Ethnobotanical and pharmacognostic review of medicinal plants used for musculoskeletal disorders and paralysis in Ethiopia: Bridging traditional knowledge with pharmacological pvidence

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Review

Abstract

Background: Traditional medicine remains an integral part of Ethiopia healthcare system, with a substantial proportion of the population relying on medicinal plants to manage conditions such as musculoskeletal disorders and paralysis. Despite their longstanding use, scientific evidence supporting the efficacy and safety of these remedies remain limited. This review provides available ethnobotanical studies to provide a comprehensive overview of medicinal plants used for these conditions and to future research directions.

Methods: Following PRISMA guidelines, relevant data were retrieved from PubMed, Google Scholar, Research Gate, Scopus and Science Direct.

Results: A total of 35 studies were included documenting 122 plant species belonging to 61 families, with Asteraceae*,* Fabaceae*,* and Solanaceae being the most represented. Herbs consti tuted the predominant growth form, while leaves and roots were the most frequently utilized plant parts. The majority of remedies were administered orally or applied topically.

Conclusions: Approximately half of the reported plant species demonstrated anti-inflammatory activity; however, none have been scientifically evaluated for antiparalytic effects in the Ethiopian context. These findings highlight the need for rigorous pharmacological and clinical investigations to validate traditional practices and to facilitate the development of novel plant based therapeutic agents.

Keywords: Ethnobotany, Ethiopian traditional medicine, Paralysis, Musculoskeletal

Background

Musculoskeletal disorders (MSDs) and paralysis are major public health challenges in Ethiopia (Afework *et al*. 2024), leading to significant disability and loss of productivity and reduced quality of life. MSDs including back pain, arthritis, rheumatism, tendinitis and bursitis affect muscles, bones, joints, tendons and ligaments (Kgakge *et al*. 2024). Clinically, MSDs are characterized by pain, stiffness, swelling, inflammation and muscle weakness, often leading to chronic disability and limited mobility (WHO 2022). Paralysis, defined as the partial or complete loss of muscle function due to neurological damage, may result from conditions such as stroke, spinal injuries, or infections like poliomyelitis. It is classified into types including hemiplegia, paraplegia and quadriplegia and often associated with secondary musculoskeletal complications such as muscle atrophy, joint contractures and chronic pain (Debsingha *et al*. 2021).

These conditions are highly prevalent globally, particularly among aging populations and individuals engaged in physically demanding occupations and are often triggered by factors such as poor posture, repetitive movements, obesity and trauma (Soares *et al*. 2019). Musculoskeletal conditions affect around 1.71 billion people worldwide, making them the leading cause of disability (WHO 2022). Among these, back pain is the most common, with an estimated 570 million cases globally based on the 2019 the Global Burden of Disease data (Cieza *et al*. 2020). In addition, over 40% of the world's population has a neurological condition, including strokes and spinal injuries that may result in paralysis (Steinmetz *et al*. 2024). Stroke incidence and mortality are increasing in low and middle-income countries like Ethiopia, where it is the leading cause of adult paralysis and a major cause of disability (Abate *et al*. 2021).

Both conditions are managed with similar approaches, including physiotherapy, pain management, assistive devices and traditional medicinal plants. Examining MSDs and paralysis together provides a more comprehensive understanding of their shared burden, risk factors and therapeutic gaps (Shiferaw *et al*. 2020). Traditional plant based medicine remains central to Ethiopian culture and is often the first line of treatment particularly in rural areas (Debsingha *et al*. 2021). Ethiopia, with over 80 ethnic groups and approximately 6,500 species of higher plants, of which around 800 are used medicinally (Bekele 2007), represents a rich reservoir for potential drug discovery.

However, much of this traditional knowledge is transmitted orally, making it vulnerable to loss. Furthermore, challenges such as limited rehabilitation centers, shortages of trained healthcare professionals and poor integration with modern healthcare systems persist. Ethnobotanical reviews play a crucial role in documenting and preserving this knowledge, identifying candidate species for for pharmacological and phytochemical investigation, supporting primary healthcare and promoting sustainable herbal industries, thereby linking traditional practices with modern scientific research (Mesfin *et al*. 2013; Mekonnen *et al*. 2022).

Ethnobotanical studies conducted across different regions of Ethiopia have documented the extensive use of indigenous medicinal plants for the management of musculoskeletal disorders (Lulekal *et al*., 2013; Teklehaymanot, 2017). Traditional herbal remedies are commonly employed for the treatment of conditions such as rheumatism, arthritis, bone fractures, dislocations, muscle cramps and swelling. Although the present review primarily focuses on human musculoskeletal disorders and paralysis, some ethnobotanical studies also document the use of medicinal plants for animal musculoskeletal conditions. Therefore, blackleg is clostridial disease of livestock characterized by skeletal muscle involvement and impaired locomotion (Teklehaymanot, 2017; Agize *et al*. 2013), is considered separately as an ethnoveterinary condition. These medicinal plants are commonly prepared in forms such as decoctions, poultices and topical pastes and are administered by traditional healers. Such traditional knowledge is particularly well documented in regions including Oromia, Amhara and the Southern Nations, Nationalities and Peoples' Region (SNNPR), where indigenous healing practices remain an important component of healthcare systems. The geographical distribution of the study regions across Ethiopia is illustrated in Fig. 1.
This review provides an overview of ethnobotanical and ethnopharmacological evidence regarding the diversity and utilization of Ethiopian medicinal plants for the management of musculoskeletal disorders and paralysis related conditions. It highlights traditional knowledge systems, treatment practices and medicinal plant species with promising potential for further pharmacological investigation as sources of anti-inflammatory, analgesic, neuroprotective and other bioactive agents relevant to these conditions.

Materials and Methods

Study design

Following to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) checklist the review was performed (Page *et al*, 2022).

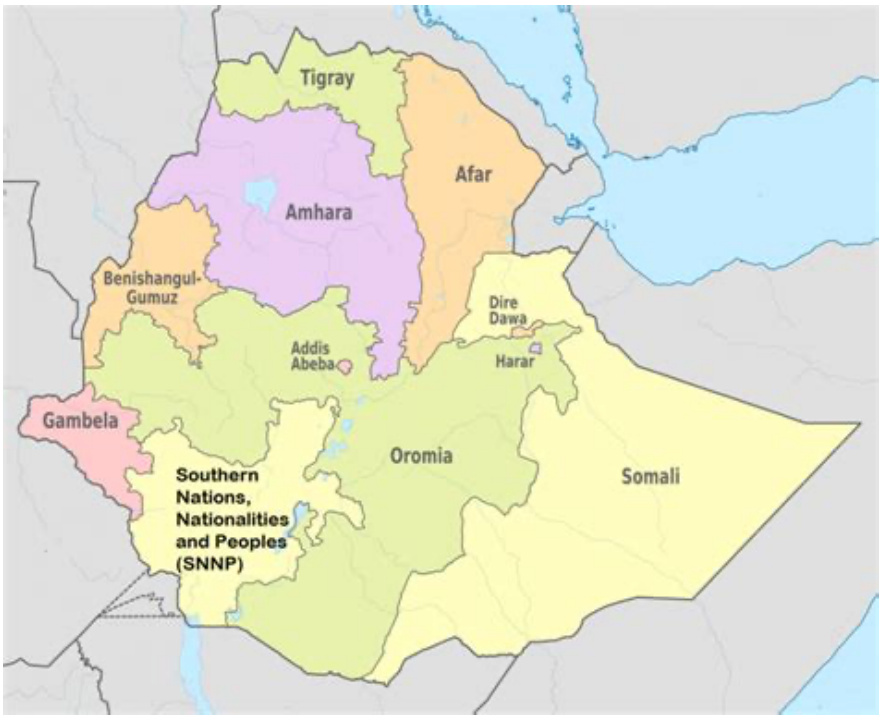

Figure 1. Administrative regions of Ethiopia

Search strategy

Scientific databases including Google Scholar, PubMed, Scopus, ScienceDirect and ResearchGate, were used to retrieve relevant studies conducted in Ethiopia. “ethnobotany," "paralysis," "musculoskeletal “and” medicinal plants".

Inclusion and exclusion criteria

Studies published between 2000 and November 2025 concerning medicinal plants used for the treatment of musculoskeletal disorders and paralysis in Ethiopia were included in this review. The inclusion criteria comprised: (i) articles published in English; (ii) field-based ethnobotanical survey studies; (iii) studies containing complete ethnobotanical data; and (iv) studies reporting medicinal plants used in the management of musculoskeletal disorders and paralysis.

The exclusion criteria included: (i) articles without clearly specified study areas or scientific names of plants; (ii) studies available only in abstract form; (iii) articles published in languages other than English; (iv) newspapers; (v) review papers; and (vi) reports describing plant species identified only at the genus level, such as *Acalypha* sp.

Data retrieval

A Microsoft Excel sheet was prepared to compile all relevant information obtained from the studies, including botanical names, plant families, local names, plant parts used, growth habits, methods of preparation and administration, and extraction methods of medicinal plants used for the treatment of musculoskeletal disorders and paralysis. Incomplete information, such as local plant names, growth habits, geographic locations of the study areas and incorrectly spelled scientific names, was verified and corrected through direct online searches.

Data analysis

All relevant information collected on Ethiopian traditional medicinal plants was organized using Microsoft Excel and subsequently transferred to the Statistical Package for Social Sciences (SPSS) version 20.0 for analysis. Descriptive statistics, frequencies and percentages, were applied to summarize and analyze the ethnobotanical data of the reported medicinal plants.

Outcomes of interest

The primary objective of this systematic review was to gather and summarize information on medicinal plants traditionally used for the treatment of musculoskeletal disorders and paralyses in Ethiopia; provide valuable information for the research community to support and guide further scientific investigations into anti-inflammatory, analgesic, bone-healing, neuroregenerative and muscle strengthening effects of traditionally used medicinal plants.

Results

Literature search results

290 studies were initially identified through the literature search. After removing duplicate records, 185 studies remained for further screening. Of these, 150 studies were excluded following assessment of their titles, abstracts, and full ethnobotanical content, as they did not meet the inclusion criteria. Ultimately, 35 studies were included in the systematic review (Fig. 2).

