



Research Article

ETHNOBOTANICAL SURVEY OF MEDICINAL PLANTS FOR BONE FRACTURE TREATMENT IN LINGMOO, SIKKIM

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ABSTRACT

Background: This study documents the use of herbal plants by traditional healers in Lingmoo, Namchi district, Sikkim, to treat bone fractures. **Methodology:** The methodology used were survey-based, pre-structured questionnaire, field investigation and face to face interaction with one traditional healer. We have recorded about 29 ethno-medicinal plants naturally available in the selected area. **Results:** According to the survey results, a total of 29 numbers of ethnomedicinal plant species belonging to 23 different families (Rosaceae topped the list) were identified and summarized in Table 1. The study revealed that herbs (48%) are mainly used, followed by trees (24%), climbers (17%), and shrubs (11%). In case of frequency of use, these plants were highly cited during the interview: *rivularis*, *Kaempferia rotunda*, *Viscum articulatum*, *Urtica dioica*, *Curcuma longa*, *Lepidium sativum*, *Beaumontia grandiflora*, *Bergenia ciliate*, and *Laportea bulbifera*. The parts used were roots, stem barks, whole plants, and seeds. The most commonly used preparation was paste. According to gender-wise comparison, males (60%), females (25%), and children (15%) were getting the treatment. Out of 29 plant species, 12 species are abundant and, 1 is in threatened condition; only 3 species are cultivated in present days. **Conclusion:** Documentation of local plants used by a specific traditional healer will benefit the sustainable use of indigenous medicinal plant practices. It will also provide preliminary information for future biological resource management and research development, which will eventually help in the conservation of ethnomedicinal plants and the advancement of such ideas.

INTRODUCTION

Sikkim is a small, beautiful (7096 square kilometers) Indian state located in the Eastern Himalayas with six districts. The three ethnic groups that constitute Sikkim—the Lepcha, Bhutia, and Nepali—have long relied on their traditional medical systems and firmly believed in the therapeutic potential of plants. Sikkim has 490 medicinal plants due to its wide range of elevations and

climates [1]. Buddhist organizations have supported ancient medicinal systems in Sikkim for their traditional Tibetan Pharmacopeia, which are still used today [2]. Based on continual trial-and-error learning from the old generation to the newer generation, the tribal people of Sikkim have a great deal of faith in herbal therapy. The aim of traditional healers worldwide is to

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cure illnesses and maintain human health despite their diverse beliefs and practices. The primary healthcare method for almost 60% of the world's population is traditional medicine [3,4]. According to the World Health Organization, approximately 80% of the world's developing countries rely on traditional medicine for healthcare (WHO, [1978]). Complementary medicine is another term used to refer to traditional medicine [5]. Their customs differ from one nation to the next and from one region to another due to influences from philosophy, history, and culture [6]. Sushruta (500 BC) wrote about traction, manipulation, and immobilization using a splint and a unique type of clay to repair fractures. Hippocrates (400–335 BC) also mentioned this method. Similar to how the plaster of Paris is used today, the Egyptian doctor used to immobilize the damaged limbs with a bandage soaked with resin. Provided a thorough explanation of fracture by outlining the use of extension in fracture treatment. Bones are the forms of connective tissue that are strengthened by bone cells and calcium. The softer center of bones, also known as bone marrow, is where the blood cells are produced. The primary function of our skeleton is to support our body, allow for movement, and shield our interior organs. A fractured or shattered bone occurs when the force acting on it exceeds its capacity to bear it. This breakdown of the bone's strength and structure causes pain, loss of function, bleeding, and damage surrounding the location. In the emergency room, fractures are frequently seen [7]. The most frequent cause of these injuries continues to be traffic accidents (RTAs). One of the most excruciating emergencies is a fracture. Planning to treat fracture pain requires careful consideration of the patient's medical history and the location of the fracture. Numerous drugs have been used in fracture reduction, according to studies. These consist of tramadol, ketamine, propofol, fentanyl, pethidine alone, and pethidine with diazepam. Vitamin D, which is received from diet and cutaneous production by ultraviolet B

radiation, is a necessary nutrient that can act as a hormone. Patients experience significant agony during fracture reduction operations. Successful fracture management is made possible by the effective management of fracture pain and anxiety, which also lessens patient discomfort. The most often recommended analgesic for kids was ibuprofen. This might be because of its safety and effectiveness [8]. A direct association between vitamin D and childhood rickets indicates that vitamin D is necessary for bone formation and remodeling [9-10].

