Ethnomedicinal plants uses for the treatment of respiratory disorders in tribal District North Waziristan, Khyber Pakhtunkhawa, Pakistan

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Research

Abstract

Background: The current survey aimed to assess the traditional knowledge and use of therapeutic plants to treat various respiratory disorders by traditional healers. The local communities of District North Waziristan are reliant on therapeutic plant species for their primary health care needs.

Methods: Ethnobotanical data were collected through semi-structured interviews. A sum of 130 informants (107 male and 23 female) selected randomly and the demographic information (age, gender, herbalists (hakeem's), housewives and professional) was recorded through face-to-face interviews, as well as by using semi-structured questionnaires. Ethnobotanical data was quantitatively analyzed by using Use Value (UV), Relative Citation of Frequency (RFC), and Fidelity Level (FL).

Results: A total of 56 plants related to 32 plant families were recorded which were used to cure 24 various respiratory disorders. Lamiaceae (7 species) was the most prevalent plant family, followed by Asteraceae (5 species), Moraceae and Solanaceae (4 species) each, 8 families have (2 species each), while the remaining 20 families has only (1 species each).The dominant growth form was herbs (53.57%), while leaves (28.57%) were the leading plant part used in remedies preparation for respiratory disorders. The dominant method of medications preparation was decoctions (42.86%), which were all administered orally. The plant species with highest use values were *Ephedra procera* (0.87), followed by *Morus nigra* (0.86), while the highest RFC values were recorded for *Ephedra procera* (0.36), followed *Cydonia oblonga* (0.35), *Morus nigra* (0.34). The therapeutic plant species with maximum use values reported in the survey may indicate the possible presence of important bioactive compounds which need a search for potential new drugs to treat various respiratory disorders.

Conclusions: The study accomplishes that indigenous communities yet prefer therapeutic plants species over allopathic drug for curing different disorders. However this valuable traditional information is limited to elder people. So, attention is required to conserve this traditional knowledge.

Keywords: Traditional knowledge, Respiratory disorders, Medicinal plants, fidelity level; North Waziristan, Pakistan

Background

Respiratory disorders have remained a communal health challenge all over the world, with over 500 million cases being detect in developing countries, where environmental and individual conditions influence them to a high incidence. Internationally, these disorders influence millions of people across different ages and account for major levels of death and disability particularly in children less than 5 years (Ahmad *et al.* 2016; Bryce *et al.* 2005; Liu *et al.* 2016; Secher *et al.* 2018). The occurrence of respiratory diseases remains high in both developed and developing countries. Most of these diseases for example, asthma, cough, pneumonia, whooping cough and chronic obstructive pulmonary disease (COPD) are preventable (Irfan *et al.* 2017; Yeh & Horwitz, 2017). Respiratory disorders often occur as a result of polluted air, microbial infection and way of life while the jeopardy factors include air pollution, tobacco smoke and dusts as well as common lower respiratory infections during babyhood. Although the advances in pharmaceuticals and generally medicine development, the significance of plants for medical care and common safety cannot be overemphasized (Atanasov *et al.* 2015, 2018; Hwang *et al.* 2018; Langeder *et al.* 2020; Musa *et al.* 2022; Sher *et al.* 2022). For instance, (Younis *et al.* 2018) alluded to the extensive use of medicinal plant species for the treatment of respiratory diseases in Pakistan. The authors reported that the high occurrence of cough is treated with regarding 56% of the 384 therapeutic plants used for different respiratory diseases (Assiri, 2018).

The ethnobotanical significance of therapeutic plant species mostly support to keep community health from a period of time in various traditions and cultures throughout the globe (Bahmani and Eftekhari, 2013; Ghasemi *et al.* 2013; Sahebka *et al.* 2014; Ullah *et al.* 2018). According to the (WHO) report, that 80% worldwide inhabitants is reliant on therapeutic plants for their basic health care systems. Furthermore, approximately 11% of vital drugs are derived from medicinal plants (Haq, 2004). Thus to analyze the utilization of therapeutic plants for the cure of ailments, the researcher obtained important information several years ago (Heinrich, 2000; Ullah *et al.* 2022). Due to high price and side effect of allopathic drugs factors most of the indigenous communities depend on traditional medicinal plant for basic health care needs (Heinrich, 1997). The inhabitants of the rural area due to their low income are mostly dependent on traditional plants. Therefore, indigenous people utilize traditional remedies of available medicinal plants (Irfan *et al.* 2019, 2022; Ramesh and Okigbo, 2008). Approximately, about 80% of medicinal plants were used by the inhabitants for basic health care systems (Khan *et al.* 2021; Wang *et al.* 2021). The traditional medication about respiratory disorders for human medical care are common in those region, where indigenous people depend more on therapeutic plant species than synthetic drugs. Enormous therapeutic plant species have naturally diverse benefits for human being, which are helpful against respiratory disorders globally and other regions of Pakistan (Hameed *et al.* 2011; Iftikhar *et al.* 2019). New species with highly medicinal importance have been added to the flora of Pakistan that can be used for the further extraction of phytochemicals and pharmacological activities (Ali *et al.* 2017).

The indigenous knowledge of the study area was still not documented. Therefore, the aim of this survey was to report therapeutic plant species and related indigenous knowledge of tribal district North Waziristan, Pakistan.

Materials and Methods

Study area

North Waziristan is a tribal area bordering Pakistan with Afghanistan. It lies between 32°35′ and "33°20" N latitudes and "69°25′" and "70°40′" E longitude. It is bordered on the North by district Kurram, district Hangu, and Afghanistan, on the south by district South Waziristan, on the east by Bannu district and on the west also by Afghanistan (Rehman *et al.,* 2022a) (Figure 1). North Waziristan falls under Inrano-Turanian Region. The average rainfall is 45cm. Wazir and Dawar are the main tribes. Pushto is the major language.