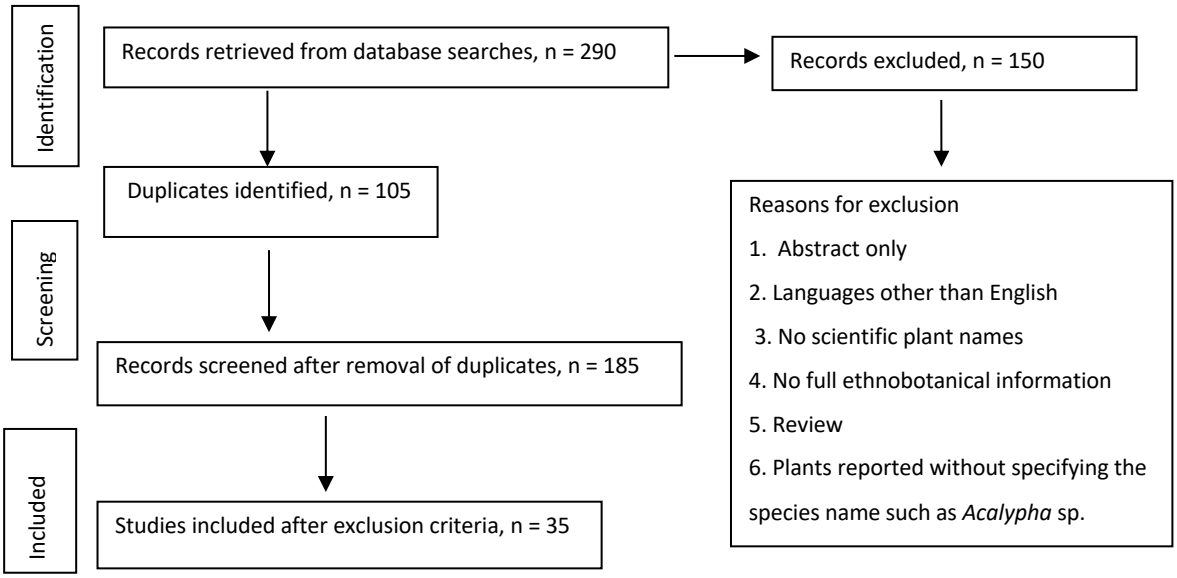

Figure 2. Flow diagram illustrating the study selection process for the current systematic review

Table 1 summarizes the included studies, presenting information on the scientific names of medicinal plants, their families, vernacular names, growth forms, plant parts used and modes of preparation and administration. Overall, 122 plant species were documented as being used in the treatment of musculoskeletal disorders and paralysis, with various plant parts employed for remedy preparation.

Taxonomic distribution of medicinal plants used for the treatment musculoskeletal disorders and paralysis in Ethiopia

A total of 122 plant species traditionally used for the treatment of musculoskeletal disorders and paralysis were identified from the 35 ethnomedicinal studies included in this review. These species belong to 61 families, with Asteraceae (8.9%), Fabaceae (8.1%) and Solanaceae (6.8%) being the most represented (Fig. 3).

Growth form of medicinal plants used in the treatment of musculoskeletal disorders and paralysis

The growth form of plants used in the treatment of musculoskeletal disorders and paralysis indicate that herbs constitute the largest proportion (49.6%), followed by shrubs (24.4%), trees (16.3%) and climbers (8.9%). Bulbous plants accounted for the smallest proportion (0.8%). (Fig. 4)

Plant parts used for preparation of traditional remedies

Most traditional herbal remedies were prepared using a single plant part (91.9%). Leaves were the most frequently used plant part (45.5%), followed by roots (25.2%). Other plant parts used in traditional remedy preparation included seeds (8.9%), whole plants (6.5%), and fruits and bark (4.9%). In the remaining cases, two or more plant parts were combined to prepare traditional remedies for musculoskeletal disorders and paralysis. Aerial parts, stems, and bulbous parts were rarely used in traditional remedy preparations (Fig. 5).

Routes of administration of traditional herbal remedies

Various formulations and routes of administration are employed in the traditional use of medicinal plants across different regions of Ethiopia. Oral administration was the most frequently reported route (54.5%), followed by dermal (topical) application (38.2%) and intranasal administration (sniffing) (4.9%). Combined oral and dermal administration was the least frequently reported route (2.4%) (Fig. 6).

Table 1. Ethiopian medicinal plants used for treatment of musculoskeletal disorders and paralysis with different plant parts

Botanical name	Family	Local name	Growth Habit	Parts used	Methods of preparation	ROA	Traditional uses	Region	Reference
Acacia abyssinica Hochst. ex Benth.	Fabaceae	**Dadecca/ Laaftoo(Or)**	T	Br	The bark is ground, mixed with water, and taken orally.	Oral	Inflammation	Oromia	(Fassil & Gashaw 2019)
Acacia mellifera (Vahl) Bosc.	Fabaceae	**Markaqto (Af) Schweinf (Af)**	T	L Fr	Fresh leaves are pounded and combined with goat's milk and wild animal dung, then applied to the joints using the left hand. The fruit is charred, ground, and mixed with butter to form a paste, which is applied topically.	Dermal	Arthritis	Afar	(Seifu *et al*. 2004, Teklehaymanot 2017)
Acanthus sennii Chiov.	Acanthaceae	**Key kusheshilie(Am)**	H	R	The roots are either crushed and tied onto the arm or mixed with honey and taken orally.	Oral	Arthritis/ Rheumatism	Amhara	(Chekole *et al*. 2015)
Afrocarpus falcatus (Thunb.) C.N.Page	Podocarpaceae	**Zigba (Am)**	T	R	The ground root is made into a paste and tied around the affected area.	Dermal	Bone fracture	Amhara	(Birhanu *et al*. 2015)
Agave sisalana Perrine	Asparagaceae	**Algee (Or)**	H	R	Fresh root is crushed, mixed with water, and administered to cattle.	Oral	Blackleg	Oromia	(Beyi *et al*. 2018)
Ageratum conyzoides L.	Asteraceae	**zingube-qumbe (Shk)**	H	L	The leaves are crushed and rubbed onto the affected area of the body.	Dermal	Back bone pain	SNNPR	(Giday *et al*. 2010)
Albizia malacophylla (A.Rich.)	Fabaceae	**Arganboobee (Or)**	T	Br	Powdered bark is administered to cattle.	Oral	Blackleg	Oromia	(Megersa *et al.* 2013)
Albizia gummifera (J.F.Gmel.) C.A.Sm.	Fabaceae	**Muka arbaa (Or)**	T	Br	The powdered bark is chewed	Oral	Rheumatism	Oromia	(Megersa *et al.* 2013).
Albuca abyssinica Jacq.	Asparagaceae	**Shingurti zibe (Tg)**	T	L	The crushed leaves are mixed with water and administered orally.	Oral	Rheumatism	Tigray	(Mesfin *et al*. 2013)

Allium sativum L.	Alliaceae	**Tsaeda shingurti (Tg)** **Nech shenkurt(Am)**	Bu	B	The bulb is crushed and rubbed onto the body; it may also be chewed, chopped, or pounded.	Dermal	Paralysis	Tigray and SNNPR	(Demir, 2020, Agize *et al*. 2013)
Aloe pubescens Reynolds	Asphodelaceae	**Haamaaresaa (Or)**	H	Fr	The fruit is mixed with water and applied topically	Dermal	Muscle cramps	Oromia	(Wondimu 2007)
Aloe trichosantha A.Berger	Asphodelaceae	**NR**	H	R	The root is crushed and rubbed onto the body.	Dermal	Blackleg /joint illness	Afar	(Teklehaymanot 2017)
Amaranthus caudatus L.	Amaranthaceae	**Gaggabba (Or)**	H	Sd	The seeds are roasted and ground	Oral	Rheumatism	SNNPR	(Agize *et al*. 2013)
Amaranthus graecizans L.	Amaranthaceae	**Mezi (Shk)**	H	L	The leaves are crushed and rubbed onto the body.	Dermal	Bone fracture, dislocation	SNNPR	(Giday *et al*. 2010)
Anarrhinum forskaohlii (J.F.Gmel.) Cufod.	Plantaginaceae	**Turtsay, (Shk)**	H	L	NR	Dermal	Arthritis	SNNPR	(Giday *et al*. 2009)
Arundo donax L.	Poaceae	**Shembeko (Am)**	H	St	The stem is applied to the affected area and rubbed The stem is splintered into samll pieces, and tied to the affected area	Dermal	Bone fracture	Amhara and Tigray	(Yimer *et al*. 2022, Misganaw &Yiblet 2024)
Aspilia mossambicensis (Oliv.) Wild	Asteraceae	**Kishshuwa (Or)**	H	L	The leaves are pounded and taken orally.	Oral	Blackleg	SNNPR	(Agize *et al*. 2013)
Balanites aegyptiaca (L.) Delile	Zygophyllaceae	**Udayto (Af)**	Sh	R	The root's outer cover is eaten fresh, while the inner part is eaten boiled.	Oral	Blackleg	Afar	(Teklehaymanot 2017)
Balanites rotundifolia (Tiegh.) Blatt.	Zygophyllaceae.	**Allayto (Af)**	Sh	R	The root's outer part is eaten fresh. The inner part is bitter; therefore, it is soaked in water overnight, washed two to three times then boiled.	Oral	Blackleg	Afar	(Teklehaymanot 2017)
Becium filamentosum (Forssk.) Chiov.	Lamiaceae	**NR**	H	L	The crushed fresh leaves are mixed with the spent grain of the local alcoholic drink called "tella" and taken orally.	Oral	Blackleg	SNNPR	(Mesfin *et al.* 2014)

