



REVIEW ARTICLE

An overview of the genus *Anemone* L. (Ranunculaceae) in India

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ABSTRACT

The present paper documents the genus *Anemone* L. (Ranunculaceae) from India. A total of 26 taxa (which includes 24 species, one subspecies and one variety) has been recorded from Indo Himalayas. Western Himalaya is endowed with 9 taxa, Eastern Himalaya with 8 taxa, while 9 are common to both the flanks. Three species are present in Northeast India which are common to IHR and one species has also been reported from Western Ghats. This genus constitutes flowering plants of high altitude and maximum diversity has been observed between 2000–3000 m asl. The genus possesses high medicinal potential and needs urgent assessment of taxonomic and conservation status for its sustainable utilization.

Introduction

The genus *Anemone* L. stands out as one of the largest genera in the family Ranunculaceae representing more than 200 species worldwide (1). The genus is divided into 15 Subgenera, 23 Sections, 4 Subsections and 23 Series, under which 200 species including 20 subspecies and 27 varieties have been reported (2). *Anemone* is mainly distributed in the temperate zones of Northern hemisphere but few taxa have also been reported from Southern hemisphere (3) and the maximum diversity has been observed from subtemperate to subalpine zones of Asia, Europe, Japan, and North America. The word *Anemone* has originated from the Greek word “anemos” meaning “the wind”. On this basis, the genus is commonly known as “windflower”. It is morphologically and phytochemically related to *Pulsatilla*, *Clematis* and *Hepatica*.

Anemone is a perennial herb having basal leaves and erect or prostrate stems. Leaves are compound with lobed and sublobed, parted, or undivided leaf blades. The involucral leaves are various in number and form, sometimes reduced and bract-like. Flowers are usually actinomorphic possessing 4–27 sepals produced singly or in umbels, or in cymes of 2–9 flowers, above a cluster of leaf- or sepal-like bracts. Sepals vary in colour having different shades of white.

Stamens are numerous; pistils constitute one ovule; fruits achene, sometimes glabrous or tomentose; few to many. Achenes have various types of morphology which varies from species to species.

Most species of *Anemone* are diploid with basic chromosome number $n=7$ or 8 but some of them are polyploids (49, 50). Genus possesses high medicinal potential that has been used in folk medicine and ethnomedicine in India, Korea, America, Mongolia, Europe, China etc (Table 1).

Several chemical compounds have been elucidated from *Anemone* plants, especially pentacyclic triterpenoid saponins as oleanolic acid, 3-acetyloleanolic acid, raddeanosides, botulin (4, 58), coumarins, steroids (diosgenin), lactones (ranunculin, protoanemonin, anemonin), saccharides, fats and oils as 3-ethyl-2-methyl-hexane, acetophenone, pentadecane (4, 57) which are important constituents of many medicines. It displays a broad spectrum of pharmacological activities, including anti-inflammatory, antioxidant, antimicrobial and analgesic activities (4, 58).

In India, approximately 26 taxa of *Anemone* are found in diverse habitats of Indian Himalayan Region, some Northeastern states and Tamil Nadu in Western Ghats (Fig. 1).

Methodology

The present study on the genus *Anemone* from India is based on literature surveys, on Indian Himalaya, North eastern states and Western Ghats. Indian Himalaya Region situated at 27°50' – 37°06' N and 72°30' – 97°25' E covers an area of ca 4,19,873 km² with 2500 km length and 240 km width. The region of Northeast covers ca 8% (262179 km²) of the total geographical area of India that lies between 21°34' N to 29°50' N latitude and 87°32' E to 97°52' E longitude (54, 55). Western Ghats lies between 8°20' – 8°40' North latitude 73°77' East longitude covering an area of about 160000 km² (56). Different species of *Anemone* have been listed alphabetically with altitude, distribution (in India as well as World) along with flowering and fruiting seasons. The species of *Anemone* are calculated and computed in state wise

and Arunachal Pradesh whereas WH includes Jammu & Kashmir, Himachal Pradesh and Uttarakhand. The EH occurs at lower altitude than the WH. The eastern region shows high rainfall over lower elevation areas (below ~1000 m AMSL) whereas western region exhibits high rainfall over higher elevation areas (below ~1000 m AMSL) (60). The average annual rainfall of Western Ghats varies between 3000-4000 mm. Some *Anemone* species are present in two Northeast Indian states as in Meghalaya and Nagaland and also in Tamil Nadu of Western Ghats.

