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Medicinal Plant Knowledge Among Lay People in Five Eastern Tibet Villages

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Abstract Tibetans in five villages in the Mount Khawa Karpo area of the Menri (Meili Xueshan in Chinese) range, Northwest Yunnan, People's Republic of China, were interviewed about their knowledge of a number of medicinal plants and their uses. There was large variation in people's knowledge with significant differences among the villages and between men and women. Most of the reported knowledge focused on a small number of commercial plants and their uses. In comparison with Tibetan doctors, villagers generally knew fewer applications and focused on general health remedies. Many people collected medicinal plants for their own use as well as for sale, but also obtained medicinal plant remedies from markets and Tibetan doctors, and often used traditional Tibetan healthcare in conjunction with biomedical treatment.

Keywords Tibetan medicine · Traditional knowledge · Knowledge variation · Health care pluralism

Introduction

Tibetan medicine belongs to one of the great scholarly medicinal systems of the world, and consequently has attracted great academic as well as applied interest (e.g., Beckwith 1979; Cantwell 1995; Janes 1995; Adams 2001; Prost 2006). With its ancient roots (dating back to the eighth century) and a canon of sacred texts, it is highly systematised and theorised (Cantwell 1995), but also comprises great diversity in the form of different schools and groups of practitioners (Cantwell 1995; Janes 1995; Schrempf 2007; Craig 2008). Another much less studied aspect of Tibetan medicine is the everyday medicinal practices and knowledge of "ordinary" Tibetans (Schrempf 2007). Even in societies with highly formalised medicinal systems there often remains a layer of folk medicinal knowledge and practices that people rely on for the treatment of less serious illnesses and health problems frequently encountered in daily life (Kleinman 1984). Here we present first results on the use of selected medicinal plants among lay Tibetans in five villages near Mount Khawa Karpo in Northwest Yunnan and contrast it with the use of plants among representatives of the more well-studied formal Tibetan medical system and local Tibetan doctors (Salick *et al*. 2006). The use and knowledge of Tibetan medicine amongst villagers has so far received little attention, leaving incomplete our understanding of Tibetan medicine in all its many facets as well as of Tibetans' health care practices in present day China.

Medicinal knowledge manifests itself in many different forms and at many different levels. It consists of textual and verbal knowledge, preventive and curative health care, etiology, and of cultural definitions of what constitutes health and illness. Here we look at one aspect of Tibetan villagers' medical knowledge only, namely villagers' familiarity with selected plants used within the official Tibetan medical system and their application of these plants. We used this knowledge subset as an indicator of the variation and spread of knowledge and practices among villagers. Far from being an exhaustive treatment of the medical knowledge and health care practices of Tibetan villagers, our study should be seen as a starting point for further studies on the wider field of medicinal knowledge and practices among Tibetan villagers.

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While folk knowledge is seldom very highly regarded (either by professional health practitioners, policymakers or researchers), it may fulfil an important albeit often unrecognised function in basic health care, especially in areas or situations where formal health care is difficult to obtain (WHO 2002; Aumeeruddy-Thomas and Pei 2003). In Tibetan areas of China, the access to Tibetan as well as biomedical health care has in many ways increased since the 1950s. It is generally believed that few trained practitioners of Tibetan medicine were to be found outside of Lhasa (Cantwell 1995; Glover 2005). Today, Tibetan hospitals can be found in many towns, while some villages have local doctors in residence. In addition, new types of health care (in the form of biomedical and Chinese Traditional Medicine clinics and doctors) are nowadays available to those Tibetans who can afford them and who are able to reach these mostly urban-based institutions. On the other hand, prices for health care have increased steeply as a result of economic reforms and liberalisation. Economic reform has entailed a reduction of state subsidies to and privatisation of Tibetan hospitals and medicines forcing practitioners to charge higher fees for their treatments and prescriptions. At the same time, increased market demand for Tibetan medicines has also contributed to rising prices (Janes 1999; Fischer 2005).

However, at the same time the increasing prices of Tibetan medicine have not only made it more difficult for Tibetans to obtain traditional health care, but have also offered new opportunities and accorded new value to Tibetans' own knowledge of medicinal practices and plants. As a consequence, the worldwide increasing demand for Tibetan medicine has made the collection of medicinal plants a significant source of revenue for villagers in some Tibetan areas (Glover 2005; Salick *et al.* 2005). Although our study represents only a snapshot in time, the present day state and practice of Tibetan medicine, including Tibetan villagers' use and knowledge of medicinal plants and their health care practices, need to be seen in relation to these developments.

Methods

Fieldwork was conducted in October 2006 in five Tibetan villages in Deqin County, Diqing Tibetan Autonomous Prefecture, Northwest Yunnan province, People's Republic of China (Fig. 1). The five villages, in which the authors had previously worked, were chosen to represent different conditions with regard to elevation, road access and access to alpine areas where most of the medicinal plants used in the official Tibetan medical system grow (Glover 2005; Salick *et al.* 2005). Although some tourism occurs in two of the villages, agriculture remains the main source of income. Two of the villages (one at high elevation and one at low elevation) were without any Tibetan doctor, while one village had both a Tibetan and a biomedical doctor. One village was situated at high elevations (>3,000m), two at intermediate elevations and two at "low" elevation (~2,000m). Market accessibility is generally inversely related to elevation with lower lying villages having easier access to markets.

In each village ten people were interviewed, selected on the basis of availability, gender (equal numbers of men and women), age (equal representation of different age groups), and family (no more than one person from each household). Each person was shown a set of 23 pictures of plants representing 20 species of vascular plants, one fungus and one lichen (Table 1) selected 1) for a range of commonality (common to rare) in alpine areas around the villages, 2) for their use in formal Tibetan medicine, 3) based on previous interviews with Tibetan doctors and herbalists (Salick *et al.* 2006; Law and Salick 2007), 4) in consultation with literature (Yang 1989), and 5) for the availability of high quality photographs which were made into laminated cards. Some of the plants were important market commodities while others had only little or no economic value (Table 1). One vascular plant species was represented by two different colour morphs as colour can play an important part in the selection of medicinal plants (Boesi 2005; Kala 2005). For the sake of simplicity we will henceforth use the term "plants" to refer to all of these. We chose to concentrate on a relatively small number of plants, reducing the duration of the interviews to keep peoples' interest and not interfere with heavy village work schedules. These necessarily limited numbers of plants and interviewees mean that results are only preliminary and generate topics for further investigation.

