by in Bignoniaceae (*J. mimosifolia*) to be accountable for the antibacterial, antiprotozoal, antidiabetic, and antitumor. *Aloe vera* contains anthraquinones and phenols responsible for antibacterial and antiplasmodial actions. *Azadirachta indica* was reported by to consist of limonoids, phenols, terpenoids, and coumarins, used as antimicrobial, antiplasmodial, and antiulcer.

Jatropha curcas produced atropine, terpenoids, and curcumin, which were associated with antibacterial, anti-HIV, relieve toothache, wound, and tumor healing properties. *Lantana camara* yields verbascoside and lantadene had antimicrobial activities. Moringa oleifera contains Benzyl glycosylates and gallic acid, which signifies antimicrobial, anticancer, antihyperglycemic, anti-infertility, and modulating the immune system. Clematis terniflora contains clematichinenoside, benzylisoquinolines, and triterpenoid, which are antibacterial, antiplasmodial, and antitumor and facilitate programmed cell death. *Cymbopogon citratus* was investigated by and found that it possesses scent citral and limonene, which are utilized as anticarcinogenic and can potentially kill bacteria and reported the family Leguminosae (*E. Abyssinia*, *S. siamea*, and *S. didymobotrya* possess resins, quinolizidine, anthraquinones, sennosides, naphthalene, and naphthalene with pharmacological significance in helminth and microbial infections.

According to the previous study, *Harungana madagascariensis* (Hypericaceae) produces the anthraquinones hypericin, hyperoside, and harungin used to treat diabetes, ulcers, and typhoid. *Ipomoea America* (Convolvulaceae) has phenylpropanoid, glycolysis, convolving, cyanogenic glycoside, and phytate, used as antimicrobial, antidiabetic, treats high blood pressure, and antitumor. *Neocarya macrophyla,* which incorporates terpenes and stigmasterol, was reported to be vital for antimicrobial and skin infections. Cucurbitacin and phytosterols from *Zehneria scabra* are used to fight against cancer and microbiological diseases. Finally, phytochemical analysis conducted by revealed the synthesis of gingerol isomers and zingiberene in *Zingiber officinale,* both of which have antibacterial and antifungal potentialities. Other species and their antimicrobial activities in different families are indicated in (Table 9). The 29 medicinal plants (69%) identified out of the total 42 were found to have related therapeutically

implications, ethnobotanical assertions, pharmacological justifications in literature, or possessed potential phytochemicals enough to treat UTI or related microbial illnesses.

5.0 Conclusion

This study succeeded in documenting UTI medicinal plants used in Biharamulo district rather than oral herb information dissemination as practiced by indigenous people. Phytochemical screening and sensitivity tests in the literature revealed that medicinal plants well known and mentioned at high frequencies from the ethnobotanical survey had little active phytochemicals, which accounted for weak antimicrobial activities compared to those mentioned by few people at low frequencies; this indicated that few people know vibrant UTI medicinal plants due to secrecy of traditional healers and this study will disseminate efficacies of the selected UTI medicinal plants.

This study justified the claims of traditional healers and herbalists on the uses of identified selected medicinal plants to have efficacies against UTI microbes and other related microbial infections. Therefore, the present study provided a direction, evidence, and scope for further discovering new UTI drugs for combating antimicrobial resistance.

6.0 Recommendations

Further research should be conducted to evaluate the antimicrobial effectiveness of identified medicinal plants and ensure their safety to users. Social and public health officers should educate people unaware of UTIs and their medicinal plants. Due to their pharmacological activities, society is advised to use environmentally friendly utilization of the herbs to sustain them so that they become reliable for the next generation.

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Conflict of Interest

The authors declare no conflict of interest, financial or otherwise.

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