Quantitative Assessment of the Medicinal Flora of Gadoon valley, District Swabi, Khyber Pakhtunkhwa, Pakistan

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Research

Abstract

Background: This study explores the folk medicinal knowledge of Gadoon Valley, District Swabi, Khyber Pakhtunkhwa, Pakistan, focusing on the diversity of medicinal plants and their uses for various human health issues. The information was collected through field assessments to document the local ethnobotanical practices.

Methods: Regular ethnobotanical surveys were conducted from November 2022 to 2023. The objective was to gather and document ethnobotanical knowledge from local residents and farmers. Participants were briefed that the survey was solely for research purposes, ensuring their willingness to share authentic information.

Results: The study illustrates 60 plant species consists of 28 families. Among these, one family belonged to the Gymnosperm division with two species, while the rest were Angiosperms. The most dominant family was Fabaceae with six species (10%), followed by Lamiaceae with five species (8.33%), and Asteraceae, Brassicaceae, and Cucurbitaceae each with four species (20%). Herbs were the most common habit with 34 species, followed by trees with 17 species. Leaves were the most commonly used plant part (21 species), followed by whole plants (20 species). The use value (UV) of ethnomedicinal taxa ranged from 1.24 to 0.06, with the highest UV for *Foeniculum vulgare* (1.24). The relative frequency of citation (RFC) ranged from 1.99 to 0.01, highest for *Morus alba* (1.99). Fidelity level (FL) values ranged from 1.980 to 0.09, with the highest for *Pinus roxburghii* (1.980). Relative preference level (RPL) values ranged from 1.96 to 0.5, highest for *Convolvulus arvensis* and *Daucus carota* (1.96). Relative popularity (ROP) values ranged from 1.97 to 0.15, highest for *Prunus domestica* and *Taraxacum officinale* (1.97). However, among the treated disease the bronchitis was the most commonly treated disease (0.969).

Conclusions: The findings indicate that Gadoon Valley is rich in floristic diversity. However, the medicinal plant resources are threatened by flooding, unsuitable agricultural practices, overgrazing, overexploitation, and deforestation for fuel and timber.

Keywords: Ethnobotany; Gadoon valley, Swabi, Khyber Pakhtunkhwa, Pakistan

Background

The medicinal plants are consisting of those biochemical constituents that give sure physiological responses to the various illnesses (Arshad *et al.* 2022). The extraction of these plant has a biological role in contradiction of pathogenic organisms such as bacterial microbes, fungi, and viruses (Farooq *et al.* 2019). These are causative agents of several ailments in humans in other livings organisms but these can be controlled by therapeutic applications of plants (Batool *et al.* 2017). Due to the proper action against the different disease, these medicinal plants have active ingredients with the potential of curing a particular disease but these active ingredients have depended upon the extraction protocol and preparation (Hussain *et al.* 2018; Ahmad *et al.* 2021). Those plants that have any bio-chemical constituents and having some active ingredients that help in the treatment of various ailments are known as medicinal plants (Aziz *et al.* 2018; Bhatia *et al.* 2019). Pakistan having a diverse flora having about six-thousands of different species reported amongst them six hundred species show medicinal importance. It is a fact that chemical and synthetic drugs have caused many side effects as compared to traditional uses of Plants. Disease resistant medicinal plants are also grown by the local inhabitants of the area (Irfan *et al.* 2019). Due to the uses of these medicinal plants by the local communities' various pharmaceutical companies are interested to isolate certain active compounds from them for the making of various modern medicines (Giday *et al.* 2003; Jan *et al.* 2020). Correspondingly, people throughout the periods used thousands of plants as of food, together wild and domesticated (Sher *et al.* 2011). The name of ethnos botany was presented in 1895 by Hershberger, in this time documentation and plants classification used by old people remained not widespread. Medicinal Plants are a worldwide source of the local residents. It is also a true and established reality that therapeutic plants play an important role in human societies (Haq *et al.* 2011; Asif *et al.* 2021). It is expected that 70 to 80% of the world population used traditionally, herbal medicine to happen their principal health care requirements (Butt *et al.* 2015; Ullah *et al.* 2022). "Universally, hundreds of thousands of people are resting on medicinal herbs not just for healthcare services, as well as for income generation and developing their livelihood. The aim of the entire study was to find out from ethnobotanical directions, the unexplored botanically rich flora of the target areas and how many of the plants have been used by the people.

Under the scientific field "Ethnobotany," the shared relationship of native flora and the populations of the study area are investigated the very first person to introduce the term "Ethnobotany" was (Agbor and Naidoo 2016). The word is indeed a mixture of two words, i.e., "Ethno" study of people and "Botany" study of plants. Different individuals describe this different manner. Certain believed that it was identical with commercial botany or herbal medicine (Orech *et al.* 2007). The delivery of the traditional knowledge traced back to China about five thousand years ago. Approximately 80% of the total human population are still depends upon the traditional uses of the plants (Gidey *et al.* 2015). The plants that contain the active biochemical constituent and having some response in the curing of the different disorders in the living organisms are known as medicinal plants (Sher *et al.* 2023). Pakistan has a diverse flora having about 6000 of the flowering Plants species. And about 700 of the plant species are used medicinally, for medicinal and aromatic purposes (Marwat and Rehman 2011). In Pakistan, 80% of the people belonging to the rural areas still depend upon the herbal medicines (Ullah *et al.* 2022). In the recent years, more efforts have been made to document the traditional knowledge. The herbal medicines occupy distinct position, right from the primitive period to present day (Rashid *et al.* 2022).

Ethnobotany advantages in recognizing man's intimate connection with plants (Ahmad *et al.*, 2019). It can also be obtainable as the methodical investigation of the communications that occur among humans and plants, concluded their traditional knowledge (Mussarat *et al.* 2014). The phenomenon of ethnic background applies to people, to their convictions, understanding, language, principles of esthetics as well as regional procedures Ethnicity refers to people, their collective life, and their culture: their beliefs, knowledge, language, ideals of esthetics, and local practices. Ethnobotany attentions among people with plants in time and space on the connections (Hamayun *et al.* 2006). Throughout the last century, ethnobotany has appeared as a systematic and fast-growing field of science (Ali *et al.* 2023). The ethnobotany of today's world needs many abilities, for example plant identification and preservation; understanding of folk culture and appropriate sociological training to appropriately recognize and perceive the ideas of plants in cultures around the world. Communication is an announcement barrier with residents, what training and talents are required for all plant study in the same area, which is why language training was also necessary (Irfan *et al.* 2021).