Plant picture cards were presented randomly, and people were asked to sort them into piles of known and unknown plants. Out of the known plants they were then asked to select those that could be used for medicinal purposes, and for each of these were asked its name and application. People were asked to identify which medicinal plant(s) they considered especially important. Finally, they were asked in general where they normally obtained medicine and medical treatment. In addition to information on medicinal plants, personal information (age, birth place, education) was also recorded and included in the analyses, as were village location and elevation.

With SPSS (Vers. 14.0), numbers of plants recognised, number of plants known as medicinal, plant species, numbers of applications, and types of applications treated were statistically analysed by ANOVA, linear standard least square regression, and frequency analyses (χ^2–test). Welch ANOVA and Kruskal-Wallis tests were used in cases where data did not possess homogeneity of variances or deviated too much from the normal distribution (skewness and/or kurtosis values outside of the range between −1 and +1). Plant-disease associations (which plants were used to treat which diseases) were analysed by frequency analyses only. For a subset of the

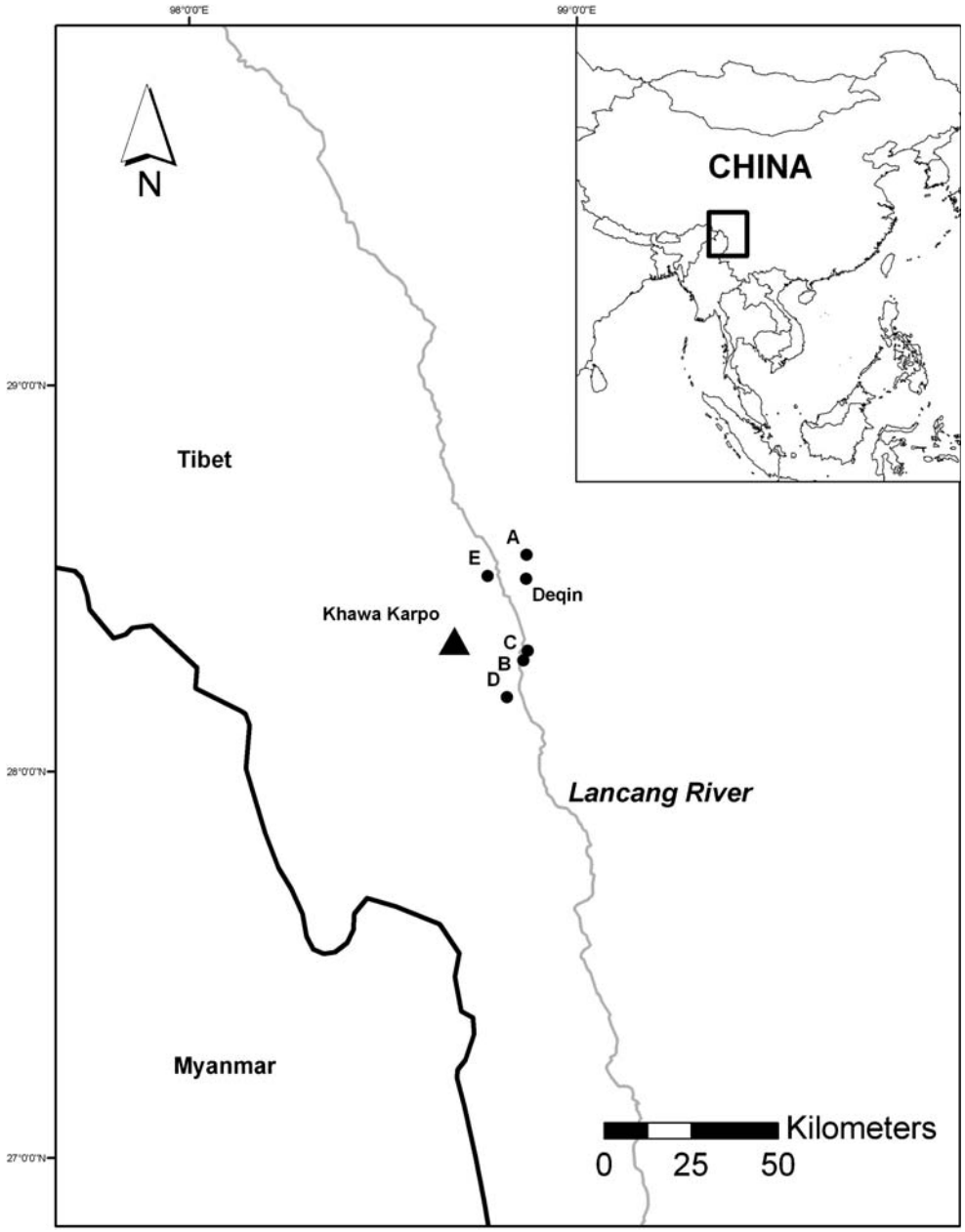


Fig. 1 Study area showing the five villages (A to E) where interviews were conducted as well as the nearest market town (*Deqin*) and the major peak (*Khawa Karpo*) in the medicine mountains (*Menri*)

plants shown to villagers we had supplemental information from Tibetan doctors collected in a previous study (Law and Salick 2007). For these species, the number of applications per plant and which diseases were targeted by villagers and doctors, respectively, were compared by means of frequency analysis (χ^2–test).

Results

Medicinal Plant Knowledge and Variation

Recognition and knowledge of plants varied greatly among Tibetan villagers; the number of plants recognised was 10± 5[1] while the number of plants known as medicinals was 5± 2 (Fig. 2a). While there was no significant difference in number of plants recognised among villages, there were significant village differences in number of plants known as medicinals (ANOVA, F=3.1 ; p=0.024; Fig. 2b). Part of the differences among villages was related to elevation: people in higher villages (i.e., closer to alpine areas) knew more medicinal plants than people in lower villages (Kruskal-Wallis, χ^2=10.0; p=0.035). There were significant differences between genders in the number of plants

[1] Number's reported are means±standard deviations.