METHODOLOGY

Study area and consent for the study:

The study area was Namchi districts in Sikkim-India, i.e., Lingmoo villages/towns, which were covered under this present survey. Geographically, Sikkim is the smallest and least populated state but ecologically most diversified of India's Himalayan states, located between 27°05' and 28°07' N latitude and 88°31' and 56' E longitude. During the monsoon season, the region experiences heavy rains and a tropical environment. The area has mostly clay loam soil texture [11]. We have obtained the institutional approval letter for conducting a field visit study: Memo No. 96/GPC/2024, dated 24th April 2024. It was part of undergoing a Bachelor of Pharmacy, 8th Sem, 6-month report from March 2024 to August 2024. We conducted a field-based study by developing the pre-prepared questionnaires and collecting information from traditional healer belongings, particularly from Lingmoo, Namchi district of Sikkim. The survey was conducted from March 2024 to July 2024, employing face-to-face questions, field visits, etc. The concern of the traditional healer was taken to publish the traditional healer's collected data on medicinal plants and their traditional knowledge for scientific communication in the future. The participation of the people was entirely cooperative, and by answering the questionnaires [12-15].

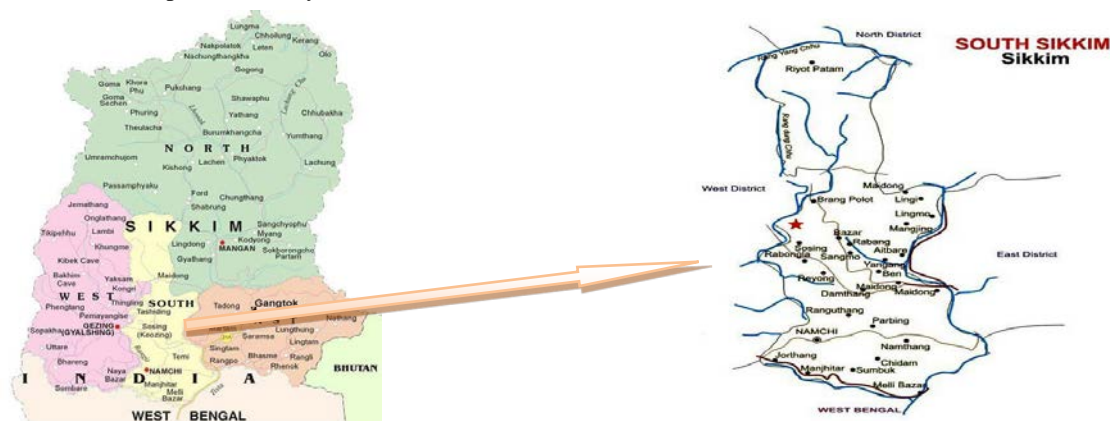


Figure 1: Study area Lingmoo, Namchi district of Sikkim

Table 1: Pre-structured survey Questionnaires:

1. Detail of the traditional healer (Name, age, gender, education, occupation, etc.) for easy identification for future information.
2. Traditional healer is 1 st , 2 nd or 3 rd generation practitioner?
3. How long have you been a traditional healer?
4. What are the local medicinal names, habitats, and portions of the plant used?
5. List of Endangered, cultivated, abundant, Sparse, common & threaten species for bone fracture treatment?
6. What are the herbal plants that treat bone fracture are available in the South Sikkim area?
7. What are the herbal plants practically used to treat bone fracture in South Sikkim area?
8. Can you explain the procedure to prepare the herbal medicine?
9. Could you kindly clarify the proper dosage, timing, and route for using herbal plants?
10. What is the patient's feedback regarding the traditional treatment?
11. Which herbal plants have faster recovery time?
12. Is there any patient who felt any side effects? If yes, then what are the problems?
13. Which age group and gender mostly came here for treatment of bone fracture?
14. What is the procedure to do follow up of the patient's case?