Each bite of food, lots of cloth, most medicinal products, fibers, shelter (houses), fuel and other needs come from plants. This is the purpose that all persons are reliant on plants. Plants offer a improper for life. Plants are considered an important source of treatment for just the treatment of several diseases in herbal medicines (Alamgeer *et al.*, 2013; Akhtar *et al.* 2013). Ethnobotanical information spends energetically and is there for varying and addition new detections and novel approaches. Ethnobotany identifies solutions to urgent problems, higher food development, increased agricultural productivity, modern medicinal products, vegetables and modern products, environmental preservation strategies sustainable development and social preservation Ethnobotany is really a study of the relationship between plants and humans (Wali *et al.* 2021). Ethnobotany has been used in two forms, immediately. The first is the discovery of economically productive plants and the second is the examination of aboriginal environmental information (Khan *et al.* 2023).

This study assesses the medicinal flora of Gadoon Valley, highlighting its biodiversity and local healthcare reliance on these plants. Objectives include quantitative evaluation, documentation of traditional practices, and ecological significance. Additionally, this study addresses the gap in quantitative assessments of medicinal flora in this region, contributing to a better understanding of the biodiversity and its potential applications in healthcare. The findings contribute to regional and global conservation efforts, with future research aimed at exploring the pharmacological properties of these species for community well-being.

Materials and Methods

Field Study

During 2022 to 2023 the Gadoon valley district Swabi, Kyber Pakhtunkhwa, Pakistan was visited for several time to collect the ethnobotanical information. The study area well known for greenery and cold environment. The most of the population are correlated with farming but additionally working as laborer in Gadoon industrial state. The Gadoon valley, Swabi, Khyber Pakhtunkhwa, Pakistan on the map, where it is located. Latitude and longitude coordinates: 34°16'8"N and 72°41'24"E (Figure 1).

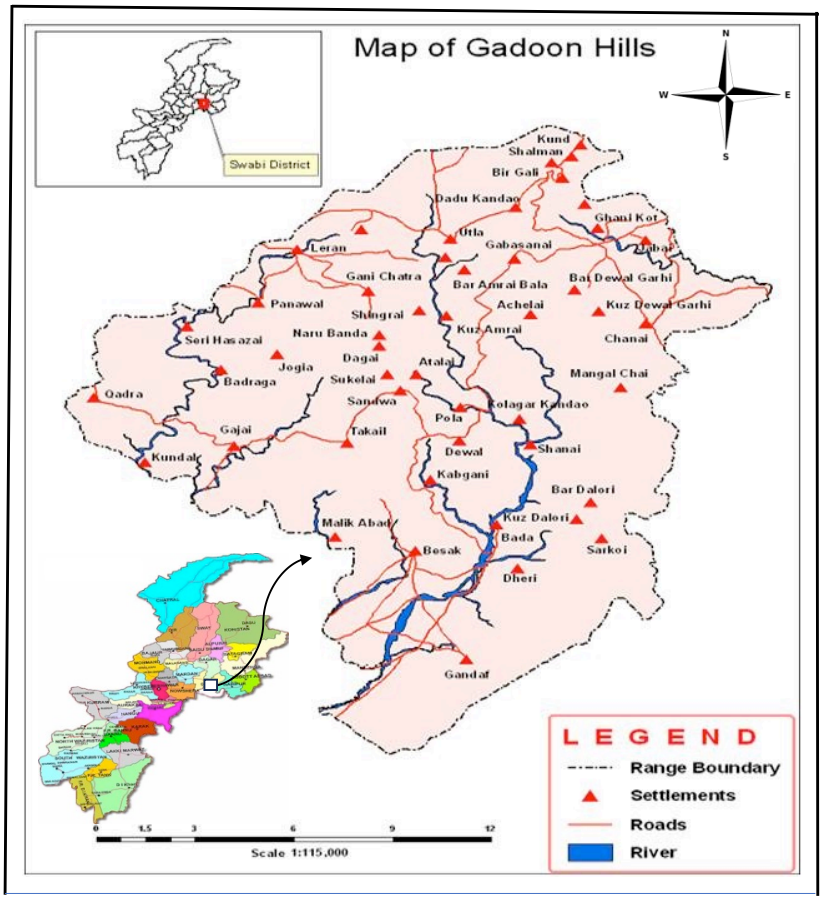

Figure 1. Map of the study area of Gadoon valley District Swabi, Khyber Pakhtunkhwa, Pakistan

Ethnobotanical survey

The plant specimens recorded from the study area have been properly categorized. The local inhabitants, local tabibs, and hakeems gathered important data. The uses of the plant include medicine, forage, wood, timber, fruits and vegetables, etc. For the steering of ethnobotanical information, a semi structured questionnaire was created. The structure of the questionnaire is shown on the last page.

Analysis and Documentation of Data

After field survey the data recorded were analyzed and accepted for final reporting. With accessible literature, i.e., (Mir *et al.* 2022a), data on plant uses by local residents were tested.

Data collection & layout

The different tools like a cutter, mobile camera, and paper bags for collecting samples. The study was done between 2022 and 2023 in Swabi district, Khyber Pakhtunkhwa, Pakistan (Fig 1). We prepared questionnaires and interviewed older people, practitioners, and experts in medicinal plants and recipes. During the study the informants were selected based on their relevance to the study, long-term residency in Gadoon Valley, diverse demographics, community roles related to medicinal plants, and willingness to participate. However, the prior informed consent (PIC) was obtained from all informants before the interviews to ensure ethical compliance and voluntary participation in the study. Data collection involved gathering plant specimens and utilizing local knowledge to ensure comprehensive documentation. Tools employed included structured questionnaires to capture local insights and cameras for detailed photographic records of plant specimens. We documented the results by filling out forms. During field visits, we recorded information about plants, like their scientific names, local names, families, where they grow, and how they are used for medicine or recipes, in a notebook. We identified the plants using a book called the flora of Ali and Qaiser (1993). Each plant was pasted onto a sheet and given a number, then stored in the Department of Botany, University of Swabi. We presented the data in tables using different statistical methods.

Quantitative Data Analysis

Different statistical measures to understand the traditional medicinal plants used by people in the specific area we studied.