Bidens camporum (Hutch.) Mesfin	Asteraceae	**Tselime teneg (Tg)**	H	Wp	The whole plant is dried, ground and the powder is placed on fire for fumigation.	Dermal	Paralysis	Tigray	(Demir 2020)
Boscia coriacea Graells	Capparaceae	**Ayteneba (Af)**	Sh	L	Fresh parasite collected from *Boscia coracea*, the whole *Baroberu* plant, and the fruit of *Solanum incanum* are soaked in hot water and the preparation is administered intranasally	Inhalation	Black leg	Afar	(Seifu *et al*. 2004)
Boswellia papyrifera (Caill. ex Delile) Hochst.	Burseraceae	**Eatan zaf (Am)**	T	Br	The bark is crushed and placed on fire.	Inhalation	Inflammation	SNNPR	(Zemede *et al*. 2024)
Bridelia scleroneura Müll.Arg.	Phyllanthaceae	**Zuzie (Gamo)**	Sh	L	The leaves are pounded with water.	Oral	Inflammation	SNNPR	(Zemede *et al*. 2024)
Cadaba farinosa Forssk.	Capparaceae	**Melud (Am)**	Sh	R	The root is crushed, mixed with goat milk, and applied to the affected part.	Dermal	Joint pain	Dire Dewa	(Ayalew *et al.* 2017)
Calpurnia aurea (Aiton) Benth.	Fabaceae	**Chekketa (Or)**	Sh	R	The fresh root is crushed and pounded with fresh leaves of *Parthenium hysterophorus*, mixed with the residue of local alcoholic beverage (areqe or tella).	Oral	Blackleg	Oromia	(Mesfin *et al*. 2009)
Calotropis procera (Aiton) Dryand.	Ascelpiadaceae	**Galaqto (Af)**	Sh	L	The leaves' latex is mixed with butter and applied to the affected area.	Dermal	Prevention of Blackleg	Afar	(Seifu *et al*. 2004)
Capsicum annuum L.	Solanaceae	**NR**	H	R	NR	Dermal	Arthritis	Afar	(Teklehaymanot 2017)
Capsicum frutescens L.	Solanaceae	**Mis'imis'uwa (Or)**	H	Fr	The fruit is ground.	Oral	Rheumatism	SNNPR	(Agize *et al*. 2013)
Carissa spinarum L.	Apocynaceae	**Agaamsaa (Or)**	Sh	Sd	The seed is crushed and homogenized in water.	Dermal	Muscle cramp	SNNPR	(Wondimu 2007)
Celosia polystachia	Amaranthaceae	**None**	H	R	NR	Oral	Blackleg	Afar	(Teklehaymanot 2017)

(Forssk.) C.C.Towns.									
Cicer arietinum L.	Fabaceae	**Shenebera (Am)**	H	Sd	The seeds are boiled, mixed with salt and taken orally.	Oral	Broken bone	Amhara	(Teshome *et al*. 2023)
Cissus quadrangularis L.	Vitaceae	**Yezhon anjet (Am)**	Cl	Wp	The whole plant is ground, made into a paste, and tied to the affected area.	Oral	Arthritis, Swelling leg	Amhara and SNNPR	(Alem *et al*. 2024, Zemede *et al*. 2024)
Clematis simensis Fresen.	Ranunculaceae	**Fiitii, Yazo egier (Am)**	Cl	L	The leaves are crushed and tied to the affected area.	Dermal	Swelling leg, Rheumatism	Oromia	(Wondimu 2007, Woldeamanu 2022)
Clutia abyssinica Jaub. & Spach	Peraceae	**Foonii, Fyele fej (Am)**	Sh	Br R	The fresh bark is crushed, boiled together with honey. The dried root powder mixed with *zagol* (cowrie shell), *medab* (copper), and *gracha eshoh* (a thorny plant**)** is applied and tied to the affected area.	Oral Dermal	Rheumatism,Bone fracture	Amhara and Oromia	(Beyi *et al*. 2018, Birhanu 2015)
Clutia lanceolata Forssk.	Peraceae	**Fiyelefeg (Am)**	Sh	L	The leaves are crushed and tied to the affected area.	Dermal	Bone fracture	Amhara	(Chekole *et al*. 2015)
Coccinia abyssinica (Lam.) Cogn.	Cucurbitaceae	**Ancootee (Or)**	Cl	R	The root is cooked with the leaves of *Croton macrostachyus* and eaten with local pancake (injera) for four days.	Oral	Fracture	Oromia	(Birhanu 2015)
Combretum collinum Fresen.	Combretaceae	**Woyba (Am)**	Sh	St	The fresh stem is powdered and applied to the affected area.	Dermal	Lower back pain	Amhara	(Yimer *et al*. 2022)
Commelina africna L.	*Commelinaceae*	**Gulbbatiya (Or)**	H	L	The leaves are pounded and applied topically	Dermal	Blackleg	SNNP	(Agize *et al*. 2013)
Commicarpus plumbagineus (Cav.) Standl.	*Nyctaginaceae*	**Karbati [Af]**	H	L	The fresh leaf is pounded and applied to the joints	Dermal	Arthritis	Afar	(Seifu *et al*. 2004)
Cordia africana Lam.	Cordiaceae	**Awhi (Tg)**	T	Fr	NR	Dermal	Broken body/hand	Tigray	(Mesfin *et al*. 2013)
Coronopus didymus (L.) Sm.	Brassicaceae	**Shipa/Sibika (Or)**	H	L	The leaves are chopped and pounded.	Oral	Rheumatism	SNNPR	(Agize *et al*. 2013)

Croton macrostachyus Hochst. ex Delile	Euphorbiaceae	**Mekanissa (Or)**	T	Wp	The whole plant is powdered and mixed with the spent grain of the local alcoholic drink "tella". It may also be crushed and combined with the leaves of *Carissa spinarum.* The leaves of *Croton macrostachyus* and the bulb of *Allium sativum* arke are crushed together, and the filtrate is drunk with camel milk.	Oral	Blackleg, paralyzed leg, arthritis, swelling leg	Amhara and Oromia	(Mesfin 2014, Chekole *et al*. 2015, Usman 2022, Megersa & Woldetsadik 2022)
Cucumis ficifolius A.Rich.	Cucurbitaceae	**Ramboambo (Or)**	Cl	R	The root is crushed, filtered, and drunk	Oral	Blackleg	Tigray and Oromia	(Demir 2020, Megersa *et al.* 2013, Agize *et al*. 2013)
Cucurbita pepo L.	Cucurbitaceae	**Duba (Am)**	Cl	Sd	The seeds are pounded and eaten.	Oral	Rheumatic paralyzed	Amhara	(Alemneh 2021)
Cynoglossum marifolium Roxb.	Heliotropiaceae	**ay-charo (Shk)**	H	L	NR	Dermal	Arthritis	SNNPR	(Giday *et al*. 2010)
Datura stramonium L.	Solanaceae	**Astenagir (Am)**	H	Ap	The arial part is crushing and smoking	Inhalation	Rheumatic paralyzed	Amhara	(Alemneh 2021)
Dichrocephala integrifolia (L.f.) Kuntze	Asteraceae	**biaqin-charo, tsuq (Shk)**	H	L	NR	Dermal	Bone fracture	SNNPR	(Giday *et al*. 2010)
Discopodium penninervium Hochst.	Solanaceae	**Serbae, ameraro (Or)**	H	L	The fresh or dried leaves are rubbed onto the affected area.	Dermal	Inability to move	Oromia	(Mesfin *et al*. 2009)
Dissotis canescens (Graham) Hook.f.	Melastomataceae	**Siroriya/Biitatuus (Or)**	H	L	The leaves are chopped and pounded.	Dermal	Rheumatism	SNNPR	(Agize *et al*. 2013)
Dodonaea angustifolia L.f.	Sapindaceae	**Kitkita, Ketetina (Am)**	Sh	Wp	Tie twig parts together and Fresh roots are cut, washed, and then 5 pieces of roots are chewed with salt Paste of leaf powder is tied on fractured bone with bark of *Dombeya schimperiana*	Dermal	Bone fracture	Amhara and Oromia	(Chekole *et al*. 2015, Mekonnen *et al*. 2022)

Dodonaea viscosa subsp. angustifolia (L.f.) J.G.West	Sapindaceae	**Kitkita(Am)**	Sh	L	The fresh leaves are tied by treads on the affected	Dermal	Bone fracture	Amhara	(Mekonndn *et al*. 2022)
Dovyalis abyssinica (A.Rich.) Warb.	Flacourtiaceae	**Koshim(Am)**	Sh	R	Fresh or dried root powder mixed with pounded young shoots of *Cordia Africana* is smoked.	Inhalational	Rheumatic Paralyzed	Oromia	(Beyi. 2018)
Drymaria cordata Willd. ex Schult.	Caryophyllaceae	**pits-asht(Shk)**	H	L	The leaves are crushed and applied topically	Dermal	Arthritis	SNNPR	(Giday *et al*. 2009, Giday *et al*. 2010)
Echinops amplexicaulis Oliv.	Asteraceae	**Kashiya (0r)**	H	R	The root is chopped, pounded and taken orally.	Oral	Black leg	SNNPR	(Agize *et al*. 2013)
Echinops kebericho Mesfin	Asteraceae	**Dechimerach (Shk)**	H	R	NR	Oral	Stabbing pain	SNNPR	(Weldearegay and Awas. 2021)
Ehretia cymosa Willd. ex Roem. & Schult.	Boraginaceae	**Ulaaga (Or)**	Sh	L	The fresh leaf is boiled together with roots of *Rumex nepal* and the filtrate is drunk for three days	Oral	Rheumatism	Oromia	(Usman *et al*. 2022)
Ensete ventricosum (Welw.) Cheesman	Musaceae	**Wesse (Or)**	H	R	The root is mixed with water, then dried and ground into a powder, which is subsequently prepared as a traditional drink called *bulla*.	Oral	Bone Fracture	SNNPR	(Giday *et al*. 2010, Alemayehu & Chinthapalli, 2021)
Erythrina abyssinica DC.	Fabaceae	**Borttuwa (Gad'awa) (Or)**	T	L	The leaves are chopped and pounded.	Oral	Blackleg	SNNPR	(Agize *et al*. 2013)
Eucalyptus globulus Labill.	Myrtaceae	**Baher zaf (Am)**	T	L	The leaves are prepared by concocting, crushing, and decocting.	Oral	Arthritis	Amhara	(Kidane 2018)
Euclea racemosa subsp. schimperi (A.DC.) F.White	Ebenaceae	**Keleaw (Tg)**	Sh	R	The root is crushed, and the juice is taken orally with milk.	Oral	Paralysis	Tigray	(Demir 2020)
Euphorbia hirta L.	Euphorbiaceae	**Shatomaataa (Or)**	H	R	The root is chopped and pounded	Oral	Blackleg, Rheumatism	SNNPR	(Agize *et al*. 2013)