Table 1 Species shown to fifty lay people in five eastern Tibetan villages. All species are used within official Tibetan medical systems and can be found growing in alpine meadows in the study area. The "number of use reports" in the fourth column gives the number of reports of uses for the species, where one report consists of one person mentioning one application. Information on distribution and habitat according to Flora of China (http://mobot.mobot.org/W3T/Search/FOC/projsfoc.html and http://www.efloras.org/flora_page.aspx?flora_id=2, accessed October 2009) unless otherwise indicated. Information on status according to www.chinabiodiversity.com (accessed October 2009), Hamilton and Radford (2007), and Law and Salick 2007. Information on commercial sale according to Salick *et al.* 2006

Species	No. of people who recognised the species	No. of people who knew a species as medicinal	No. of use reports	No. of different applications	No. of people who consider a species important	Distribution, habitat and status of a species (where information available)
Aconitum brachypodum Diels (Ranunculaceae)	17	3	4	3	0	Endemic (Sichuan, Yunnan) 2,800–4,300 m Endangered Grassy slopes, mountains
Cordyceps sinensis (Berk.) Sacc. (Clavicipitaceae, Fungi)	46	45	64	11	40	Himalayas & Tibetan Plateau, 3,300–5,000 m Alpine grasslands[a] Commercially important Vulnerable
Corydalis benecincta W.W. Sm. (Papaveraceae)	10	0	0	0	0	Endemic (Sichuan, Tibet, Yunnan) 4,000–6,000 m Alpine scree, on "shale" and on limestone
Delphinium forrestii Diels (Ranunculaceae)	22	7	7	4	0	Endemic (Sichuan, Tibet, Yunnan) 3,100–4,900 m stony places near Rhododendron thicket margins, grassy slopes, gravelly slopes, alpine slopes, screes, cliffs
Fritillaria cirrhosa D. Don (Liliaceae)	48	39	57	15	31	Distributed in India, Nepal, Bhutan & China 3,200–4,600 m Commercially used, threatened Forests, alpine thickets, meadows, flood lands, moist places Commercial Threatened
Gentiana atuntsiensis W.W. Sm. (Gentianacaea)	23	10	11	2	1	Endemic (Tibet, Yunnan) 2,700–4,800 m Alpine meadows, scrub, forests
Gentiana veitchiorum Hemsl. (Gentianacaea)	11	2	2	2	0	Bhutan, Myanmar, China 2,500–4,800 m River banks, grassland slopes, alpine meadows, scrub, forests

Hippophae rhamnoides L. (Elaeagnaceae)	29	6	7	4	1	Central Asia 600–4,200 m River banks and terraces, dry river beds, forest margins, thickets on mountain slopes, moraines, meadows at highest elevations
Incarvillea compacta Maxim. (Bignoniaceae)	9	0	0	0	0	Endemic (Gansu, Qinghai, Sichuan, Xizang, Yunnan) 2,600–4,100 m Slopes, thickets, grasslands
Incarvillea mairei (H. Léveillé) (Bignoniaceae)	12	0	0	0	0	Bhutan, Nepal, China 2,400–4,500 m Slopes, road sides, grasslands, forests
Lagotis alutacea W.W. Sm. (Scrophulariaceae)	13	2	2	1	0	Endemic (Sichuan, Yunnan) 3,400–5,000 m Alpine grassland, sandy and stony slopes
Lamiophlomis rotata (Bentham ex J. D. Hooker) Kudô (Lamiaceae)	17	6	6	4	0	Bhutan, India, Nepal, China 2,700–4,900 m Weathered alpine alluvial fans, stony alpine meadows, floodplains
Meconopsis integrifolia (Maxim.) Franch. (Papaveraceae)	23	5	6	3	0	Myanmar, China 2,700–5,100 m Grassy and rocky slopes, forest understories, open shrublands, mountain moorlands, stabilized moraines
Meconopsis speciosa Prain (Papaveraceae)	12	3	3	3	0	Endemic (Tibet, Yunnan, Sichuan) 3,700–4,400 m Among alpine shrubs, grasslands, rocky slopes, cliff ledges and crevices, alpine scree Vulnerable
Panax japonicus (Nees) C.A. Mey. (Araliaceae)	13	3	3	2	0	South Asia 1,200–3,600 m Forests in valleys
Pedicularis longiflora Rudolph (Scrophulariaceae)	18	1	1	1	0	Central Asia 2,100–5300 m Alpine meadows, along streams, springs, seeps
Pedicularis siphonantha D. Don (Scrophulariaceae)	11	0	0	0	0	Bhutan, India, Nepal, China 3,000–4,600 m Alpine meadows, swampy places

Table 1 (continued)

Species	No. of people who recognised the species	No. of people who knew a species as medicinal	No. of use reports	No. of different applications	No. of people who consider a species important	Distribution, habitat and status of a species (where information available)
Rheum nobile Hook. f. & Thomson (Polygonaceae)	5	1	1	1	0	Afghanistan, Bhutan, India, Myanmar, Nepal, Pakistan, China 4,000–4,800 m Slopes
Rhodiola crenulata (Hook. f. & Thomson) H. Ohba (Crassulaceae)	9	1	1	1	0	Bhutan, Nepal, China 2,800–5,600 m Thickets, grassland slopes, schist on mountain slopes, rocky places, rock crevices
Saussurea laniceps Hand.-Mazz. (Asteraceae)	42	39	43	10	15	Endemic (Sichuan, Tibet, Yunnan) 3,200–5,300 m Rocky habitats[b] Vulnerable Commercially important
Sinopodophyllum hexandrum (Royle) T.S. Ying (Berberidaceae)	23	8	8	3	0	Endemic (Sichuan, Tibet, Yunnan, Ganzu, Qinghai, Shaanxi) 2,200–4,300 m Vulnerable (included on list of threatened medicinals)
Thamnolia vermicularis (Sw.) Ach. Ex Schaer. (Teloschistaceae, Lichen)	42	42	44	8	7	Global distribution[c] Commercial