Informant consensus factor

The ICF index was a statistical index to predict the value of similarities among the informant's reports of each species and categorized them based on disorders. The ICF index is like a number that helps us see how much people agree on which plants treat certain illnesses in a particular place. It helps organize the illnesses people talk about and how they use plants for them. The index's value can range from 0 to 1. The Scientists use a special equation, explained by Heinrich and his colleagues in 1998, to calculate this index. The following equation were followed:

$$ICF=((Nur-Nt))/(Nur-1)$$

"Nur" shows how many different plants were mentioned by people for each type of illness. "Nt" shows the total number of plants mentioned overall.

Use value (UV)

The Used value (Uv) index used for the evaluation of the relative importance of useful species and it is evaluated by the sum of all species which reported by the number of uses per species. It is representing the vital species of the resident area. These parameters were calculated by the following equation based on the previous approaches of (Wali *et al.* 2019; Mir *et al.* 2022b)

$$\sum Ui/N=UV$$

"UV" denotes the occurrence frequencies of individuals reporting plant usage, "Ui" represents the frequencies of specific plant taxa usage records, while "N" indicates the total frequency of informants.

Fidelity Level (FL)

The FL index is employed to assess the utilization of certain plants reported by informants for a specific disease within a given locality, utilizing informant numbers. It is calculated by summing the informant numbers and dividing by the reports of informants for a disease. The necessary calculations are performed using the equation provided by (Ogeron *et al.* 2018; Mahmood *et al.* 2013) as follows:

$$100\times Np/N=FL$$

"NP" represents the total frequency of informers, while "N" denotes the total frequency of informants reporting the use of plants for specific ailments.

Relative Frequency Citation (RFC)

The RFC parameters were calculated based on the former cited for evaluating the importance and the resident vitality of each species. The index was calculated according to the equation of (Ali-Shtayeh *et al.* 2008; Albuquerque, 2009):

$$(0<RFC<1)\ FC/N=RFC$$

"FC" denoting the frequency of informants who's reported about the use of a particular medicinal species while the "N" is stand for the total numbers of informants for a specific plant species in given area.

Relative Popularity Level (RPL)

RPL is a statistical parameter that forecasts the number of diseases cured by a particular species relative to the total number of informants reporting any ailment. This index was elucidated in a previous study by Ali-Shtayeh *et al.* (2008), differentiating between popular and unpopular species.

Rank Order Priority (ROP)

The ROP index is derived from the FL and RPL indices, serving to rank medicinally significant species. Its computation is conducted according to the equation provided by Ullah *et al.* (2023) as follows:

$$ROP = FL \times RPL$$

Jaccard index (JI):

The Jaccard index analysis to compare our findings with previous ethnomedical assessments. The primary objective was to assess the similarity between current taxa and previously published data. To compare the data, we utilized Jaccard index frequency, employing the equation outlined by Ouelbani *et al.* (2018) and Irfan *et al.* (2018b).

$$JI= c \times 100 / (a+b-c)$$

In represented formula "a" indicating the number of taxa in the area (A) with same medicinal uses and also with different uses, while "b" denotes the number of taxa in area (B) with same uses and also with different use. Though, the "c" is indicating the commonness of taxon in both areas in (A) and (B) of same use and with different uses.

Results

Demographic Feature of informants

The survey tends to tabulate the informant's data for accurate information. The total 396 informants were interviewed, among the informants the 71% percents Men were interviewed while the only 29% women knowledge investigated due the strict restriction of community. Based on literacy rate the area the 37% people were educated while the 63% individuals were illiterate. In informants' data the dominate quarter of people where 71% informants were correlated with farming. However, the 8% percent people were correlated with timber cutting while only 4 percent people. Although among of them 7 informants were shopkeeper and 10% people were local traders. Furthermore the 44% informants were had the age above than 65% years while 29 %informants were between 52 to 62 years several on the 21% informants age were lying between 41-51 years and the 6% Informants age were lying between 30 to 40 years (Table 1).

Table 1. Ethnicity, occupation, age and illiteracy of respondents

Informants	**%**	**Occupation**	**%**	**Age Group**	**%**
Men	71	Farmers	71	30-40	6
Women	29	Timber cutting	8	41-51	21
Educated	37	Govt. servant	4	52-62	29
Illiterates	63	Shopkeeper	7	> 65	44
		Local traders	10		

Family importance value (FIV)

In the present study 60 plant species were collected, distributed in 28 families. Although among the 28 families one family belong to Gymnosperm division with two species, while the rest of 27 families belong to angiosperm division. Among the families the most dominant family was Fabaceae with 6 species (10%), followed by the second dominant family was Lamiaceae had 5 species (8.33%), while the third most dominant families were Asteraceae, Brassicaceae, and Cucurbitaceae with 4 species each (20%). In rest of the families the Apiaceae, Poaceae, Polygonaceae, and Moraceae had 3 plant species each (20%), Alliaceae, Pinaceae, Solanaceae, Rutaceae, Oleaceae, and Rosaceae had 2 species each (20%). However, the Amaranthaceae, Chenopodiaceae, Convolvulaceae, Cannabaceae, Sapindaceae, Ebenaceae, Myrtaceae, Fumariaceae, Juglandaceae, Malvaceae, Platanaceae, Portulacaceae, and plantaginaceae had one species each (21.6%) see (Table 4).

Habit wise Distribution

In habit wise distribution the most leading habit was herbs with 34 plant species while the second leading habit was trees with 17 species. However, the shrubs were documented with nine plant species (Table 3 & Figure 2).