Results and Discussion

In India, *Anemone* is represented by 26 taxa (24 species, 1 subspecies and 1 variety) recorded from Indian Himalayan Region, NE India and Western

Table 1. Ethnopharmacological uses of few *Anemone* species with their chromosome number

Taxa	Chromosome No. (2n)	Useful Parts of Plant	Medicinal Uses	References
<i>Anemone albana</i> Stev.	16	Leaf	Respiratory system disorders, headache, sinusitis	(48)
<i>Anemone demissa</i> Hook. f. & Thomson	14	Root, Fruit	Rheumatism, dysentery, dyspepsia	(4, 50)
<i>Anemone griffithii</i> Hook. f. & Thomson	–	Rhizome, Seed	Blood-activating, pain-relieving, detoxicating, traumatic injury, arthritis pain, stomach worms	(4)
<i>Anemone narcissiflora</i> L.	14	Leaf, Root, Seed	Rheumatism, headache, toothache	(4, 50)
<i>Anemone obtusiloba</i> D. Don	14	Root, Fruit, Seed	Wound healing, tonsillitis, hepatitis, gastric disease, dysentery, arthritis pain	(4, 51, 52)
<i>Anemone polyanthes</i> D. Don	16	Seed	Food poisoning	(51, 52)
<i>Anemone pulsatilla</i> L.	32	Root	Rheumatism, bronchitis, asthma, cough	(49, 53, 53)
<i>Anemone rivularis</i> Buch.-Ham. ex DC.	16	Rhizome, Leaf, Seed, Root, Fruit	Malaria, cough, jaundice, arthritis pain, tonsillitis, hepatitis, gastric disease	(4, 50)
<i>Anemone rockii</i> Ulbr.	–	Rhizome	Muscle-relaxing, arthritis pain	(46)
<i>Anemone rupicola</i> Cambess.	32	Seed	Stomach worms, snakebite	(4, 49)
<i>Anemone tetrasepala</i> Royle	14	Seed	Stomach worms, sharp pain, snakebite	(4)
<i>Anemone trullifolia</i> Hook. f. & Thomson	–	Root, Flower	Gastric disease, snakebite	(4)
<i>Anemone tschernaewii</i> Regel	–	Bulb	Boils, burns, cut & wounds	(47)
<i>Anemone vitifolia</i> Buch.-Ham. ex DC.	16	Root, Leaf, Rhizome	Antirheumatic dysentery, relieve tooth pain and headache, ringworm	(4, 49, 51, 52)

representation. For enumeration of different taxa, Himalayan Region (HR) is divided into Eastern Himalaya (EH) and Western Himalaya (WH). The EH of India includes the states of West Bengal, Sikkim

Ghats of South India (Table 2). Data analysis shows that the maximum diversity of *Anemone* taxa is found in the Himalayan region from where all 26 taxa have been reported, out of these 9 taxa are known to occur in the Western Himalaya, 8 taxa in the Eastern Himalaya where as 9 taxa are present in both the flanks (Fig. 2). Western Ghats has distribution of only one species i.e. *Anemone rivularis* Buch.-Ham. ex DC.