Statistics

The scientific ethnobotanical data from the field survey on locally available medicinal plants used for the bone fracture treatment were collected from the selected area and the

traditional data obtained during the survey were analyzed and presented in the tabular and graphical presentation within the manuscript by using the software-Microsoft Excel 2013.

RESULTS**Table 2: Medicinal Plants claimed to have bone fracture treatment found in Lingmoo, Namchi district-Sikkim**

S No.	Botanical name	Family	Local name (Nepali name)	Habit	Parts used	Present status
1.	<i>Astilbe rivularis</i> D.Don	Saxifragaceae	Buro Okhoti	Herb	Roots	Abundant
2.	<i>Curcuma longa</i> L.	Zingiberaceae	Hardi	Herb	Rhizome	Cultivated
3.	<i>Lepidium sativum</i> L.	Brassicaceae	Chamsur	Herb	Seeds	Cultivated
4.	<i>Rubus ellipticus</i> Smith.	Rosaceae	Aiselu	Shrub	Roots	Abundant
5.	<i>Beaumontia grandiflora</i> Wall.	Apocynaceae	Gothale Lahara	Climber	Roots	Abundant
6.	<i>Rheum palmatum</i> Linn	Polygonaceae	Padamchal	Herb	Roots	Cultivated
7.	<i>Aleuritopteris anceps</i> (Blanf.)	Pteridaceae	Rani Sinka	Herb	Rhizome	Abundant
8.	<i>Fraxinus floribunda</i> Wall.	Oleaceae	Lakuri	Tree	Stem bark	Sparse
9.	<i>Nyctanthes arbor-tristis</i> L.	Oleaceae	Parijat	Tree	Stem bark	Sparse

10.	<i>Smilax elegans</i> Wall. Ex. Kunth	Smilacaceae	Kukurdaino	Climber	Stem bark	Sparse
11.	<i>Acacia pennata</i> L. Wild.	Fabaceae	Areri	Climber	Roots	Abundant
12.	<i>Ampelocissus sikkimensis</i> (Lour.) Planch	Vitaceae	Macha Joday	Climber	Whole plant	Sparse
13.	<i>Artocarpus lacucha</i> Wall. Ex Roxb.	Moraceae	Barhar	Tree	Stem bark	Abundant
14.	<i>Asparagus racemose</i> Willd.	Asparagaceae	Kurilo	Herb	Aerial roots	Sparse
15.	<i>Bergenia ciliate</i> (Haworth.) Sternberg.	Saxifragaceae	Pakhanbet	Herb	Whole plant	Threatened
16.	<i>Datura metel</i> L.	Solanaceae	Dhatura	Herb	Seeds	Sparse
17.	<i>Equisetum debile</i> Roxb. Ex Vaucher	Equisetaceae	Kurkure jhar	Herb	Roots	Abundant
18.	<i>Laportea bulbifera</i> Siebold & Zucc.	Urticaceae	Patle Sisnu	Herb	Roots	Common
19.	<i>Kaempferia rotunda</i> L.	Zingiberaceae	Bhui Champa	Herb	Roots	Abundant
20.	<i>Pouzolzia hirta</i> Blume ex. Hassk.	Urticaceae	Chiplej Jhar	Herb	Roots	Common
21.	<i>Spermadictyon suaveolens</i> Roxb.	Rubiacea	Ban Champa	Shrub	Stem bark	Abundant
22.	<i>Tinospora sinensis</i> (Lour.) Merr.	Menispermaceae	Gurjo Lahara	Climber	Roots and stem bark	Sparse
23.	<i>Urtica dioica</i> L.	Urticaceae	Ghaira Sisnu	Herb	Roots	Common
24.	<i>Oxalis corniculata</i> L.	Oxalidaceae	Chari amilo	Herb	Whole plant	Common
25.	<i>Betula alnoides</i> Buch. Ham. ex. D. Don.	Betulaceae	Saur	Tree	Stem bark	Abundant
26.	<i>Engelhardia spicata</i> Lesch. Ex Blume	Juglandaceae	Mauwa	Tree	Stem bark	Common
27.	<i>Schima wallichii</i> (DC.) Kort.	Theaceae	Chilaune	Tree	Stem bark	Sparse
28.	<i>Prunus cerasoides</i> D. Don	Rosaceae	Painyung	Tree	Stem bark	Abundant
29.	<i>Woodfordia fruticosa</i> (L.) Kurz.	Lythraceae	Dhainyaro	Shrub	Flower	Abundant

