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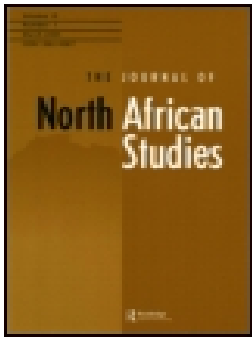
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# Mountain isolation and the retention of traditional knowledge in the High Atlas of Morocco

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## ABSTRACT

Most literature on *Amazigh* (Berber) in Morocco and in the *Journal of North African Studies* revolve around historical, social and political issues. Literature also covers issues of Berber cultural recognition, linguistic identity, and colonization. However, little is known of the ethnobotanical knowledge associated with the traditional way of life that maintains the livelihood and health of Berber communities in isolated regions of the High Atlas. In this paper, we aim to identify whether ethnobotanical knowledge is eroding and whether geographical isolation shapes its transmission in the context of globalization. This paper focuses on the differences between men's and women's medicinal plant knowledge. We conducted ethnographic and ethnobotanical fieldwork over 33 months interviewing 51 men and 146 women in ten villages with different degrees of access to urban areas and modern commodities and services. We used and analyzed quantitative data drawn from plants' free listing to assess whether ethnobotanical knowledge is eroding. Our results show that gendered differences in ethnobotanical knowledge are concomitant of integration to market economies, revealing significant knowledge retention differences in the most isolated study sites. We conclude that despite strong forces at work to integrate remote communities into globalized markets, there are important risks to TEK which supports local environmental and community health.

**KEYWORDS** Ethnobotanical knowledge; Erosion; Gender; Globalisation; Morocco

## Introduction

A large body of Berber (*Amazigh*) literature in Morocco has so far focused on historical, social and political issues, cultural recognition and linguistic identity, colonization, and ethno-political identity (Hoffman 2000; Crawford 2002; Errihani 2006; Maddy-Weitzman 2006; Brett 2013; Jay 2016; Gabsi 2020). Literature has also covered water management, division of irrigation water, land tenure, and desertification (Barrow and Hicham 2000;

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Klik, Kaitna and Badraoui 2002; Genin and Simenel 2011; Rignall and Kusunose 2018; Houdret and Amichi 2020).

Moreover, ethnobotanical studies in the High Atlas have been conducted and extensively described (Teixero-Toneu et al. 2016; Barkaoui et al. 2017; Najem, Ibjibijen, and Nassiri 2019; Belhaj et al. 2020; El Hilaly, Hmammouchi, and Lyoussi 2003; Merzouki, Ed-Derfoufi, and Molero Mesa 2003). Yet, there is currently no literature that focuses and discusses the factors that trigger erosion of ethnobotanical knowledge of Berber communities living in the High Atlas Mountains. This is particularly relevant as globalization reaches even the most isolated regions around the globe, absorbing traditional communities who have traditionally and extensively relied on plant medicine.

With the pull towards globalised markets and goods, the risk of erosion for traditional knowledge within cultures and the mechanisms of transmission are pertinent. Retaining the transmission of knowledge is important as the maintenance of important biological resources through decisions related to their production, management, distribution, and consumption depends on it (Grenier 1998; Berkes, Colding, and Folke 2000; Folke 2004; Turner and Garibaldi 2004). For instance, the channels by which traditional knowledge is transmitted depends on multiple and complex factors. Transmission of ecological knowledge among and within rural communities worldwide is often informal, and unplanned activity, context-related and participatory (Katz 1986, 1989; Lave and Wenger 1991; Ellen and Harris 2000; Prince et al. 2001; Zarger 2002; Lozada, Ladio, and Weigandt 2006; Zent 2009). Evolution of knowledge is mediated by culture (Hewlet and Cavalli-Sforza 1986; Ohmagari and Berkes 1997; Zent 2009; Blanco and Carrière 2016), through complex and dynamic learning processes (Berkes, Folke, and Gadgil 1995, 2000) and social institutions (Ellen and Harris 2000; Davis and Wagner 2003; Ellen 2011). Traditionally, oral knowledge is transmitted horizontally between living members of the same generation and vertically between individuals across generations, typically between parents and their offspring (Cavalli-Sforza and Feldman 1981; Guglielmino et al. 1995). This diversity of transmission pathways contributes to the maintenance of local knowledge, particularly when its transmission occurs vertically. According to Guglielmino et al. (1995), vertical transmission tends to be more conservative than its counterparts, i.e., it is less likely to erode than when knowledge is acquired through horizontal channels introduced from external social groups.