[a] Information on distribution and habitat from Winkler 2008

[b] Law and Salick 2005

[c] GBIF Data Portal, www.gbif.net, accessed October 2009

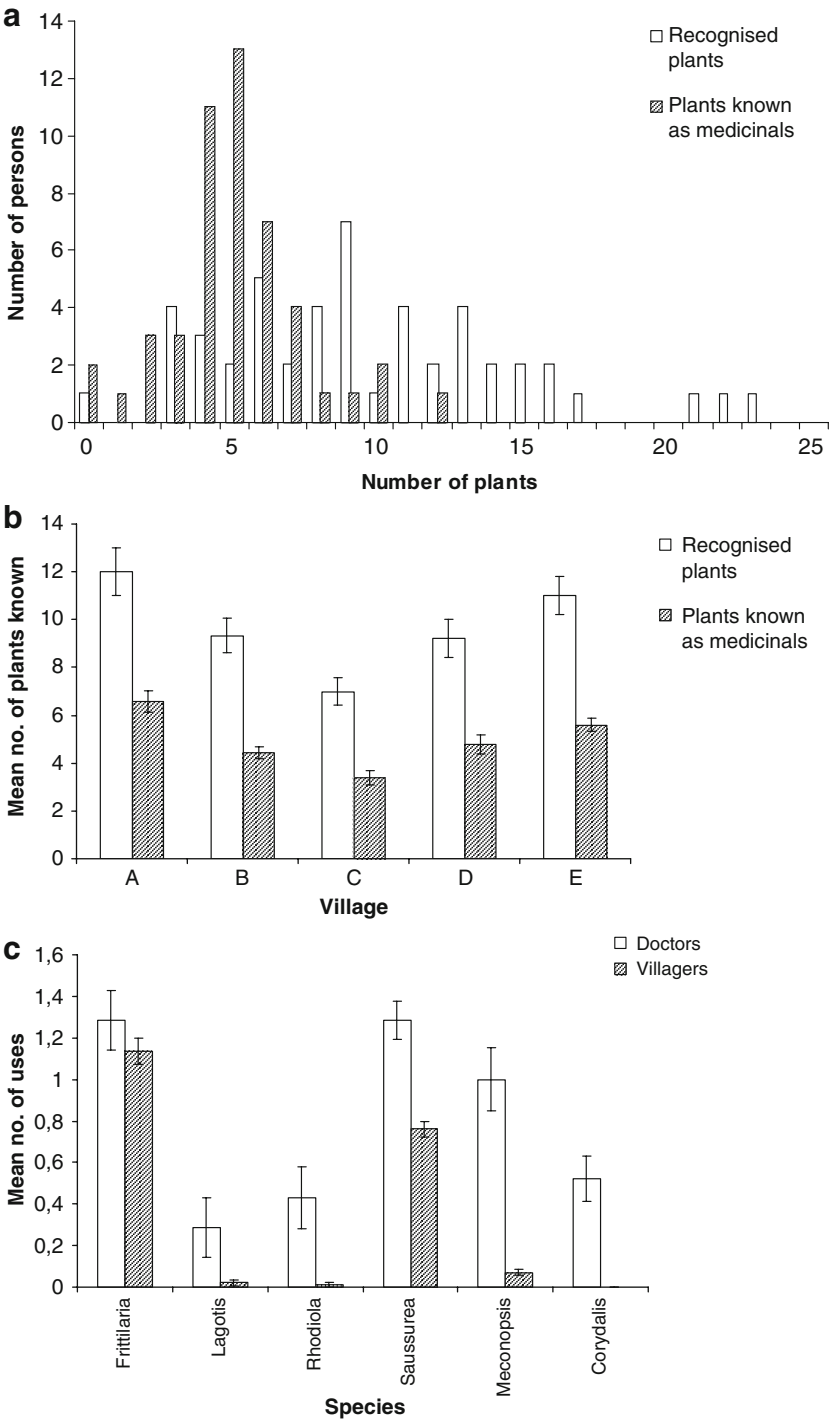


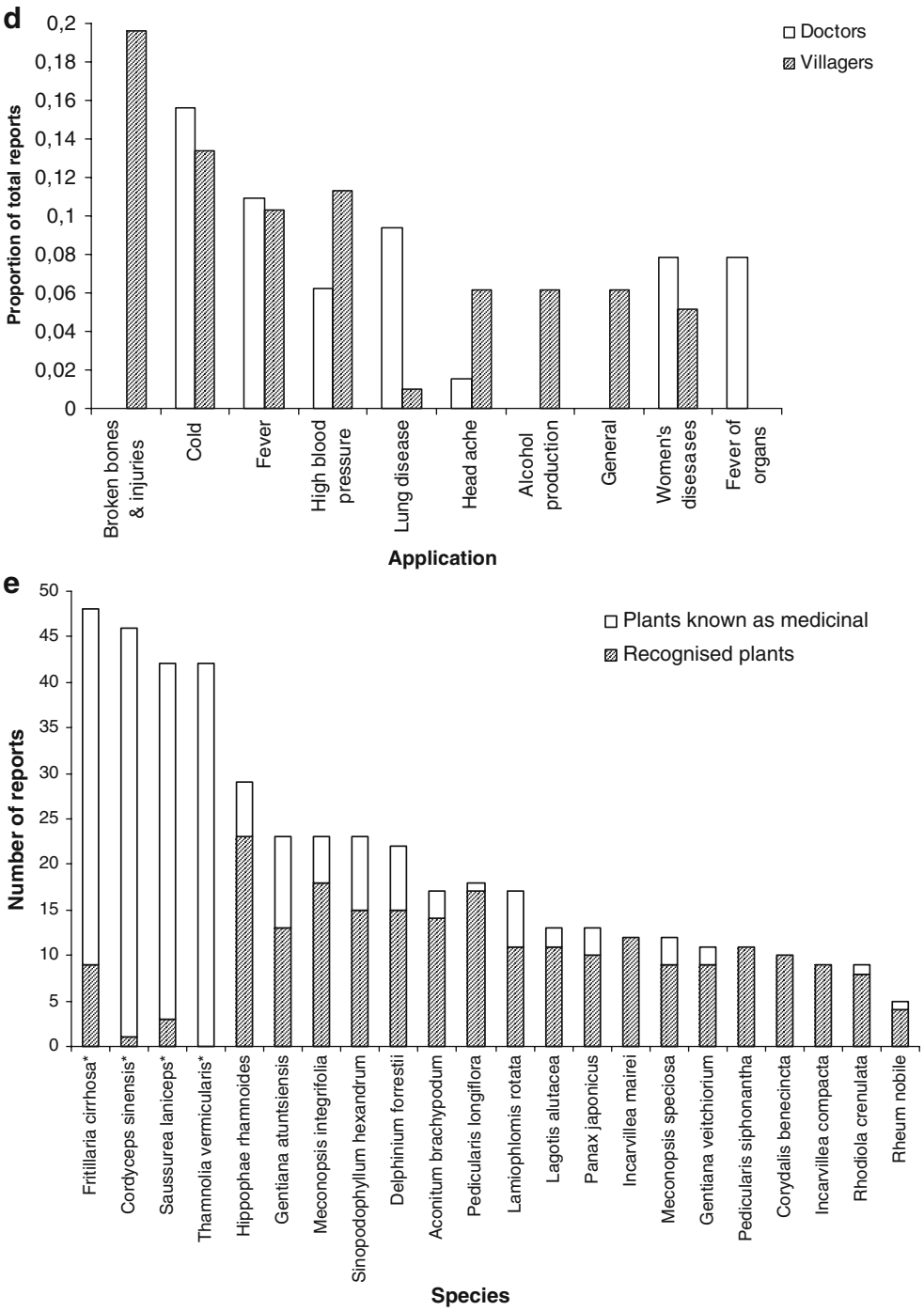
Fig. 2 **a** Numbers of medicinal plants known and used by eastern Tibetans in five villages. The investigated medicinal species comprised 20 vascular plant species (including two colour morphs of one species), one fungus and one lichen. **b** Differences in knowledge and use of medicinal plants among five eastern Tibetan villages. Error bars indicate standard errors. Differences among villages were not significant with regard to known plants, but were significant with regard to used plants at (Anova, p=0.024). **c** Mean number of uses known for six medicinal plants by Tibetan doctors and villagers, respectively. Error bars indicate standard deviations. Differences in the number of applications known by doctors and villagers were only significant in the case of Meconopsis (Welch Anova: p=0.023) and when known applications for all six species were summed (Welch Anova: p=0.035). **d** Most frequently mentioned applications for six medicinal plants by Tibetan villagers and doctors, respectively. The applications are the five applications mentioned most frequently by each group. Numbers give the proportion of times a particular application was mentioned out of the total reports of all applications given by each group for the six plants. Differences between doctors and villagers (considering all mentioned applications of the six medicinal plants) were significant at $p<0.001$ (χ^2-test). **e** Knowledge and use of different medicinal species among people in five eastern Tibetan villages. The shaded part of bar indicates how many persons recognised a particular plant, but who did not know of any medicinal uses of it. The white part of the bar indicates the number of people who knew a plant as medicinal. Species which are sold in the nearest market are indicated with an asterisk

recognised and number of medicinal plants known. The number of plants recognised was 12±5 for men and 8±4 for women, while the number of medicinal plants known was 6±2 for men and 4±2 for women. In both cases, these differences were statistically significant (ANOVA, for number of plants recognised: F=10.0; p=0.003 and for number of plants known as medicinals: F=5.6; p=0.022). There was no significant relationship between people's ages or education and the numbers of plants recognised or numbers of plants known as medicinals.

Comparison of Villagers' and Doctors' Knowledge of Medicinal Plants

For each plant, doctors knew more applications than villagers (Fig. 2c). Differences in the number of applica-

Fig. 2 (continued)



tions between doctors and villagers were significant across all plants (Welch ANOVA: asymptotic F=7.1; p=0.035).