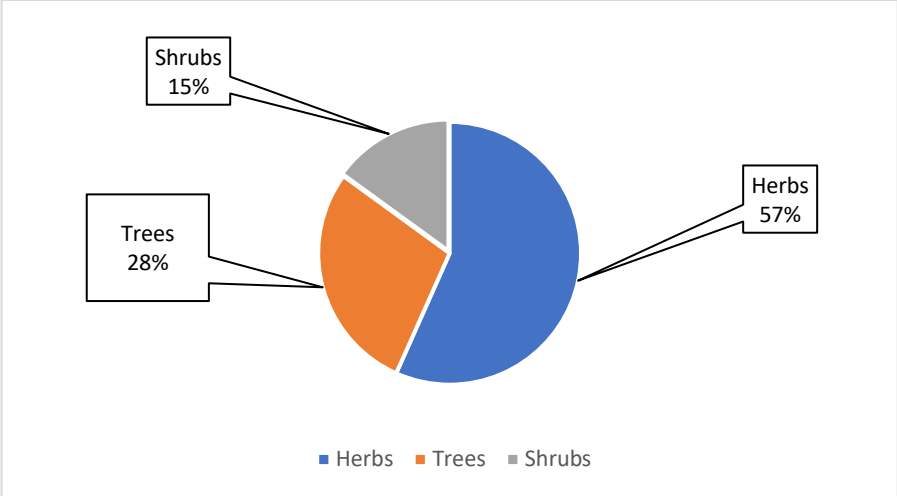

Figure 2. Habit wise distribution of the flora of Gadoon valley District Swabi, Khyber Pakhtunkhwa, Pakistan

Parts Used

In documented data for effective work specific parts were used. However, in documented data the Leaves were dominantly used of 21 species while the second dominant the 20 species where whole plant species were utilized. Although the five species fruits were used while the flower and Barks were utilized of 4 species each. Several on the for effective work the seeds and stem were utilized of 3 species each see (Table 3 & Figure 3).

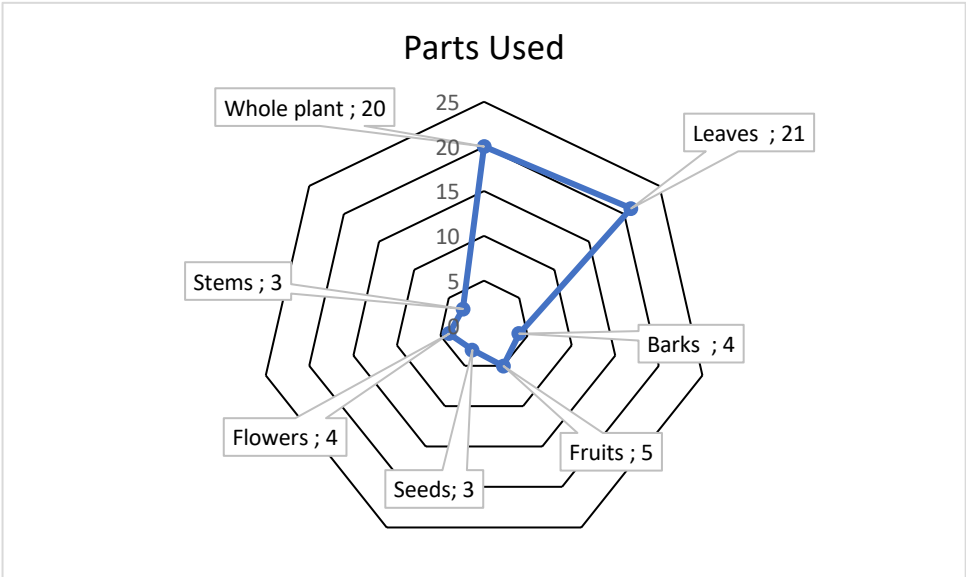

Figure 3. Graphical representation of parts used of the flora of Gadoon valley District Swabi, Khyber Pakhtunkhwa, Pakistan

Informant consensus factor (ICF)

Based on the categorization of disorder there were 12 categories were resulted along with consensus factor. The leading category were bronchitis with (0.969) while the second leading category were wounds healing with (0.954) followed by the third leading category blood pressure (0.916). However, in assessment the lowest value was resulted for constipation (0.5) while the second lowest for diabetes (0.756) see (Table 2).

Table 2. Tabulated representation of informant's consensus factors.

Disorders	Nt	Nur	Informants' Consensus Factor
Stomach Problem	7	37	0.833
Diabetes	10	38	0.756
Headache	3	14	0.846
Blood Pressure	4	37	0.916
Bronchitis	2	34	0.969
Kidney Problems	7	32	0.806
Analgesic	5	19	0.777
Blood Clotting	16	46	0.666
Wounds Healing	2	23	0.954
Jaundice	3	15	0.857
Blood Purification	2	12	0.909
Constipation	2	3	0.5

Use value (UV)

The use value of Ethnomedicinal taxa ranged from (1.24) to (0.06). The highest UV were recorded for *Foeniculum vulgare* (1.24), *Daucus carota* (0.99), *Morus alba* (0.97), *Prunus domestica* (0.94), *Taraxacum officinale* (0.92), *Luffa cylindrica* (0.87), *Convolvulus arvensis* (0.86), *Capsella bursa-pastori* (0.79), *Platanus orientalis* (0.70), *Diospyros lotus* (0.60). However, the top five lowest were *Brassica rapa* (0.06), *Mentha longifolia* (0.09), *Acacia modesta, Alternan therapungens* and *Raphanus sativus* (0.10) each, *Brassica campestris* (0.11), *Cynodon dactylon*, *Citrus sinensis* and *Eucalyptus globulus,* (0.12) each see (Table 3).

Relative frequency citation (RFC)

The RFC ranged from (1.99) to (0.01), highest RFC value was recorded for *Morus alb* (1.99), *Pinus roxburghii* (1.87), *Cedrus Deodara* (1.5), *Luffa cylindrica* (0.99), *Olea ferruginea* (0.98)*, Prunus domestica* (0.96), *Zea mays* (0.93), *Acacia modesta* and *Daucus carota* (0.87), *Diospyros lotus* (0.85), *Thymus linearis* (0.80). Although the top five lowest were recorded for *Juglans regia* (0.01), *Robinia pseudoacacia* (0.02), *Dalbergia sissoo* and *Jasminum mesnyi* (0.03), *Solanum nigrum* (0.04), *Trifolium repens* and *Xanthium stramarium* (0.07) see (Table 3).

Fidelity level (FL)

The FL value recorded ranged from (1.980) to (0.09). The top value of FL for *Pinus roxburghii* (1.980), *Taraxacum officinale* (1.96), *Prunus domestica* (1.95), *Zea mays* (1.67), *Foeniculum vulgare* (1.36), *Daucus carota* (1.34) *Dodonaea viscosa* Jacq (1.3), *Morus alba* (0.931), *Luffa cylindrica* (0.98), *Allium sativum* (0.70). The lowest value result from *Portulaca oleraceae* (0.09), *Medicago denticulate* and *Cedrus Deodara* (0.01), *Cestrum nocturnum* (0.02), *Juglans regia* (0.03), *Carthamus oxycantha* (0.04) see (Table 3).