This is well demonstrated in the High Atlas. Typically, children accompany their parents to the terraces and take part in the various activities there; these are important locations also for practical knowledge transmission. The garden is the place where the children absorb plant and other knowledge while weeding and preparing the terraces, or when gathering cow fodder or wood with their parents on the nearby mountains. Furthermore, the transmission of plant knowledge through women is entirely within the

community. Within families, parents are a strong vector and girls learn particularly from their mother. Knowledge is also acquired from the grandparents. To an extent, girls also learn by themselves, either by watching other women preparing medicine in the house and when collecting medicinal plants in the garden, at the river or in the mountains (Montanari 2013, 2014). Other means of learning for women are through friends, from the elderly people of the village, and for older women from the local herbalist or the *ferragua* (local healer for children) or from the local *qbla* (local midwife). Men's knowledge is acquired from their mother but to a lesser extent and acquired from their grandparents.

While these communities rely extensively on traditional knowledge and these pathways of transmission that perpetuate traditional practices from which the maintenance of livelihood and natural resources depends, the imminent gradual erosion of local traditional knowledge is increasingly a concern for local communities and the scientific community and policymakers; the current sweeping global changes across the planet, affect many communities and traditional societies (Reyes-García et al. 2005; Cámara-Leret, Fortuna, and Bascompte 2019).

As globalized development reaches even the most isolated regions around the globe, communities increasingly adhere to the global economy and become exposed to new social models. Global relationships between different cultures are constant throughout history; however, with the ongoing, accelerated and intense adherence to a globalized economic framework, cultural diversity and related knowledge is threatened of disappearing rapidly (Benz et al. 2000; Harmon and Loh 2000; Godoy et al. 2005; Gray et al. 2008; Reyes-García et al. 2008; Turner and Turner 2008); and that includes medicinal plant knowledge; Reyes-García et al. 2005; (Howard 2003; Geck et al. 2016; Weckmüller et al. 2019).

Furthermore, as the socio-economic and environmental context of a community changes, so do the processes for plant knowledge acquisition and transmission (Howard 2003; Gómez-Baggethun and Reyes-García 2013; Gallois et al. 2015; Teixidor-Toneu et al. 2017). Globalization impacts the socio-economic and environmental changes in several ways: (1) access to market and integration (Weckmüller et al. 2019); (2) improved infrastructure and transportation (Reyes-García et al. 2005) that facilitates access to health-care facilities and exposure to allopathic medicine; (3) increased formal education as in westernised countries (Voeks and Leony 2004); (4) migration of the youth to the cities and urban areas (Grau and Mitchell Aide 2007). Also, these processes tend to affect differently the various segments of a population; for example, by age, gender, and occupation/status (e.g. Purkayastha 2012; Montanari 2014).

In Morocco, for instance, rural women who have moved to the cities tend to see traditional practices as backward. This prompts them to reach for

readily available urban commodities, including allopathic medicine. In the rural areas, the acquisition of material goods (electrical apparatuses for instance) to improve the comfort of the household reflect the occupational upgrade and status and increased revenues. Moreover, gender programmes that promote the empowerment of women through cooperative structures and income generating activities have flourished in Morocco in recent years. These programmes are primarily destined to enrol rural women in economic development with the overall goal of overcoming issues of poverty and to gain empowerment. For rural women living away from urban centres enduring chronic poverty yet influenced by a westernised way of life accessed through TV and other media, the possibility of gaining equality, empowerment and financial autonomy are attractive features (Montanari and Bergh 2019a; Montanari and Bergh 2019b; Perry et al. 2019; Perry 2020). However, not all rural women are able to benefit from these economic opportunities. For those who can participate, earning money from these initiatives influence to some extent the economy in the household, gain some financial independence from the husband and decision making for their children, a pathway towards their aspirations. Montanari and Bergh (2019a) reported that women were able to get recognition and gained social status determined by the tasks that one does, the role and position that one holds, i.e., illiterate women working in a labour chain doing mundane tasks were not gratified, whereas educated women recruited to work in the administration and in the technical aspects of production were widely recognised within the communities.