Villagers and doctors differed significantly in the types of applications for which these medicinal plants were used (χ^2-test: Pearson χ^2=73.0; Likelihood ratio=89.7; Fisher's exact test=67.8; in all cases: p<0.001; Fig. 2d). Notably, villagers more often mentioned applications of medicinal plants for the treatment of broken bones and injuries, against high blood pressure, against headache, for alcohol production, and for general health/remedy. Doctors on the other hand more often used the same medicinal plants to treat illnesses associated with specific organs (liver, lung, or gall bladder) and for "women's illnesses" (e.g., irregular menstruation, and problems during pregnancy or after giving birth).

Most Used Species and Targeted Diseases

All the plants shown to villagers were used within the official Tibetan medicine system. Nevertheless, only some were regarded as having medicinal properties by villagers despite

the fact that all plants were recognised by at least some of the villagers. Which plant species (as opposed to how many species) were most often mentioned as medicinal plants did not vary statistically among villages, genders, ages or education levels. The most frequently recognised medicinal species were *Cordyceps sinensis* (64 use reports by 45 people), *Fritillaria cirrhosa* (57 use reports by 39 people), *Thamnolia vermicularis* (44 use reports by 42 people), and *Saussurea laniceps* (43 use reports by 39 people) all of which have commercial value (Table 1 and Fig. 2e). The remaining species were more rarely mentioned as medicinal plants. No plant was completely unknown to villagers and on average every plant was recognised by 21 (±13) persons. However, recognition varied depending on the plant species with the most well-known species, *Fritillaria cirrhosa*, mentioned by 48 people (39 mentioning medicinal uses) and the least well-known by five people (only one mentioning medicinal use). Variation was greater for medicinal properties than for plant species recognition. The most used species, *Cordyceps sinensis*, was used by 45 people and four plants were not used by any of those interviewed.

The most commonly mentioned applications of medicinal plants were treatment for high blood pressure followed by promotion of health/general remedy, broken bones and fractures, rheumatism, cough and fever (Table 2). Another commonly mentioned application was in the production of alcohol, but opinions were divided on any medicinal properties of this alcohol. The types of applications people mentioned was related to village (χ^2-test, Pearson χ^2= 200.5; Likelihood ratio=202.6; $p<0.001$; $R^2=0.14$) and elevation (χ^2-test, Pearson χ^2=106.2; Likelihood ratio=114.2; $p=0.0002$, $R^2=0.08$), but not to gender, age or education level.

