Medicinal plants used in the treatment of neurological disorders by traditional practitioners of YSR Kadapa District, Andhra Pradesh, India

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Research

Abstract

Background: The YSR Kadapa District of Andhra Pradesh, India, possesses a rich heritage of ethnomedicinal knowledge, with local communities relying heavily on plant-based remedies for healthcare. Neurological disorders present a significant health burden and traditional plant-based treatments offer a vital, culturally important alternative to conventional medicine. However, this traditional knowledge is vulnerable to erosion due to modernization and environmental degradation.

Methods: Ethnobotanical data were collected through interviews and discussions with 75 informants, including traditional healers and local villagers across the district. Information on plant species, local names, families, modes of administration and specific medicinal uses for neurological conditions was meticulously documented and verified. Herbarium specimens were prepared for each species.

Results: The present study documented 41 plant species under 39 genera from 39 families used by traditional practitioners to treat 15 different neurological disorders, including epilepsy, Alzheimer's disease, Parkinson's disease, migraine, depression etc. The botanical name, local name, habit, family and precise mode of administration for each species are presented.

Conclusions: This research underscores the profound ethnomedicinal knowledge within local communities of YSR Kadapa and highlights the critical role of plant biodiversity in regional healthcare. The findings emphasize the urgent need to conserve both this invaluable traditional knowledge and the plant species themselves. Further, pharmacological validation of these plants is essential to integrate these traditional remedies into evidence-based healthcare and ensure their sustainable use for future generations.

Keywords: Ethnomedicinal plants, neurological disorders, traditional knowledge, YSR Kadapa District

Background

Traditional medical systems are playing a vital role in the healthcare of rural people across the world depend on phytoremedies passed by word of mouth over generations (Awas and Demissew 2009, Aziz *et al.* 2018). Plants have been indispensable to human survival, providing food, oxygen, fuel, shelter and medicine since time immemorial (Silva *et al.* 2024). The indigenous systems of medicines are evolving among different communities all over world by influencing rituals, faiths, superstitions alongside modern medicine (Chevallier 2016). Traditional ethnomedicine practices are common in developing countries like India, China, Pakistan, Sri Lanka, South Africa, Nepal etc. First and the most important necessity for human life is the oxygen which is provided by the plants. Besides this, for day-to-day life, plants have offered food, fodder, fuel wood, timber, dyes, latex, gums, fibres, shelter, fruits etc. Additionally, there are many plant species which have continuously been used by the natives for traditional medicines. There is considerable development in contemporary medicine, the rural population in India and the globe still entrust in herbal medicines for many health-related issues because of the scarcity of health services (Sen and Chakraborty 2017).

India, household to over 500 tribal communities, possesses a rich heritage of ethnomedicinal knowledge belonging to 27 ethnic groups (Sajem & Gosai, 2006). India is one among the 12 mega biodiversity centres in the world and harboring rich bioresources which are used in indigenous systems of medicines (Manju & Ahd 2021). Eastern Ghats, Western Ghats and Nilgiris have significantly flora and fauna which supports livelihood of local communities. Seshachalam Biosphere Reserve is one among the 18 Biosphere Reserves in India and passes through the study area. Approximately 85% of rural populations rely on wild medicinal plants for healthcare needs. This traditional knowledge, often orally transmitted, is at risk of extinction due to modernization, deforestation and displacement of indigenous communities. According to World Health Organization (WHO), nearly 21000 medicinal plants are used for different diseases and ailments (WHO, 2005). Still, herbal medicine is practicing in the remote areas across the world. These herbal therapists using 2500 plants to treat common ailments which is effective treatment of illness in Indian medicine (Panmei *et al.* 2019, Akbar *et al*.,2020). Neurological disorders such as stress, anxiety, depression, Parkinson's disease, Alzheimer's disease, muscular pain, headache etc., significantly impact human well-being. Plants play vital role in the traditional medical system, history and cultural norms in developing nations (Pan *et al.* 2014). Conventional medical treatments are often costly and carry side effects, prompting rural populations to depend on plant-based remedies. The present study focussed on documenting and analysing medicinal plants traditionally used for neurological disorders in YSR Kadapa District, Andhra Pradesh.

Since time immemorial tribal people use plants to cure various ailments and diseases. Claims of medicinal plants constitute one important way of maintaining good health. Traditional knowledge is a record of human achievement in comprehending the complexities of life and survival of human society. The information about medicinal properties of plants came traditionally through generation by word of mouth. Ethnomedicinal studies are often significant in revealing locally important plant species for discovering of crude drugs. Traditional healing systems play an important role in maintaining the physical and psychological wellbeing of the vast majority of tribal people in India. Many traditional plants are using to treat various neurological disorders are due to a function of many factors, such as exposure to stress, genetic disposition, family background and so on. The symptoms and severity of neurological disorders vary greatly. Neurological disorders can affect people at any age, early diagnosis and treatment are crucial for managing many neurological disorders. India has its own traditional medicinal systems such as Ayurveda, Homeopathy, Siddha, Yunani, Folk medicine, Phytomedicine and practicing these medicines and treating the people for diseases and ailments. Neurological disorders are conditions that affect the brain, spinal cord and nerves. There is a wide range of these disorders, from common conditions like headaches and migraines to more severe, degenerative diseases like Alzheimer's disease and Parkinson's disease. Many neurological disorders are chronic and some can be progressively worsen over time. The people in the study area are suffering with neurological disorders such as Stroke (sudden weakness, trouble speaking, vision problem, loss of balance and dizziness), Epilepsy (loss of consciousness, temporary confusion, sudden fear, anxiety and weakness), Alzheimer's disease (memory loss, Parkinson's disease (shaking, slow movement, rigidity of muscles, impaired balance and coordination, slurred speech), Multiple sclerosis (numbness in face, body and limbs, fatigue, vision problem, loss of coordination), Migraine (severe one-sided-headache, sensitivity to light, sound, nausea, vomiting, visual disturbances), Neuropathy (stabbing pain, numbness in hands, feet, weakness, muscle wasting), Brain tumors (continuous headache, nausea, vomiting, vision problem, behavioral change), Amyotrophic lateral sclerosis (progressive muscle weakness, speaking problem, muscle cramps, loss of ability to move arms, legs, breathing problems), Huntington disease (jerky movements, difficulty in coordination and balance, mood change, depression, memory loss), Headache (pain in head, vision problem, confusion), Muscular dystrophy (unbalanced body, giddiness), Meningitis (pain in back, fever, chills, fatigue, irritability, light sensitivity, mental confusion, fast breathing, fear of loud sounds, sleepiness), Encephalitis (confusion, hallucinations, seizures, weakness and loss of sensation), Septicemia (fever, difficulty in breathing, low blood pressure, fast heart beating, mental confusion). Anxiety disorders are

type of abnormal behaviours characterized by unrealistic, irrational fear. Depression is a state of low mood and aversion to activity that can affect a person's thoughts, behaviour, feelings and sense of well-being. Most of the people do not approach doctors due to lack of knowledge, costly medicine and different instrumental treatments. A neurological illness can make the people miserable and can cause problems in daily life, such as at school or college or work or in relationships. In most cases, symptoms can be managed with a combination of medications. Signs and symptoms of neurological illness can vary, depending on the disorder, circumstances and other factors. Neurological illness symptoms can affect emotions, thoughts and behaviors. The signs and symptoms include feeling sad or down, confused thinking or reduced ability to concentrate, excessive fears or worries, or extreme feelings of guilt, extreme mood changes of highs and lows, withdrawal from friends and activities, significant tiredness, low energy or problems sleeping, detachment from reality (delusions), trouble speaking, confusion, slow movement, numbness etc.