Ficus vasta Forssk.	Moraceae	**Qilxuu (Or)**	T	R	The root is crushed	Oral/ Dermal	Back pain, Rheumatism	Oromia	(Kidane 2018)
Foeniculum vulgare (Mill.) Holub	Apiaceae	**Walaga/Shilariya (Or)**	H	Ap	The leaves are chopped and pounded The fresh stem is crushed and painted on the affected area	Dermal	Rheumatism,	Amhara and SNNP	(Agize *et al*. 2013, Mekonnen 2022)
Girardinia bullosa (Hochst. ex Steud.) Wedd.	Urticaceae	**Gurgubbee(Or)**	H	R	Root powdered and mixed in water and applied orally	Oral	Black leg	Oromia	(Birhanu *et al*. 2015, Megersa *et al.* 2013)
Gossypium hirsutum Cav.	Malvaceae	**Puutuwa (Or)**	H	Sd	The seed is chopped, pounded, and used as a dry bath.	Inhalation	Blackleg	SNNPR	(Agize *et al*. 2013)
Grewia villosa Willd.	Tiliaceae	**NR**	Sh	Br	The bark is crushed.	Oral	Boils, abscess and swelling	Oromia	(Teklehaymanot & Giday 2010)
Hordeum vulgare L.	Poaceae	**Garbuu, Baangaa (Or)**	H	Sd	The seeds are powdered with the seeds of *Brassica carinata*. The seed flour is made into porridge and eaten. The roasted seeds are powdered, mixed with milk, boiled and 2–3 glasses of the mixture are given daily until recovery.	Oral and Dermal	Broken bone, Back pain	Oromia	(Megersa *et al.* 2013, Abdela 2022, Birhanu 2015, Desalegn 2022)
Ilex mitis Radlk.	Aquifoliaceae	**NR**	T	L	The leaves are prepared by concoting and decocting.	Oral	Rheumatic	Oromia	(Yineger 2008)
Impatiens tinctoria A.Rich.	Balsaminaceae	**Ensosila (Am)**	H	R	The fresh root is crushed and tied around the affected part.	Dermal	Rheumatic/ Arthritis	Amhara and Oromia	(Megersa *et al.* 2013, Mekonnen 2022)
Indigofera coerulea Roxb.	Fabaceae	**Gebeldiyo (Or)**	Sh	L	The leaves are pounded and applied to the affected area.	Dermal	Paralysis	Dire Dewa	(Ayalew *et al.* 2017)
Justicia schimperi (Hochst.) Dandy	Acanthaceae	**Shimieya (Tg)**	Sh	L	The leaves boiled in water, and the body is washed with the decoction.	Dermal	Arthritis	Tigray	(Demir 2020)
Kalanchoe laciniata (L.) DC.	Crassulaceae	**Bosoqqee (Or)**	H	R	The fresh or dried root is mixed with the seeds of *Capsicum frutescens*, *Allium sativum*, and the leaves of *Croton macro-*	Oral	Black leg	Oromia	(Megersa *et al.* 2013)

					stachyus and given to affected cattle				
Kalanchoe petitiana A.Rich.	Crassulaceae	**Hancuurraa (Or)**	H	L	The leaves are heated and chopped.	Dermal	Rheumatism, Leg swelling	Oromia	(Abdela 2022)
Kalanchoe quartiniana A.Rich.	Crassulaceae	**Adeaka, dekaeta (Tg)**	H	L	The leaves are mixed with water, and the body is washed with it.	Dermal	Paralysis	Tigray	(Demir 2020)
Kanahia laniflora (Forssk.) R.Br.	Apocynaceae	**Leehamohcaxa (Af)**	H	L	The fresh or dried leaves are administered nasally.	Inhalation	Arthritis	Afar	(Seifu *et al*. 2004)
Lactuca inermis Forssk.	Asteraceae	**Dememerarit (Am)**	H	R	The root is tied to the affected area.	Dermal	Broken bone	Amhara	(Chekole *et al*. 2015)
Lannea fruticosa (Hochst. ex A.Rich.) Engl.	Anacardiaceae	**Dechimarac'c'iya (Or)**	Sh	R	The root is powdered.	Oral	Rheumatism	SNNPR	(Agize *et al*. 2013)
Lepidium sativum L.	Brassicaceae	**Sifika/feto (Am**	H	Sd	The seed is ground with the bulb of *A. sativum* and eaten 1-2 spoons with other food daily for 3 days.	Oral	Arthritis Black leg, Rheumatism	Oromia and SNNPR	(Megersa and Woldetsadik. 2022, Megersa *et al*. 2013, Agize *et al*. 2013)
Leptadenia hastata Vatke	Ascelpiadaceae	**Dunkal(Or)**	Cl	R	Fresh root crushed and boiled and consumed like tea	Oral	Lower back Paralyzed	Dire Dewa	(Shimels *et al*. 2017)
Leucas deflexa Hook.f.	Lamiaceae	**Mezi, wonchi (Shk)**	H	L	NR	Dermal	Joint dislocation	SNNPR	(Giday *et al*. 2010)
Maesa lanceolata Voigt	Primulaceae	**Geggec'uwa**	Sh	Sd	The seed is chopped, pounded and grounded.	Oral	Black leg	SNNPR	(Agize *et al*. 2013)
Nicotiana tabacum L.	Solanaceae	**Tambbuwa, Tinbaho (Am)**	H	L	The fresh leaves are roasted, ground, squeezed, and given to livestock.	Oral	Blackleg	Amhara and SNNPR	(Agize *et al*. 2013, Mekonnen. 2022)
Ocimum gratissimum Forssk.	Lamiaceae	**Damakasiya (Am)**	H	L	The leaves are smashed or pounded.	Oral	Rheumatism	SNNPR	(Giday *et al*. 2010)
Ocimum lamiifolium Hochst. ex Benth	Lamiaceae	**Mechtale (Or)**	H	L	Leaves are decocted for oral use and applied externally by rubbing.	Oral/Dermal	Joint pain	SNNPR	(Zemede *et al*. 2024)
Oxalis corniculata L.	Oxalidaceae	**pitsi-charo (Shk)**	H	L	NR	Dermal	Arthritis	SNNPR	(Giday *et al*. 2010)

Oxalis radicosa A.Rich.	Oxalidaceae	**pitsi-charo (Shk)**	H	L	NR	Dermal	Arthritis	SNNPR	(Giday *et al*. 2010)
Parthenium hysterophorus L.	Asteraceae	**Baaxobbaru (Af)**	H	Wp	NR	Inhalation	Black leg	Afar	(Seifu *et al*. 2004)
Pentas lanceolata (Forssk.) Deflers	Rubiaceae	**Tigoch (Shk)**	Sh	L	The leaves are crushed	Oral	Arthritis	SNNPR	(Giday *et al*. 2009)
Pentas schimperi (Hochst.) Wieringa	Rubiaceae	**Aanbursaa (Or)**	Sh	Wp	The whole part is boiled, and 1–2 glasses of the decoction are drunk daily	Oral	Skeletal problem	Oromia	(Megersa & Woldetsadik 2022)
Persea americana Mill.	Lauraceae	**Abokatuwa (Or)**	T	Fr	The fruit is chopped, pounded, heated, and cooked.	Oral	Rheumatism	SNNPR	(Agize *et al*. 2013)
Phytolacca dodecandra L'Hér.	Phytolaccace	**Hanc'c'iic'a (Or)**	H	L	The leaves are chopped and pounded.	Oral	Rheumatism	SNNPR	(Agize *et al*. 2013)
Piper nigrum L.	Piperaceae	**K'unddobambbariyaa (Or)**	Cl	L	The leaves are chopped, ground and chewed.	Oral	Rheumatism	SNNPR	(Agize *et al*. 2013)
Plumbago zeylanica L.	Plumbaginaceae	**Amira (Am)**	Sh	L	The fresh leaves are boiled and the filtrate is taken with honey orally for seven days.	Oral	Rheumatic Pain	Amhara	(Yineger 2008)
Podocarpus falcatus (Thunb.) Endl.	Podocarpaceae	**Birbirsa (Or)**	T	L	The chopped leaves are mixed with water, filtered, and drunk.	Oral	Fever and joint pain	Oromia	(Usman 2022)
Rhoicissus tridentata (L.f.) Wild & R.B.Drumm.	Vitaceae	**Gaaleewaata, abbaa (Or)**	Cl	L	The leaves are crushed.	Oral	Blackleg	Oromia	(Kidane 2018)
Rubus steudneri Schweinf.	Rosaceae	**Gadda (Or))**	Cl	L	The fresh leaves are chewed and its juice is drunk	Oral	Rheumatic	SNNPR	(Alemayehu & Chinthapalli 2021)
Rumex nepalensis Spreng.	Polygonaceae	**Timijjii (Or)**	H	R	The root is powdered and mixed with water.	Oral	Blackleg	Oromia	(Megersa *et al.* 2013)
Rumex nervosus Vahl	Polygonaceae	**Embaucho (Am)**	H	L	The fresh leaves are tied to the affected area using threads.	Dermal	Bone fracture	Amhara	(Mekonnen 2022)