Ethnobotanical data collection

Ethnobotanical knowledge of medicinal plants was documented which were used to cure respiratory disorders. This study was conducted from April 2018 to October 2020. Ethnobotanical data was collected through questionnaire (Albuquerque *et al.* 2014). Traditional knowledge related to ethnomedicinal plants was recorded from 130 local respondents including elder people, herbalist (Hakeems), housewives, and professional with respect to the utilization of medicinal plants for the treatment of respiratory diseases. The data were recorded from local informants through face-to-face interviews, as well as by using semi-structured questionnaires. The questionnaire had two parts. The first part comprise of demographic information of respondents including gender, age, occupation, level of education and experience of using therapeutic plants. The 2nd part of questionnaire was comprised, includes common name, family name, part used, mode of preparation, route of administration and disease cured.

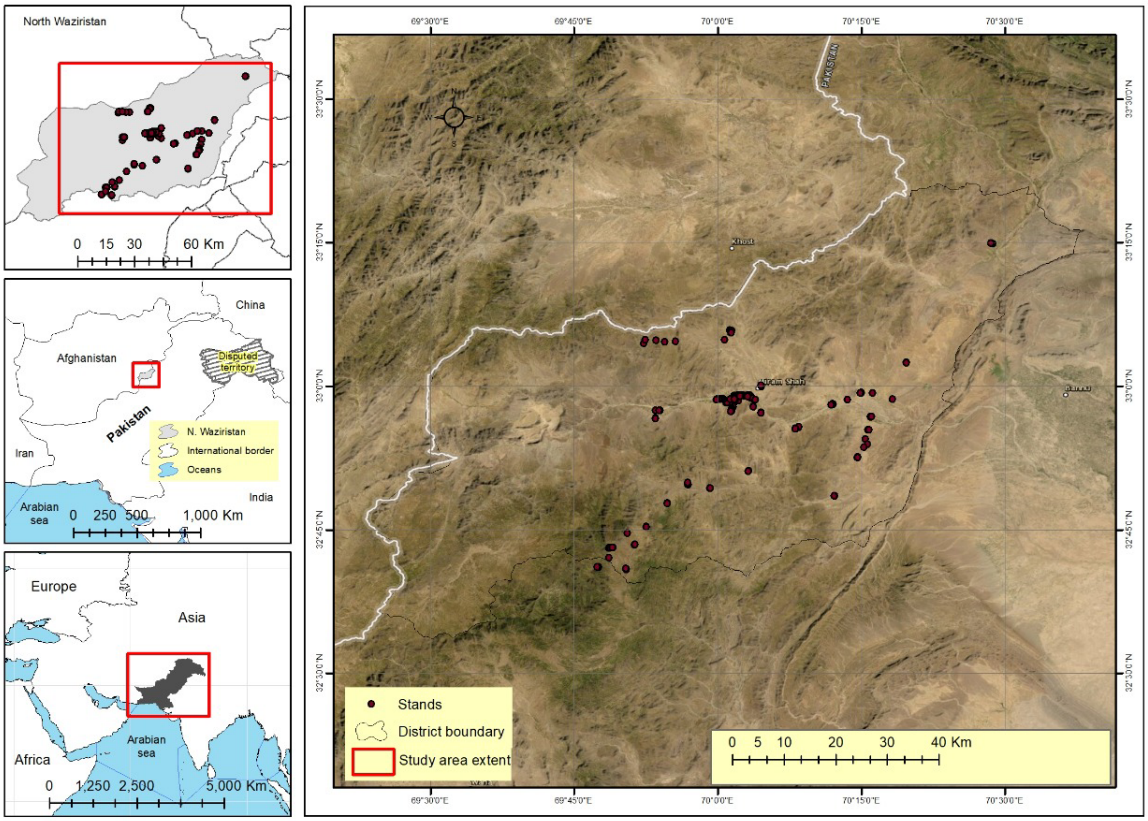

Figure 1. Map of the Study area, the black dots shows study points.

Plant identification and Preservation

The collected plant specimens were pressed, dried in the newspaper, and poisoned with (1% $HgCl_2$ solution), and mounted on standard herbarium sheets. Plants were identified by plant taxonomist (Dr. Rahmatullaha Qureshi) at Arid Agricultural University Rawalpindi Pakistan and confirmed the scientific names and families names with the available literature (Ali and Nasir 1970– 2002). The plant specimens were deposited to the herbarium, Department of Botany (HU) Mansehra Dhudial for future records.

Quantitative data analysis

Ethnobotanical data were analyzed by using various statistical indices like use value (UV), relative citation of frequency (RFC), and fidelity level (FL).

Use Value (UV)

The relative importance of each therapeutic plant was calculated by using the following equation according to (Savikin *et al.,* 2013).

$$UV = u/n$$

U= Total number of used reports of each medicinal plant; n = Sum of informants cited for a specific therapeutic plant.

Relative Frequency Citation (RFC)

Relative Frequency of citation was calculated by using the following equation according to (Vitalini *et al.* (2013).

$$RFC = FC / N$$

Where FC= Number of respondents mentioned the use of plant; N= Sum of informants who took part in the survey

Fidelity level (FL)

Fidelity level was used to determine the preference of a specific plant to cure respiratory diseases in the survey. High FL indicates high utilization of a medicinal plant for respiratory disorders while low FL indicates a low frequency for this condition. The Fl index was calculated according to (Friedman *et al.* 1986; Rehman *et al.* 2022a).

$$FL = Np/N * 100$$

Where Np = Number of respondents that cited a particular plant to treat respiratory disorders; N = Total number of respondents cited the plant species for any ailment.