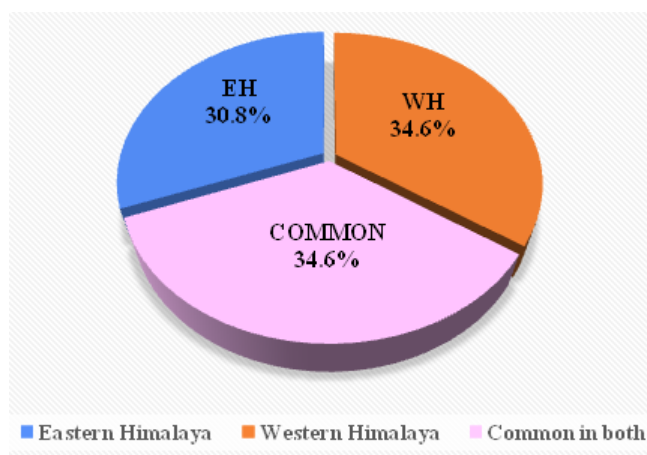


Fig. 2. Distribution of taxa of *Anemone* in IHR

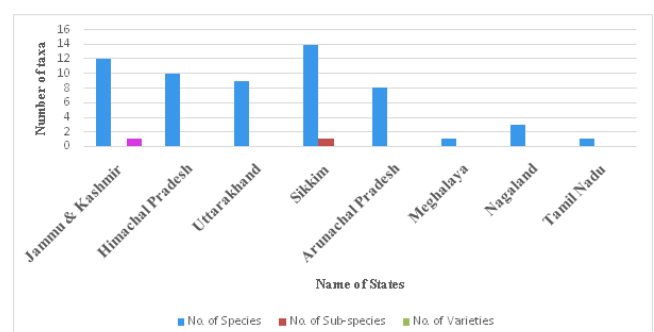


Fig. 3. Distribution of *Anemone* taxa in different states

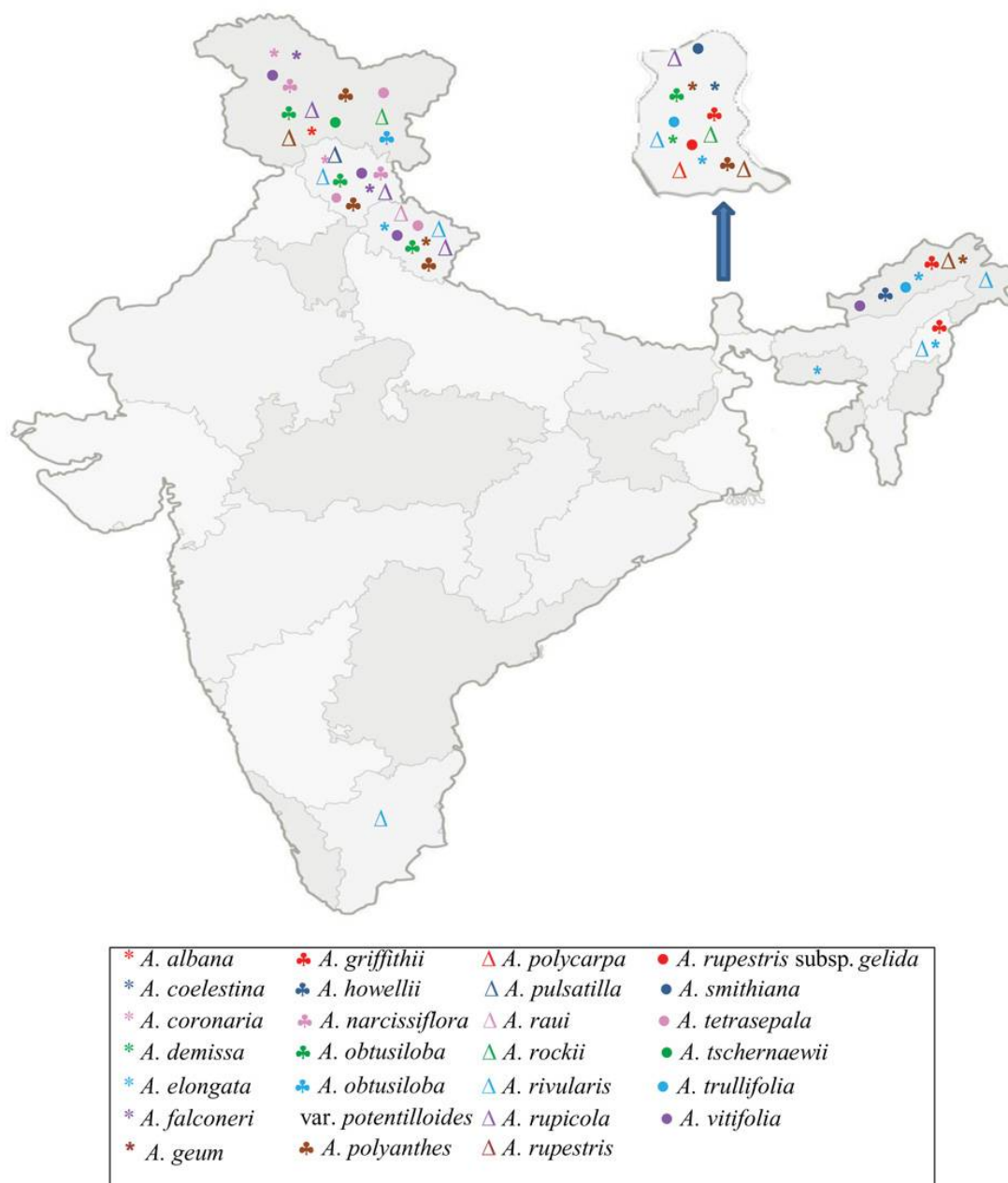


Fig. 1. Distribution of genus *Anemone* L. in India

After the perusal of previously published literature and study of specimens from different herbaria, it is observed that the highest diversity (57.7%) of *Anemone* is observed in Sikkim of EH (Fig. 3) where four species, *A. coelestina*, *A. demissa*, *A. polycarpa* and *A. smithiana* and one subspecies, *A. rupestris* subsp. *gelida* are found only in this state, that's why Sikkim may be regarded as a hotspot for *Anemone* species. After Sikkim, Jammu & Kashmir of WH is identified as second most favourable habitat for *Anemone* species where 50% taxa are distributed from temperate to alpine region, two species namely *A. albana*, *A. tschernaewii* are restricted to Jammu & Kashmir Himalaya. Himachal Pradesh is identified as the third most favourable habitat for *Anemone* where 38.4% taxa are mainly distributed and *A. pulsatilla* is restricted to this region. Uttarakhand is also known for its rich diversity that has 34.6% taxa and one species *Anemone rauii* is restricted to Uttarakhand Himalaya. *Anemone rivularis* is commonly distributed in different parts of India i.e. IHR, NE

India and WG. The distribution of *Anemone* in relation to altitude is depicted in Fig. 4. As evident from the figure, most of the taxa of the genus are found to be distributed from subtemperate to alpine zones and grassy moist meadows of Himalaya in the altitudinal range from 2000-3600 m asl. Few species such as *A. coelestina*, *A. demissa*, *A. geum* are present at high altitude 5000 m asl and *A. obtusiloba*, *A. polyanthes*, *A. rivularis*, *A. rupicola*, *A. vitifolia* are widely distributed in IHR and cover wide altitudinal range from 1100-5000 m asl. Some species such as *A. coronaria*, *A. elongata*, *A. narcissiflora*, *A. pulsatilla*, *A. rupestris*, *A. smithiana*, *A. tschernaewii* have very narrow range of altitudinal distribution in IHR.

Taxonomic studies on the genus *Anemone* from India started with the Hooker's work (5), where he described 15 species from Indian subcontinent. Thereafter, 17 species with several infra-specific taxa have been reported (8). Out of these taxa, six have been synonymized by various workers and two taxa namely *A. obtusiloba* var. *potentilloides* and *A.*

Table 2. Distribution of the taxa of *Anemone* L. in India and adjacent countries