*NN=Nepali Name

Table 3: Medicinal plants practically used for bone fracture treatment in Lingmoo, Namchi district-Sikkim

SNo	Botanical name/ Family	Local name	Parts used	Method of preparation	Uses	ROA
1.	<i>Astilbe rivularis</i> D. Don Saxifragaceae	Buro Okhoti	Roots	Boil 1-2 teaspoons of dried <i>Astilbe rivularis</i> roots in two cups of water for 10-15 minutes. Strain and drink 2-3 times a day.	a. Inhibition of osteoclast activity b. Antioxidant properties.	Oral
2.	<i>Curcuma longa</i> L. Zingiberaceae	Hardi	Rhizomes	Mix turmeric powder with warm water to form smooth paste. Add coconut oil or ghee to enhance absorption and anti-inflammatory	a. Reduce inflammation and pain b. Promote bone healing and density	Topical

				activity. Apply the paste topically to the affected area, covering the fracture site. Use a bandage or cloth to secure the paste in place. Leave it for 2-3 hours or overnight before washing off with warm water.	c. Enhance wound repair.	
3.	<i>Bergenia ciliate</i> (Haworth.) Sternberg Saxifragaceae	Pakhanbet	Whole plants	Grind the dried root into fine powder. Mix powder with ghee to form paste and add honey and mixed well. Apply the paste topically on the injured/affected area 2-3 times a day (4-6 weeks). Mix 1 teaspoon of the paste with warm water or milk to make decoction. Drink 2-3 time a day for 4-6 weeks.	a. Enhance bone density and strength b. Reduce inflammation c. Promote fracture healing and repair.	Topical Oral
4.	<i>Kaempferia rotunda</i> L. Zingiberaceae	Bhui Champa	Rhizomes	Boil 1-2 teaspoons of dried rhizomes in a cup of water for 10-15 minutes. Strain and drink 2-3 times a day. Grind fresh rhizome into paste and apply it to the affected area 2-3 times a day.	a. Anti-inflammatory properties b. Osteoprotective effects c. Antioxidants properties	Oral Topical
5.	<i>Tinospora cordifolia</i> (Lour.) Roxb Menispermaceae	Gurjo lahara	Roots and stem	Steep 1 teaspoons of dried stem in 1 cup of boiling water for 5-7 minutes. Strain and drink 2-3 times a day. Grind fresh stem along with paste and apply it to the injured/affected area 2-3 times a day.	a. Bone regeneration b. Pain relief	Oral Topical
6.	<i>Lepidium sativum</i> L. Brassicaceae	Chamsur	Seeds	Grind fresh seeds into a paste and apply to the affected area, 2-3 times a day. Boil 1-2 teaspoons of dried seeds in 2 cups of water for 10-15 minutes. Strain and drink 2-3 times a day.	a. Enhance bone mineralization and density. b. Anti-inflammatory effects c. Antioxidants	Topical Oral
7.	<i>Pouzolzia hirta</i> Blume ex. Hassk. Urticaceae	Chipley jhar	Roots	Plants roots paste is applied topically to reduce swelling and associates with bone fractures.	a. Reduce pain and inflammation b. Promoting bone healing c. Antioxidants	Topical
8.	<i>Oxalis corniculata</i> L. Oxalidaceae	Chari amilo	Whole plants	A paste made from the plant's leaves and roots is applied topically to reduce swelling and pain associated with bone fractures. The juice of plant's leaves is mixed with milk or water and consumed to aid in bone healing.	a. Improve calcium deposition b. Enhance bone density c. Reduce inflammation and pain.	Topical Oral
9.	<i>Datura metel</i> L. Solanaceae	Dhatura	Seeds	Oil made from the plant's seeds is applied topically to reduce pain and inflammations. A paste made from the plant's leaves and roots is applied topically to reduce the swelling and pain.	a. Relax muscles and reduce spasms. b. Reduce pain and inflammation. c. Enhance bone density.	Topical