Sarcostemma viminale (L.) R.Br.	Ascelpiadaceae	**Halengi hibey (Tg)**	Cl	R	The root is crushed and applied to the affected area.	Dermal	Paralysis	Tigray	(Demir 2020)
Scadoxus multiflorus (Martyn) Raf.	Amaryllidaceae	**Burii (Or)**	H	L	The leaves are crushed.	Oral	Stabbing	Oromia	(Abdela 2022)
Schefflera volkensii (Harms) Harms	Araliaceae	**Bahirzaf (Am)**	T	L	The leaves areprepared by concocting and decocting.	Oral	Arthritis	Amhara	(Kidane 2018)
Securidaca longepedunculata Fresen.	Polygalaceae	**Sangano (Shk)**	T	L	NR	Oral	Rheumatism	SNNPR	(Weldearegay 2021)
Sesamum indicum L.	Pedaliaceae	**Selit (Am)**	H	Sd	The seed is pounded and mixed with the seeds of *Trigonella foenum-graecum*, then applied to the affected area.	Dermal	Bone breakage	Amhara	(Teshome 2023)
Sida schimperiana Hochst. ex A.Rich.	Malvaceae	**Tifraria (Tg)**	Sh	R	The root is tied around the affected area.	Dermal	Paralysis	Tigray	(Demir 2020)
Solanum capsicoides All.	Solanaceae	**Buluwa (Karetsamee)(Or)**	Sh	Sd	The seed is chopped, pounded, cooked and ground.	Oral	Arthritis, Rheumatism	SNNPR	(Agize *et al*. 2013)
Solanum incanum Ruiz & Pav.	Solanaceae	**Yekolla enboy (Am)**	Sh	R	A cup of fresh or dried root powder is prepared with leaves of *Vernonia amygdalina* by boiling in seven cups of water until reduced to one cup. The decoction is then mixed with the spent grain of the local alcoholic drinks (tella" or "areki") and taken orally for 3 days.	Oral	Arthritis/ Rheumatism	Amhara and Afar	(Chekole *et al*. 2015, Seifu *et al*. 2004, Mesfin *et al*. 2009)
Tagetes minuta L.	Asteraceae	**Derek'aa/Wonttak'a (Or)**	H	Wp	The whole plant part is chopped and pounded.	Oral	Rheumatism	SNNPR	(Agize *et al*. 2013)
Teclea nobilis Delile	Rutaceae	**Hadheessaa (Or)**	T	L	The leaves are pounded and mixed with water.	Oral	Blackleg	Oromia	(Usman 2022)

Thalictrum rhynchocarpum Quart.-Dill. & A.Rich.	Ranunculaceae	**Mararree (Or)**	H	Wp	The whole part is crushed.	Oral	Blackleg	Oromia	(Megersa *et al.* 2013)
Tragia cinerea (Pax) M.G.Gilbert & Radcl.-Sm.	Euphorbiaceae	**Kinkkilishuw (Or)**	Sh	R	The root is chopped, pounded and chewed.	Oral	Rheumatism; Blackleg	SNNPR	(Agize *et al*. 2013)
Trigonella foenum-graecum L.	Fabaceae	**Abish (Am)**	H	Sd	The dried seeds are ground, powdered and homogenized in water.	Oral	Rheumatic/ Arthritis	Amhara	(Mekonnen 2022)
Triticum polonicum L.	Poaceae	**Qanbaraa (Or)**	H	Sd	The seed powder is boiled with milk, and 2–3 glasses are taken daily until recovery.	Oral	Bone break	Oromia	(Megersa & Woldetsadik 2022)
Urtica simensis Hochst. ex A.Rich.	Urticaceae	**Sam (Am)**	H	L	The leaves are boiled.	Oral	Rheumatism	Amhara	(Alemneh 2021)
Verbascum sinaiticum Benth.	Scrophulariacea	**Tirnake (Tg) (handega)**	H	R	The root is chewed. The root is tied around the affected area.	Oral	Stabbing pain, Dislocated bone	Oromia and Tigray	(Chekole *et al*. 2015, Demir 2020)
Vernonia amygdalina Del.	Asteraceae	**Garaa (Or)**	Sh	L	The leaves are chopped, pounded, cooked and chewed	Oral	Rheumatism	SNNPR	(Agize *et al*. 2013)
Vernonia jugalis Oliv. & Hiern	Asteraceae	**Giginaa (Or)**	Sh	L	The leaves are chopped.	Oral	Rheumatism	SNNPR	(Agize *et al*. 2013)
Vinca rosea L.	Apocynaceae	**Wuluwusha (Or)**	H	L	The leaves are pounded.	Oral	Rheumatism	SNNPR	(Agize *et al*. 2013)
Withania somnifera (L.) Dunal	Solanaceae	**S'eemusha (Or) Kookaxa (Af)**	T	L	The leaves are chopped, ground, and placed on fire for fumigation	Oral	Blackleg, Rheumatism	SNNPR and Afar	(Agize *et al*. 2013, Seifu *et al*. 2004)
Zehneria scabra (L.f.) Sond.	Cucurbitaceae	**Hafaflo (Tg)**	Cl	L	The leaves are crushed and tied on the affected area.	Dermal	Paralysis	Tigray	(Demir 2020)
Zornia pratensis Milne-Redh.	Fabaceae	**NR**	H	L	The leaves are chopped and smashed.	Oral	Rheumatism	SNNPR	(Agize *et al*. 2013)

ROA: Route of administration; NR: Not reported; SNNPR: Southern Nations, Nationalities and Peoples' Region

Key to growth forms: Ap = Aerial part; B = Bulb; Br= Bark; Bu = Bulbous; Cl = Climber; Fr = Fruit; H = Herb; L= Leaves; R = Root; Sd = Seed; Sh = Shrub; St = Stem T = Tree; Wp = Whole plant.

Key to languages used for local names of plants: Am = Amharic; Ar = Afaregna; Or = Oromigna; Shk = Sheko; Tg = Tigrigna; G = Gamo.

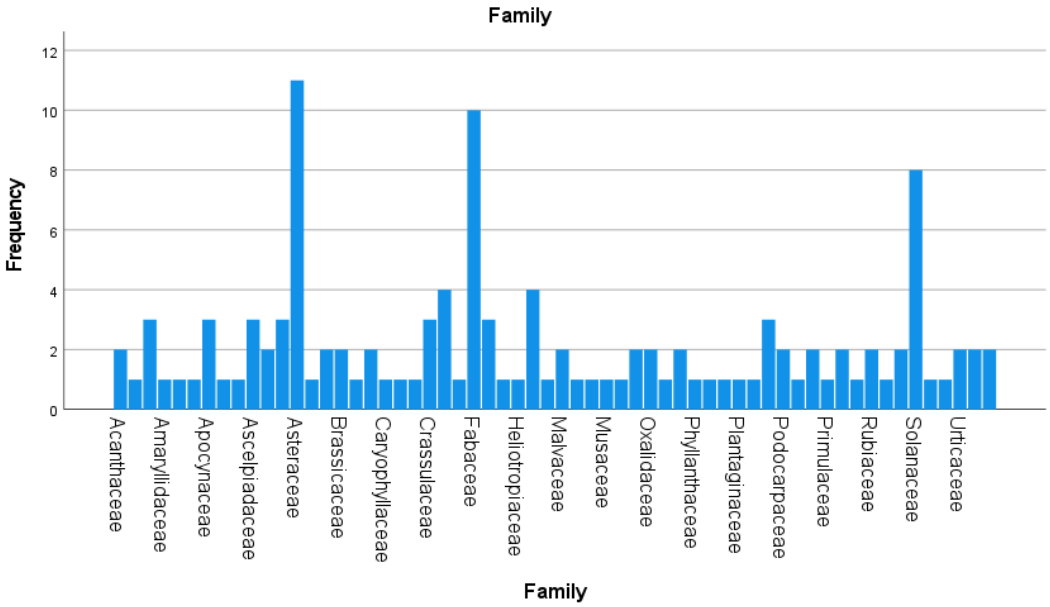

Figure 3. Dominant plant families of medicinal plants used in the treatment of musculoskeletal disorders and paralysis in Ethiopia

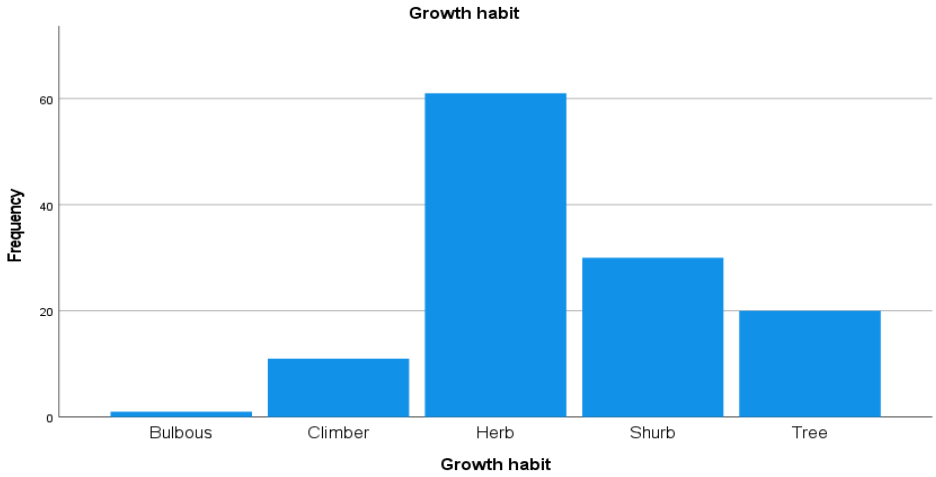

Figure 4. Proportions of growth form of medicinal plants used in the treatment of musculoskeletal disorders and paralysis

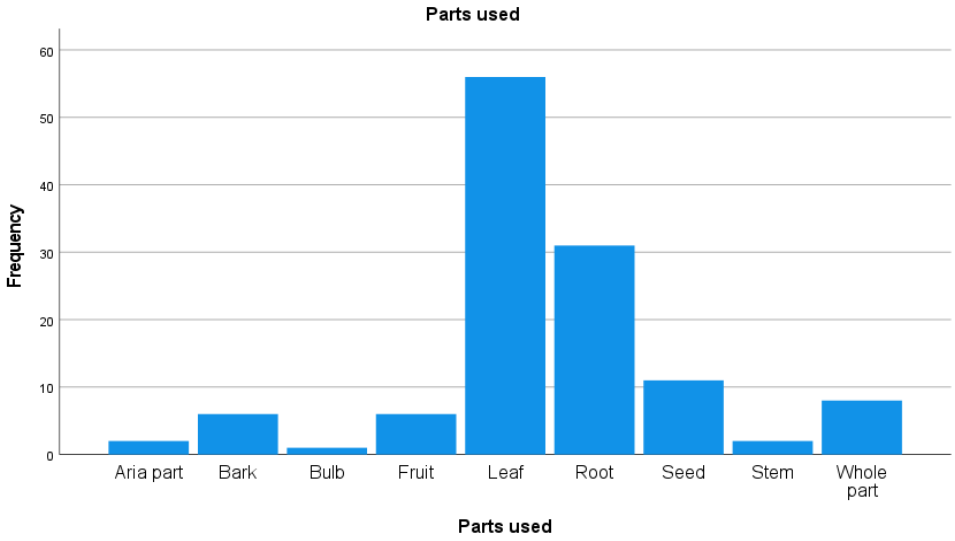

Figure 5. Proportions of plant parts used in the treatment of musculoskeletal disorders and paralysis