Currently, constant deforestation and environmental deprivation in many areas of India exhausting the medicinal plant resources. In the modern days, there has been increase in the demands of herbal products and plant-based drugs across the world resulting in the over exploitation of medicinal plants. Habitat degradation, unscientific harvesting and over exploitation to meet the demands of medicinal plants have led to the extinction of plant species in the world. The leaves of *Erythroxylum monogynum* and roots of *Aloe vera* used as food during paucity (Krishnamachari 1900). A study conducted on the floristic studies on the flora of YSR Kadapa District and stated there are 710 species of angiosperms in the district (Madhusudhan Rao 1989). Maria and Rita reported 46 plants used for neurological and mental disorders from Navarra, Spain (Maria & Rita 2015). A study exposed on 29 plant species used to treat mental disorders by traditional practitioners of Vijayapura District of Karnataka (Arati Laddimath & Srinath 2016). Yendube *et al.* (2016) reported medicinal plant species used in folk medicine against central nervous system disorders in Togo. Kiran Sharma *et al.* (2022) reported 73 ethnomedicinal plants used to cure various neurological disorders in Himachal Pradesh. Balachandar Vellingiri (2023) presented an overview on neurological disorders in India. Yogesh and Krishna Kumar (2023) documented 143 plant species used to treat neurological disorders from Western Ghats region of Dakshina Kannada district, Karnataka, India. Greeshma *et al.* (2017) reported some medicinal plants used in the treatment of neurodegenerative diseases. Patrick Amoateng *et al.* (2018) reported 32 plant species used in the treatment of mental and neurological disorders in Ghana. Mahabat Nadaf *et al.* (2019) investigated 58 medicinal plant species for the treatment of nervous disorders at the herbal market of Bojnord, North Khorasan Province, Iran. Noureddine *et al.* (2020) collected data from 31 medicinal plant species to treat Nervous System Diseases in the Rif of Morocco. Lepcha *et al.* (2023) reported Neurological potency of native plants from sub Himalayan West Bengal through reverse pharmacology about 25 plants in the treatment of neurological disorders. Swetza Singh and Rajiv Gupta (2024) stated that ethno-pharmacological activities of some important medicinal plants on mental health. In this investigation researchers proved that medicinal plants are used to treat neurological disorders like anxiety, memory loss, depression etc. Deboral Eshak and Mohanapriya Arumugam (2025) investigated on phytocompounds in *Bacopa monnieri* and *Centella asiatica*. Ravindra Mishra and Vinay Jain (2025) explored the potential of traditional herbal medicine in the management of central nervous system disorders. Neha Takur *et al.* (2025) investigated ethnobiological survey on medicinal plants used by Gaddi and Gujjar tribes of riparian regions of Beas River of Himachal Pradesh in Northwestern Himalayas, in which they documented 64 plant species from 39 families, many of them used in the treatment of neurological disorders. Spandana Kullampady Janardhana and Bhagya Nekrakalaya (2025) investigated bioprospecting of medicinal plants used in the treatment of some neurological disorders.

Documenting ethnobotanical knowledge across different regions of Andhra Pradesh is a challenging task due to ecological diversity, cultural heterogeneity and the plodding erosion of traditional knowledge. Yet several researchers have made methodical efforts to explore and document ethnobotanical information from various parts of the state (Hemadri *et al.* 1987a 1987b, Muralidhar Rao and Pullaiah 1989, Jeevan Ram and Raju 2011, Ramesh *et al.* 2017, Tanuja Sivaram *et al.* 2018,). Sripriya and Naik (2019) recorded 30 potential ethnomedicinal plants from Sesshachalam Biosphere Reserve of Andhra Pradesh. Kanwaljeet Singh *et al.* reported 53 plant species used by people to treat several ailments from Polavaram Mandal of Andhra Pradesh (2024). According to report of all India Ethnobiological survey accomplished by Ministry of Environment and Forests & Climate Change (MoEFCC), Government of India, there are over 8000 plant species that are being used by the local people. These plants are used in Ayurveda, Siddha, Unani and Homeopathy Systems of medicine (Prasad 2008). Allopathic treatments are often associated with adverse side effects, consequently, many people prefer natural drugs for the management of various ailments and diseases. Natural drugs are considered relatively safe and have been used since ancient times. The present study principally aims to document medicinal plant resources and their traditional applications with particular emphasis on the treatment of neurological disorders by traditional practitioners to analyze ethnobotanical data by using indices such as Relative Frequency Citation, Informants Important Factor of YSR Kadapa District, Andhra Pradesh, India.

Materials and Methods

Study area

YSR Kadapa District, covering an area of 15,378.41 km², is located in the south-central part of Andhra Pradesh, India. The district is bounded by Kurnool District to the north, Chittoor District to the south, Nellore District to the east and Anantapur District to the west. Geographically, it lies between 13°43′–15°14′ N latitude and 77°55′–79°29′ E longitude (Fig. 1). The district extends along the western slopes of the Eastern Ghats and includes important hill ranges such as Velikonda, Palakonda, Nallamalais and Yerramalais. The forests of YSR Kadapa District mainly consist of dry deciduous vegetation, much of which has been degraded into scrub forest (Champion & Seth, 1968). The total forest area is approximately 5,050 km², accounting for 32.87% of the district's geographical area. Rainfall is comparatively higher in the northeastern region of the district. The vegetation supports several endemic, rare and threatened plant species (Ahmedullah & Nair, 1987). The endemic and endangered medicinal tree *Pterocarpus santalinus* (Fabaceae) occurs naturally in this region. YSR Kadapa District was selected as the study area due to its rich floristic diversity, varied topography and the presence of rural and traditional communities with well-preserved ethnobotanical knowledge**.** The sample size in the present study was determined based on standard ethnobotanical research practices**,** data saturation**,** and informant consensus**,** rather than purely statistical sampling. The district is primarily drained by the Penna River and its tributaries, including Kunderu, Sagileru, Cheyyeru, Papagni and Chitravati. The forest ecosystems of YSR Kadapa District exhibit considerable plant species diversity, providing a suitable setting for ethnobotanical investigations.