Thus, the extensive erosion of ecological knowledge is problematic for local communities themselves, caught between tradition and modern lifestyle, and for sustainable development planning and biodiversity conservation initiatives that rely to some extent on traditional knowledge and practices.

To come back to TEK, communities who have undergone considerable cultural, economic, and ecological changes have managed to remain resistant (Lykke, Kristensen, and Ganaba 2004; Godoy et al. 2005). For instance, Lykke, Kristensen, and Ganaba (2004) showed that the elders and the younger generations in Gourounsi (Burkina Faso) retained the traditional knowledge associated with useful woody plants even though significant economic changes had occurred in the community. Bussmann et al. (2016) found that people's medicinal plants knowledge in the Republic of Georgia remains extensive and prevalent in daily living. In Azerbaijan, Söukand and Pieroni (2019) and Kaliszewska and Kołodziejska-Degórska (2015) in Dagestan showed that biocultural diversity was highly prevalent in mountain communities, to the extent that the whole region could serve as a reference point for monitoring biodiversity.

While the above literature on TEK and the factors that contribute to its loss is extensive; little is known of whether the communities' geographical isolation, particularly in mountain environment contributes to the retention or loss of traditional ethnobotanical knowledge. The most recent research on isolation and how communities are affected is the work of Cámara-Leret, Fortuna, and Bascompte (2019) in communities of the Andes and Chocó in the Amazon, Reyes-García et al. (2013) in the Tsimane's communities in the Bolivian Amazon, and Weckmüller et al. (2019) who conducted research in communities of the Yasuni National Park and Waorani Ethnic Reserve in the Ecuadorian Amazon; the early work of Buor (2002) researching in an expanding urban suburb in Ghana; Stock (1983) in rural Nigeria and Vandebroek et al. (2004) in the Andes. Reyes-García et al. (2013) suggest that the Tsiname communities had managed to retain some form of cultural identity because of the relative isolation. Weckmüller et al. (2019) found that communities struggled to sell their agricultural and handicraft products to tourists and markets because of their geographical isolation. Buor (2002) working in the Kumasi expanding urban metropolis in Ghana, found that the distance and the costs to reach medical facilities refrained people from travelling. Similarly, Stock (1983) showed the impact of distance on the utilization of health care facilities in the Hadejia area of Kano State, Nigeria. He revealed that the utilization of and access to health services declined considerably because of the distance people had to travel. Regarding medicinal plants use, Reyes-García et al. (2013) and Vandebroek et al. (2004) found that communities living close to a national park were inclined to use local medical facilities and thus allopathic treatment, whereas communities living at the farthest end of the park tended to use more medicinal plants than allopathic medicine.

## Materials and methods

Studies that document and analyze the intersection between transmission of medicinal plant knowledge are widely available. However, they lack attention to gender and geographical isolation, especially in mountain environment.

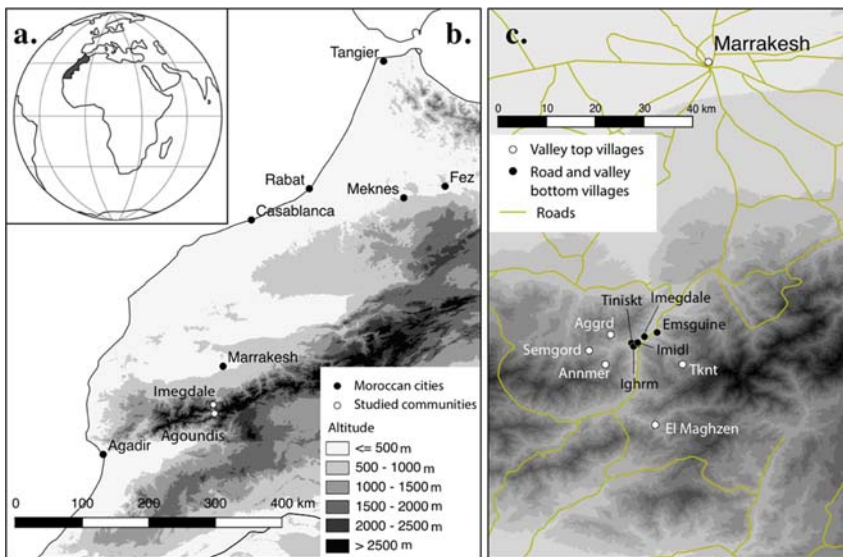
In the context of isolated communities and villages of the High Atlas, our study aimed to elucidate which aspects of medicinal plant knowledge was undergoing erosion. First, we analyzed the role of the geographical situation for the retention/erosion of gendered traditional knowledge and how the latter likely impacts the gendered transmission from which the natural resources management depends and the continuity of traditions. Second, we describe the variation in medicinal plant knowledge among the inhabitants of villages in two rural communities in the High Atlas Mountains. Third, we identify the processes of medicinal plant knowledge transmission and evaluate the narratives of the role of medicinal plant use in the