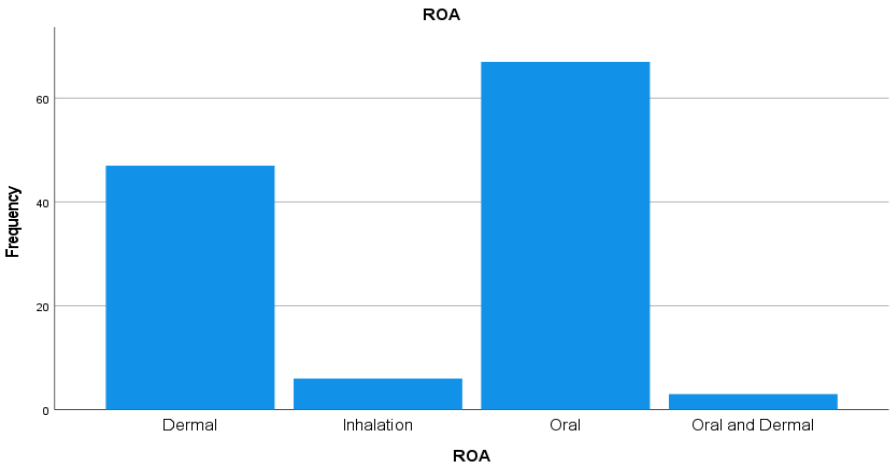

Figure 6. Proportions of route of administration (ROA) of medicinal plants used in the treatment of musculoskeletal disorders and paralysis

Regional distribution of medicinal plants

The highest number of medicinal plants used for musculoskeletal disorders and paralysis was reported from SNNPR (33.3%) followed by Oromia (22.8%) and Amhara (13.0%). The Afar and Tigary regions contributed 9.8% and 8.1% of the documented species, respectively (Fig. 7).

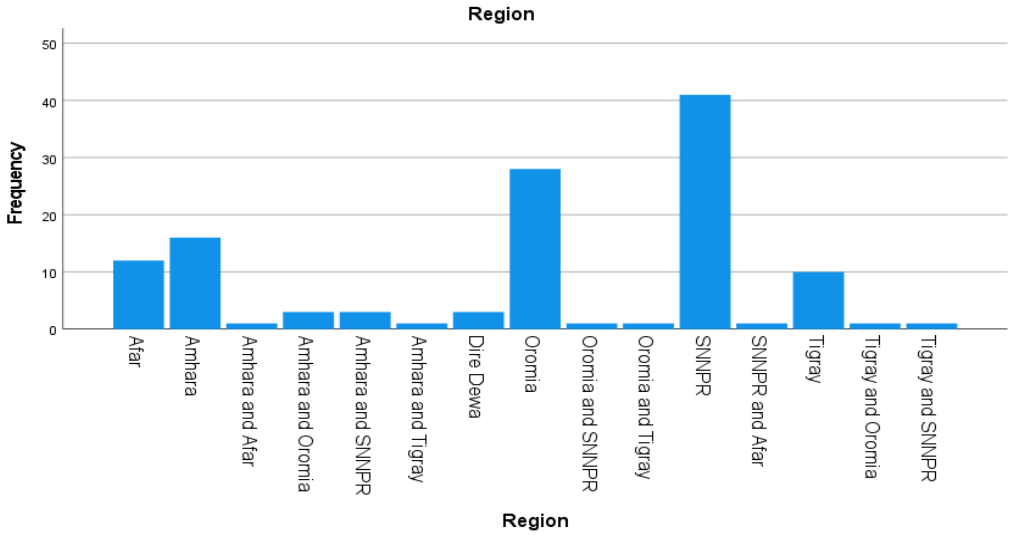

Figure 7. Regional distribution of medicinal plants for the treatment of musculoskeletal disorders and paralysis

Medicinal plants with documented experimental or clinical evidence for the treatment of musculoskeletal disorders and paralysis

Out of the 60 plants reported in this review with experimental or clinical evidence of anti-inflammatory activity, 11 studies were conducted in Ethiopia, thereby confirming the traditional knowledge (Table 2). These include *Albizia gummifera, Aloe trigonantha, Boswellia papyrifera, Calpurnia aurea, Calotropis procera, Cucumis ficifolius, Dovyalis abyssinica, Dodonaea angustifolia, Echinops kebericho, Ocimum lamiifolium* and *Vernonia amygdalina,* all of which have been investigated in Ethiopian research centers and universities. However, the ethnobotanical and pharmacological properties of the remaining 62 plants have not been evaluated. Notably, no Ethiopian medicinal plants have been scientifically assessed for antiparalytic activity.

Table 2. Medicinal plant species with documented pharmacological evidence of anti-inflammatory properties

Plant species	Part used	Extract type	Experimental model	Dose	Observed effect	Reference
Acacia mellifera (Vahl) Bosc.	Stem bark	Dichloromethane	Carrageenan paw edema	50–150 mg/kg	Strong dose dependent anti-inflammatory activity	(Veronica *et al.* 2017
Agave sisalana Perrine.	Leaves	Aqueous	Carrageenan, formaldehyde, histamine edema	100–400mg/kg	Up to 93% inhibition (carrageenan); moderate effect in other models	(Mwale *et al.* 2012)
Ageratum conyzoides L.	Aerial part	Methanol	Carrageenan paw edema	500mg/kg	Significant inhibition of edema during early hours	(Galati *et al.* 2008)
Albizia malacophylla (A.Rich.)	Wood	Ethanol	EPP-induced ear edema	15% w/v	81–95% edema inhibition	(Bakasatae *et al.* 2018)
Allium sativum L.	Whole plant	Ethanol	Paw edema & topical inflammation	Multiple doses	Significant systemic & topical anti-inflammatory effects	(Obi *et al.* 2022)
Aloe trichosantha A.Berger.	Leaf gel	Methanol	Xylene ear edema & cotton-pellet granuloma	100–400 mg/kg	Reduced ear edema and granuloma formation	(Tazeze *et al.* 2021)
Balanites aegyptiaca (L.) Delile.	Aerial parts	Ethanol & petroleum ether	Carrageenan paw edema	300 – 600 mg/kg	Significant reduction of paw edema	(Gaur *et al.* 2008)
Boscia coriacea Graells.	Leaves	8% methanol	Egg albumin denaturation	100-500µg/mL	Consistent anti-inflammatory effects	(Tseha *et al.* 2024)
Cadaba farinosa Forssk.	Leaves	Ethanol	Carrageenan paw edema	75, 150, 300 mg/kg	Significant reduction in paw swelling	(Tijjani *et al.* 2017)
Calotropis procera (Aiton) Dryand.	Leaves	Ethanolic	Carrageenan paw edema	100–400mg/kg	Dose-dependent reduction in swelling	(Saba *et al.* 2011)
Calotropis procera (Aiton) Dryand.	Root bark	Ethanol	CFA-induced arthritis; vascular permeability	100–200mg/kg	21–71% inhibition; strong anti-arthritic activity	(Parihar *et al.* 2011)
Calpurnia aurea (Aiton) Benth.	Leaves	80% methanol	Carrageenan-induced paw edema	100–400mg/kg	Significant reduction of paw edema	(Ayal *et al.* 2019)
Capsicum annuum L.	Leaves and fruits	Ethanol	LPS-stimulated RAW 264.7 macrophages	100-500µg/mL	Decreased nitric oxide, IL-6, and TNF-α production; anti-inflammatory activity correlated with luteolin glycosides	(Cho *et al.* 2020)
Capsicum frutescens L.	Fruit	Ethyl acetate	Egg albumin-induced paw edema	0.5 ml/kg	Significant inhibition similar to capsaicin	(Jolayemi & Ojewole 2013)
Carissa spinarum L.	Root	Methanol	COX-2 inhibition	0.04–25 µM	Significant COX-2 inhibitory activity	(Liu *et al.* 2021)