10.	<i>Viscum articulatum</i> Burm.f. Loranthaceae	Harchur	Whole part	Stem paste or decoction. A paste made from the root's epidermal layer peelings is administered to the afflicted area. The entire plant's dried powder is consumed orally.	a. Nourish the bones and tendons. b. Reduce pain & inflammation.	Topical Oral
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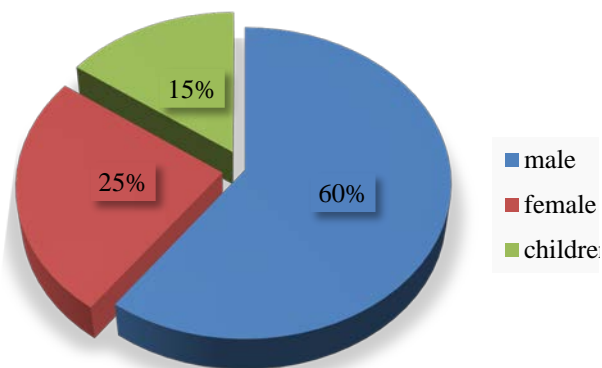


Figure 2: Gender-wise distribution of patients receiving herbal treatment for bone fractures

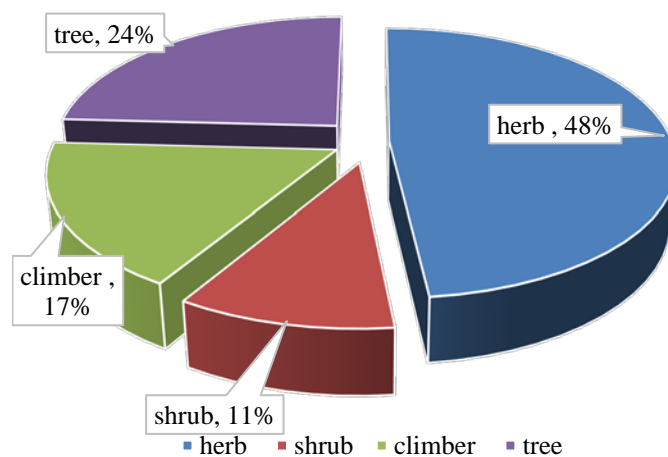


Figure 3: Habit wise distribution of the species

Table 4: Frequency of most common family of herbal plants:

S No	Family	Number of plant species
1.	Zingiberaceae	2
2.	Saxifragaceae	2
3.	Pteridaceae	1
4.	Solanaceae	1
5.	Equisetaceae	1
6.	Oleaceae	2
7.	Apocynaceae	1
8.	Betulaceae	1
9.	Polygonaceae	1
10.	Brassicaceae	1
11.	Smilacaceae	1
12.	Fabaceae	1
13.	Vitaceae	1
14.	Urticaceae	2
15.	Menispermaceae	1
16.	Rubiacea	1
17.	Theaceae	1
18.	Lythraceae	1
19.	Rosaceae	3
20.	Asparagaceae	1
21.	Moraceae	1
22.	Juglandaceae	1
23.	Oxalidaceae	1

DISCUSSION

From the above survey findings, A single traditional healer participated in the study, he was a male, and a herbalist; literate, done middle level of education. The traditional healer age was 51 years. The main occupation of the informant was traditional healer for bone fracture as a full time and farming as a part time job. A Total of 29 numbers of local medicinal flora species belonging to 23 different families were presented in this work (Table 1) for the management of fissure (bone fracture) by the traditional healer from Lingmoo, Namchi districts of Sikkim (Figure 1). As compared to previous investigation (Tamang *et al.*,2020), 41 medicinal plants were documented that are used by indigenous people for treatment of bone fracture (fissure) in the whole selected district (west-Sikkim). Also highlighted the demographic studies, such as plant names, families, local names, habits, distribution, part used, used by ethnic people and medicinal flora status.