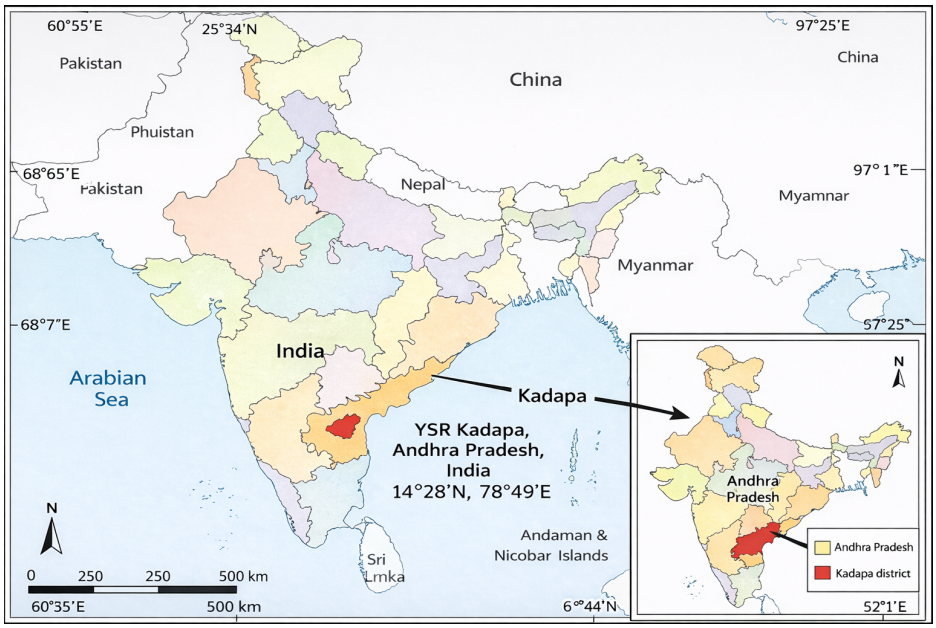


Figure 1. Map of YSR Kadapa District, showing the study area

Ethnobotanical Survey and Data Analysis

The investigation on ethnomedicinal plants and their uses was carried out during 2023-25 across various regions of YSR Kadapa District to find out some important traditional medicinal plants which are used in the treatment of various neurological disorders. Ethnobotanical data were collected through interviews, deliberations, questionnaire and personal annotations involving 75 informants, including traditional therapists, elder people, agriculturists, natu vaidyas, herbalists, farmers, forest dwellers, tribal men and local villagers. (Jain and Rao 1977, Hassan *et al.* 2022). The informants were selected based on possessing traditional knowledge, preference is given to elderly people as they often retain extensive knowledge, informants who have lived in the area long period are preferred as they are more familiar with local flora, informants who are recognized by community as knowledgeable in the identification of local plants and mode of administration, priority given to those who are cooperative and willing to give information, both men and women selected as gender-specific knowledge is essential duly following ethical consideration like informants' consent, authorization and institutional approval. The data collected from 75 informants, ranging in age from 30 to 60 above. Local healers and tribal doctors have sound knowledge on local medicinal plants and their uses. The interview procedure includes the preliminary survey and rapport building, identification of informants, informants' consent, interview techniques, collection of socio-cultural data, documentation of ethnobotanical data, field visits, cross checking of data, data analysis and informant evaluation etc. Twenty field visits were conducted across the district to collect wide-ranging data. (CBD,1992). The field visits are conducted in the

regions of Badvel, Rajampeta, Rayachoty, Pulivendula, Jammalamadugu and Proddatur, Mydukur. The reputation given to the level of traditional knowledge having by informants in an interview determining the key informants. Herbal doctors are having potential traditional knowledge comparing other informants and they are practicing this phytomedicine from their forefathers. The survey conducted along with informants bringing them into field and supplying of questionnaire and gathered data on each plant species. The questionnaire contains questions like name, age, education, occupation, community, local name of the plant, availability (common/rare/seasonal), part of plant used, ailment and disease treated, mode of administration, dosage and duration etc. The collected information on each plant species was authenticated in the field itself with group of informants and general informants. Later identified plant species and recorded scientific names for each plant. The botanical names of collected plant species were patterned with data base of different floras (WFO, 2023, POWO, APG IV)). The ethnobotanical information validated repeated interviews, cross verification and comparison with herbarium specimens. Field visits were conducted during March, May, June, October and December (2023), February, April, May, September and November (2024), March, April, July and August (2025). These surveys encompassed all major climatic seasons summer, monsoon and winter thus facilitating comprehensive documentation of seasonal variations. The summer season was particularly favorable for collecting flowers and fruits of tree species. Overall field visits were carried out four times per year for the collection of ethnobotanical information and plant specimens and three times per block for data validation and cross-verification.ç

Some of the selected photographs of the plant species presented in Fig. 8. The demographic details were presented in table 1. Information on plant species, local names, families, modes of administration and medicinal uses was recorded. The interviews were preferably conducted in local language Telugu for the convenience of the respondents. Older people have restored knowledge than younger people.

Identification of Plants

The collected plant specimens in the field visits were identified with the help of standing Flora of Presidency of Madras, Flora of India Vol 1-3 and Flora of Andhra Pradesh (Gamble 1935, Pullaiah & Chennaiah1993, Hajra *et al.* 1996). The voucher specimens are equipped by SRGR and AMR. The specimens were first dipped in FAA solution for sterilization, dried in blotting paper and mounted on handmade white herbarium sheets. The voucher number given for each specimen (Table 2). The voucher herbarium specimens were deposited in Yogi Vemana University herbarium, Kadapa, Andhra Pradesh and Central National Herbarium (CAL or CNH), Botanical Survey of India, Ministry of Environment, Forest and Climate Change, Government of India which is a repository of national herbarium and internationally recognized. The plant species are arranged alphabetically with botanical names with herbarium voucher number followed by local names, habit, family and medicinal significance of plants with mode of administration.

Table 1. Demographic details of Informants (Fig. 3 A, B, C, D & E)

Variable	Number of Informants	Percentage of Informants
Informants gender	Male - 55	73.33
	Female - 20	26.66
Informants educational status	Illiterates - 40	53.33
	Primary education - 30	26.66
	Secondary education - 10	13.33
	Higher education - 5	6.66
Informants age group	30 – 40 - 5	6.66
	40 – 50 - 18	24.00
	50 – 60 - 14	18.66
	60 above - 38	50.66
Informants occupation	Farmers - 11	14.66
	Agricultural labor - 12	16.00
	Local healers - 28	37.33

Data analysis

The information collected from 75 informants about 41 species has been analyzed by using following statistical tools.

Relative Frequency Citation (RFC)

RFC calculated by dividing Information Knew the Value of plant (IKV) by total number of informants (TI).

$$RFC = \frac{IKV}{TI} \times 100$$

Where IKV is Informants Knew the Value of Plant
TI is Total number of Informants

Information Consensus Factor (ICF)

ICF indicates whether informants accepted on the use of particular plant in certain neurological disease as per previous reports and it is calculated by using following formula.

$$ICF = \frac{NIAR}{TI} \times 100$$

Where NIAR is Number of Informants Accepted Reports
TI is Total number of Informants

Frequency Percentage (FP)

Frequency percentage can be calculated to habit of plants, parts of plants used, drug form, disorders etc. FP calculated for habit of plants by using following formula.

$$FP = \frac{HPN}{TP} \times 100$$

Where HPN is Habit wise Plant Number
TP is Total Plants

Results and Discussion

The present study displays that 41-plant species are used in the dealing of neurological disorders. They are belonging to 39 genera and 39 families. These plants are used to treat 15 neurological disorders. These plant species regularly used by the local people treat various neurological disorders. Some plants like *Boswellia*, *Terminalia*, *Withania* are more prominent medicinal plants to treat neurological and other ailments and disorders. The medicinal significance of each plant is enumerated in table 2. The importance of plants in human life as food, fibre, cosmetics, medicines, wood, gums, resins, oils etc., was discussed time to time by many researchers. Since time immemorial conservation of natural resources has been an integral part of diverse cultures in different ways. The traditional use of plants shows the symbiotic relation of human beings and nature. Indigenous communities all over the world lived in harmony with the nature and conserved its valuable plants. It is very important to uphold traditions and beliefs in order to protect and conserve these medicinal plants. The traditional culture and religion of human beings have deep faith in the nature and its components in every walk of life. These plants are used to treat neurological disorders such as stroke, epilepsy, Alzheimer's disease, Parkinson's disease, Multiple sclerosis, Migraine, Neuropathy, Brain tumors, Amyotrophic lateral disorders. Huntington disease, Headache, Muscular dystrophy, Meningitis, Encephalitis and Septicemia. Many of these medicinal plants are found in every household in the study area and are used in religious activities as well as health care. Therefore, these medicinal plants play a major role in wellbeing of people. These medicinal plant resources are to be conserved by employing various conserving methods.