context of increased exposure to globalized economies and access to the allopathic health system. Fourth, we reveal the differences between transmission pathways in the two different locations. Finally, we conclude and show that in the current era of economic and cultural globalization, geographical isolation is the main factor that contributes to the retention of traditional ethnobotanical knowledge in this part of the High Atlas of Morocco.

## Study sites

The research was conducted in two neighbouring valleys in the High Atlas (Figure 1). The first author spent 26 months in eight villages of the Agoundis valley (from February 2007 to April 2009). The second author spent eight months in the neighbouring rural community of Imeddale, in the N'Fiss valley (from November 2014 to June 2015). Both locations were subject to development initiatives; the former an essential oil distillation project which started in 2007; the latter, a cooperative to coordinate medicinal plant harvest and trade in 2011 to benefit the local inhabitants.

Both valleys share borders and due to the proximity, the population is intimately linked through family ties and kinship. Administratively, each valley corresponds to a rural commune or municipality, a system based on a reminiscent model of the former French colonial administration style still applied



**Figure 1.** Global map showing the location of Morocco (a), Moroccan altitude map with the location of the main Moroccan cities and the communes of Agoundis and Imeddale (b), and regional altitude map indicating the main roads and the villages where data were collected in the village of El Maghzen in the Agoundis and Imeddale valleys (c).



today. Data from one village in the Agoundis valley (El Maghzen) and nine villages in the valley of Imegdale were used in this study (Figure 1).

El Maghzen is located farthest away from Marrakech and situated in the middle of the Agoundis valley at an altitude of 1,300 metres; the main rural commune of Ijoukak is eight kilometres away with the main paved road running along the N'Fiss valley. The 37 villages (*douar*) are home to 6700 inhabitants spread across the valley (HCP census 2014). The connecting transportation and communication systems to the main urban area are fewer and less efficient than in Imegdale until early 2011 when it became more accessible by regular trucks, and electricity was installed around the same period. Children attend primary education in the village, but access to secondary education is limited.

Imegdale has an approximate population of 5537 inhabitants in 1156 households spread in 28 villages (*douar*) (altitudes between 900 and 2000 metres) (HCP 2014). Running water is now available for 81, 5% of the population and electricity was installed in the most isolated villages in early 2014, benefiting 94% of the population. The latest census of the Haut Commissariat au Plan (2014) reveals that only 4.1% have access to secondary schooling and poverty reduction remains the main concerns for the national authorities.

The High Atlas represent an important refuge for Berber communities. Although there is some migration to urban areas, population growth in the mountains is an important feature of human capital. The balance of natural resources has permitted these populations some degree of economic independence. However, living in the area has several disadvantages. These are related to topographic compartmentalization, a very fragile environment, and a lack of basic infrastructures. In this respect, the High Atlas still demonstrates many of the poverty and livelihood issues found among mountain communities that experience environmental degradation that is both a cause and a consequence of acute rural poverty (Crawford 2002; Houdret and Amichi 2020; Perry 2020).