Cicer arietinum L.	Leaves	Ethanolic & hydroalcoholic	Protein denaturation	500 µg/mL	Dose-dependent inhibition of denaturation	(Mhamane & Adat 2023)
Cissus quadrangularis L.	Whole plant	Methanol	Carrageenan, arachidonic acid & EPP ear edema	75,150,300mg/kg, 2mg/ear	Significant inhibition of acute inflammation	(Panthong *et al.* 2007)
Clutia abyssinica Jaub. & Spach	Root	Dichloromethane	Carrageenan paw edema	50,100,150mg/kg	Mild reduction of edema compared to diclofenac	(Cheruiyot 2017)
Combretum collinum Fresen.	Leaves	Aqueous & methanolic	TNF-α induced inflammation	1–200 µg/mL	Reduced pro-inflammatory mediators	(Marquardt *et al.* 2020)
Cordia africana Lam.	Leaves & bark	Methanol & aqueous	LOX inhibition	0.08–5 mg/mL	Significant LOX inhibitory & antioxidant activity	(Imam *et al.* 2016)
Coronopus didymus (L.) Sm.	Whole plant	Ethanol & aqueous	Carrageenan paw edema	200 mg/kg	Aqueous extract showed significant anti-inflammatory activity	(Prabhakar *et al.* 2008)
Croton macrostachyus Hochst. ex Delile	Stem bark	Aqueous & CH_2Cl_2/MeOH	Carrageenan, histamine & formalin models	150–600mg/kg	Strong anti-inflammatory effect across models	(Kamanyi *et al.* 2009)
Cucumis ficifolius A.Rich.	Root	Methanol	Carrageenan paw edema	200–800mg/kg	Significant inhibition in crude & fraction	(Yimer *et al.* 2020)
Cucurbita pepo L.	Fruit	Methanol	RBC membrane stabilization, protein denaturation	150–300µg/mL	Dose-dependent membrane stabilization & enzyme inhibition	(Fathima *et al.* 2024)
Datura stramonium L.	Leaves	Ethyl acetate	Paw/anal edema	150–300mg/kg	Strong anti-inflammatory	(Nasir *et al.* 2022)
Datura stramonium L.	Leaves & seeds	Essential oil	Egg albumin-induced paw edema	2% w/v	22–95% inhibition over time	(Aboluwodi *et al.* 2017)
Dichrocephala integrifolia (L.f.) Kuntze	Whole plant	Methanol	Neutrophil assays (superoxide, elastase)	1–50 µg/mL	Strong anti-inflammatory activity in neutrophil assays	(Lee *et al.* 2015)
Discopodium penninervium Hochst.	Stem bark	Methanol	COX-1, COX-2, LTB4 inhibition	50 µM	Moderate inhibition of COX & leukotriene pathways	(Abebe *et al.* 2008)
Dodonaea angustifolia L.f.	Leaves	Aqueous	Protein denaturation (in vitro)	100-500µg/mL	Concentration-dependent inhibition	(Revathi 2019)
Dodonaea viscosa subsp. angustifolia (L.f.) J.G.West	Leaves	Hautriwaic Acid	12-O-tetradecanoylphorbol 13-acetate (TPA) mice ear edema models	0.25–1 mg/ear; 15 mg/kg	Very strong dose-dependent anti-inflammatory activity	(Salinas-sánchez *et al.* 2012)
Dovyalis abyssinica (A.Rich.) Warb.	Fruit	80% Methanol	Carrageenan paw edema	100–400mg/kg	Significant dose-dependent reduction of edema (3–5 h)	(Abdissa 2011)
Echinops kebericho Mesfin	Root	80% Methanol	Carrageenan & formalin paw edema	100–400mg/kg	Strong dose-dependent anti-inflammatory effect	(Yimer *et al.* 2020).

Ehretia cymosa Willd. ex Roem. & Schult.	Leaves	80% methanol	Carrageenan & cotton-pellet granuloma	100-400mg/kg	Reduced inflammation and granuloma formation	(Ashagrie 2023)
Euphorbia hirta L.	Leaf & root	Ethanolic	Albumin denaturation, anti-proteinase, anti-lipoxygenase	100 µg/mL	Significant inhibition of protein denaturation and enzyme activity	(Agize *et al*. 2013)
Gossypium hirsutum Cav.	Leaves	Aqueous	Carrageenan paw edema	300 mg/kg	Significant anti-inflammatory activity	(Ashagrie *et al.* 2023)
Hordeum vulgare L.	Seed	Ethanol extract	LPS-stimulated RAW 264.7 macrophages	50-500 µg/mL	Significantly inhibited NO, PGE_2, TNF- α	(Eun *et al.* 2016)
Lepidium sativum L.	Seeds	Methanol	Carrageenan & formaldehyde-induced paw inflammation in rats	550 mg/kg	Significant NO inhibition; anti-inflammatory potential	(Linn 2013)
Maesa lanceolata Voigt	Leaves	Acetone	LPS-stimulated RAW 264.7 macrophages	30 µg/mL	Inhibited nitric oxide production by 99.16%; strong anti-inflammatory activity	(Elisha *et al.* 2016)
Nicotiana tabacum L.	Leaves	Phytosome formulation	LPS-induced NO assay	15.6–500 µg/mL	Inhibited NO production; anti-inflammatory potential	(Chittasupho *et al.* 2023)
Ocimum basilicum L.	Leaves	Volatile oil & hexane	Xylene ear edema	50 µg/ear	Significant edema inhibition	(Okoye *et al.* 2014)
Ocimum gratissimum Forssk.	Leaves	Volatile oil & hexane	Xylene ear edema	50 µg/ear	Strong anti-inflammatory activity	(Okoye *et al.* 2014)
Ocimum gratissimum Forssk.	Leaves	Hydroethanolic	Carrageenan & granuloma	200–800mg/kg	Strong anti-inflammatory & membrane-stabilizing activity	(Ajayi *et al.* 2015)
Oxalis corniculata L.	Leaves	Petroleum ether (β-sitosterol)	Carrageenan paw edema	20 mg/kg	Reduced paw edema	(Dighe *et al.* 2016)
Parthenium hysterophorus L.	Leaves	Ethanolic	Carrageenan paw edema	200 mg/kg	Strong anti-inflammatory activity	(Bagchi *et al.* 2016)
Persea americana Mill.	Fruit & seed	Fatty acid & sterol-rich	Carrageenan-induced edema	10 g/kg	Reduced paw swelling	(Arya & Kumar 2005)
Piper nigrum L.	Fruit	Hexane & ethanol	Carrageenan-induced paw edema	10–15 mg/kg	Reduced paw inflammation in a time-dependent manner	(Asleem *et al.* 2014)
Plumbago zeylanica L.	Root	Dichloromethane	Carrageenan-induced paw edema and cotton pellet-induced granuloma	250 mg/kg and 500 mg/kg	Significant dose-dependent anti-inflammatory activity	(Subramaniyan & Paramasivam, 2018)

Podocarpus falcatus (Thunb.) Endl.	Stem	Ethanol	COX-1/COX-2 enzyme assay	250 - 4.625 µg/ml	Strong COX-2 inhibition (~96%)	(Finnie 2021)
Rumex nepalensis Spreng.	Root	Ethanol	Carrageenan paw edema	50–200 mg/kg	Significant, dose-dependent edema inhibition	(Devkota *et al.* 2015)
Sarcostemma viminale (L.) R.Br.	Leaves	Ethanol	Macrophage activation assay	1.0% v/v (also tested 0.5% v/v)	Promoted pro-inflammatory macrophage phenotype (not anti-inflammatory)	(Brestovac *et al.* 2014)
Securidaca longepedunculata Fresen.	Root bark	Methanol	Mouse ear edema & rat paw edema	5 mg/ear &5 or 10 mg/kg	Significant suppression of edema	(Okoli and Akah 2006)
Solanum capsicoides All.	Leaves	70% Ethanol (inositol derivatives)	LPS-induced BV2 microglia	IC_{50} = 11–14 µM	Significant inhibition of inflammatory mediators	(Liu *et al.* 2022)
Solanum incanum Ruiz & Pav.	Root	Flavonoid rich fraction	Formalin & acute edema	6.5–25 mg/kg	Significant reduction of inflammation	(Enoc *et al.* 2018)
Tagetes minuta L.	Seed	Essential oil	LPS-stimulated macrophages	50 µg/mL	Reduced NO, TNF-α, and iNOS expression	(Karimian *et al.* 2014)
Trigonella foenum-graecum L.	Seed	Methanol	Carrageenan paw edema	10–20 mg/kg	Significant acute anti-inflammatory activity	(Vyas *et al.* 2008)
Urtica simensis Hochst. ex A.Rich.	Leaves	80% Methanol	Carrageenan & cotton-pellet granuloma	100, 200, 400 mg/kg	Significant acute & chronic anti-inflammatory effects	(Dadi & Shibeshi 2021)
Verbascum sinaiticum Benth.	Root	Methanol	Carrageenan & formalin paw edema	200, 400mg/kg	Significant anti-inflammatory effect at later hours/days	(Asefa *et al.* 2022)
Vernonia amygdalina Del.	Stem bark & root	Methanol	Albumin denaturation	167–550 µg/mL	Moderate to strong inhibition of protein denaturation	(Atolani *et al.* 2024)
Zehneria scabra (L.f.) Sond.	Leaves	Ethanol	Carrageenan-induced paw edema	400 mg/kg	Up to 76% inhibition at 5 hours	(Belay & Makonnen 2020)

Discussion

The present review documented 122 medicinal plant species belonging to 61 botanical families that are traditionally used for the treatment of musculoskeletal disorders and paralysis in Ethiopia. The predominance of the families Asteraceae, Fabaceae and Solanaceae corroborates previous ethnobotanical investigations conducted throughout Ethiopia, which consistently identify these families as among the most represented in traditional medicine because of their broad ecological distribution, species richness and adaptability to diverse agroecological zones(Yineger *et al*. 2008; Lulekal *et al*. 2013). Similar patterns have also been documented in ethnobotanical studies from other African countries, suggesting that these families constitute important reservoirs of bioactive natural products with potential therapeutic applications against inflammatory and musculoskeletal diseases (Aremu & Pendota 2021; Khumalo *et al*. 2021; Codo *et al*. 2022).

Most ethnomedicinal reports included in this review originated from the Southern Nations, Nationalities and Peoples Region (SNNPR), Oromia, and Amhara regions. This distribution likely reflects not only the remarkable floristic diversity of these regions but also their rich indigenous knowledge systems and the relatively larger number of ethnobotanical investigations conducted there (Lulekal *et al*. 2013; Kindie 2024). In contrast, comparatively few studies were available from Afar and Tigray regions, indicating substantial gaps in the documentation of indigenous medicinal knowledge. Future ethnobotanical surveys should prioritize these underexplored regions before valuable traditional knowledge is lost because of urbanization and environmental degradation (Gonfa *et al*. 2020).

In terms of growth forms, herbs constituted the highest percentage (49.6%), followed by shrubs and trees. This agrees with other Ethiopian ethnobotanical studies (Mesfin *et al*. 2009; Belayneh *et al*. 2012), which reported that herbal species are more accessible, easy to harvest and generally possess a high concentration of secondary metabolites in above ground parts. Similarly, the dominance of leaves (45.5%) as the most utilized plant part for remedy preparation is also consistent with earlier reports (Giday *et al*. 2009; Demir 2020). Leaves are utilized to a larger extent since they are renewable, easily harvested without causing damage to the plant and rich in phytochemicals. However, the extensive use of roots (25.2%) is a cause for conservation concern, as root harvesting threatens plant survival, particularly for plants with narrow distributions (Getachew *et al*. 2022).