Habit of the collected medicinal plants

Tallied plants include herbs 11(27%), shrubs 10 (24%), trees 16 (39%), climbers 3 (7%) and one liana (3%) (Fig. 2). Among 41 plant species collected information in the study area, 40 plants are wild and *Curcuma longa* is the only cultivated plant.

Drug forms and parts of plant used and mode of administration

Diverse drug forms are used to treat neurological illnesses such as extract from 15 plants (20%), powder from 11 plants (14.66%), paste from 5 plants (6.66%), oil from 4 plants (5.33%), resin, juice and decoction from each 2 plants (8%). (Fig. 3A). Plant parts are used to make drugs such as stem (12), leaf (10), fruit (5), flower (4), root (4), bark (3) and seed (3) (Fig. 3B). Majority medicines were given alone, and few medicines are administered along with other ingredients such as lemon, honey, milk, salt, garlic, water, ginger, butter milk etc. These medicinal plants are not only used in the treatment of neurological disorders but also used in the treatment of other diseases and disorders. My investigation mainly focused on neurological disorders.

Figure 2. Habit of medicinal plants explored in the ethnobotanical survey

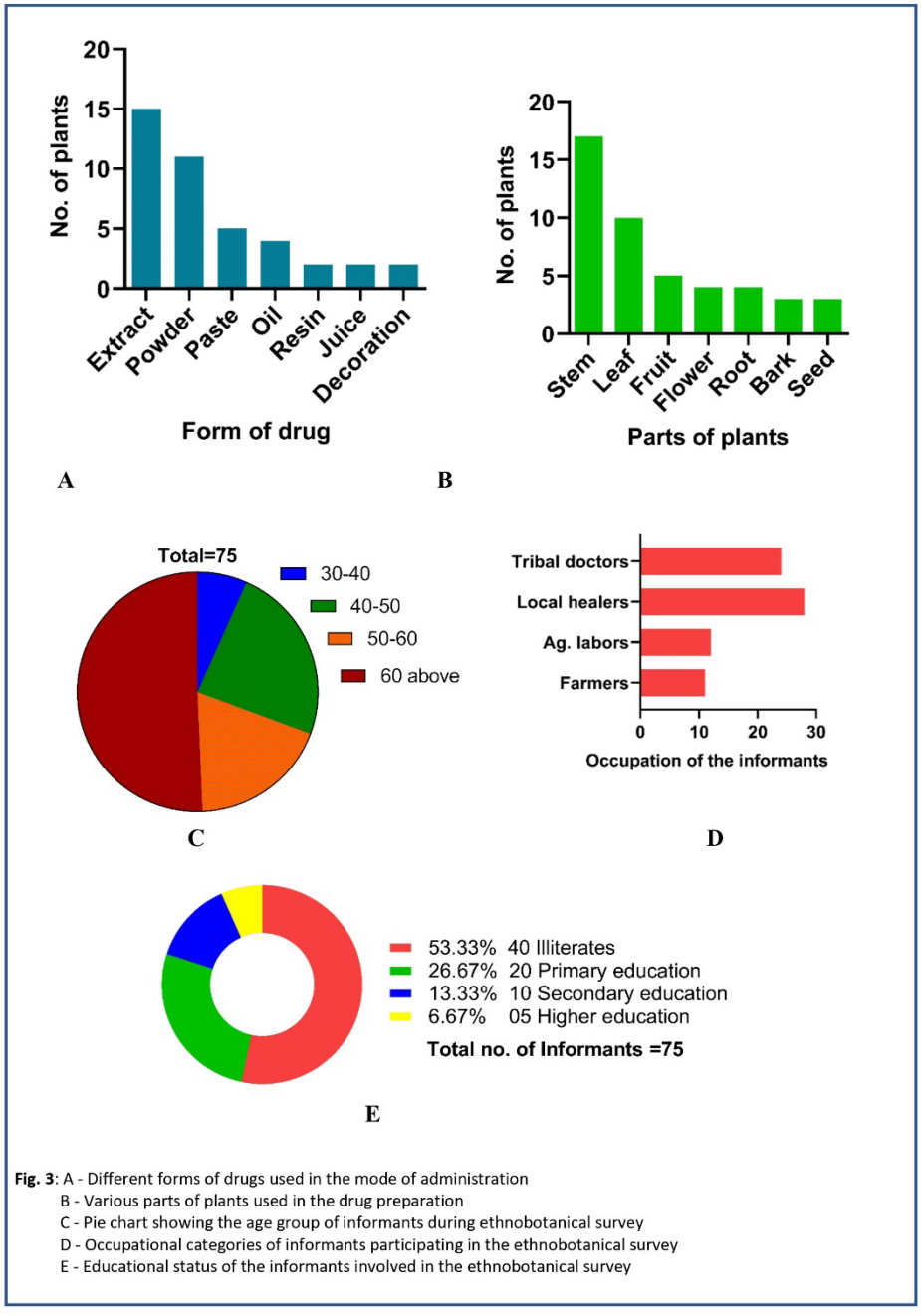


Fig. 3: A - Different forms of drugs used in the mode of administration
B - Various parts of plants used in the drug preparation
C - Pie chart showing the age group of informants during ethnobotanical survey
D - Occupational categories of informants participating in the ethnobotanical survey
E - Educational status of the informants involved in the ethnobotanical survey

Figure 3. Administration, plant parts used, demographics of participants

The ethnomedicinal practices documented in the present study determine strong biomedical relevance particularly in the context of neurological disorders which involve neurological mechanisms such as oxidative stress, neuroinflammation, neurodegeneration etc. The medicinal plants collected in the study area reflects a rationale and experience based therapeutic system of neurological health. Some high RFC and ICF species documented in the study possess established neuroprotective properties. For illustration, *Withania somnifera*, *Bacopa monnieri* and *Centella asiatica* commonly cited by informants are traditionally used for memory enhancement, stress reduction, anxiety and cognitive decline. Similarly, plants such as *Curcuma longa*, *Tinospora cordifolia*, *Boswellia serrata* and *Terminalia chebula* are traditionally used for conditions involving neuroinflammation, headache, rigidity and neurological weakness.