The communities rely heavily on subsistence agriculture and pastoralism, local resources, and traditional techniques to manage land, water and biodiversity. Harvesting of medicinal plants is an additional source of revenues, especially for women. Other income is from family members living and employed in the cities of Agadir, Casablanca, Rabat, or Marrakech. Throughout history, the integration of these isolated mountain communities into development strategies has always been a challenge for the central authorities (Hart 2000). This is mainly due to the lack of national measures to address the social, psychological, and material dimensions of poverty and the necessary measures to empower the communities (Montanari and Bergh 2014; Montanari and Bergh 2019). El Maghzen has remained particularly resilient to change and development initiatives due to its relative isolation and the failure of past initiatives.

As there is no public healthcare centre in the Agoundis valley except a dispensary in Ijoukak, eight kilometres at the bottom of the valley, home-based ethnobotanical medicine is prevalent. In Imegdale, the healthcare centre is staffed with a fulltime nurse but without a doctor. Doctors are intermittently present in neighbouring communes, which can be up to three hours away from the most isolated villages. The nearest hospitals are another half hour further away in Tahanaout, or even further, in Marrakech.

## Data collection

Ethnographic and ethnobotanical methods (participant observation, informal discussions, free-listing and semi-structured interviews) were used to investigate: (1) the variation of medicinal plant knowledge among the inhabitants of these communities, (2) the processes of transmission, and (3) healthcare preferences. Random and snowball techniques, which consist of being introduced to new informants by previous interviewees (Van Meter 1990; Atkinson and Flint 2001; Bernard 2011) facilitated access to the most isolated populations, who are usually shy to interact with foreigners. Interviews were conducted in *Tashelhit* (the Berber dialect spoken in the region), translated back into French with a research assistant/translator, and recorded with pen and paper, as most informants did not feel comfortable with audio-recording. All interviews in both locations were conducted with informants' prior consent and following the code of ethics of the Society of Ethnobiology.

Free-listing collection of known plants with all informants were recorded and used in the quantitative analysis to compare individual medicinal plant knowledge. Plant species corresponding or not to one-to-one with botanical species (Berlin, Breedlove, and Raven 1973), were identified from the vernacular names given by informants. The lists of plant species were used as a proxy for medicinal plant knowledge in the quantitative analyses. Semi-structured interviews were used to gather further information about the medicinal plants' traditional therapeutic applications, the parts used, and the locations of the collection. To understand the processes of knowledge transmission and the factors likely to contribute to the erosion of transmission, we enquired about the location (i.e. indoors, outdoors) and the source of information where the interviewees had acquired medicinal plants knowledge and whether this has been passed on to anyone in particular, children, grandchildren and neighbours. Participant observation was applied throughout and informal discussions with people while doing their mundane activities (helping women in the kitchen and gardens, during medicinal plants collection in the mountains fodder and wood collection in El Maghzen) and going or coming back from the public healthcare centre in Imegdale.

In El Maghzen, 56 women and 35 men were interviewed (Table 1). Because all the interviewees were residents of the village, no variability in the places of

**Table 1.** Socio-demographic characteristics of the informants from El Maghzen and average number of plant species cited in the lists.

		Number of interviewees	Average number of plant species listed ( $\pm$ standard deviation)
Gender	Men	35	9 ( $\pm$ 3)
	Women	56	10 ( $\pm$ 5)
Age	Old	13	10 ( $\pm$ 4)
	Middle aged	38	10 ( $\pm$ 5)
	Young	40	8 ( $\pm$ 4)

residency was observed. In Imegdale, a total of 90 women and 16 men were interviewed in nine villages (Table 2). This gender disproportion was roughly representative of the community due to the large number of men migrating to the cities for seasonal or permanent work. Meta-data and data on the informants' place of residence were collected as in El Maghzen. Nine surveyed villages in Imegdale were selected according to their geographical situation (Figure 1c). This includes: (a) not isolated villages by the road (where public transport to urban centres and access to local public health facilities is readily available), (b) villages at the bottom of the valley, away from the road; and (c) isolated villages at higher altitude (See Figure 1 and Table 2 below).

## Data analysis

Quantitative data were analyzed, and ethnographic and qualitative ethnobotanical data were summarised and synthesized to build a narrative account on medicinal plant knowledge transmission and healthcare preferences in each valley (Newing et al. 2011). Narratives from the two communes were

**Table 2.** Demographic characteristics of the informants from Imegdale ( $n = 56$ ) and average number of plant species cited in their lists were omitted.