Results

Demography of the Informants

A total of 130 participants were interviewed and the informants' age ranged from 30 to above 75. A total of 107 were men (82.31%) and 23 were women (17.69%) participants (Table 1). The vast majority of informants were herbalists (55.38%), followed by professional (26.92%) and housewives (17.69%). Based on age, the respondents were categories into 4 main groups i.e., 30-45 years (9.23%), 46-60 years (30.77%), 61-75 years (40%) and above 75 years (20%). Based on level of education, the traditional information to cure respiratory disorders is more common among uneducated people i.e., (41.54%), and the similar information was declining in the well-educated level (5.38%). Similar results were reported in previous published literature (Gedif and Hahn, 2003; Giday *et al.* 2009).

Table 1. Informant's demographics of district North Waziristan, Pakistan.

Variable	**Categories**	**No. of Participants N=130**	**Percentage (%)**
Gender	Male	107	82.31
	Female	23	17.69
Age	30–45	12	09.23
	46–60	40	30.77
	61-75	52	40.00
	Above 75	26	20.00
Occupation	Herbalists	72	55.38
	Housewives	23	17.69
	Professional	35	26.92
Education qualification	Illiterate	54	41.54
	Primary level	33	25.38
	Middle level	17	13.08
	Secondary level	10	07.69
	Undergraduate	9	06.92
	University level	7	05.38

Diversity of therapeutic plants used for respiratory ailments

During the current survey documented 56 medicinal plants belonging to 32 plant families which were used to cure 24 different types of respiratory diseases in Tribal district North Waziristan. All therapeutic plants along with botanical name, family name, local name, voucher number, parts used, preparation method, route of administration and diseases cured) and statistical analysis (FC, RFC, UR, UV, FL%) of each therapeutic plants are presented in (Table 2). Among 32 families, Lamiaceae was the dominant family with (7 taxa), followed by Asteraceae with (5 taxa), Solanaceae and Moraceae with (4 taxa) each, 8 families have (2 taxa) each, while the rest of 20 plant families have only (1 taxa) each (Fig. 2). In the present survey, the leading growth form used in herbal remedies preparation for respiratory disorders were herbs with 30 taxa (53.57%), followed by trees with 12 taxa (21.41%), shrubs with 10 taxa (17.86%), climbers, ferns, parasites and sedges have 1 species(1.79%) each (Fig. 3).

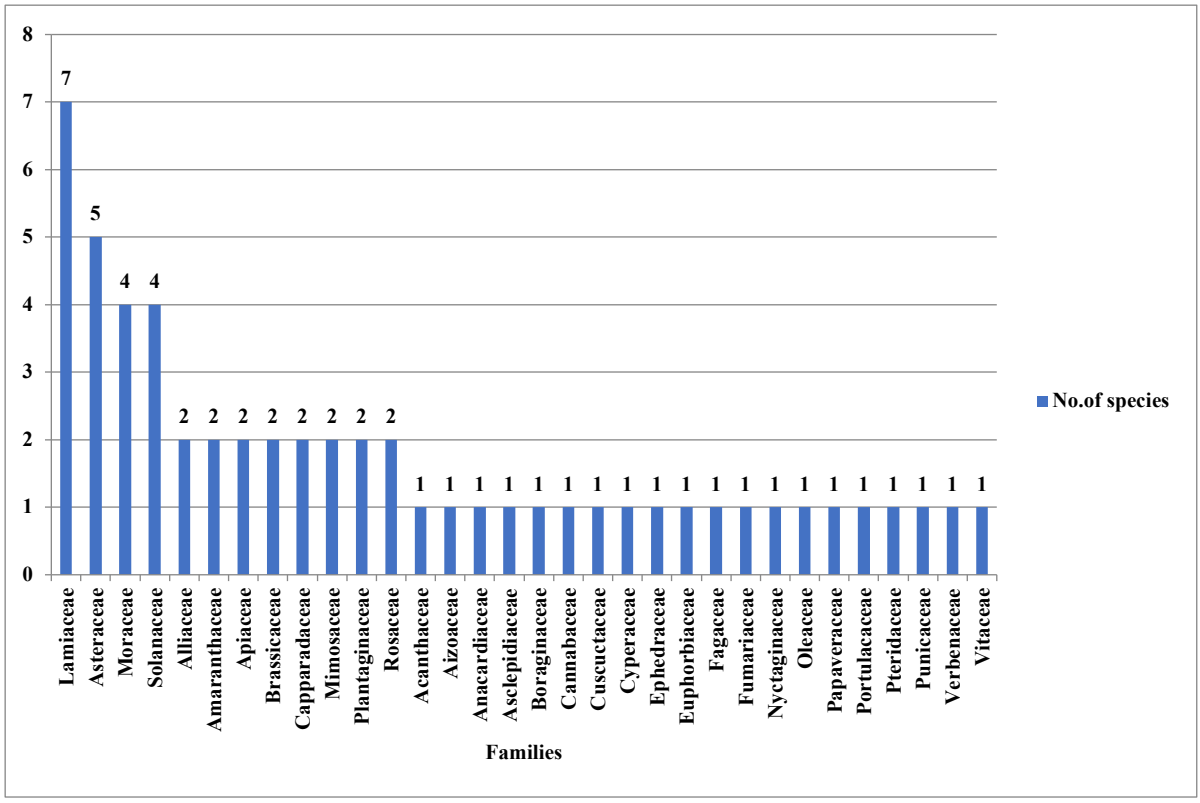

Figure 2. Number of plants taxa used in each family for the treatment of respiratory disorders in the study area.