In the present study, multiple complementary validation approaches were employed to validate ethnobotanical information related to neurological disorders in YSR Kadapa District, Andhra Pradesh. Initially, information was collected through structured and semi-structured interviews using a pre-tested questionnaire directed to 75 informants, including traditional healers, tribal doctors, elderly villagers, herbalists and forest dwellers. To validate the consistency of responses, the same questions regarding plant identity, local name, plant part used, mode of preparation, dosage and therapeutic application were questioned repeatedly during different field visits. Only those plant uses that were consistently reported by multiple informants across different locations and time periods were considered reliable and included in the final dataset. Cross verification among informants is a key validation method adopted in the present study. For each plant species collected in the field visits prepared voucher specimens and authenticated with standard regional floras and scientific names were identified using updated taxonomic databases WFO, POWO and APG IV. Relative Frequency Factor (RFC) and Informant Consensus Factor (ICF) are also used as additional tools for validation of ethnobotanical information. High RFC values indicated widespread recognition and frequent use of certain species, while high ICF values reflected strong agreement among informants regarding their therapeutic applications. Plants with high RFC and ICF values were considered highly reliable and culturally validated remedies. Conversely, species with low values were interpreted as specialized or less commonly known practices, highlighting areas where traditional knowledge may be declining. Comparative validation was also achieved by reviewing earlier ethnobotanical and ethnopharmacological studies from Andhra Pradesh, other parts of India and comparable regions worldwide.

Table 2. Enumeration of ethnomedicinal plants

Botanical Name With voucher no	**Local Name**	**Habit**	**Family**	**Mode of administration**
Acorus calamus L 5367	Vasa	Herb	Acoraceae	Rhizome powder tea used for speech disorders
Aegle marmelos (L.) Corr. 5371	Maredu	Small tree	Rutaceae	Leaf powder is mixed with honey and administered for stroke, sudden weakness, trouble speaking, vision problems and loss of balance.
Argemone mexicana L 5390	Bramhadandi	Herb	Papaveraceae	The whole plant extract is mixed with lemon and used to treat temporary confusion, sudden fever and anxiety
Bacopa monnieri (L.) Wettst. 5385	Brahmi	Creeping herb	Plantaginaceae	Whole plant powder with milk used to improve memory power
Boswelia serrata Roxb. 5398	Guggilam	Tree	Burseraceae	Resin capsules used for neuro-inflammation, muscle weakness, speaking problems
Capparis zeylanica L. 5376	Arudonda	Shrub	Capparaceae	Root bark decoction with ginger used to treat memory enhancement, anxiety, improve memory
Cassia fistula L 5396	Rela	Tree	Fabaceae	Flowers mixed with garlic and used to treat stress and Alzheimer's disease.

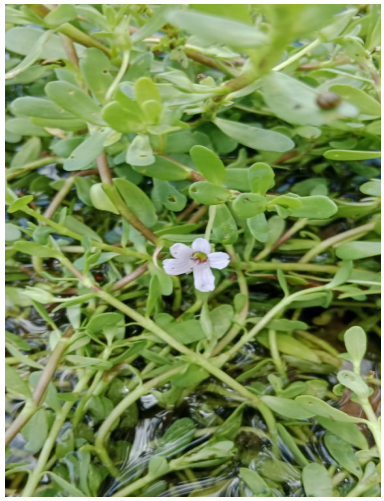
Celastrus paniculatus Willd. 5321	Teega palleru	Liane	Celastraceae	Seed oil with milk used to treat memory loss and depression
Centella asiatica (L.) Urban 5380	Saraswati aku	Herb	Apiaceae	Leaf juice or decoction used orally for reduce anxiety, neural disorders
Cissus pallida (Wight & Arn.) Planch 5389	Nallateega	Shrub	Vitaceae	Root paste is taken orally for mood, anxiety, cognitive impairment and panic disorder.
Clitoria ternatea L 5368	Sankupuvvu	Climber	Fabaceae	Leaf powder with hot water used to treat epilepsy and anxiety
Cochlospermum religiosum (L.) Alston. 5372	Kondagogu	Tree	Cochlospermaceae	Leaf powder mixed with heat water taken orally to treat memory enhancement, hypothermia.
Curcuma longa L 5373	Pasupu	Perennial herb	Zingiberaceae	Turmeric powder with milk and water used for Alzheimer's disease, and Parkinson's disease.
Decalepis hamiltonii L. 5384	Pedda sugandi	Herb	Apocynaceae	Root extract used to treat stress, cognitive decline, anxiety
Evolvulus alsinoides L. 5391	Vishnukantham	Herb	Convolvulaceae	The plant extract used for neuropathy, in balance and depression.
Ficus religiosa L. 5379	Ravi	Tree	Moraceae	Leaf decoction used for tension, headache and anxiety
Indigofera aspalacthoides Vahl 5397	Nela vempali	Shrub	Fabaceae	Whole plant extract mixed with cow milk and used to treat Alzheimer's disease, memory, anxiety, motor integrity
Jasminum pubescens L. 5381	Manchi malle	Climber	Oleaceae	Jasmine oil applied externally for depression, stress, mood disorders and anxiety
Lannea coromandelica (Houtt.) Enum Merr 5395	Gumpina	Tree	Anacardiaceae	Leaf and stem bark extract used for depression, oxidative stress, epilepsy
Lawsonia inermis L. 5369	Gorintaku	Herb	Lythraceae	Cooling leaf paste used for headache, migraine and anxiety
Mimusops elengi L. 5328	Pogada	Tree	Sapindaceae	Flower extract used for headache, anxiety, cognitive function
Murraya paniculata (L.) Jacq. 5392	Naga golugu	Shrub	Rutaceae	Plant extract used for the treatment of Alzheimer's, disease, Parkinson's disease, rigidity of muscles
Ocimum basilicum L. 5377	Bhu tulasi	Herb	Lamiaceae	Leaf paste mixed with ginger and used orally for mood change, jerky movement and numbness.
Ocimum sanctum L. 5329	Krishna tulasi	Herb	Lamiaceae	Fresh leaf and stem powder mixed with garlic and used to cure stress, headache, anxiety and mood disorder
Piper longum L. 5388	Chillangi	Herb	Piperaceae	Fruit powder with honey used for multiple sclerosis, migraine, muscle wasting

Phyllanthus emblica L. 5387	Usiri	Small tree	Euphorbiaceae	Fresh fruit juice extract used to treat Huntington disease and weakness
Plumbago zeylanica L. 5342	Tella Chitramulam	Herb	Plumbaginaceae	Whole plant extract used for stress, numbness, confusion and cramps
Salvia officinalis L. 5394	Darba	Shrub	Lamiaceae	Leaf paste used to treat fatigue and memory loss
Santalum album L. 5349	Srigandham	Tree	Santalaceae	Sandal oil used for depression, anxiety, memory improvement and Parkinson's disease
Shorea robusta Gaertn.f. 5375	Guggilam	Tree	Dipterocarpaceae	Plant resin used for neuro pain, breathing problems, shaking, loss of coordination
Semecarpus anacardium L.f. 5399	Nallajeedi	Tree	Anacardiaceae	The root bark powder mixed with butter milk and used to treat memory enhancement, reduce cognitive stress and Alzheimer's disease
Sida rhombifolia L. 5347	Attibala	Shrub	Malvaceae	Leaf and flower extract used for epilepsy, cognitive impairment and amnesia
Syzygium aromaticum L. 5370	Neredu	Tree	Myrtaceae	Flower bud oil used for headache, neuralgia, visual problems
Terminalia arjuna (Roxb.ex DC.) Wight&Arn. 5383	Tella maddi	Tree	Combreta ceae	The leaf extract applied on head to cure psychotic disorder.
T. chebula (Roxb.) L. 5378	Karakkaya	Tree	Combreta ceae	Fruit powder used to treat memory loss, anxiety and meningitis
Tinospora cordifolia (Willd.) Miers 5393	Tippateega	Climber	Menispermaceae	Fruit powder used to treat headache and meningitis
Toddalia asiatica (L.) Lam 5400	Konda mirapa	Shrub	Rutaceae	Fruit extract used for neuroglia and epilepsy
Vitex negundo L. 5405	Vavili	Shrub	Verbenaceae	Leaf paste/steam used for migraine, neuroglia, cervical spondylosis pain and anxiety.
Withania somnifera (L.) Dunal 5382	Aswagandha	Shrub	Solanaceae	Root extract used to manage anxiety and depression
Wrightia tinctoria (Roxb.) R.Br. 5386	Palavareni	Tree	Apocynaceae	Leaf extract with ginger used for headache, depression, pain management
Ziziphus mauritiana L. 5374	Regu	Shrub	Rhamnaceae	Seed powder tea used for anxiety, tumors and in balance