Relative popularity level (RPL)

RPL values ranged from (1.96) to 0.5 and the highest RPL value were recorded for *Convolvulus arvensis* and *Daucus carota* (1.96), *Mentha arvensis* (1.9), *Zea mays* (1.83), *Helianthus annuus* (1.77), *Prunus americana* (1.74), *Platanus orientalis* and *Thymus linearis* (1.70), *Allium cepa* (1.69), *Allium sativum* (1.65), *Diospyros lotus* Linn (1.64) *Rumex crispus* (1.63). The top five lowest value were resulted for *Cedrus Deodara* (0.5), *Foeniculum vulgare* (0.17), *Morus alba* (0.56), *Olea ferruginea* Royle (0.93), *Prunus domestica* (0.97) see (Table 3).

Rank order priority (ROP)

The ROP value ranged from (1.97) to (0.15), the highest value was recorded for *Prunus domestica* and *Taraxacum officinale* (1.97), *Helianthus annuus and Luffa cylindrica* (1.59*) Cedrus Deodara* (1.56) *Rumex crispus* (1.46) *Olea ferruginea* (1.34) *Jasminum mesnyi* (1.25) *Foeniculum vulgare (1.23) Thymus linearis (1.15) Allium cepa* (1.14*) Daucus carota* (0.983). The top five value were resulted for lowest *Allium sativum* and *Dodonaea viscosa (0.15) Portulaca oleraceae* (0.101) *Medicago denticulate* (0.127*) Alternan therapungens* (0.165) *Citrus sinensis* (0.168) see (Table 3).

Table 3. Checklist of the medicinal flora of Gadoon valley District Swabi, Khyber Pakhtunkhwa, Pakistan

Voc	Botanical name	Family	H	Lo	Seed	Ethnobotanical use					
DOB-134	*Alternanthera pungens* Kunth.	Amaranthaceae	H	Fai Botee	Wp	Dry plant leaves and their spines are good remedy for eye and lumbago problems.	0.10	0.8	0.11	1.5	0.165
DOB-135	*Ajuga bracteosa.* Wall.ex Benth.	Lamiaceae	S	Goote	Wp	In powder mixed and boiled water added and then used for blood purification.	0.4	0.1	0.23	1.26	0.24
DOB-136	*Acacia modesta* Wall.	Fabaceae	T	Palosa	Wp	The decoction of flowers and leaves is used as tonic and stimulant, and also helps to treat diarrhea and dysentery. Wood is used as a building material and fuel.	0.10	0.87	0.11	1.52	0.165
DOB-137	*Allium sativum* L.	Alliaceae	H	Ooga	L	Garlic cloves are given to sick chickens and the garlic crushed and mixed with yogurt used lowering the blood pressure.	0.49	0.33	0.70	1.65	0.15
DOB-138	*Allium cepa* L.	Alliaceae	H	Piaz.	Wp	Used to treat diabetes, cholera and so on. Lamps used in cooking. Bulb juice is rubbed onto the skin after a toxic bee has bitten it.	0.43	0.8	0.67	1.69	1.14
DOB-139	*Brassica campestris*. Linn	Brassicaceae	S	Sharshum	L	The leaves were used for the treatment of diarrhea and dysentery.	0.11	0.17	0.14	1.5	0.21
DOB-140	*Brassica rapa* L.	Brassicaceae	H	Tepar	L	The leaves heat up and applied in poultices form on warts.	0.06	0.8	0.5	1.40	0.7
DOB-141	*Cedrus deodara* (Roxb.) G. Don	Pinaceae	T	Diyar	Ba	The bark boiled in water and then used for reducing the diabetes.	0.9	1.5	0.1	0.5	1.56
DOB-142	*Chenopodium album* L.	Chenopodiacea	S	Sarmay	L	leaves are heated in water and used for body pain, and the seed oil is used as an anthelmintic.	0.4	0.25	0.20	1.7	0.34
DOB-143	*Cymbopogon citratus* (Dc.) Stap	Poaceae	H	Lemon grass	L	It is cultivated in houses for decoration. Green tea is also made from its leaves and is good to cure stomach-ache and also in nausea.	1.2	0.47	0.36	1.47	0.26
DOB-144	*Cynodon dactylon* L.	Poaceae	H	Kaabal	Wp	The whole plant used as diuretic and astringent.	0.12	0.10	0.23	1.2	0.276
DOB-145	*Cucumis sativus* Linn	Cucurbitaceae	H	Baadrang	Fr	It is used as a daily salad. The leaves are used for fuel purposes when dry.	0.6	0.9	0.18	1.28	0.230
DOB-146	*Cucurbita maxima* Duchesne	Cucurbitaceae	H	Gurhe kadoo	Se	The dried seeds in powder form use as demulcent.	0.7	0.12	0.15	1.22	0.183
DOB-147	*Cucurbita pepo* L	Cucurbitaceae	H	OgadKadoo	Fr	It is used in diet for patients of Jaundice, heart and stomach problems.	0.33	0.19	0.44	1.52	0.668
DOB-148	*Cestrum nocturnum* L.	Solanaceae	S	Rat key rani L.	Fl	The flowers are emollient and also used as antimicrobial.	0.29	0.20	0.2	1.07	0.214
DOB-149	*Citrus sinensis* (L.) Osbeck	Rutaceae	T	Malta	L	Its leaves are stimulant and used for constipation purposes.	0.12	0.8	0.12	1.40	0.168
DOB-150	*Convolvulus arvensis* L.	Convolvulaceae	H	Perwatae	Wp	It is used in externally as hair shampoos that are used for removing dandruff.	0.86	0.53	0.14	1.96	0.266
DOB-151	*Coriandrum sativum* L.	Apiaceae	S	Danya	L	Leaves are aromatic and also used as carminative in powder form with water.	0.4	0.4	0.24	1.11	0.266