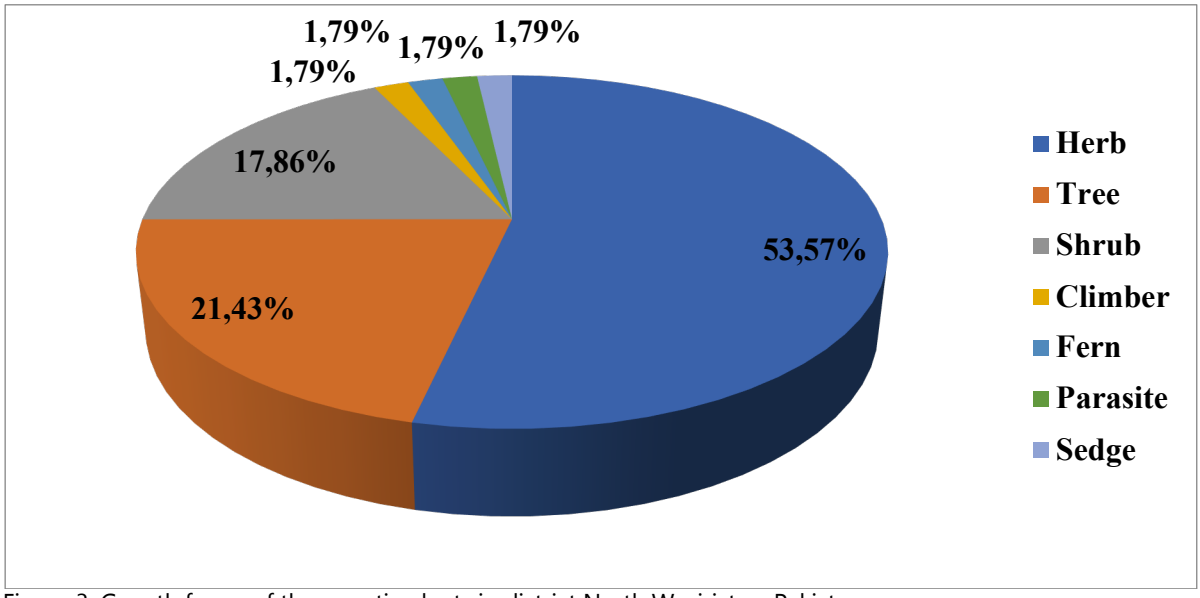

Figure 3. Growth forms of therapeutic plants in district North Waziristan, Pakistan.

Table 2. Medicinal plants with botanical name, voucher no., vernacular name, family name, growth forms, part used, mode of preparation, diseases cured, FC, RFC, UV, URs and FL.

Scientific Name/Voucher No.	Local Name	Family	Habit	Part/s used	Mode of preparation	Diseases cured	FC	RFC	UV	UR	FL %
Justicia adhatoda L. SR-13233	Bikar	Acanthaceae	Shrub	Leaves	Powder	Whooping cough, sore throat, asthma and tuberculosis	43	0.33	0.84	36	95.35
Trianthema portulacastrum L. SR-13339	Mardor boti	Aizoaceae	Herb	Leaves	Herbal tea	Cough and asthma	17	0.13	0.35	6	52.94
Allium cepa L. SR-13461	Pyoz	Alliaceae	Herb	Seed	Powder	Whooping cough	21	0.16	0.52	11	66.67
Allium sativum L. SR-13462	Yuza	Alliaceae	Herb	Bulb	Extract	Asthma, whooping cough and respiratory disorders	27	0.21	0.56	15	70.37
Achyranthes aspera L. SR-13311	Phutkanda	Amaranthaceae	Herb	Leaves	Decoction	Asthma and whooping cough	39	0.30	0.74	29	82.05
Amaranthus viridis L. SR-13341	Surmi	Amaranthaceae	Herb	Leaves	Decoction	Flu and cold	23	0.18	0.61	14	65.22
Pistacia integerrima J L. Stewart ex Brandis. SR-13464	Sheena	Anacardiaceae	Tree	Fruit	Extract	Asthma, cough and expel phlegm	32	0.25	0.53	17	68.75
Coriandrum sativum L. SR-13468	Dhania	Apiaceae	Herb	Seed	Powder	Cold and inflammation of respiratory ducts	25	0.19	0.52	13	56.00
Trachyspermum ammi L. SR-13206	Sperkai	Apiaceae	Herb	Leaves	extract	Cold and Cough	41	0.32	0.76	31	87.80
Calotropis procera (Willd.) R.Br. SR-13185	Spelmai	Asclepidiaceae	Shrub	Flower	Extract	Cough and asthma	22	0.17	0.55	12	63.64
Carthamus tinctorius L. SR-13498	Zergulai	Asteraceae	Herb	Flower	Decoction	Cough and throat problems	17	0.13	0.41	7	52.94
Cichorum intybus L. SR-13334	Ghut khatakai	Asteraceae	Herb	Root	Decoction	Asthma, cough	32	0.25	0.63	20	90.63
Eclipta prostrata L. SR-13496	Terkvanai	Asteraceae	Shrub	Whole plant	Extract	Cough	27	0.21	0.48	13	59.26
Lactuca serriola L. SR-13493	Zrk khatakai	Asteraceae	Herb	Whole Plant	Decoction	Cough, bronchitis, phthisis and asthma	25	0.19	0.56	14	56.00
Senecio chrysanthemoides DC. SR-13426	Zer gul	Asteraceae	Herb	Flower	Decoction	Asthma and respiratory problems	18	0.14	0.33	6	61.11
Cordia myxa L. SR-13476	Lawsera	Boraginaceae	Tree	Fruit	Pulp	Cough, throat infection	40	0.31	0.80	32	95.00