Species mentioned as being especially important to the person interviewed were *Cordyceps sinensis* (40 persons), *Fritillaria cirrhosa* (30 persons), *Saussurea laniceps* (15 persons), *Thamnolia vermicularis* (7 persons), *Gentiana atuntsiensis* (1 person), and *Hippophae rhamnoides* (1 person). The species regarded as important were generally

Table 2 Use of medicinal plants for different purposes in five eastern Tibetan villages. The category "general" includes use of plants to strengthen health in general and/or as a general remedy that can be used in any circumstances. The category "uncertain" indicates those instances where people said that they knew a plant was used for medicinal purposes, but were not sure what exactly it was used for

	Total no. of reports	Village A	Village B	Village C	Village D	Village E
Blood pressure	48	15	4	13	11	5
General	31	4	7	7	11	2
Broken bones	25	5	5	2	6	7
Alcohol	18	1	4	2	3	8
Rheumatism	16	5	4	1	6	0
Cough	13	6	1	3	1	2
Fever	12	1	3	3	5	0
Eye disease	11	3	0	2	0	6
Eye sight	10	2	5	0	0	3
Head ache	10	0	3	0	6	1
Women's diseases	8	1	3	1	2	1
Diarrhoea	6	1	4	1	0	0
Tooth ache	3	3	0	0	0	0
Back ache	2	0	2	0	0	0
Bile	2	2	0	0	0	0
Cooling	2	0	0	0	0	2
Warming	2	0	0	0	1	1
Old age	2	1	1	0	0	0
Post partum	2	0	0	0	0	2
Throat	2	1	0	1	0	0
Additive	1	0	0	1	0	0
Heart	1	1	0	0	0	0
Livestock	1	0	0	0	1	0
Lungs	1	0	0	0	1	0
Pregnancy	1	0	1	0	0	0
Stomach ache	1	0	1	0	0	0
Tea	1	0	1	0	0	0
Blood vessels	1	0	0	0	0	1
Waist ache	1	0	1	0	0	0
Wounds	1	0	0	0	0	1
Uncertain	38	17	1	2	5	13

also the ones recognized by most people. There were no statistically significant differences for importance by village, gender, age or education level. Important medicinal plants were used for the treatment of significantly more illnesses (8±5 applications per species) than species not mentioned as being particularly important (2±1 applications per species) (Welch ANOVA, asymptotic F=9.3; p=0.027).

Types and Sources of Health Care

The most commonly subscribed health care was Tibetan medicine. This was mentioned by 20 out of 50 people. Another 13 people said that they used both Tibetan and Western biomedical health care. Of those that used both, one person said that he used predominantly Tibetan medicine while three persons said they used mainly biomedicine. An additional nine people said they exclusively relied on biomedicine, while one person relied on a mixture of Tibetan and Chinese medicine and the remainder did not specify what type of health care they used. There were no statistically significant differences among villages, ages, gender and education level in kind of health care used.

More than half (29) of those interviewed said that they bought Tibetan and biomedical medicine in the nearest town (Table 3). Twenty-one people said that they collected medicinal plants themselves, and 14 went to local doctors to get medicine. Strategies were not exclusive, and several people mentioned collecting for themselves as well as buying or consulting local doctors. How people obtained medicine was significantly related to the village in which they lived (χ^2-test, Pearson χ^2=33.6; Likelihood ratio= 39.1; Fisher's Exact Test=31.1; for all of these p<0.001).

Discussion

Medicinal Plant Knowledge and Variation

The status and situation of traditional Tibetan medicine in the People's Republic of China has undergone repeated and dramatic shifts, ranging from suppression to encouragement, and recently, increasing commercialisation (Cantwell 1995; Janes 1995; Adams 2001). Several of these studies have documented how these changes have affected the official Tibetan medicinal system and the availability of health care services to Tibetans. However, much less attention has been paid to how the medicinal knowledge and practice of Tibetan lay people have fared during these turbulent developments. One study of lay people's knowledge of medicinal plant use close to the main city (Zhongdian or Shangrila) in Diqing prefecture showed that most people could mention only one or two medicinal plants (Glover 2007). In contrast to that study, our survey showed much greater medicinal plant knowledge, but also that there was large variation among people. These differences may be due to a number of factors. Firstly, the former study was based on people enumerating most common diseases, and then indicating which plants could be used to treat these diseases. In contrast, our methodology was based on photographs of specific plants and did not require people to give names for these plants. This in itself may have made it easier for people to recall plant related knowledge, especially in cases where people were familiar with the plants and knew them to have medicinal properties, but without being certain about their specific use or name. Another difference is that the former study concentrated on most common diseases whereas our study included all kinds of applications. This is important in that many of the applications mentioned in our study were not for villagers' own health problems, but were applications of commercial species (see below). In addition, the study location of the two studies differed: Glover (2007) concentrated on people living in or near a city with a large choice of health care facilities available, while the villages in our study were situated further from the nearest urban centre and close to the Menri mountains ("medicine mountains") which are renowned for their wealth of medicinal plants. Methodological issues apart, these factors could account for actual differences in use and knowledge of medicinal plants between the two areas. The likelihood of such actual differences is supported by the differences among villages within our study (see below).

While we do not have any detailed historical data with which to compare present day medicinal knowledge of Tibetan villagers, our survey showed that the older generation of Tibetans did not know significantly more plants as medicinals than younger Tibetans. This indicates that there is not a lack of transmission of medicinal plant knowledge between the presently living generations. However, this does not rule out knowledge loss or changes in previous generations. The above-mentioned study by Glover (2007) found that villagers regarded their own medicinal plant knowledge as the degraded remnants of a

Table 3 Sources of medicine used by eastern Tibetans in five villages. Several villagers obtained medicine from more than one source. Villages differed significantly with regard to the sources of medicine used (χ2-test, p<0.001)

	Market	Mountains	Doctors
Village A	2	2	8
Village B	3	7	0
Village C	8	0	5
Village D	7	5	0
Village E	9	7	1
Total	29	21	14

more extensive knowledge held by previous generations. However, her study did not show a relationship between age and medicinal knowledge either. That some knowledge may have been lost seems probable considering the politically contentious nature of Tibetan medicine due to its relationship with Tibetan Buddhism. During the Cultural Revolution many practitioners were persecuted and their knowledge lost (Hofer 2008). Even today the official Tibetan medical system is being modified to comply with the official political view of materialistic medicine, downplaying the spiritual aspects of Tibetan medicine (Janes 1995; Adams 2001, 2004).