DOB-152	*Cannabis sativa* L.	Cannabaceae	H	Bhung	Wp	Narcotic and sedative leaf decoction is used to treat malaria, colic, and flatulence.	0.2	0.26	0.6	1.55	0.93
DOB-153	*Capsella bursa-pastori* L.	Brassicaceae	H	Bans	L	The infusion of leaves is used for pain relief also used as a diuretic. Tea with leaves and young seeds is used for hemorrhaging of the heart, kidneys and lungs.	0.79	0.18	0.19	1.22	0.183
DOB-154	*Carthamus oxycantha* L.	Asteraceae	H	kareeza	Se	Leaves used to cure irritate skin. Leaves have antiseptic character. Such are laxative, effective in measles fever. Oil is derived from seeds which are used in the treatment of ulcer. The oil is used as a tonic to the hair.	0.5	0.5	0.4	1.14	0.456
DOB-155	*Dodonaea viscosa* L.	Sapindaceae	S	Ghwaraskay	L	It is used to treat wounds & burns in poultice form externally.	0.9	0.6	1.3	1.5	0.15
DOB-156	*Diospyros lotus* Linn.	Ebenaceae	T	Toora amlok	L	Leaves are edible in grinded form as carminative, and purgative.	0.60	0.85	0.65	1.64	1.06
DOB-157	*Dalbergia sissoo* Roxb.	Fabaceae	T	Shawa	Wp	Seed powder is used to remove clotted blood from wounds.	0.8	0.03	0.45	1.42	0.504
DOB-158	*Daucus carota* L.	Apiaceae	H	Gazara	Fr	Fruits are used for treating eye disorders, in soups and tea used for bronchitis. Although the fruits are boiled with sugar in water then used for constipation.	0.99	0.87	1.34	1.96	0.983
DOB-159	*Eucalyptus globulus* Labill.	Myrtaceae	T	Laachi	L	It is used as an antiseptic in poultice form, while also used as flavoring agent	0.12	0.5	0.19	1.23	0.233
DOB-160	*Foeniculum vulgare* Mill.	Apiaceae	S	Kaga	Wp	It enhances both sight of the eye and appetite. The herb soothes chronic constipation. Seeds are best in digestion of food and stomach acid reduction.	1.24	0.25	1.36	0.17	1.23
DOB-161	*Ficus carica* Linn.	Moraceae	T	Inzar	L	Leaves decoction used for treating constipation, piles, and also used for urinary bladder problems.	0.35	0.16	0.16	1.35	0.216
DOB-162	*Fumaria indica* L.	Fumariaceae	H	Paprah	Wp	The decoction of the entire plant is used to eliminate the skin pimples, to purify the blood, body inflammation, jaundice, constipation and as a cooling agent.	0.59	0.11	0.5	1.13	0.565
DOB-163	*Helianthus annuus* Linn	Asteraceae	H	Nvarr paras	Fl	Flower extraction used for curing cough, fever, and throat infection diagnosis.	0.9	0.4	0.9	1.77	1.59
DOB-164	*Jasminum mesnyi* Hance	Oleaceae	S	Chambeli	Fl	The extraction of flower used for curing bronchitis cough and also used as flavoring agent.	0.5	0.03	0.8	1.57	1.25
DOB-165	*Juglans regia* L.	Juglandaceae	T	Ghooz	Ba	Bark is used for Teeth & Gums washing and removed bad smell from mouth.	0.8	0.01	0.3	1.12	0.336
DOB-166	*Luffa cylindrica* (L.) M. Roem.	Cucurbitaceae	H	Toorai	L	Fresh leaves infusion used for curing ulcer and stomach ache.	0.87	0.99	0.98	1.34	1.59
DOB-167	*Morus nigra* L.	Moraceae	T	Tor toot	Wp	Leaves are Emollient stem powder used as anthelmintic and flower used as astringent.	0.45	0.25	0.43	0.88	0.56

DOB-168	*Mentha longifolia* (Linn) Huds.	Lamiaceae	H	Elanay	Wp	Whole plant grinded and then powder form with water used as gastrointestinal medicine.	0.09	0.15	0.35	1.37	0.479
DOB-169	*Mentha arvensis* L.	Lamiaceae	H	Podina	Wp	Powder orally with water used for food digestion and also use relives in nausea, vomiting, irritable, bowl and bloating. Helps to purify the blood and acidity reduction.	0.8	0.5	0.14	1.9	0.266
DOB-170	*Malva neglecta* Wallr.	Malvaceae	H	Panirak	L	The leaves are boiled in water and used for curing colds, coughs, and as purgatives.	0.3	0.16	0.4	1.3	0.52
DOB-171	*Morus alba* L.	Moraceae	T	Tooth	Fr	The powder of fruits with water orally used for stomachache and anthelmintic.	0.97	1.99	0.931	0.56	0.90
DOB-172	*Medicago denticulate* Coastal M	Fabaceae	H	Shpeshty	Wp	Fresh extraction used for curing asthma, bronchitis, and also used for curing wound healings.	0.3	0.13	0.1	1.27	0.127
DOB-173	*Olea ferruginea* Royle.	Oleaceae	T	Khoona	Wp	Plant leaves are chewed and used for treating cough and mucous discharge in green tea.	0.55	0.98	0.33	0.93	1.34
DOB-174	*Ocimum basilicum* L.	Lamiaceae	H	Kashmalay	L	Leaves of the plant used as expectorant and for mouth inflammations. The powder leaves are best suited for culinary use in blood and heart diseases Lamiaceae.	0.10	0.22	0.18	1.5	0.27
DOB-175	*Pinus roxburghii* Sargent.	Pinaceae	T	Nakhtar	Ba	Plant resin stimulates and is used for severe cough, tumor and bleeding.	0.67	1.87	1.980	0.467	0.889
DOB-176	*Platanus orientalis* L.	Platanaceae	T	Chinar	Ba	Leaves are taken in constipation, twisted remedial and give relieve in pain	0.70	0.19	0.55	1.70	0.935
DOB-177	*Prunus americana* Marshall	Rosaceae	T	Khoobani	S	Stem gum has anti-cancer properties and in powder form its used for wound healing.	0.46	0.3	0.5	1.74	0.87
DOB-178	*Prunus domestica* L	Rosaceae	T	Alochay	L	In many foods, when dried, it acts as a flavoring agent and also its pulp used in Murabba preparation	0.94	0.96	1.95	0.97	1.97
DOB-179	*Pisum sativum* L	Fabaceae	H	Matar	Wp	cooking seeds are used and raw young pods are eaten. Leaves are used for fodder purposes	0.13	0.9	0.31	1.10	0.341
DOB-180	*Polygonum barbaratum* L.	Polygonaceae	H	Pulpulak	L	Leaves are freshly used for reducing gas trouble in stomach.	0.3	0.4	0.18	1.07	0.192
DOB-181	*Portulaca oleracea* L.	Portulacaceae	H	Warkharay	S	Using (saag) as vegetable. For liver and kidney failure a decoction of the shoot is used.	0.9	0.21	0.09	1.13	0.101
DOB-182	*Plantago major* L.	Plantaginaceae	H	Ispheghol	S	Sowing is laxative, used for mouth disease, sore, and warts.	0.9	0.21	0.8	1.06	0.848
DOB-183	*Raphanus sativus* Linn.	Brassicaceae	H	Molay	L	Used as salad and carminative, nutritional, and diuretic. Hepatitis, jaundice, ailments and urinary diseases. Leaves are nutritious for use in cooking.	0.2	0.10	0.8	1.36	1.08