Scientific Name/Voucher No.	Local Name	Family	Habit	Part/s used	Mode of preparation	Diseases cured	FC	RFC	UV	UR	FL %
Lepidium didymium L. SR-13320	Salad	Brassicaceae	Herb	Whole plant	Decoction	Bronchitis, Flu, cough, lung problems, asthma and difficulty in breathing	27	0.21	0.56	15	59.26
Nasturtium officinale R. Br. SR-13317	Pest boti	Brassicaceae	Herb	Whole plant	Decoction	Tuberculosis	38	0.29	0.61	23	68.42
Cannabis sativa L. SR-13324	Bhanga	Cannabaceae	Herb	Leaves	Extract	Throat infection and chest problems	20	0.15	0.55	11	60.00
Capparis decidua (Forssk.) Edgew. SR-13484	Sre dane	Capparadaceae	Tree	Fruit	Infusion	Asthma, cough and bronchial problems	33	0.25	0.48	16	51.52
Capparis spinosa L. SR-13177	Ghr tonda	Capparadaceae	Shrub	Fruit	Decoction	Asthma and cold	19	0.15	0.42	8	57.89
Cuscuta reflexa Roxb. SR-13343	Samio boti	Cuscuctaceae	Parasite	Whole plant	Powder	Bronchitis, chest infection	29	0.22	0.52	15	65.52
Cyperus rotendus L. SR-13296	Delgai	Cyperaceae	Sedge	Bulb	Decoction	Cough, asthma	26	0.20	0.42	11	50.00
Ephedra procera Fish. & C. A. Mey. SR-13444	Mova	Ephedraceae	Shrub	Aerial part	Decoction	Hemoptysis, congestion of the lungs, asthma, and whooping cough	47	0.36	0.87	41	100.00
Euphorbia hirta L SR-13538	Showed	Euphorbiaceae	Herb	Whole Plant	Decoction	Asthma, cough and respiratory disorders	26	0.20	0.46	12	69.23
Acacia modesta Wall. SR-13196	Palusa	Fabaceae	Tree	Bark	Decoction	Cough and respiratory tract disorders	37	0.28	0.70	26	83.78
Acacia nilotica (L.) Delile. SR-13448	Kekar	Fabaceae	Tree	Bark	Decoction	Chest infection, cough, sore throat, asthma and respiratory tract disorders	35	0.27	0.49	17	71.43
Quercus dilatata Royel. SR-13212	Serai	Fagaceae	Tree	Fruit	Powder	Asthma, cough	28	0.22	0.50	14	57.14
Fumaria indica (Hausskn.) Pugsley. SR-13312	Papra shatra	Fumaraceae	Herb	Whole plant	Infusion	Cough and throat infection	29	0.22	0.52	15	68.97
Ajuga brateosa Wall. SR-13425	Varekai boti	Lamiaceae	Herb	Leaves	Powder	Throat infection and tonsillitis	35	0.27	0.60	21	65.71
Marrubium vulgare L. SR-13239	Babar boti	Lamiaceae	Herb	Leaves	Infusion	Asthma and bronchitis	29	0.22	0.55	16	58.62
Mentha piperita L. SR-13283	Velanai	Lamiaceae	Herb	Leaves	infusion	Cough, influenza and sore throat	34	0.26	0.62	21	70.59

Scientific Name/Voucher No.	Local Name	Family	Habit	Part/s used	Mode of preparation	Diseases cured	FC	RFC	UV	UR	FL %
Mentha viridis L. SR-13284	Sarkore velanai	Lamiaceae	Herb	Leaves	Infusion	Throat infection	30	0.23	0.70	21	63.33
Salvia moorcroftiana Wall. Ex Benth. SR-13431	Plane pakhe	Lamiaceae	Herb	Leaves	Powder	Cough and cold	29	0.22	0.45	13	55.17
Salvia nubicola Wall. ex Sweet. SR-13394	Khez bee	Lamiaceae	Herb	Leaves	Decoction	Cough asthma and respiratory disorders	19	0.15	0.47	9	68.42
Thymus serphyllum L. SR-13451	Prata	Lamiaceae	Herb	Whole plant	Decoction	Cough, flu, chest infection, sore throat, bronchitis, and whooping cough	22	0.17	0.68	15	50.00
Ficus carica L. SR-13124	Anzar	Moraceae	Tree	Fruit	Raw	Lungs diseases	31	0.24	0.52	16	74.19
Ficus palmata Forssk. SR-13139	Zangali anzar	Moraceae	Tree	Fruit	Powder	Lungs diseases	26	0.20	0.50	13	65.38
Morus alba L. SR-13435	Speen toot	Moraceae	Tree	Fruit	Juice	Throat infection	42	0.32	0.81	34	95.24
Morus nigra L. SR-13330	Teer toot	Moraceae	Tree	Fruit	Juice	Tonsillitis, cough, sore throat and wheezing in chest	44	0.34	0.86	38	100.00
Boerhavia diffusa L. SR-13373	Prata betai	Nyctaginaceae	Herb	Leaves	Decoction	Asthma and Cough	24	0.18	0.63	15	58.33
Olea europaea L. SR-13404	Shawan	Oleaceae	Tree	Fruit	Raw	Cough, influenza and pharyngitis	30	0.23	0.57	17	60.00
Papaver rhoeas L. SR-13499	Afeem	Papaveraceae	Herb	Capsule	Decoction	Expel sputum	31	0.24	0.52	16	54.84
Plantago lanceolata L. SR-13210	Khatakai	Plantaginaceae	Herb	Whole plant	Decoction	Whooping cough and bronchitis	27	0.21	0.48	13	66.67
Plantago ovata Forssk. SR-13391	Sobghel	Plantaginaceae	Herb	seed husk	Soaking	Cough and cold	31	0.24	0.55	17	61.29
Partulaca oleracea L. SR-13169	Parkhurai	Portulacaceae	Herb	Aerial part	Decoction	Flu, cold and respiratory problems	32	0.25	0.56	18	65.63
Adiantum capillus-veneris L. SR-13459	Ebe boti	Pteridaceae	Fern	Fronds	Infusion	Cough, bronchial problems and expel sputum	31	0.24	0.55	17	67.74
Punica granatum L. SR- 13333	Valengai	Punicaceae	Shrub	Fruit	Powder	Whooping cough, lungs diseases and tuberculosis	40	0.31	0.75	30	92.50

