Gender Influence on Local Botanical Knowledge about Medicinal Plants: A Study in Northeast Brazil

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Research

Abstract

Background: Ethnobotanical studies commonly employ the gender variable to understand how knowledge about medicinal plants is structured. However, most focus specifically on the number of species known among men and women, with limited attention to issues such as collection location, species endemism, and the repertoire of medicinal plants. This study primarily seeks to understand if there are differences in various types of knowledge and in the composition of known and used medicinal species between genders.

Methods: The study was conducted in the rural community of Morrão de Cima, Bahia, Brazil. We gathered information about the knowledge and use of medicinal species, including details on collection sites, through semi-structured interviews. To answer our questions, we used generalized linear models and a multivariate permutational analysis of variance.

Results: We found no significant difference in the total number of known medicinal species between genders. However, women showed greater knowledge of species close to their homes and exotic species, while men demonstrated more knowledge of species in forested areas and native species. We also observed a significant difference between the species known and used by men and women.

Conclusions: Our findings emphasize the need to use various knowledge metrics for a deeper understanding of the relationship between medicinal species knowledge and gender. Differences in the composition of medicinal plants between men and women highlight the heterogeneity of knowledge, underscoring the essential role of both genders in shaping local medical systems, resulting from the health/disease dynamics among genders.

Keywords: Ethnobotany; Local ecological knowledge; Medicinal plants; Composition; Knowledge and use.

Background

Local botanical knowledge and the use of plant resources are heterogeneous among individuals in a community. This heterogeneity is influenced by several factors, such as income (Paniagua-Zambrana et al. 2014), age (Pérez-Nicolás et al. 2017), occupation (Oliveira & Menini Neto 2012), and gender (Camou-Guerrero et al. 2008, Torres-Avilez et al. 2019). The latter emerges as a widely researched factor to explain the heterogeneity of knowledge/use of medicinal plants.

There are three distinct scenarios regarding medicinal plant knowledge among genders: firstly, where women know more medicinal plants than men (Alqethami et al. 2020, Camou-Guerrero et al. 2008); secondly, where men know more medicinal plants than women (Albuquerque et al. 2011, Torres-Avilez et al. 2019); and thirdly, where no difference is observed in the knowledge of medicinal plants between genders (Giraldi & Hanazaki 2010, Santoro et al. 2022). Literature suggests that variation in medicinal species knowledge in relation to gender may be associated with the division of social roles, encompassing family health care responsibilities and the collection of resources in various cultures (Arjona-García et al. 2021, Beltrán-Rodríguez et al. 2014, Howard 2006).

In Brazil, women tend to have greater knowledge about medicinal plants compared to men (Torres-Avilez et al. 2016). The literature explains this fact, sometimes in a simplistic and stereotyped way (Pfeiffer & Butz, 2005). These explanations have to do with the social role of women, responsible for primary family health and household-related activities, while men engage in activities related to resource procurement for family subsistence, according to Voeks et al. (2007). However, ethnobiology should be cautious with this explanation, as several social-ecological contexts do not exhibit such clear-cut divisions of social roles.

Beyond the difference in the number of known species, studies suggest that some plants are cited primarily or exclusively by men, while others are referred similarly by women (Melo et al. 2021, Souza et al. 2021). These differences might be attributed to the therapeutic targets indicated by each gender, as some diseases are more common in men or women, leading to the use of specific plants for their treatment (Tng et al. 2021). However, despite some sporadic observations of gender-exclusive medicinal plants, there's a lack of statistical comparison between the repertoires of medicinal plants among men and women, which is our proposal in this study.

Additionally, literature often suggests that gender can influence knowledge about native and exotic medicinal species in specific contexts. Miranda et al. (2011) attribute this difference to women's greater involvement in domestic activities, keeping them closer to their homes, where there's often a higher variety of exotic species. Conversely, Caniago & Siebert (1998) point out that men tend to be more familiar with native species and primary vegetation since they often visit these areas to collect resources. Despite this discussion, ethnobiology still requires studies testing this hypothesis.

Given the above, we formulated two questions for our study: (a) Does gender influence knowledge of medicinal species? Hypothesis: There is a difference in medicinal species knowledge, concerning total richness, collection location, and species endemism in relation to gender. Prediction: Women are familiar with a greater richness of medicinal species overall, as well as from environments near their homes and exotic species, whereas men know more species from forested areas and native species. (b) Does gender influence the composition of medicinal species? Hypothesis: There's a difference in the composition of species in the medical repertoire concerning gender. Prediction: Women know and use different medicinal species than men in their medical repertoire.