S.No.	Name of Taxa	Flowering & Fruiting Time	Altitude (m asl)	Distribution		References
				In India	In world	
1	<i>Anemone albana</i> Stev.	May – June	3500-4500	J&K	Pakistan	(5-7)
2	<i>Anemone coelestina</i> Franch.	July – September	2500-5000	SK	Bhutan, Nepal	(9, 46)
3	<i>Anemone coronaria</i> L.	June – September	1700-1900	J&K, HP	Turkey, Iraq, Africa, Italy	(10, 11)
4	<i>Anemone demissa</i> Hook. f. & Thomson	May – July	3000-5000	SK	Nepal, Bhutan, N. Myanmar, W. China	(5, 8, 9, 12)
5	<i>Anemone elongata</i> D. Don	July – September	2800-3000	UK, SK, ML, AP, NL	Nepal, Myanmar	(5, 8, 9, 13- 17)
6	<i>Anemone falconeri</i> Thomson	May – August	2100-3100	J&K, HP	Pakistan	(5, 6, 7, 10, 11, 18-20)
7	<i>Anemone geum</i> H. Lev.	July - August	1900-5000	UK, SK, AP	Nepal, W. China (S. Tibet)	(8, 9, 14, 15, 46)
8	<i>Anemone griffithii</i> Hook. f. & Thomson	June – September	1900-3600	SK, AP, NL	Bhutan, China, Nepal	(5, 8, 12, 15, 17)
9	<i>Anemone howellii</i> Jeffrey & W. W. Sm.	March – August	700-2300	AP	Myanmar	(8, 9, 15)
10	<i>Anemone narcissiflora</i> L.	July – August	3500-3750	J&K, HP	North America, Eurasia	(5, 6, 10, 21, 22)
11	<i>Anemone obtusiloba</i> D. Don var. <i>obtusiloba</i>	May – September	1600-4500	J&K, HP, UK, SK	Bhutan, China, Afghanistan, Pakistan, Nepal, Myanmar	(5, 6, 8, 16, 19, 21-34)
12	<i>Anemone obtusiloba</i> D. Don var. <i>potentilloides</i> Cambess. ex Lauener	June – August	3600-4100	J&K	--	(8, 27, 46)
13	<i>Anemone polyanthes</i> D. Don	May – October	3000-4200	J&K, HP, UK, SK	Pakistan, Nepal, Bhutan	(5, 6, 8, 10, 12, 13, 21, 23-31)
14	<i>Anemone polycarpa</i> W. E. Evans	July – September	3600-4800	SK	Nepal, Bhutan, W. China	(8, 9, 46)
15	<i>Anemone pulsatilla</i> L.	June – September	2500-2600	HP	UK, Switzerland, Netherland	(10, 21)
16	<i>Anemone raui</i> Goel & U. C. Bhattach.	July – September	2900-3300	UK	--	(8, 14, 30)
17	<i>Anemone rivularis</i> Buch.-Ham. ex DC.	May – October	1500-3600	HP, UK, SK, AP, NL, TN	Sri Lanka, Myanmar, China, Sri Lanka	(5, 8, 13-15, 17, 29, 30, 35-40)
18	<i>Anemone rockii</i> Ulbr.	June – August	2100-4000	J&K, SK	Bhutan, Nepal, China	(9)
19	<i>Anemone rupestris</i> Wall. ex Hook. f. & Thomson subsp. <i>rupestris</i>	May – September	3500-4200	J&K, SK, AP	Bhutan, Nepal	(5, 6, 8, 12, 15, 41, 42)
20	<i>Anemone rupestris</i> Wall. ex Hook. f. & Thomson subsp. <i>gelida</i> (Maxim.) Lauener	June – October	3500-4800	SK	Nepal, Bhutan, S.W. China	(8, 46)
21	<i>Anemone rupicola</i> Cambess.	May – July	1600-4200	J&K, HP, UK, SK	Bhutan, Nepal, Pakistan, W. China	(5, 6, 8, 10, 13, 14, 21, 25, 27, 28, 31, 33, 41)
22	<i>Anemone smithiana</i> Lauener & Panigrahi	July – October	3800-4300	SK	Nepal, Bhutan, China	(8, 9)
23	<i>Anemone tetrasepala</i> Royle	June – August	2000-3600	J&K, HP, UK	Pakistan, China, Afghanistan	(5, 6, 8, 10, 19, 22, 24, 27, 28, 31)
24	<i>Anemone trullifolia</i> Hook. f. & Thomson	May – August	2500-4500	SK, AP	China, Bhutan, Nepal	(5, 8, 12, 46)
25	<i>Anemone tschernaewii</i> Regel	March – August	1200-1800	J&K	Pakistan, Afghanistan, Iran, Russia	(5, 6, 8, 45)
26	<i>Anemone vitifolia</i> Buch.-Ham. ex DC.	May – October	1500-3000	J&K, HP, UK, AP	Nepal, Pakistan, SW China, Europe	(5, 8, 10, 20-24, 38, 42, 43)

[Abbreviations used: J&K = Jammu & Kashmir; HP = Himachal Pradesh; UK = Uttarakhand; SK = Sikkim; AP = Arunachal Pradesh; ML = Meghalaya; NL = Nagaland; TN = Tamil Nadu]

rupestris subsp. *gelida* are existing. Rau had not included three species namely, *A. albana*, *A. falconeri*, *A. narcissiflora* in his account, whereas they have been reported from Jammu & Kashmir and Himachal Pradesh. In the meantime, four more species, which were not included in Hooker's and Rau's work, have been reported by various taxonomists from Indian Himalayan Region. Therefore, the present status of

the genus *Anemone* from India includes 24 species, one subspecies and one variety.