Scientific Name/Voucher No.	Local Name	Family	Habit	Part/s used	Mode of preparation	Diseases cured	FC	RFC	UV	UR	FL %
Cydonia oblonga Mill. SR-13520	Behi	Rosaceae	Shrub	Fruit	Jam	Cough, lung diseases, sore throat and pneumonia	45	0.35	0.84	38	97.78
Prunus armeniaca L. SR-13125	Mondata	Rosaceae	Tree	Fruit	Raw	Coughing	27	0.21	0.56	15	66.67
Datura innoxia Miller. SR-13377	Berbaka	Solanaceae	Shrub	Leaves	Decoction	Asthma, cough	29	0.22	0.55	16	58.62
Datura stramonium L. SR-13376	Berbaka	Solanaceae	Shrub	Leaves	Decoction	Asthma and bronchitis	28	0.22	0.50	14	57.14
Solanum surratense Brum. F SR-13396	Kwerkundai	Solanaceae	Herb	Root	Decoction	Tuberculosis, asthma and whooping cough	36	0.28	0.61	22	86.11
Withania somnifera (L.) Dunal. SR-13230	Bulbel boti	Solanaceae	Shrub	Root	Decoction	Asthma, bronchitis and tuberculosis	38	0.29	0.68	26	78.95
Phyla nodiflora (L.) Greene. SR-13319	Ebe botai	Verbenaceae	Herb	Aerial part	Infusion	Asthma and influenza	28	0.22	0.68	19	39.29
Vitis vinifera L. SR-13538	Melaw	Vitaceae	Climber	Fruit	Juice	Diphtheria	23	0.18	0.39	9	52.17

Legend: FC: Frequency of Citation, RFC: Relative Frequency of Citation, UV: Use Value, UR: Used Reports, FL: Fidelity level.

Plant part used for respiratory disorders

The leading plant part used in the preparation of herbal recipes were leaves (28.57%), followed by fruits (25%), whole plant (16.07%), aerial parts, bulb, flowers and roots (5.36%) each, Bark and seeds (3.57%) each, and capsule (1.79%) (Fig. 4).

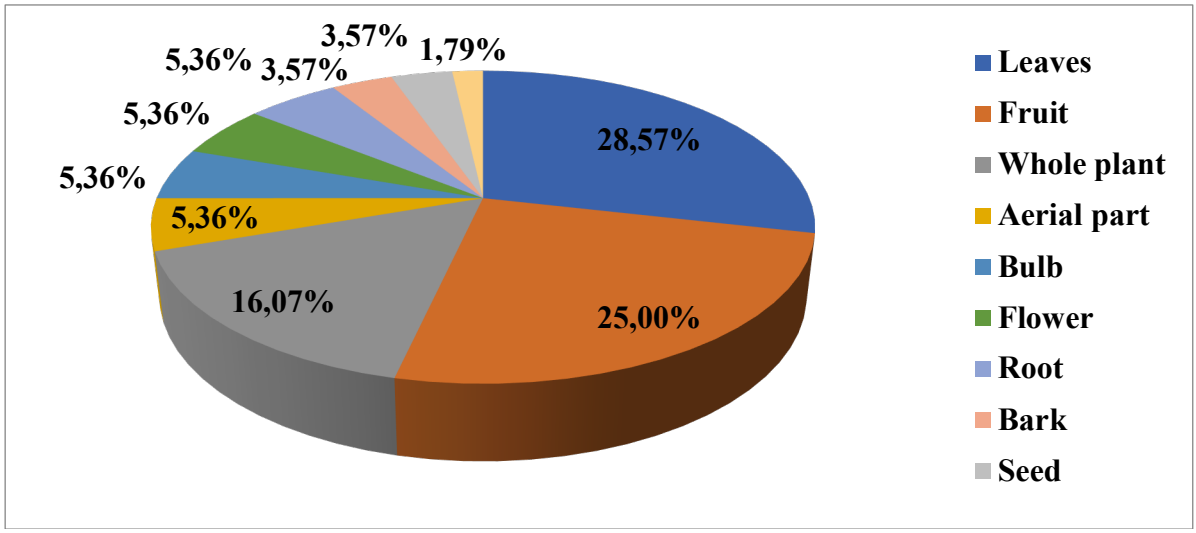

Figure 4. Plants parts used for medicinal purpose in district North Waziristan, Pakistan.

Modes of Preparation, and Administration

In the current study decoction (42.86%), was the leading method of herbal recipes preparation, followed by Powder (16.07%), infusion (12.50%), extract (10.71%), juice and raw (5.36%) each, herbal tea, jam, pulp and soaking (1.79%) each (Fig. 5). In current study all the herbal medication was used orally.