Materials and Methods

Study area

The study was conducted in the rural community of Morrão de Cima (12°16’10.9"S and 45°01’58.9"W), located in the municipality of São Desidério, western region of the state of Bahia (Figure 1). The community is about 14 km away from the São Desidério town center. According to the Köppen-Geiger climate classification, the region's climate is type "Aw", meaning the community is in a tropical area with summer rains. The rainy season occurs between November and April, with precipitation levels reaching 1700 mm/year. The study area is part of a vegetational mosaic within the *Cerrado* biome. Among the phytophysiognomies present in the area, the following stand out: *Chapada* - a term used by the community to refer to the *Cerrado stricto sensu*; *Brejo* - a term attributed by the community to different types of wet areas near watercourses; *Serra* - a term referring to escarpment areas; and *Mata Seca* - a term used for regions of deciduous seasonal forests (Barros et al. 2019, Gama et al. 2018).

The community consists of 30 households, with about 70 inhabitants distributed among elderly, adults, and youth (we consider individuals aged up to 17 as young, those between 18 and 59 as adults, and seniors as individuals aged 60 or older). Generally, the community's economy revolves around agricultural practices (cassava, sugarcane, corn, etc.) and small-scale livestock farming (cattle, goats, chickens, etc.), activities that play a significant social and economic role in the community. The lack of health services in the community requires residents to travel to São Desidério for essential services. The only access to biomedical care in the community comes from regular visits by a local health professional (nurse).

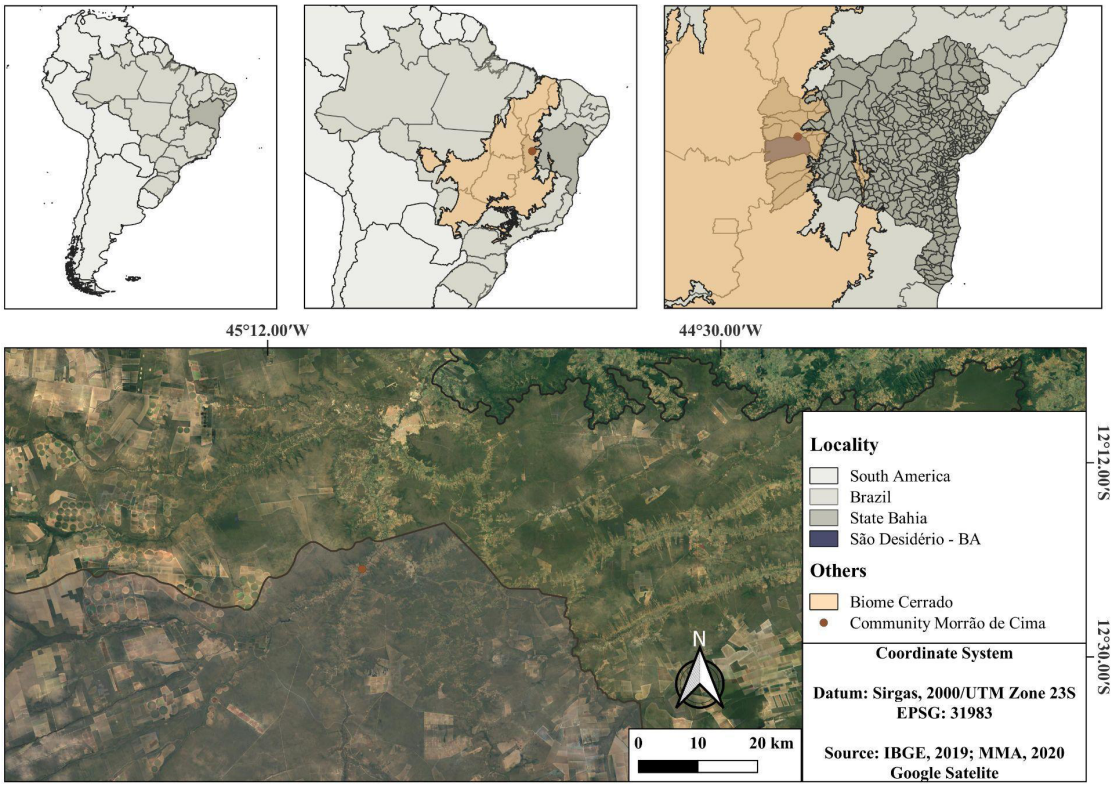

Figure 1. Location of the Morrão de Cima community, Bahia.