		Number of interviewees	Average number of plant species listed ( $\pm$ standard deviation)	
Gender	Men	8	8 (3)	
	Women	48	15 (8)	
Age	Old	17	15 (9)	
	Middle aged	31	17 (8)	
	Young	8	16 (8)	
Place of residence	Road	Imidl + Imegdale	7	12 (6)
		Emesguine	3	8 (7)
		Valley bottom	13	15 (6)
	Valley top	Ighrm	3	13 (3)
		Tiniskt	7	18 (7)
		Aggrd	6	25 (8)
		Annamer	6	16 (11)
		Semgourd	6	20 (11)
		Ighdiwen	11	20 (11)

then compared. Medicinal plant free lists were used as a proxy of the informants' medicinal plant knowledge for the quantitative data analysis. A list including the ethno-species documented and mentioned by more than four interviewees ( $n = 73$ ) was compiled. The data on the collected local plant species were then scored as present or absent from each interviewees' free list, resulting in a presence and absence table. Informants were classified by their gender and age. A two-way ANOVA test for unequal sample sizes (Type III) was used to evaluate differences in the number of plants given during free listing by informants between the two communes and across gender. To check if there were differences across gender in one commune, and not in the other, two one-way ANOVA tests (Type III) were used with the datasets of each of the communes separately. All analyses were carried out in R (R Core Team 2018).

Based on our qualitative results and participant observation, we hypothesised that medicinal plant lists would be significantly different between men and women. We also anticipated that plant lists given by inhabitants of the two communes would differ, as El Maghzen is geographically more isolated than Imegdale.

## Main results

The two-way ANOVA test identified significant differences in the plant lists given by the interviewees of the two communes ( $p$ -value  $< 0.005$ ). No differences between men and women were observed using the full dataset, however the interaction between the two independent variables was also significant ( $p$ -value  $< 0.005$ ) (Table 3). One-way ANOVA tests showed significant gender differences in Imegdale, but not El Maghzen.

In Imegdale, men cited less plants than women bearing significant differences ( $p$ -value = 0.009, Table 3). Men's plant lists included the most salient medicinal plant species in the commune as many of these are harvested in large quantities and traded in national and international markets. These include *azukni* (*Thymus saturejoides* L.), *shih* (*Artemisia herba-alba* Asso), *timja* (*Mentha suaveolens* Ehrh.), *azuka* (*Tetraclinis articulata* Vahl) and *timzurri*

**Table 3.** Two and one-way ANOVA tests for unbalanced sampling.

	Both communes		Imegdale		El Maghzen	
	F value	p value	F value	p value	F value	p value
(Intercept)	158.47	<2.2e-16*	180.62	<2.2e-16*	309.2	<2e-16*
Commune	18.73	2.9e-5*				
Gender	0.61	0.434	7.42	0.009*	1.19	0.227
Commune: Gender	12.03	0.0008*				
Residuals	3965		2746.2		1219.5	
N interviewees	139		56		83	

\*Statistical significance  $p$ -value  $> 0.05$ .

(*Lavandula dentata* L.) (Teixidor-Toneu et al. 2016). However, men's lists also included less common traded plants, especially medicinal roots like *igudi* (*Pterocephalus depressus* Coss. & Balansa) and *awgdmi* (*Armeria alliacea* (Cav.) Hoffmanns. & Link) because these are mostly collected in the alpine area during seasonal transhumance and traded mainly in villages situated at the bottom of the valley. On the other hand, medicinal roots were sometimes but not always present in women's lists; rather they cited a wider range of species that are used medicinally. This is due to women's role at the household level where women cook, use spices and other food plants which were often mentioned as having medicinal value (43% of the citations were cultivated or imported plants) compared to men (27%) and only one male mentioned spices and other imported plants, which are common in women's lists. However, these gendered differences were not observed in El Maghzen (Table 3). As in Imegdale, the trade of medicinal plants is important for the inhabitants of El Maghzen who harvest large quantities for the national and international markets. These include mainly *azukni*, and *timzurri* and *salmia* (*Salvia aucheri* subsp. *Canescens* (Boiss. & Heldr.) Celep, Kahraman & Doğan). Both men and women are engaged in plant harvesting activities.