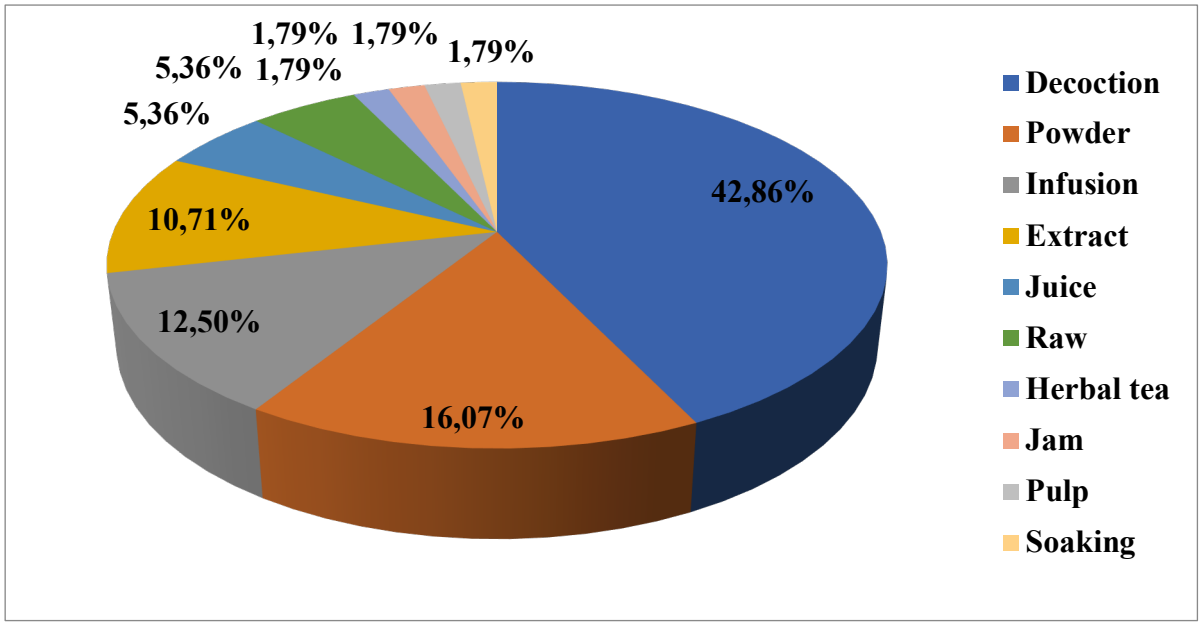

Figure 5. Percentage contribution of herbal recipes in district North Waziristan, Pakistan.

Medicinal plants used to cure respiratory ailments

The local communities have great indigenous knowledge for primary healthcare needs. During the current study, 24 respiratory ailments were reported, which were cured by using 56 therapeutic plants. The most prevalent respiratory disease in the study area was cough (26 taxa), followed by asthma (24 taxa), throat infection (11 taxa), bronchitis (10 taxa), whooping cough (9 taxa), cold and respiratory disorders (7 taxa) each, lungs disorders and tuberculosis (5 taxa) each and so on (Fig. 6).

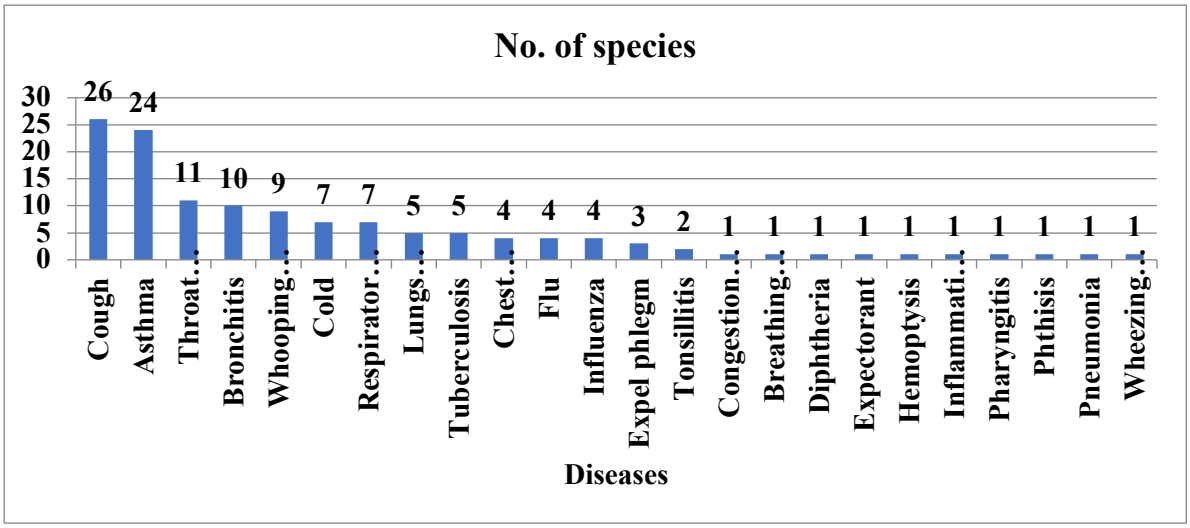

Figure 6. Number of plant species used for respiratory disorders in district North Waziristan, Pakistan.

Quantitative data analysis

Relative Frequency of Citation (RFC)

Relative citation of frequency was calculated to determine the most frequently occurring medicinal plants used for respiratory diseases. Based on the RFC values, number of respondents who mentioned the plants to cure respiratory diseases. The RFC value ranged from 0.13 to 0. 36. The maximum RFC values were reported for *Ephedra procera* (0.36), followed *Cydonia oblonga* (0.35), *Morus nigra* (0.34), *Justicia adhatoda* (0.33), *Morus alba* (0.32), *Cordia myxa* and *Punica granatum* (0.31 each), while the lowest RFC value were reported for *Carthamus tinctorius and Trianthema portulacastrum* (0.13 each) (Table 2).

Use Value (UV)

In the current study, the use value (UV) ranged from 0.33 to 0.87 (Table 2). The maximum use value were reported for *Ephedra procera* (0.87), followed by *Morus nigra* (0.86), *Cydonia oblonga* and *Justicia adhatoda* (0.84 each), *Morus alba* (0.81), *Cordia myxa* (0.80). The lowest use value was recorded for *Senecio chrysanthemoides* (0.33).