The local medical system relies on both biomedicines and natural resources, where medicinal plants play a central role as therapeutic resources. In the community, these plants are highly valued for their cultural importance and the need due to the high costs associated with conventional treatments (Gama et al. 2018). Meanwhile, the use of biomedicines in the locality is mainly associated with more severe illnesses (Gama et al. 2018).

Most community members are either retired or currently engaged in farming activities. While both men and women engage in farming activities, men typically handle tasks that take them further from home, such as wood harvesting, whereas women predominantly focus on household activities like childcare and cooking, and they serve as the primary managers of homegardens.

Data Collection

Data collection took place between 2015 and 2016, through semi-structured interviews with individuals over 18 years old, covering both genders. The interview was conducted individually with each participant at their respective residence. A total of 44 people, representing 62.85% of the total population of Morrão de Cima and 93.16% of those over 18, participated in the survey. Three individuals either chose not to participate or could not be located during the research process. The sample consisted of 20 (45.45%) men and 24 (54.55%) women. Generally, interviews gathered socioeconomic information (age, marital status, origin, occupation, number of children, and monthly income) and questions related to knowledge (i.e., all mentioned species) and use (i.e., species respondents claim to use) of medicinal plants, their application, indications for use, parts of the plants used, and application methods.

In this study, the age of the interviewees ranged from 18 to 91 years, with a mean of 46.7 years and a standard deviation of 17.4 years. The majority of respondents were middle-aged or elderly married individuals.

Botanical material collection was carried out on a guided tour, followed by an identification stage, using bibliographic references and morphological comparisons, including the analysis of specimens stored at the BRBA Herbarium, under the care of the Federal University of Western Bahia (UFOB). The collected species were classified as exotic and native based on the Cerrado Biome distribution. For this purpose, we used the specialized literature and websites such as the Brazilian Flora Species List (http://floradobrasil.jbrj.gov.br/).

Ethical and Legal Aspects

Residents were duly informed about the study's objectives and invited to formalize their agreement by signing the Informed Consent Form, in accordance with the guidelines established by Resolution (196/96) of the National Health Council, in line with the guidelines of the Research Ethics Committee. The research protocol received approval from the Research Ethics

Committee involving Human Beings of the São Francisco de Barreiras College (FASB), in accordance with the process registered on the Brazil Platform under number CAAE 44962515.5.0000.5026.

Data Analysis

To test our hypotheses involving gender's influence on known species richness, we built generalized linear models (GLM), using the poisson family, as all our response variables are discrete numeric and count values (i.e., species richness, native species richness, exotic species richness, species collected in natural environments, and species collected in domestic yards) of medicinal plants. After building the models, we observed overdispersion of the residuals using the 'simulateResiduals' function from the 'DHARMa' package and chose to use the negative binomial family, remaking the models using the 'glm.nb' function from the 'MASS' package. We then tested the model's assumptions to assess their reliability (Zuur et al. 2010).

For our second hypothesis, where we assume gender influences the repertoire of known and used medicinal plants, we constructed presence and absence tables, with all species listed by the community in columns and respondents in rows. In our knowledge spreadsheet, each individual received a 0 if they did not know the species and a 1 if they did. Similarly, we built a presence and absence matrix for used species, this time using plant-use combinations as columns (e.g., *Schinus terebinthifolia* Raddi for flu). We then built a similarity matrix using gender as an indicator. Subsequently, we conducted permutational multivariate analysis of variance (PERMANOVA) test using the Adonis test from the 'vegan' package. The first PERMANOVA aimed to assess the differences in composition between the repertoire of medicinal plants known by men and women, while the second aimed to assess the differences in the repertoire of medicinal plants effectively used by men and women. All analyses were conducted using the R software version 4.3.1.

Results

A total of 187 medicinal plants were mentioned based on their popular names. Out of these, 176 species were precisely identified down to the specific level. These species were divided into 104 native species and 72 exotic species, spread across 65 distinct families and 119 different genera (see appendix 1).

Does gender influence knowledge of medicinal species?