### Knowledge transmission in both locations

The interviewees from both locations revealed a combination of sources of knowledge, revealing complex and complimentary processes of knowledge transmission. Typically, children observe and participate in the preparation of herbal remedies and are familiar with the medicinal plants that they or other members of the family take regularly to treat colds, headaches, stomach aches, and menstrual cramps, among other ailments. Men and women in both locations recalled learning from their mothers during childhood and observing herbal remedies being used at home or with family members in outdoor activities during the collection of medicinal plants. Mountain slopes where wood and fodder are collected, and family home gardens are important outdoor locations where knowledge of medicinal plants is vertically transmitted to younger generations. In indoor and outdoor locations, children learn from their relatives and by themselves. Interviewees from both communes also mentioned sharing knowledge of medicinal plants between peers during adulthood. We also observed that women, especially mothers and grandmothers, played a pivotal role of family healers to treat common and minor ailments. Most adult informants, and particularly women, consulted neighbours or in-law family members to source information on medicinal plant use, and to acquire new knowledge for treatment, in the case of an unusual illness for instance. However, despite similar processes of transmission of knowledge observed in El Maghzen and Imegdale,

differences between the two communities were identified when comparing informants' plant free lists.

In addition, most people in El Maghzen thought that it was important to transmit herbal knowledge to the younger generations. The isolation of the village, away from the main communication and trade axis which prevents easy access to the dispensary may be significant. On the contrary, although most people in Imegdale had some knowledge of the use of medicinal plants and believed that they were useful, allopathic medical care in the local health care centre was the preferred option to treat most ailments. We observed that newly learned remedies replaced old ones as they are perceived as more efficient or convenient. Most women indeed recognised that pharmaceuticals replaced herbal remedies when available. Both young and older women in Imegdale expressed little interest in transmitting or acquiring new medicinal plant knowledge and use skills.

## Discussion

Variation in medicinal plant knowledge across locations and socio-demographic characteristics reflect both the *Amazigh* (Berber) mountain culture and trends of cultural change. In the High Atlas, gendered labour and household responsibilities do not always result in medicinal plant knowledge differences between men and women. In our study, the differences between the rural communes of El Maghzen and within the geographically isolated villages in Imegdale, indicate that integration into the globalized economy and access to allopathic medicine significantly affect the transmission of medicinal plant knowledge. Specifically, medicinal plant knowledge differs across gender in less isolated villages.

In the context of intensive forms of social change in rural spaces, the differences between men's and women's knowledge and gendered processes of transmission are still poorly understood. Regarding medicinal plant knowledge, general cross-cultural trends whereby women and elders have more knowledge has long been observed (Howard 2003; Quinlan and Quinlan 2007; Voeks 2007; Singh, Pretty, and Pilgrim 2010; Ong and Kim 2017; Hatfield et al. 2018). This has been attributed to women's responsibility for household healthcare (Wayland 2001; Howard 2003; Voeks 2007; Silva et al. 2011; Teixidor-Toneu et al. 2017); it also stems from gendered labour and spaces, which result in gendered patterns of medicinal plant harvest and management (Howard 2003, 2006; Voeks 2007). In rural Morocco, including in the High Atlas Mountains, gendered work patterns indeed characterize local livelihoods, and men and women conduct distinct and complimentary tasks. Typically, household and health care lie within women's responsibilities (Montanari 2013; Teixidor-Toneu 2017; Perry et al. 2019). Women possess an inherent plant knowledge that is embedded in the cultural and social

landscape. Consequently, higher medicinal plant knowledge among women compared to men has been observed across Morocco (Merzouki, Ed-Derfoufi, and Molero Mesa 2000; El Rhaffari and Zaid 2002; Tahraoui et al. 2007; Abouri et al. 2012; Fakchich and Elachouri 2014). In our study, we observed that women's and men's medicinal plant knowledge is not different in isolated communities, where knowledge is orally transmitted in informal, unconscious, and unplanned ways across gender (e.g. Lozada, Ladio, and Weigandt 2006). While women typically practice traditional medicine, men have equally knowledge of these plant activities.