Fidelity level (FL %)

The fidelity level (FL) value ranged from 39.29 to 100% (Table 2). In the present study, the maximum FL value was recorded for *Ephedra procera* and *Morus nigra* (100% each) against hemoptysis, and sore throat, followed by *Cydonia oblonga* (97.78%) for lung diseases, *Justicia adhatoda* (95.35%) for cough, *Morus alba* (95.24) for throat infection, *Cordia myxa* (95.00) for cough, *Prunus armeniaca* (92.50%) for coughing respectively. while the lowest FL was recorded for *Phyla nodiflora* (39.29%) for asthma.

Novelty and future impact of the survey

It is the first survey in the region and the area as a total to the best of our information. The present survey contributes knowledge on the valuable utilization of therapeutic plant species for respiratory diseases. This ethno-respiratory knowledge is in relevance approximately with a few other ethnomedicinal survey with the adjacent area and worldwide, but rather this survey reported a total of 56 therapeutic plant species, which were particularly used for respiratory diseases. The data acknowledged that the plant parts used, preparation mode of remedies by the indigenous people, and its mode of administration greatly vary within the area and worldwide, therefore providing new ethnomedicinal information.

Discussion

In the current study, we recorded 56 therapeutic species of plant belonging to 32 families used against respiratory disorders. A large number of therapeutic plants have been previously reported from adjacent tribal areas. Hussain *et al.* (2018) reported 52 medicinal plants, out of which 8 plant species were used for the treatment of respiratory diseases from lower kurram, Kurram agency. Hussain *et al.* (2022) reported 106 medicinal plants, out of which 27 plant species were used for the treatment of respiratory disorders from central Kurram, district Kurram Khyber Pakhtukhwa. The leading families in the current study were Lamiaceae, and Asteraceae, in line with (Aziz *et al.* 2016), who reported form Ladha, subdivision, South Waziristan. The leading life form was herbs used in herbal remedies

preparations. Because herbs contain high quantity of biologically active compounds. Our findings are similar to the reports of (Abbasi *et al.* 2013; Tariq *et al.* 2015; Hussain *et al.* 2022; Irfan *et al.* 2018a, b, c). Indigenous people used all plant parts in drug preparation, but leaves were used most commonly in this study. Our finding are Similar to the reports of (Giday *et al.* 2010; Leto *et al.* 2013; Ullah *et al.* 2013) Semenya and Maroyi, 2018; Al-Fatimi, 2019; Yebouk *et al.* 2020). Modes of preparations were grouped into ten categories. Of these decoctions was the dominant mode of crud preparation in our study. The use of decoction for respiratory disorders was also reported in other studies (Tabuti *et al.* 2003; Suroowan & Mahomoodally, 2016; Boadu and Asase, 2017; Irfan *et al.* 2018d, e, f; Younis *et al.* 2018). Similar result was also reported in previous published literature (Adnan *et al.* 2014; Merrouni and Elachouri, 2020; Mechaala *et al.* 2021; Savić *et al.* 2019; Zatout *et al.* 2021. All the herbal medicines were administered orally in the study area. Similar result was also reported in other studies (Poonam and Singh, 2009; Mahmood *et al.* 2012; Sarri *et al.* 2014; Mrabti *et al.* 2019; Mir *et al.* 2021; Zatout *et al.* 2021). The most common respiratory ailment in the survey was cough, asthma, throat infection, bronchitis, whooping cough, cold, Lungs diseases, and tuberculosis. The highest relative citations of frequency (RFC) values report the information that these therapeutic plants were familiar to highest number of respondents (Butt *et al.* 2015: Rehman *et al.* 2022b). Highest used values of reported therapeutic plant species may be due to their frequent distribution in the study area with high use reports and most of the informants are familiar of their medicinal uses (Ullah *et al.,* 2014; Rehman *et al.* 2022c). Furthermore, it is not right that therapeutic plant species with least use values (UV) are less significant, but it show that the information of these therapeutic plant species is at threat or availability of the specific therapeutic plant species is less (Chaudhary *et al.* 2006; Mahmood *et al.* 2013). FL value is used to decide the therapeutic species that are most recommend by the local community for the treatment of particular ailments. Drugs discovery from medicinal plant species links multidisciplinary way to joining botanical, pharmacological, and ethnomedicinal methods. Though, any therapeutic plant of the current study was not exposed to the complete pharmacological screenings.

Conclusions

In the present study, a total of 56 medicinal plants belonging to 32 plan families were reported to cure respiratory ailments in tribal district North Waziristan. The current ethnomedicinal survey has revealed that traditional communities of district North Waziristan have traditional knowledge about the therapeutic utilization of medicinal plants. Indigenous people of the study area prefer local plants for the treatment of ailments due to low priced and easily accessible. Most of medicinal plant species with maximum use value are frequent in the study area are also well-known to indigenous people. Although this indigenous use of therapeutic plant species is only restricted to elderly people whereas younger generations is not interested in gaining this knowledge. Those therapeutic plant species, with highest UV, FL and RFC value should be exposed to phytochemical and pharmacological analysis to authenticate their effectiveness and safety for huge utilization.

Declarations

Ethics statement: Prior to the survey, we obtained oral informed consent from each participant.
Consent for publications: Not applicable.
Funding: Authors have not received any funding during this research.
Conflicts of Interest: The authors declare that there are no conflicts of interest in this article.
Data Availability statement
The figures and tables supporting the results of this study are included in the article, and the original data sets are available from the first author upon request.
Author's contribution: SR wrote the original draft of the manuscript ZI and RQ supervised this work RQ and GMS helped in statistical analysis MI did the formal analysis. All the authors approved the final manuscript after revision.

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