In other parts of the world, studies have shown that introduction and enforcement of formal education may contribute to loss of traditional knowledge by limiting the time and opportunities available to children to acquire traditional knowledge and skills from their elders (Ohmagari and Berkes 1997; Luoga *et al.* 2000; Somnasang and Moreno-Black 2000; Heckler 2002). In our study, however, we did not find any indication of a negative impact of formal schooling on medicinal plant knowledge. This may indicate that knowledge of medicinal plants is passed on later in life, when children are no longer at school, or that formal education has not disrupted the transmission of knowledge.

People in higher elevation villages knew more medicinal plants than people in lower villages. All villages had access to alpine meadows where many of the medicinal plants used in the official Tibetan medical system grow (Salick *et al.* 2005). However, people living at higher elevations had shorter distances to travel in order to reach these areas (Salick *et al.* 2005). Use and knowledge of Tibetan medicinal plants may thus be related to how easily collection areas can be accessed. Elevation only explained part of the observed differences in knowledge distribution among villages. The villages also differed in other aspects such as road access, size, and availability of a resident doctor. None of these differences among the villages were significantly related to people's knowledge and use of medicinal species. In other parts of the world similar differences in knowledge and use of natural resources and choice of livelihood strategies have been demonstrated among proximate villages (e.g., Benz *et al.* 2000; Byg and Balslev 2001a; Ladio and Lozada 2001; Takasaki *et al.* 2001; Kristensen and Lykke 2003). In some cases such differences have been related to specific circumstances (e.g., pressure on resources, access to suitable agricultural soils, roads, markets, social networks, etc.; see e.g., Pichón 1996; Scatena *et al.* 1996; Schelhas 1996; Coomes and Barham 1997; Pichón 1997; Atran *et al.* 1999; Byg *et al.* 2007). However, less obvious factors may also play a role. History, chance events, traditions and recent experiences may all influence subsistence choices and use of natural resources for individual households as well as villages (Ellen 1979; Padoch and de Jong 1992; Brodt 2002). In the villages in our study that underwent so much change during the Cultural Revolution and before as NW Yunnan oscillated among political and cultural influences, potential historical differences abound.

In addition to differences among villages, there were also significant differences between men and women in the numbers of plants recognised as well as the numbers of plants known as medicinal. These differences may be due to gender-related division of labour, such as has been shown in many other parts of the world. Although Tibetan women in the area participate in the collection of valuable plants and fungi such as *Cordyceps sinensis* and *Tricholoma matsutake*, there is a general tendency for women to be more closely associated with household chores, while men are more associated with tasks outside the home, where they would be in more contact with wild plants (Aziz 1987; Hillman and Henfry 2006). Another reason may be differences in confidence between men and women. Especially young women sometimes seemed reluctant to voice any opinion in the presence of strangers. While it was rare that women did not recognise any plants, they may have been more inclined to plead ignorance than men in cases of plants where they were not certain of the applications.

Comparison of Villagers' and Doctors' Knowledge of Medicinal Plants

Given the extensive training of Tibetan doctors (with an important component being the collection and preparation of medicinal substances) and the fact that we were asking about medicinal plants that we knew doctors and herbalists were using, it is hardly surprising that the doctors knew more applications for these plants than did the villagers. More interesting than the quantitative differences are the qualitative differences in the application of the same plants by Tibetan doctors and villagers. The applications mentioned by doctors were to a large degree directed at internal illnesses and were very specific (e.g., liver disease). The knowledge of villagers differed from that of doctors in that it focused on commercial applications such as high blood pressure, frequently encountered and easily diagnosed ailments such as cough, fever, and broken bones, and on more general applications (health promotion or general remedy). While there was also some overlap between doctors and villagers, the differences indicate that the medicinal knowledge of Tibetan villagers is at least partly distinct from that of professional practitioners and serves different purposes. The knowledge and health care practices of villagers can thus be regarded as yet another layer in Tibetan medicine with its multiple groups of practitioners and approaches serving different purposes and being consulted in different situations.

In the present study we looked at villagers' knowledge of plants that were known to be used within the official

Tibetan medical system. However, it is conceivable that the array of plant species and vegetation types used by villagers also differ from those of Tibetan doctors. Thus, the medicinal knowledge and practices of villagers may be far more extensive than indicated by our study. It has been shown, for example, that staple foods such as milk and barley play an important dual role as foods and medicines in the health care strategies of Tibetan villagers (Glover 2007). This suggests the importance of investigating the role of food as medicine (Etkin 2006) in Tibet.

Most Used Species and Targeted Diseases

The most often identified and most important medicinal plants were all marketed in local medicinal shops and pharmacies, and many of these were also marketed in other parts of Tibet, China and abroad. Collection of medicinal plants can contribute substantially to villagers' cash income in the Himalayas (Olsen and Larsen 2003; Salick *et al*. 2005; Winkler 2008). Many villagers reported that they collected medicinal plants for sale as well as for their own use. Commercial collection was manifest also in the repeated mention of high blood pressure—an ailment typical of modern and urban life styles. Tibetan villagers' knowledge of medicinal plants thus seems influenced partly by the commercial use of Tibetan plants to treat the health problems of urban populations in China and abroad.

Increasing integration into markets reshapes traditional plant knowledge (Godoy *et al*. 1998) leading to an increase of knowledge and skills associated with commercially valuable species and to a decrease of knowledge of species without commercial value. This "commercial" knowledge may comprise new species as well as new uses and processing techniques for traditionally used species. At the same time traditional knowledge may be discarded if it is not regarded as appropriate, useful or important any longer. A similar process may be at work in Tibetan villages with medicinal knowledge being reshaped in response to market forces.

Tibetan medicinal plants may be threatened by over-collection due to high commercial demand for certain species. A highly valued commercial species, the snow lotus (*Saussurea laniceps*) is already showing serious impacts of over-collection (Law and Salick 2005; Law and Salick 2007), while several other of the species in this study are also considered threatened (Table 1). Commercial collection is regarded as the main reason for the over-harvesting of medicinal plants in the area (Xu and Wilkes 2004). However, local use or habitat threats may also endanger medicinal plants (Pordié 2002).