During the study, it was found that a few taxa are endemic to IHR at global level such as *A. howellii* to Arunachal Pradesh, *A. obtusiloba* var. *potentilloides* to J&K, *A. raui* to UK (8, 59).

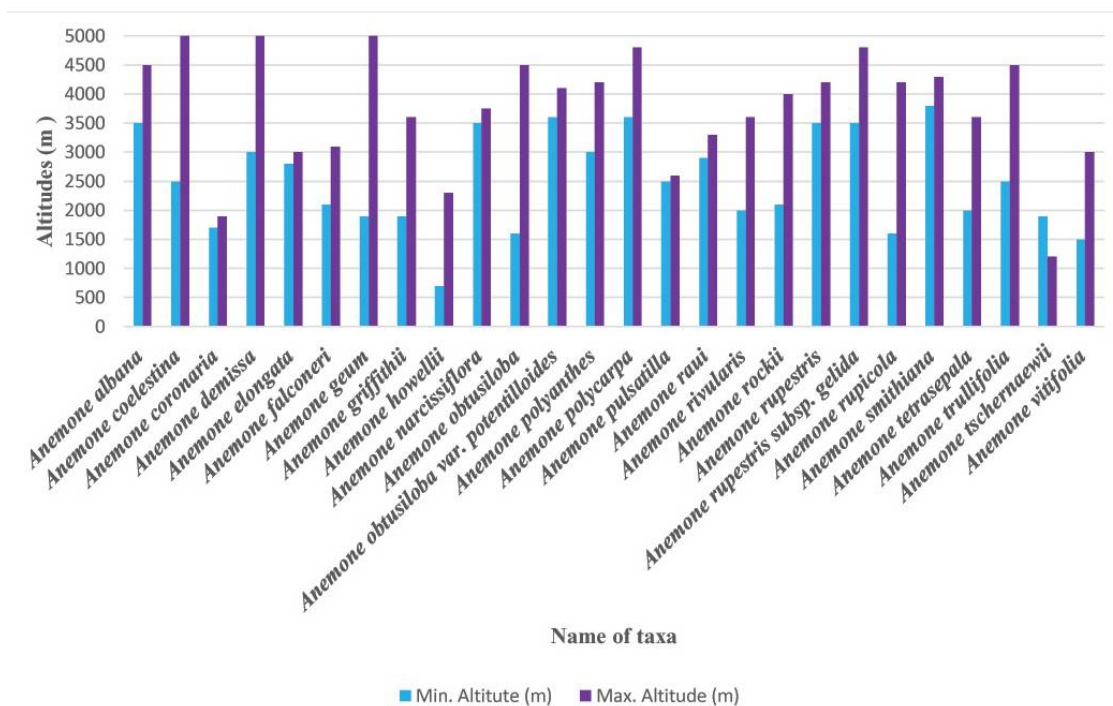


Fig. 4. Altitudinal distribution of *Anemone* taxa in India

Conclusion

Owing to high medicinal value, *Anemone* is one of the most traded plants in the indigenous drug industry. Various natural and anthropogenic factors which including soil erosion, landslide and over exploitation by several pharmaceutical industries and local health system for its highly potential medicinal compounds pose a direct threat to the population in the wild resulting in its speedy decline. Day-by-day increasing demand in current scenario needs proper assessment, conservation and alternative approach for large scale cultivation by developing agri-technique for the upliftment of the local people.

The present paper provides phenology, taxonomic status, exact distribution and medicinal potential of *Anemone* in India which would be of immense importance for other researchers in locating the plants for further investigation of newer molecules useful for humankind in different aspects.

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Competing interest

Authors do not have any conflict of interest to declare.

Authors' contribution

PA conceived the idea and edited the manuscript. PR gathered the data and wrote the manuscript.

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