New socio-economic activities can impede the specific cultural contexts that allow customary knowledge transmission processes to reproduce itself over time (Gómez-Baggethun and Reyes-García 2013). Men primarily engage in new professional activities outside the household. When they migrate, for instance, men are sheared from the home environment and the daily use of medicinal plants. Given that medicinal plant knowledge is 'the consequence of practical engagement with everyday life (Ellen and Harris 2000, 4)', medicinal plant knowledge eventually subsides. However, when men remain in the villages, new occupations change the household dynamics; this reduces the opportunities for knowledge transmission, particularly when this relates to trading medicinal plants. National and international markets' demands for the commercialisation of local natural resources, especially medicinal plants, tend to impact the medicinal plant knowledge and its transmission. For instance, in El Maghzen, the *Initiative Nationale de Développement Humain* (INDH) (*National Human Development Initiative*) initiated a project to develop the commercialisation of medicinal and aromatic plants by adding value with essential oil distillation; a project designed to involve the local populations in participatory approaches and to resolve the issues related to illegal trade and unequal benefit sharing. Montanari (2012, 2013) describes how most men were highly knowledgeable of *azukni* (*Thymus satureioides* L.) monetary added value, thereby decreasing the focus of knowledge of its therapeutic value. Because men usually remain outside the realm of household, their medicinal plant knowledge tends to lean towards specific plants associated with economic value. On the other hand, women are central to maintaining traditional livelihoods in rural Morocco and key actors for the maintenance and transmission of medicinal plant knowledge to younger generations as witnessed in El Maghzen. However, globalized models are increasingly permeating local traditional livelihoods even the most remote parts of the country.

As isolated communities become increasingly exposed to external influences and interventions, including those related to the convenient use of allopathic medicine, the transmission of medicinal plant knowledge becomes vulnerable.

We observed that in Imegdale, oral traditional healthcare knowledge no longer carries prestige as it is increasingly perceived as backwards and literacy stands as a marker of social power, as witnessed in other communities adhering to 'modern westernized lifestyle' around the world (Agrawal 1995; Campbell 2004). Furthermore, children raised in environments where allopathic medicine is readily available, learn significantly fewer medicinal plants (as in Zent 2009). This explains the differences between El Maghzen and Imegdale, and in between the isolated villages within Imegdale. Our qualitative results suggest that younger educated women who have easier access to public health facilities, who may be working in a cooperative structure for instance and therefore become socially recognized within the communities, tend to use less medicinal plants than their mothers and grandmothers; they tend to lean towards relying on the public health system for convenience. In Imegdale, medical facilities are readily accessible, whereas in more isolated El Maghzen, people seemed to maintain a cohesive transmission of knowledge. Our results align with those of Reyes-García et al. (2013) and of Vandebroek et al. (2004) who showed that isolation contributes to the retention and use of medicinal plant knowledge.

## Conclusion

As globalization increasingly permeates the traditional way of life in the High Atlas, medicinal plant knowledge is changing in the communities. In isolated villages, knowledge is shared between men and women, even though women are the primary household caregivers. With modernization and access to global economic resources, including allopathic medicine, differences between men and women's medicinal plant knowledge occur. Our study identified that although knowledge acquisition reflects inherent unconscious or conscious processes during childhood and throughout adulthood, when people are sick, they actively seek alternative forms of treatments when these are available. These choices are to a great extent influenced by new economic activities and external influences. Medicinal plant knowledge in the High Atlas is sensitive to socio-economic changes, and gendered differences are particularly exacerbated. On the one hand, allopathic medicine tends to hold a higher status than local herbal treatments due to its convenience, which in turn endangers the transmission of medicinal plant knowledge for future generations. On the other, as men focus on harvested economically viable medicinal plants, their knowledge tends to prioritize plants with high added value over those that are used daily in the households.

This article makes an important contribution to the field of medicinal plant knowledge, the factors that influence its erosion/retention in villages of the High Atlas in Morocco and its transmission pathways. We suggest that



mountain environments could serve as an observatory for traditional ethnobotanical knowledge, its preservation, and the monitoring of different trends likely to exacerbate its erosion in this location.

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