In addition to knowledge of practical value (either for providing health care or income), people sometimes mentioned plants as being medicinal, but without being able to say how or for what purposes they were used. This could be interpreted as the first step in knowledge erosion (Byg and Balslev 2001b), but might equally well indicate new knowledge acquired through hear-say or observation (Shanley and Rosa 2004) such as through observing plants being sold at medicinal markets.

Differences in which types of applications were most frequently mentioned in the villages may reflect differences in the prevalence of diseases at different elevations. Previously collected data in some of the same villages (Byg and Salick 2009) showed for example that people in lower elevation villages more often complained of stomach problems due to food spoilage in hot summers than people in villages at higher elevations where the climate generally is cooler. Such differences in health problems are likely to be reflected in the knowledge and use of plant remedies (Bourdy *et al*. 2000).

Sources and Types of Health Care

The most common source of medicine was from markets in nearby towns. This indicates that the commercialisation of Tibetan medicine influenced villagers in several ways. Not only has it provided villagers with a source of monetary income and promoted a greater focus on the collection of commercially valuable species, but commercial markets also constituted an important source of health care. In Tibetan areas within as well as outside of China, markets seem to play an increasingly greater role. In many areas Tibetan doctors themselves increasingly obtain their supplies of Tibetan medicines from markets instead of collecting these themselves due to time constraints, lack of training and (within China) increasing specialisation between those treating patients and those producing remedies (Pordié 2002; Glover 2005; Kala 2005).

People's sources of medicine were related to which village they lived in. This may be due to factors such as differences in the availability of doctors within villages and in distance to markets. The village where the largest proportion of people derived their medicine from doctors thus was unique in that it had two resident doctors (one Tibetan, one biomedically trained). However, even where official health care is available, there may be great qualitative differences as some Tibetan doctors are much more highly regarded than others. Such perceived differences in quality also influence people's health care seeking behaviour (Janes 2002; Hofer 2008).

The majority of those interviewed relied completely or partly on Tibetan medicine for treatment of illnesses. However, many also made use of biomedicine, either as a supplement to Tibetan medicine or as their exclusive source of health care. While much has been written about the demise of traditional knowledge and its replacement with modern technology and knowledge, several studies have

shown that the process rarely is so simple (Brodt 1999; Janes 1999; Ingold and Kurttila 2000; Brodt 2001). More often, traditional knowledge and skills continue to co-exist, intermix, transform or fuse with imported knowledge and technology, creating new forms of knowledge and practices. Tibetan medicine itself has arisen through a process of fusion, mix and transformation of different medical systems, including Chinese, Indian, Persian and even Greek medicine (Beckwith 1979; Janes 1995). Over time these became integrated to form a unique Tibetan medical system with its own philosophy and practices. There remained, however, several distinct subsystems and types of practitioners as well as different lineages and traditions even within the same subsystem (Janes 1995). Tibetan people have traditionally drawn on different parts of the medical system to address different health problems in different situations (Cantwell 1995; Janes 1995). In addition to doctors (trained at the medical college in Lhasa or as apprentice to another doctor), monks and lamas have important health care functions where an illness is thought to have spiritual rather than purely physical roots. It takes religious experts to identify such causes (e.g., the violation of a taboo, bad deeds in a previous life or the work of malevolent spirits) and to perform appropriate rituals and prescribe the necessary penitential or purifying actions that the patient must perform in order to get better. This duality continues to the present day and doctors trained and working for state institutions may still send people to religious experts for treatment (Glover 2005). Today the tradition of several complementary health care sources has been extended to include biomedicine (Cantwell 1995; Janes 2002; Schrempf 2007; Craig 2008).

People's choices of types of medicine may depend on a variety of interacting factors such as affordability, who the patient is (e.g., different types of health care for children, adults and older family members) and the type of illness (Kleinman 1984; Janes 1999). Generally, doctors as well as patients regard Tibetan medicine as slowly acting and as more appropriate for the treatment of chronic diseases and root causes, while biomedicine is seen as fast acting and as well-suited for the treatment of acute diseases and symptoms such as inflammations and infections (Janes 2002; Schrempf 2007; Adams and Li 2008). This fits well with a general perception of the role of traditional medical systems to treat chronic diseases which biomedicine is perceived as being unable to deal with (Cantwell 1995; Janes 1999, 2002; WHO 2002). Other factors which have previously been shown to influence Tibetans' choice of medical treatment are prices and subsidy schemes (which mostly favour biomedicine), availability, language issues and the possibility to use Tibetan or biomedical treatment as a marker of ethnic and social identity, and of people's engagement with modernity (Janes 2002; Glover 2005; Hofer 2008).

Conclusion

Our preliminary evaluation of Tibetan villagers' medicinal knowledge, a subject on which there has been little focus, showed that while villagers' knowledge of medicinal plants was far less than that of Tibetan doctors, it seemed to play an important role. Villagers knew about medicinals both as a source of income and as a source of self-help remedies for common and easily recognisable health problems such as colds and injuries and in preventive health care. Both these roles may become more important in the future, as the state support for health care diminishes further and the demand for Tibetan medicine rises worldwide. However, as past boom-and-bust cycles have demonstrated, markets for non-timber forest products are often volatile and fragile. Already there are signs that some of the most popular Tibetan medicinal plants are becoming overexploited, and this is likely to impact not only Tibetan villagers' income opportunities but also their health situation as well as medicinal plant knowledge.

As in other parts of the world, biomedicine has become an important component of people's health care. However, there are no indications that biomedicine is replacing Tibetan medicine. In this respect, our findings accord well with reports from other parts of Tibet as well as from other parts of the world where biomedicine and traditional medicines serve complementary purposes. In this way, biomedicine seems to add yet another layer to the multiple health care sources that traditionally have been employed by Tibetans. While much folk medicinal knowledge may have been lost already during the political turmoil of the previous century, it does not seem that there is a lack of knowledge transmission among the presently living generations. Most essentially, the medicinal knowledge and practices of ordinary Tibetans should not be neglected in the face of the well-developed and documented system of official Tibetan medicine. If anything, folk medicine needs more study because it faces such domination.

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