Relative Frequency Citation (RFC)

RFC is an important ethnobotanical index that measures the proportion of informants who cited a particular plant species, reflecting its local admiration, cultural reputation and healing relevance. It is calculated as the ratio between the number of informants mentioning a species and the total number of informants interviewed. Higher RFC values indicate wider recognition and use among the community, while lower RFC values suggest limited or specialized use.

Aegle marmelos



Bacopa monnieri

Clitoria ternatea

Decalepis hamiltoni

Phyllanthus emblica

Terminalia arjuna

Tinospora cordifolia

Vitex negundo

Ziziphus mauritiana

Figure 4. Important ethnomedicinal plants photographs taken during survey

General trends in the present study

RFC values in the dataset vary considerably, ranging from **18.66 (*Boswellia serrata*)** to **98.66 (*Curcuma longa*)**. This variation highlights the uneven distribution of knowledge and reliance on medicinal plants among informants.

Species with highest RFC values

Curcuma longa (98.66), *Cissus pallida* (97.33), *Ziziphus mauritiana* (96.33), *Aegle marmelos* (93.33) and *Ficus religiosa* (92.00) recorded the highest RFC values. These species are widely cited across the study population, reflecting their strong cultural and therapeutic significance, particularly in treating common and chronic ailments.

Species with moderately high RFC Values

Plants like *Lawsonia inermis* (76.00), *Murraya paniculata* (82.66), *Tinospora cordifolia* (80.66), *Terminalia arjuna* (80.00) and *Ocimum sanctum* (78.66) exhibit moderate to high RFC values. These indicate frequent but not universal use, often tied to specific ailments or cultural practices such as rituals and dietary preparations.

Species with moderate RFC Values

Species such as *Celastrus paniculatus* (66.66), Santalum album (89.66), *Syzygium aromaticum* (86.66), and *Withania somnifera* (73.33) show moderate RFC scores. Their importance may be due to specialized roles in treating neurological, reproductive, or systemic disorders.

Species with low RFC Values

Plants like *Toddalia asiatica* (58.66), *Evolvulus alsinoides* (40.00), *Semecarpus anacardium* (29.33), *Lannea coromandelica* (30.66), and *Salvia officinalis* (46.66) recorded relatively low RFC values. This suggests limited recognition, possibly due to restricted ecological availability, rare usage, or gradual decline in traditional knowledge associated with these plants.

Cultural Implications

High RFC species often align with widely documented ethnomedicinal knowledge in earlier reports (Bir Bahadur 2016), showing consistency in cultural memory. Low RFC species may indicate erosion of knowledge or regional specificity, where only a small fraction of informants retain traditional use.

Comparative Observations

RFC values strongly correlate with plant accessibility and prevalence in the local environment. Cultivated and easily available plants (*Curcuma longa, Aegle marmelos, Ocimum* species) tend to have higher RFC values than wild or seasonally available plants.

Research Significance

RFC helps to prioritize species for pharmacological validation. Plants with higher RFC values should be considered first for further biochemical, pharmacological and conservation studies since they are more integral to community healthcare. At the same time, low RFC plants should not be ignored, as they may represent rare or specialized ethnomedicinal knowledge at risk of disappearing.

RFC values in this study demonstrate both the core group of culturally dominant medicinal plants and a set of lesser-known but potentially important species. Together, they provide a comprehensive picture of the community's ethnomedicinal repertoire and its varying degrees of reliance on plant resources. RFC values are used to find out most common plants for treating diseases (Vitalini *et al.* 2013). Some informants have vast knowledge on medicinal plants in the study area. Some plants have high RFC value due to may be availability, distribution, usage etc. Such plants are used to discover drugs for chronic diseases through phytochemical screening and due to overexploitation, these plants should be conserved.

Informant Consensus Factor (ICF)

The present study revealed significant variations in the **Informant Consensus Factor (ICF)** values of medicinal plants used for treating neurological and related ailments. High ICF values indicate strong agreement among informants regarding the use of a plant species, reflecting both reliability and cultural importance. Among the recorded species, ***Cassia fistula* (ICF 96.00), *Curcuma longa* (94.66)** and ***Decalepis hamiltonii* (92.00)** exhibited the highest consensus, highlighting their strong acceptance and well-established role in traditional medicine. These species are deeply integrated into indigenous healthcare practices and widely recognized for their therapeutic potential. Other species with notable ICF values includes ***Cissus pallida* (68.00), *Ficus religiosa* (73.33), *Argemone mexicana* (74.66), *Lawsonia inermis* (66.66), *Tinospora cordifolia* (66.66),**

***Santalum album* (65.33)** and ***Terminalia arjuna* (64.00).** These plants represent highly trusted remedies and are frequently cited by informants, suggesting their importance in local ethnomedicine. Moderate ICF values were observed in species such as ***Murraya paniculata* (60.00), *Terminalia chebula* (60.00), *Mimusops elengi* (57.33), *Syzygium aromaticum* (57.33), *Boswellia serrata* (58.66)** and ***Centella asiatica* (58.66).** These values reflect a balanced but less unanimous recognition among informants, indicating their therapeutic relevance but with a relatively lower degree of agreement. By contrast, certain plants exhibited low ICF values such as ***Toddalia asiatica* (14.66), *Evolvulus alsinoides* (18.66), *Semecarpus anacardium* (20.00)** and ***Phyllanthus emblica* (21.33).** Despite their ethnomedicinal use, the limited consensus suggests that their applications are either less widespread or based on specialized local knowledge. The data demonstrate that species with **high ICF values** are central to the region's ethnopharmacological traditions, while plants with **low values** may represent underutilized or less commonly known remedies. These findings emphasize the importance of further pharmacological validation and conservation of species with high community consensus, as they hold potential for developing effective herbal formulations (Table 3).