Oral (54.5%) and dermal (38.2%) administration were the predominant routes of remedy application. These findings are consistent with previous Ethiopian ethnomedicinal studies (Lulekal *et al*. 2013), where oral administration is commonly employed to treat systemic diseases, whereas topical application is preferred for localized musculoskeletal pain, inflammation, fractures, and wounds. Dermal administration may facilitate localized delivery of bioactive compounds while minimizing systemic adverse effect (Giday *et al*. 2009; Drosopoulou *et al*. 2008). Less frequently reported routes including intranasal administration have also been documented in northern Ethiopia for neurological disorders, headaches and respiratory illnesses (Demir 2020).

Although many Ethiopian medicinal plants are traditionally used to manage musculoskeletal disorders, only a relatively few of these species have been scientifically evaluated for their anti-inflammatory activities. The 80% methanol leaf extract of *Clematis simensis* exhibited significant anti-inflammatory and antinociceptive activity in experimental models (Tadele *et al*. 2009). Similarly, the crude extract and solvent fractions of *Albizia gummifera* bark significantly reduced acute and chronic inflammation (Tamirat 2023). *Calpurnia aurea* demonstrated notable enzyme inhibition (Weletnsae *et al.* 2020). The root extract of *Echinops kebericho* produced marked dose-dependent inhibition of carrageenan-induced paw edema and cotton pellet granuloma formation, with the ethyl acetate fraction showing the greatest anti-inflammatory effect (Yimer *et al.* 2022). Likewise, crude extract and solvent fractions of *Cucumis ficifolius* significantly suppressed carrageenan-induced paw edema and other inflammatory responses (Demsie *et al*. 2019). Extracts of *Boswellia papyrifera* have also demonstrated potent anti-inflammatory activity by suppressing the production of pro-inflammatory cytokines, an effect largely attributed to their high boswellic acid content (Endalew 2018). Furthermore, *Dovyalis abyssinica, Dodonaea angustifolia and Rumex nervosus* inhibited reactive oxygen species production (IC_{50} = 10.2, 19.4 and 35.8 µg/mL, respectively), indicating their potential to attenuate oxidative inflammatory processes (Abdissa 2011; Emam *et al*. 2021). Leaf extracts of *Ocimum lamiifolium* significantly reduced carrageenan-induced paw edema with the aqueous extract exhibiting greater activity than the ethanol extract (Mequanit *et al*. 2011). Similarly, the acetone leaf extract of *Vernonia amygdalina* also showed pronounced anti-inflammatory effects in carrageenan-induced paw edema models (Nigussie *et al*. 2021). Overall, these findings support the traditional use of Ethiopian medicinal plants for inflammatory musculoskeletal disorders and highlight their potential as sources of novel anti-inflammatory agents. However, pharmacological evidence remains limited for many species warranting further investigation.

Although this review primarily focuses on the anti-inflammatory activity of Ethiopian medicinal plants, other pharmacological properties may also contribute to their therapeutic effects in musculoskeletal disorders and paralysis. For example, *Echinops kebericho*, *Albizia gummifera*, and *Cucumis ficifolius* have demonstrated analgesic activities in experimental models (Demsie *et al*. 2019; Yimer *et al*. 2022; Tamirat 2023). *Albizia gummifera*, *Aloe trichosantha, Clematis simensis* have also shown wound-healing and antimicrobial potential, which may facilitate tissue repair and prevent secondary infections (Unasho *et al*. 2009; Tazeze *et al*. 2021; Teshome *et al*. 2022). In addition, antioxidant activity has been reported for several Ethiopian medicinal plants, including the isolated compound isorhamnetin from *Vernonia amygdalina* and and *Ocimum lamiifolium*, suggesting a role in reducing oxidative stress associated with chronic inflammation (Abere & Melaku 2018; Megersa 2024). Neophytadiene, hexahydrofarnesyl, lanosterol, 2,4-dimethylbenzo[h]quinolone, and squalene isolated from *Calotropis procera* extracts exhibit analgesic, antipyretic, anti-inflammatory, antimicrobial and antioxidant activities(Endris *et al*. 2024). collectively, these complementary pharmacological activities may act synergistically with anti-inflammatory effects to support the traditional use of these medicinal plants for musculoskeletal disorders and paralysis.

Growing evidence indicates that several isolated compounds and essential oil constituents are largely responsible for the anti-inflammatory activities. *Boswellia papyrifera* resin contains boswellic acids, particularly 11-keto-β-boswellic acid, which inhibit 5-lipoxygenase and reduce pro-inflammatory mediators (Poeckel & Werz 2006). *Vernonia amygdalina* contains sesquiterpene lactones and flavonoid derivatives, including luteolin-7-α-O-glucuronide, vernoamyoside D, and vernotolaside, which demonstrated inhibition of inflammatory responses (Abbasi *et al*. 2010). Similarly, parthenolide isolated from *Parthenium hysterophorus* exhibited anti-inflammatory activity through suppression of inflammatory signaling pathways (Alkhalaf *et al*. 2019), while capsaicin from *Capsicum frutescens* showed anti-inflammatory effects by modulating inflammatory mediators (Jolayemi & Ojewole 2013).

Essential oils from *Datura stramonium* and *Ocimum* species have also demonstrated anti-inflammatory activity, attributed to bioactive terpenoid constituents such as linalool, eugenol, and other volatile compounds (Okoye *et al.* 2014; Ajayi *et al.* 2015; Aboluwodi *et al*. 2017). Furthermore, *Echinops kebericho*, *Calpurnia aurea*, *Albizia gummifera* and *Cucumis ficifolius* have shown anti-inflammatory effects, which are associated with their secondary metabolites including sesquiterpenes, alkaloids, flavonoids, saponins and phenolic compounds (Demsie *et al*. 2019; Weletnsae *et al*. 2020; Yimer *et al*. 2022; Tamirat 2023). Other compounds, including allicin from *Allium sativum*, piperine from *Piper nigrum*, plumbagin from *Plumbago zeylanica* and diosgenin from *Trigonella foenum-graecum*, have also been reported to regulate inflammatory and oxidative pathways (Duan *et al.* 2022; Petrocelli *et al*. 2023; Savairam *et al*. 2023; Shahrahmani *et al*. 2026). These findings indicate that the bioactive constituents contribute to the anti-inflammatory effects of medicinal plants, supporting their traditional use for musculoskeletal disorders and paralysis in Ethiopia**.**

Despite increasing evidence supporting anti-inflammatory activities, scientific investigations specifically addressing paralysis remain extremely limited. However, several medicinal plants possess pharmacological properties that are mechanistically relevant to paralysis, including antioxidant, anti-inflammatory, neuroprotective and neuroregenerative effects (Kantasrila *et al.* 2024; Roy *et al.* 2025). Experimental studies on *Withania somnifera*, *Curcuma longa*, *Panax ginseng* and *Ginkgo biloba* have demonstrated neuroprotective activities through reduction of oxidative stress, suppression of neuroinflammation, inhibition of neuronal apoptosis and enhancement of neuronal survival (Mishra *et al*. 2000; Kulkarni & Dhir 2008; Lee *et al*. 2013; Sarkar & Rathi 2025). Withanolides from *Withania somnifera* particularly withaferin A and withanoside derivatives have shown neuroprotective and neuroregenerative effects by reducing oxidative damage and promoting neuronal repair (Kuboyama *et al*. 2005; Dar *et al*. 2015). Curcumin from *Curcuma longa* has demonstrated protective effects in experimental models of cerebral ischemia and neurodegeneration by inhibiting NF-κB signaling, reducing inflammatory cytokines and limiting neuronal apoptosis (Chen *et al*. 2022). Similarly, ginsenosides from *Panax ginseng* and flavonoids and terpenoids from *Ginkgo biloba* have shown protective effects against neuronal injury through antioxidant, anti-inflammatory and mitochondrial regulatory mechanisms (Diamond *et al*. 2000; Kim *et al*. 2013).

Stroke-related paralysis is currently an emerging health challenge in Ethiopia, highlighting the need for safe and effective therapeutic options (Feigin *et al*. 2021). Although many Ethiopian medicinal plants are traditionally used for paralysis, their neuroprotective and antiparalytic potentials remain largely unexplored, representing a major research gap. Similar limitations have been reported in African ethnopharmacological studies (Codo *et al*. 2022). Appropriate experimental models, including middle cerebral artery occlusion-induced ischemic stroke, spinal cord injury, sciatic nerve injury, neurotoxin-induced neuronal damage and behavioral assessments of motor function are essential to validate these traditional claims. Therefore, integrating ethnobotanical knowledge with clinical investigations may provide plant-derived neuroprotective agents, particularly considering the limitations and adverse effects associated with current paralysis management approaches, such as high-dose methylprednisolone therapy (Khaling *et al*. 2018).

To realize this potential, future research should focus on bioassay guided isolation of active compounds, mechanistic studies on oxidative stress modulation and nerve regeneration and comprehensive preclinical safety evaluations. These should be followed by well designed clinical trials to establish both efficacy and safety. Such integrative research could bridge the gap between traditional practices and modern therapeutics, paving the way for the development of effective plant based treatments for paralysis and musculoskeletal disease.

Conclusion

In Ethiopia, musculoskeletal disorders and paralysis remain significant public health challenges, with many individuals relying on medicinal plants for their management. However, the majority of these traditionally used plants have not been scientifically evaluated, underscoring the need for rigorous experimental and clinical validation. Systematic assessment of their efficacy, safety and toxicity could facilitate the identification of effective therapeutic agents and potentially lead to the development of safer, more targeted treatments for these conditions.

Declarations

List of abbreviation: BV2- murine microglial cell line, CFA- omplete Freund's Adjuvant, CH_2Cl_2/MeOH - Dichloromethane/Methanol, COX- Cyclooxygenase, IC_{50} - Half maximal inhibitory concentration, iNOS - Inducible nitric oxide synthase, LOX - Lipoxygenase, LPS - Lipopolysaccharide, LTB4 - Leukotriene B4, MSD - Musculoskeletal disorders, NO - Nitric oxide, PGE_2 - Prostaglandin E_2, PRISMA- Systematic reviews and meta-analysis, RBC - Red blood cell, SNNPR - Southern Nations, Nationalities, and Peoples' Region, TNF-α - Tumor necrosis factor alpha

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