DOB-184	*Rumex crispus* L.	Polygonaceae	H	Shalkhai	Fl	Local people are using a cooling agent during hot summer days. It's a potato. The spores are best suited for ear infection diagnosis.	0.6	0.11	0.9	1.63	1.46
DOB-185	*Robinia pseudoacacia* L	Fabaceae	T	Keekar	Wp	It is best suited for the production of furniture, wheels and carts.	0.4	0.02	0.6	1.33	0.798
DOB-186	*Rumex dentatus* L.	Polygonaceae	H	Shalkhay	L	Used as a vegetable (saag) and for healing of wound.	0.33	0.12	0.5	1.16	0.58
DOB-187	*Solanum nigrum* L**.**	Solanaceae	H	Karhmacho	Wp	Used for treatment of kidney stones also used to treat hepatitis and gastrointestinal infections.	0.35	0.04	0.33	1.43	0.471
DOB-188	*Thymus linearis* Bent	Lamiaceae	H	Spairkai	Fr	Honey bees are fed with seeds and used for a toothache	0.57	0.80	0.68	1.70	1.15
DOB-189	*Trifolium repens* L.	Fabaceae	H	Shautal	Wp	Used as vegetable (saga) and for treatment of pimples. Plants are mostly used as fresh fodder	0.31	0.07	0.15	1.10	0.165
DOB-190	*Taraxacum officinale* (L.) Webe	Asteraceae	H	Zairgulay	L	The plant is diuretic and used in jaundice, and used as a tonic as well. Thick Leaf Decoction is used in diabetes	0.92	0.39	1.96	1.28	1.97
DOB-191	*Xanthium strumarium* Linn.	Asteraceae	H	Jishee	L	Leaf decoction is used for malaria fever also used as cooling agent, as anti-Inflammatory anti-allergic Anti goiter	0.35	0.07	0.25	1.10	0.275
DOB-192	*Zanthoxylum armatum* DC.	Rutaceae	T	Dambra	Se	Seeds helps to treat fever and cholera	0.4	0.2	0.27	1.09	0.294
DOB-193	*Zea mays* L.	Poaceae	S	Jowar	Wp	The flour bread is very tasty and useful for diseases such as diabetes and tuberculosis	0.27	0.93	1.67	1.83	0.84

Key words: Habit; T: Tree, H: Herb, S: Shrub. **Parts Used;** Wp: whole plant, Fr: Fruits, B: Barks, Fl: flower, Se: Seeds, St: Stem

Jaccard indices (JI)

Analogically presented data analyzed with previous published articles adjacent to area. In analysis Ji ranging between 42.4 to 2.60 the highest similarity was 42.4 resulted from district Swabi (Ullah *et al.* 2023), while the second leading Ji value 36.6 observed from district Swabi, followed by with tehsil raza 11.73 (Wheed *et al.* 2018), 9.94 from Tehsil Lahor Swabi. However, the 9.72 from District Swabi (Qasim *et al.* 2016), 6.38 with Nawagai Valley, District Buner (Zaman *et al.* 2018), 4.04 from Adenzai, Lower Dir, Pakistan (Irfan *et al.* 2018d). Although the 3.35 with Kalash Valley, District Chitral (Ullah *et al.* 2014), the 3.23 JI with Garam Chashma valley, district Chitral (Ullah *et al.* 2014), 2.60 with Samar Bagh valley, Lower Dir, Pakistan (Irfan *et al.* 2018c) see (Table 3).

Table 4. Analogy of our given knowledge with previously published articles

Reported Area	Total no. of taxa	Specie with same uses	Specie with different uses	Specie common both area (C)	% of taxa with same uses	% of taxa with different uses	JI	Citation
District Swabi	147	41	19	35	63.0	29.2	42.4	Ullah *et al.* 2023
Tehsil Razar, Swabi	81	16	7	23	22.5	9.85	11.73	Wheed *et al.* 2018
Tehsil Lahor, Swabi	100	7	12	19	11.2	19.3	9.94	Ali *et al.* 2023
District Swabi	24	6	11	17	8.10	14.5	9.19	Qasim *et al.* 2016
District Buner	55	9	7	16	8.49	6.60	36.72	Jan *et al.* 2021
Nawagai Valley, District Buner	44	5	10	15	13.8	27.7	6.87	Zaman *et al.* 2018
Garam Chashma valley, district Chitral	135	2	3	5	3.22	4.83	3.23	Birjees *et al.* 2022
Kalash Valley, District Chitral	62	27	13	40	41.5	20.0	3.35	Ullah *et al.* 2014
Samar Bagh valley, Lower Dir, Pakistan	60	26	32	58	43.3	53.3	2.60	Irfan *et al.* 2018
Adenzai, Lower Dir, Pakistan	65	41	19	34	63.0	29.2	4.04	Irfan *et al.* 2018

Discussion

Blessing The quantitative assessment of the medicinal flora of Gadoon Valley preserves traditional knowledge and supports biodiversity conservation, highlighting valuable medicinal plants for pharmacological research. It enriches ethnobotany by providing a detailed inventory and statistical analysis, guiding sustainable use and future studies. The findings of our assessment on habit based the leading habit was herbs dominant with 80 taxa, followed by shrubs with 37 taxa second dominant while the trees were 26 has been recorded and the family Lamiaceae were leading family, our assessed analysis showing clear similarities with the previous work of adjacent area (Abbasi *et al.* 2010) who documented data from Tehsil Kabal, Swat District, Khyber Pakhtunkhwa, Pakistan that family Lamiaceae having 11 species while habit wise herbs were 76 taxa, 17 were shrubs and 40 were trees. These findings are crucial as they enhance our understanding of traditional plant use and contribute valuable information to the field of ethnobotany. In our findings also showing similarities with previous work of therapeutic plants which used for various kinds of alignments, such as respiratory disorder, abdominal pain, wound healing, diabetes, carminative, diarrhea etc. Inline the same result was found with (Irfan *et al.* 2018a). Such same work was done nearby area in the Garbal valley district Swat, they had documented 176 plants species in which the 133 plant taxa belongs to medicinal category (Ahmad *et al.* 2016).