Table 3. RFC and ICF values of medicinal plants in the study area

Name of the plant	**Number of Informants accepted previous reports of the plants (Bir Bahadur 2016)**	**RFC**	**ICF**
Acorus calamus L	38	42.66	50.66
Aegle marmelos (L.) Corr.	42	93.33	42.00
Argemone mexicana L	56	90.66	74.66
Bacopa monnieri (L.) Wettst.	58	33.33	77.33
Boswelia serrata Roxb.	44	18.66	58.66
Capparis zeylanica L	29	27.00	38.66
Cassia fistula L	30	40.00	96.00
Celastrus paniculatus Willd.	40	66.66	53.33
Centella asiatica (L.) Urban	44	24.00	58.66
Cissus pallida (Wight & Arn.) Planch	51	97.33	68.00
Clitoria ternatea L	21	37.32	28.00
Cochlospermum religiosum (L.) Alston	28	50.66	37.33
Curcuma longa L.	71	98.66	94.66
Decalepis hamiltonii L.	69	52.00	92.00
Evolvulus alsinoides (L.)	14	40.00	18.66
Ficus religiosa L.	55	92.00	73.33
Indigofera aspalacthoides Vahl	44	48.00	58.66
Jasminum pubescens L.	39	88.00	52.00
Lannea coromandelica (Houtt.) Enum Merr	18	30.66	24.00
Lawsonia inermis L.	50	76.00	66.66
Mimusops elengi L.	43	52.00	57.33
Murraya paniculata (L.) Jacq.	45	82.66	60.00
Ocimum basilicum L.	38	94.66	50.66
Ocimum. sanctum L.	30	78.66	40.00
Piper longum L.	23	86.66	30.33
Phyllanthus emblica	16	90.66	21.33
Plumbago zeylanica L.	31	54.66	41.33
Salvia officinalis L.	18	46.66	24.00
Santalum album L.	49	89.66	65.33
Shorea robusta Gaertn.f.	23	54.66	30.66
Semecarpus anacardium L.f.	15	29.33	20.00
Sida rhombifolia L.	29	52.00	38.66
Syzygium aromaticum L.	43	86.66	57.33
Terminalia arjuna (Roxb.ex DC.) Wight&Arn.	48	80.00	64.00
T. chebula (Roxb.) L.	45	82.66	60.00
Tinospora cordifolia (Willd.) Miers	50	80.66	66.66

Toddalia asiatica (L.) Lam	11	58.66	14.66
Vitex negundo L.	19	54.66	25.33
Withania somnifera (L.) Dunal	42	73.33	53.57
Wrightia tinctoria (Roxb.) R.Br.	36	89.33	47.64
Ziziphus mauritiana L.	16	96.33	21.33

Frequency Percentage (FP)

Frequency percentage is a quantitative amount used in ethnobotany to regulate the proportion of informants who revealed a particular plant species for specific medicinal uses. It imitates the popularity, reliability and cultural importance of a species within a community. A high frequency percentage indicates that the plant is well-known and widely used among the local people, significant strong ethnomedicinal relevance. In contrast, a low frequency percentage shows that the species is less familiar or used only by a limited number of informants. Thus, frequency percentage is a valuable tool for identifying the most culturally significant medicinal plants and prioritizing them for further pharmacological research and conservation efforts.

The frequency percentage of medicinal plants recorded in the study highlights the diversity in plant habits, plant parts used and drug formulations. In the mode of administration, 34 plants (82.92%) are used in dry condition, and 7 plants (17.08%) are used in fresh condition. Majority plants are used in dry state to make drugs in different form. In India, several ethnobotanical studies from the **Western Ghats, Eastern Ghats, Central India, and Himalayan regions** have reported the extensive use of medicinal plants for ailments such as **epilepsy, paralysis, insomnia, anxiety, depression, memory loss and nervous weakness**. Similar to the present study, these investigations documented a predominance of **herbaceous species**, frequent use of **leaves and roots** and preference for **decoctions, pastes and powders** as modes of preparation. High informant consensus for neurological ailments reported in earlier studies also supports the reliability of the traditional knowledge recorded in the present investigation.

Table 4. Frequency percentage for habit of plants, plant parts used to make drugs, Drug form

Particulars	**Number of plants**	**Frequency percentage**
Habit of plants	Herbs – 11 plants	26.82%
	Shrubs – 10 plants	24.39%
	Trees – 16	39.02%
	Climbers – 3 plants	7.31%
	Liana – 1 plant	2.43%
Plant part used to make drug	Stem – 12 plants	16%
	Leaf – 10 plants	13.33%
	Fruits – 5 plants	6.66%
	Flowers – 4 plants	5.53
	Root – 4 plants	5.33%
	Bark – 3 plants	4%
	Seeds – 3 plants	4%
Drug forms used for treatment	Extract – 15 plants	20%
	Powder – 11 plants	14.66%
	Paste – 5 plants	6.66%
	Oil – 4 plants	5.33%
	Resin, juice and decoction – 6 Plants	8%

Withania somnifera has been extensively reported in ethnobotanical and ayurvedic literature for its use in **nervous debility, anxiety, stress, insomnia and memory enhancement**. It supports earlier findings that this species is a key component of traditional remedies for neurological disorders across India. Modern pharmacological studies have validated its **neuroprotective, anti-stress** strengthening the ethnobotanical claims recorded in the present study. ***Centella asiatica*** is a traditionally used for **memory improvement, mental fatigue, epilepsy and nervous disorders**. Ethnobotanical studies from South and Northeast India have consistently reported its role as a **brain tonic** and similar therapeutic indications recorded in the present investigation further confirm its widespread traditional acceptance. The documentation of this species emphasizes continuity between **local folk practices and classical medicinal systems.** ***Bacopa monnieri*** is one of the most

important medicinal plants used for **cognitive enhancement, epilepsy and mental disorders**. Its ethnobotanical relevance in the present study approves with numerous reports from different agro-climatic zones of India.

Similar findings reported by Yogesh and Krishna Kumar (2023) which reveals extensive use of *Withania somnifera*, *Bacopa monnieri*, *Centella asiatica*, *Clitoria ternatea*, *Ocimum* and *Tinospora cordifolia* for anxiety, epilepsy, memory loss and neurodegenerative conditions. The present investigation documented 41 species with higher informant consensus (ICF) for key plants such as *Curcuma longa, Cassia fistula and Decalepis hamiltonii* indicating sound knowledge among local healers in YSR Kadapa District. This suggests that although species richness differs geographically, core neuroactive plants remain consistent across Indian regions. Greeshma *et al.* (2017) focused mainly on medicinal plants used for neurodegenerative diseases, highlighting species such as *Withania somnifera, Bacopa monnieri, Curcuma longa and Centella asiatica*. The present study corroborates these findings, as the same plants were frequently cited by informants for Alzheimer's disease, Parkinson's disease, cognitive decline and memory enhancement. The agreement between these studies reinforces the biomedical relevance of these plants and supports their continued traditional use. Ravindra Mishra and Vinay Jain (2025) emphasized the potential of traditional herbal medicine in managing central nervous system disorders, particularly stress, anxiety, depression and epilepsy. The present study aligns closely with these observations, as a majority of recorded plants were used to manage stress-related and psychological and neurological disorders. High RFC values for *Withania somnifera, Ocimum sanctum, Lawsonia inermis and Ziziphus mauritiana* indicate their prominent role in mental health management, consistent with Mishra and Jain's conclusions. Neha Thakur *et al.* (2025) patterns were observed in the present study, including dominance of herbs and trees, frequent use of leaves and roots and preference for powders, extracts and decoctions. Swetza Singh and Rajiv Gupta (2024) highlighted the ethnopharmacological importance of medicinal plants in mental health, particularly for anxiety, depression and memory disorders. These findings strongly support the present investigation, where a large proportion of plants were used to treat anxiety, depression and cognitive impairment.