We found no significant difference in the total number of known medicinal species between genders ($p > 0.05$; $z = -1.421$). Women had a greater knowledge of medicinal species in backyards ($p < 0.05$; $z = 2.168$) and of exotic ones ($p < 0.05$; $z = 2.033$). Meanwhile, men knew more medicinal species from natural areas ($p < 0.05$; $z = -3.169$) and native ones ($p < 0.05$; $z = -2.302$) (Table 1).

Table 1. Generalized Linear Models between gender and knowledge of medicinal species (i.e., known species richness, native species richness, exotic species richness, species collected in the wild, and species collected in domestic backyards).

	Estimate	Std. error	z value	*p*-value
***Total species richness* – AIC 327.96; R^2 *adjust* 0.070**				
Intercept	3.1559	0.1241	25.433	<2e-16***
Gender-Women	-0.2381	0.1675	-1.421	0.155
***Exotic species richness* - AIC 293.96; R^2 *adjust* 0.143**				
Intercept	2.1118	0.1765	11.9968	<2e-16***
Gender-Women	0.5032	0.2319	2.168	0.0301*
***Native species richness* - AIC 350.18; R^2 *adjust* 0.164**				
Intercept	3.3508	0.2086	16.061	<2e-16***
Gender-Women	-0.6483	0.2816	-2.302	0.0213*
***Forest species richness* - AIC 270.23; R^2 *adjust* 0.278**				
Intercept	2.5151	0.1551	16.220	< 2e-16***
Gender-Women	-0.6828	0.2154	-3.169	0.00153**
***Homegarden species richness* - AIC 264.05; R^2 *adjust* 0.132**				
Intercept	1.8262	0.1713	10.660	2e-16***
Gender-Women	0.4553	0.2239	2.033	0.042*

Does gender influence the composition of known and used medicinal species?

We observed a significant trend where both men and women know exclusive plants ($R^2 = 0.072$; $p < 0.001$). The same result occurred concerning the repertoire of used plants ($R^2 = 0.067$; $p < 0.001$), indicating that both genders have specific knowledge related to different medicinal species. For example, the species *Bidens pilosa* L. was mentioned exclusively by women, while *Himatanthus obovatus* (Müll.Arg.) Woodson was cited only by men.

Discussion

Does gender influence the richness of medicinal species?

Our findings indicate no difference in the number of known medicinal species between genders, similar to what other studies have reported (Khakurel et al. 2022, Pfeiffer & Buzts 2005). Men and women show significant differences in how they acquire knowledge and use plants significantly (Alqethami et al. 2020). These authors' findings and the synthesis presented by Torres-Avillez et al. (2016) indicate that variations in knowledge between genders don't follow a single predictable direction. Both men and women can demonstrate the same knowledge within a medical system, depending on the sociocultural context in which the community is located. Santana et al. (2022) noticed this trend, where men living in Salamina show a level of medicinal plant knowledge equivalent to women regarding self-care practices. Kidane et al. (2018) and Lautenschläger et al. (2018) also found that gender did not have a significant impact on the traditional use of medicinal plants in their study communities. The finding that the total richness of medicinal species does not vary between genders might initially suggest a similarity in knowledge between men and women. However, our results emphasize a difference in the pharmacopeias' composition between genders. In the community, it was observed that women are more centered on tasks related to domestic care and tend to use exotic species found around their homes, such as backyards and gardens. This distinction highlights the importance of considering not only the quantity of species but also the diversity and origin of the plants used.

These results suggest that women have broader knowledge about exotic species, which might be attributed to their responsibilities related to home care, as demonstrated in previous studies (Caballero-Serrano et al. 2019, González-Ball et al. 2022, Tng et al. 2021). As seen by Kutal et al. (2021), women often engage more in managing local resources available nearby, while men are frequently dedicated to summer grazing, livestock raising, and extracting plants from remote and rural areas. Men, on the other hand, show greater knowledge of native species and those found in natural areas. In the studied community, men often engage in farming and grazing activities, which usually take place farther from homes and often near native forest environments. In the NAPF rural region, livestock farming represents the primary income source, traditionally a man's responsibility, which translates into specific knowledge about certain forage species (Poncet et al. 2021). Conde et al. (2017) highlighted that male specialists engage in specific activities like loggers, bushmen, and builders, involving forest resource extraction and heavy construction tasks, showcasing a gendered division of labor. Similarly to our results, previous studies also support the association between men's activities in natural environments, such as hunting, livestock supervision, and resource collection, as clear explanations for their knowledge of native species (Augustino et al. 2011; Caniago & Siebert, 1998; Porcher et al. 2022).