The quantitative analysis and traditional uses of every part of the plant was usually depend on the habit of plant and user's needs (Bussmann, 2006). The specific parts of the plant showed that these parts have most medicinal properties but it is necessary to carrying out biochemical analysis and pharmaceutical screening to check information of local informants. The

uses of leaves in the preparation of medicine and the whole plant in the preparation of medicine cause danger to the population of plants (Boesi, 2014; Musa *et al.* 2022; Hassan *et al.* 2022). The reliance on leaves for medicinal purposes highlights the need for sustainable harvesting practices to ensure the conservation of plant species (Ullah *et al.* 2023).

Recently same approached resulted by (Rehman *et al.* 2023) documented the therapeutic plant from north Waziristan, which were used for respiratory disorders which showed similarity with documented data our assessment also showed similarity in the data collection and assessment methodology. The dominance of herbs as the primary life form used underscores their accessibility and versatility in traditional medicine. In assessment the herbaceous life form of medicinal plant was the dominant with (60%), followed by shrubs (24.6%), and trees (14%) medicinal plant were, the similar results were documented local informants reported that most of the practitioner healers and hakims prevalently use herbs against diseases due to their easy availability (Hassan *et al.* 2020).

Over the past decades, herbal medicine has become a topic of global importance, making an impact on both world health and international trade. Medicinal plants continue to play a central role in the healthcare system of large proportions of the world's population (Bano *et al.* 2014; Ali *et al.* 2023). Continuous usage of herbal medicine by a large proportion of the population in the developing countries is largely due to the high cost of western pharmaceuticals and healthcare. Among the human diseases treated with the medicinal plants is cancer, which probably the most important genetic disease. Every year, millions of people are diagnosed with cancer, leading to death in the majority of the cases (Ijaz *et al.* 2016; Mushtaq *et al.* 2017).

The contemporary youth heavily rely on technological advancements across different spheres of life, including education. These technological innovations hold the potential to greatly enhance students' comprehension and valuation of ethnobotanical knowledge, as highlighted by Arif *et al.* (2021). Moreover, technology offers avenues for expanding access, preserving, promoting, and fostering collaborative efforts in traditional practices among students, as emphasized by Mahmood *et al.* (2011). Using technology in learning helps make learning more interesting and also helps protect nature, cultures, and knowledge about plants and their traditional uses. This is important, as mentioned by Yebouk *et al.* (2020). People who create technology for learning need to make sure it's easy for everyone to access, especially for students who live far away or don't have many resources. This way, everyone can enjoy the benefits of using technology for learning.

A recent study found that younger people are forgetting traditional knowledge about plants, especially their medicinal uses, while older people still remember a lot. This is because of changes in society, like modern life and globalization, which affect how much people know about these plants all over the world (Irfan *et al.* 2017a). As a result, there's less farming and gathering of these plants, which makes it harder to find natural remedies (Jan *et al.* 2020a). Also, traditional plant knowledge is closely tied to culture and history. If we lose this knowledge, it could weaken our connection to our cultural roots (Adnan *et al.* 2015; Ashfaq *et al.* 2019).

Our approaching area for the first time is novel insight through a quantitative assessment which captured the proper image of the area. Previously same exhibited based studies carried at the same area by (Irfan *et al.* 2017) in the tehsil Lalqilla of district Dir lower documented the diverse traditional knowledge of 50 taxa having 47 genera belonging to 34 families, the dicotyledons were dominant with (98.0%) which showing that the area had well adaptation in trees (Irfan *et al.* 2018c). These floras were used for various ailments as medication. Gadoon Valley, District Swabi, highlights key medicinal plants, with Foeniculum vulgare (UV 1.24) and Daucus carota (UV 0.99) being the most utilized. High Relative Frequency Citation (RFC) for *Morus alba* (1.99) and *Pinus roxburghii* (1.87) indicates their significant role in traditional medicine. Popularity and research priority are reflected in high Relative Popularity Level (RPL) for *Convolvulus arvensis* (1.96) and high Rank Order Priority (ROP) for Prunus domestica (1.97). Informants Consensus Factor (ICF) shows strong agreement on treatments for bronchitis (0.969) and wound healing (0.954). The Jaccard Indices (JI) reveal regional consistency in plant use, particularly with District Swabi (42.4). These findings underscore the need to preserve traditional medicinal knowledge and promote conservation of key species, contributing valuable insights for pharmacological research and biodiversity conservation (Rehman *et al.* 2023; Ullah *et al.* 2023).

In our study, we found that people in the area used plants a lot, with fidelity levels ranging from 62% to 100%. This means they relied heavily on these plants for medicine, not just in our area, but also in other parts of Pakistan (Irfan *et al.* 2023). Plants with high fidelity levels are especially important for scientists to study. High fidelity levels, which indicate consistent use of certain plants for specific ailments, suggest a strong potential for discovering new drugs. It can help us discover new

medicines and herbal products (Jan *et al.* 2021; Shuaib *et al.* 2021). This consistency provides a solid foundation for further pharmacological research, increasing the likelihood of identifying effective compounds for modern medicine.

Conclusion

The presenting research work it is concluded that the region is floristically rich. There are many important plants growing in the region but we are close to losing these natural resources due to many reasons including deforestation, pollution, negligence and other human disturbances. So, maintaining our natural resources is critical. This research is intended to provide basic information about plant uses in a safe manner for the study area. In addition, a nationwide survey of medicinal flora should be carried out to investigate and update the inventory of the area existing natural plant resources, especially in agricultural countries such as Pakistan. Given the abundance of plant species in Swabi and its immediate vicinity, it is suggested that the Pakistan Industrial Development Corporation may be persuaded to prepare a comprehensive report for the creation of small-scale processing units for the valued drugs.

Declarations

Ethics statement: Prior to the survey, we obtained oral informed consent from each participant.
Consent for publications: Not applicable.
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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: FU designed the project and collected the data to write the first draft of the manuscript; MI supervised the study and provided technical support, KK help in statistical analysis, MS helped in reviewing, AS and AF reviewed and edited the final manuscript.

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