Maria and Rita (2015) investigation and present study revealed the same thing, therapeutic targets such as anxiety, headache, depression and memory loss. This cross-cultural similarity indicates a global convergence in the traditional management of neurological disorders using plant-based remedies. Patrick Amoateng *et al.* (2018) comparable to the present study, they observed strong informant consensus for plants used to treat epilepsy, anxiety and depression. The reliance on traditional healers and oral transmission of knowledge reported in Ghana closely parallels the ethnomedicinal practices documented in YSR Kadapa District. Mahabat Nadaf *et al.* (2019) investigated 58 medicinal plant species used for nervous disorders in the herbal markets of North Khorasan Province, Iran. Similar to the present findings, their study emphasized the use of plant resins, roots and leaves for treating neurological pain, anxiety and cognitive disorders. Noureddine *et al.* (2020) documented 31 medicinal plant species used for nervous system diseases in the Rif region of Morocco. Both studies highlight epilepsy, headache, anxiety and neuro-pain as major treated conditions and demonstrate high cultural reliance on traditional medicine. The methodological similarity in using informant consensus further validates the reliability of the present findings. The high RFC and ICF values recorded in the present study further strengthen the credibility of the documented ethnomedicinal practices and underline their potential for future pharmacological validation.

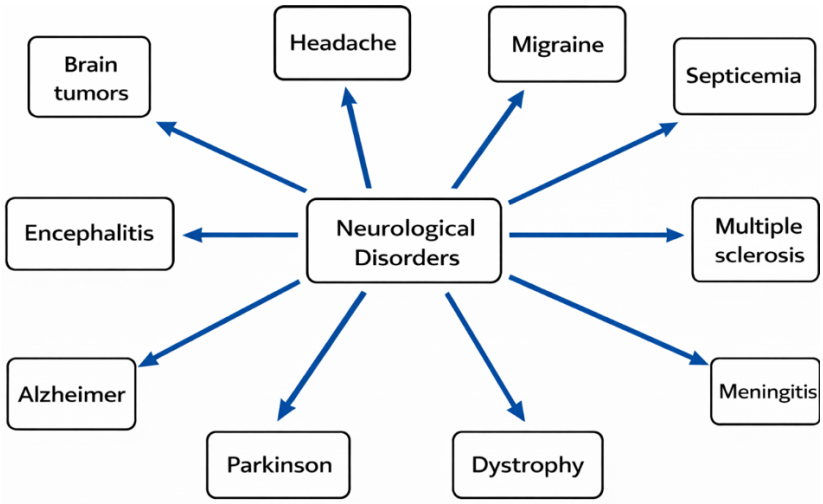


Figure 5. Neurological disorders treated using ethnomedicinal plants documented in the study area

Conclusions

The present ethnobotanical investigation in YSR Kadapa District highlights the indispensable role of medicinal plants in the traditional management of neurological disorders. The study documented 41 plant species belonging to 39 genera and 39 families, utilized by local healers and rural communities to treat a wide spectrum of neurological conditions such as epilepsy, Alzheimer's disease, Parkinson's disease, migraine, depression, anxiety and stroke. This rich diversity of species, coupled with the deep-rooted traditional knowledge, reaffirms the significance of indigenous healthcare practices that have been preserved and transmitted orally for generations. A critical outcome of this study is the recognition of Relative Frequency of Citation (RFC) and Informant Consensus Factor (ICF) as valuable ethnobotanical indices. High RFC values recorded for plants such as *Curcuma longa*, *Cissus pallida*, *Ziziphus mauritiana*, *Aegle marmelos* and *Ficus religiosa* demonstrate their cultural salience and therapeutic dominance in the region. Likewise, high ICF values for *Cassia fistula*, *Curcuma longa* and *Decalepis hamiltonii* underscore strong community consensus, making them reliable indicators of efficacy and trust in traditional medicine. In contrast, species with lower RFC and ICF values, though less widely known, may represent specialized or declining ethnomedicinal knowledge that requires urgent documentation and preservation. The high ICF values got in this study indicates that the information collected is reliable resource for further pharmacological studies in future. Some medicinal plants might be containing active bioactive compounds which are used to discover new drugs for chronic diseases.

The investigation of frequency percentages further revealed important patterns in ethnomedicinal practice. Trees emerged as the dominant growth form (39.02%), followed by herbs (26.82%) and shrubs (24.39%), suggesting that woody perennials are a sustainable and readily available source of remedies. Similarly, vegetative parts such as stems and leaves were most frequently used, reflecting a preference for renewable plant parts that minimize harm to the plant populations. Drug formulations largely comprised extracts and powders, demonstrating simple yet effective traditional preparation methods tailored to local resources. These observations reinforce the adaptive strategies of rural communities in managing plant resources sustainably while meeting healthcare needs.

The findings from this study also highlight the inter connectedness of culture, biodiversity and health**.** The widespread reliance on medicinal plants reflects not only a practical response to the high cost and side effects of allopathic medicine but also the deep cultural faith in natural remedies. Ritualistic, dietary and spiritual dimensions often accompany the therapeutic uses of these plants, strengthening the community's identity and cultural continuity. However, this invaluable knowledge is increasingly under threat from modernization, deforestation, habitat degradation and overexploitation of medicinal plants. Endemic species like *Boswellia serrata* and overharvested species such as *Cassia fistula* and *Plumbago zeylanica* highlight the urgent need for conservation strategies, both *in situ* and *ex situ*, supported by local communities and government agencies.

Similarly, significant is the potential of these traditional practices for future pharmacological research. Some of the recorded plants, including *Withania somnifera*, *Tinospora cordifolia*, *Bacopa monnieri* and *Santalum album* are already well recognized for their neuroprotective properties in Ayurveda and other traditional systems of medicine. The high RFC and ICF values observed in this study further validate their therapeutic importance and warrant systematic phytochemical and clinical investigations. Such research can lead to the identification of novel bioactive compounds, potentially contributing to the development of affordable and accessible drugs for managing neurological disorders. Current study thus represents a twofold contribution such as first, to ethnobotanical scholarship by documenting and analysing the traditional knowledge of YSR Kadapa communities and second, to applied healthcare and conservation, by identifying priority species for pharmacological research and conservation efforts. As neurological disorders continue to rise globally, integrating ethnomedicine with contemporary science may hold the key to innovative and sustainable healthcare solutions for the future.

Declarations

Abbreviations: SRGR: S. Rajagopal Reddy, AMR: A. Madhusudhana Reddy, WHO: World Health Organisation, RFC: Relative Frequency of Citation, ICF: Informant Consensus Factor

Ethics approval and consent to participate: First visited the places to be surveyed and got prior permission from informants.

Availability of data and material: All the supporting data available in the article

Funding: Funds not received from any funding agency.

Declaration of competing interest: The authors declared no competing interest.

Authors contribution: Madhusudhana Reddy conceptualized the study and Rajagopal Reddy conducted field study and gathered information about medicinal plants

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