However, in our present survey, along with above parameters, we have unveiled the preparation of ethno-medicinal plants, how to apply, general uses and route of administration, which were not highlighted in earlier studies. Another case study done in Pakyong district-Sikkim (Tamang *et al.*, 2023) also discussed only six medicinal plants used for bone fracture treatment from Pakyong-Sikkim which includes *Astilbe rivularis*-Buriokhati

(Nepali), *Cuscuta reflexa*- Akashveli, Binajarhi (Nepali), *Dendrobium densiflorum*- Ghogay sunakhari (Nepali), *Dendrobium nobile* - Sunakhari (Nepali), *Fraxinus paxiana*-Lakuri (Nepali), *Kaempferia rotunda*- Bhuichampha (Nepali), etc, In our study, the majority of plant parts were employed; either as root and stem bark to create pastes that were applied externally. These types of traditional practices were supported by numerous studies.

Most possible mechanism of action of the key plants are highlighted for the better understanding of the therapeutic application. *Viscum articulatum*, commonly referred to as mistletoe, is thought to help treat bone fractures. Its possible mechanisms of action are probably connected to its antioxidant and anti-inflammatory qualities, which may hasten tissue regeneration and healing at the fracture site [16]. Through the inhibition of osteoblast apoptosis, curcumin was able to ameliorate glucocorticoid-induced osteoporosis. In an ovariectomized rat model, another study found that curcumin could boost osteoblast counts and prevent bone loss [17-18]. Kaempferol's osteogenic effect was caused by persistent phosphorylation of SMAD1 and upregulation of BMP-2. High expression levels of ALP, Runx-2, OSX, COL1, and OCN in dexamethasone-induced rat calvarial osteoblasts demonstrated enhanced osteoblast proliferation due to kaempferol treatment's activation of SMAD1/5/8 via BMP-2 signaling [19]. Preclinical investigation of *B. ciliata* extract (IIM-160; 9.1% w/w; BER as principal ingredient). IIM-160 selectively inhibited the production of proinflammatory cytokines by lipopolysaccharide in THP-1 (human leukemia monocytic) cells, and it demonstrated an exceptional safety index. In multiple animal models, it demonstrated antinociceptive, anti-arthritic, and anti-inflammatory properties. In Swiss albino mice, it was found to be safer up to 2 g/kg (oral dose) [20]. New bone formation and the number of capillaries were significantly higher in the Stinging Nettle (*Urtica dioica*) groups than in the other groups. The statistical analysis also showed that the numbers of osteoblasts, osteoclasts, and capillaries were highest in the N + Stinging Nettle group [21].

CONCLUSION

It came to our knowledge that traditional healer had been treating bone fractures for ages using various plant formulations in Lingmoo, South-Sikkim. Lots of local people were provided with traditional benefits of this practice of bone fracture

treatment till date. Furthermore, we have to focus on sustainable use and documentation of traditional bone-healing practices can contribute to inform future pharmacological studies of these local medicinal plants, check the status and must adopt the conservation strategies for threatened and endangered species because these practices are slowly moving towards the edge of vanishing due to non-adoption by the new generation (modernization). Conservation of such traditional practices and knowledges and the selected plants species will definitely serve as a noble source for the researchers and drug development agencies to discover the lead molecules in the field of bone therapy.

FINANCIAL ASSISTANCE

NIL

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTION

Sonam Bhutia and Bhumika Chettri were responsible for selecting this survey and collecting the major data. Sonam Bhutia and Tiewlasubon Uriah Khar were responsible for guiding the project until its completion and contributed to designing, drafting, formatting, referencing, and communicating with the esteemed pharmacy journal with a reputed indexing system. All authors have thoroughly read and approved the manuscript.

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