By integrating the perspectives and knowledge of both women and men, we broaden our understanding of plants' therapeutic potential. Women bring practical understanding about the everyday use of medicinal plants. In contrast, men provide practical knowledge acquired through interactions with nature, especially in work or outdoor activity contexts. Valuing and promoting dialogue between men and women would create a richer and more comprehensive ethnobotanical discourse.

Does gender influence the composition of known and used medicinal species?

The known and used medicinal plant species vary between genders. This distinction in species composition can be attributed to the fact that men and women gather plants in different locations and also have preferences for distinct species, as highlighted in our findings and discussed earlier. This diversity in plant choice may be influenced by social, cultural, and even the availability and accessibility of plants in different environments. In rural communities in Uruguay, Ceretta and Dabezies (2023) observed that interviewed women mentioned regular use of plants for family and personal care, especially during maternity and general care periods.

The presence of significant differences in the known and used medicinal plant species between genders highlights that the knowledge and use of these species are, in part, shaped to meet specific needs. These variations may be related to distinct requirements, preferences, or social roles assumed by each gender, demonstrating the complexity of the relationship between people and medicinal plants. For instance, Matejić et al. (2020) observed distinct preferences in the use of medicinal plants between men and women in Svrljig and Tiok for treating different diseases in each group; the study by Díaz-Reviriego et al. (2016) showed that only women reported species that can be used in reproductive health, such as fertility, contraception, among others, as well as childhood illnesses. In Salamina, Santana et al. (2022) found that women have a more diversified repertoire of medicinal plants, especially for spiritual protection, indicating that health preservation encompasses both the physical and spiritual aspects. In turn, Alqethami et al. (2020) observed that women exhibit a higher frequency of citations of uses and species related to reproductive diseases.

Understanding the factors that influence medicinal practices, as well as knowledge systems, cultural transmission, and community adaptations to local ecological conditions, enables an understanding of the composition of known and utilized medicinal plant species. This understanding not only indicates the selection of plants with therapeutic properties but also reveals the mechanisms through which this knowledge is preserved, transmitted, and adapted over time, enriching the overall view of the interaction between people and the natural environment. For example, Aziz et al. (2017) observed that women mentioned specific plants for treating diseases, while men were completely unaware of the use of these plants. Similarly, Sánchez et al. (2020) pointed out gender distinctions regarding some medicinal plants. Arias et al. (2020) noticed

that both genders share only two families of commonly used plants, with differences in knowledge and use of the other mentioned plants. The choice of plants varies according to the distinct roles and knowledge about medicinal plants of each gender. Women prefer visible plants, such as shrubs and trees, while men opt for less visible wild herbs, requiring specific forest knowledge. This indicates that knowledge of use may align with issues related to biological sex or social roles of each individual.

In this way, disparities in knowledge and healthcare between genders become evident in the community, justifying the adaptation of medicinal plant repertoires to meet the specific needs of each group. Men and women may face different health conditions, requiring distinct approaches in the use of medicinal plants. This underscores the importance of both genders in the resilience of the local medical system. Furthermore, traditional knowledge associated with the use of medicinal plants differs between men and women in many societies, making it essential to appreciate and preserve this diversity of knowledge.

Conclusion

In conclusion, our findings indicate no difference in the number of known medicinal species between genders, but there's a clear distinction in the types of medicinal species they know. Women tend to be more acquainted with exotic species found in domestic environments, while men are more familiar with native species and those found in natural areas. Recognizing these gender-based nuances is crucial for the development of conservation policies, sustainable use of medicinal plants, and understanding the community's traditional knowledge.

Declarations

Ethics approval and consent to participate: All ethical and legal aspects were duly complied with. For further details, see the "Ethical and Legal Aspects" section.

Consent for publication: All individuals who provided information for this study previously consented and were informed before being interviewed.

Availability of data and materials: The tables and figures supporting this study's results are included in the article, and the original data sets are available upon request to the corresponding author.

Competing interests: The authors declare that there are no conflicts of interest in this article.

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Author contributions: CSRG: Data collection, writing; ADSG: Data collection, writing; ASC: Statistical analyses, writing, and text review; PTM: Writing and text review; PMM: Conceptualization, statistical analysis, writing, and text review; TCS: Writing and text review.

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