



Original Paper

Do socioeconomic variables explain medicinal plant knowledge and the diseases they treat? A case study in the Boa Vista community, Alagoas, Northeastern Brazil

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Abstract

Local medicinal plants knowledge varies in relation to factors as age, gender, education, and income. Understanding this variation enables the identification of weaknesses in local medical systems, since access to knowledge is well distributed in different social classes. Socioeconomic variables can influence the quantity of known medicinal plants, and therefore, there may be a qualitative variation in the plant and disease repertoire of different social groups. Thus, we aimed to identify if socioeconomic variables influence the set of known medicinal plants and diseases by people in the Boa Vista community, São José of Tapera, Alagoas. A total of 33 semi-structured interviews were conducted, using the free-listing technique for data collection. There were no significant differences between the knowledge of men and women from a quantitative point of view. We observed that older interviewees knew more medicinal plants than younger, and there was a significant difference between the medicinal plants known to older and younger people. In terms of cited diseases, there was no difference between gender or age. Therefore, making inferences about qualitative-quantitative aspects of medicinal plant and disease knowledge requires understanding the social structure of the studied community, since people with similar social roles tend to have homogeneous knowledge.

Key words: Ethnobotany, medical systems, rural community, socioeconomic factors.

Resumo

O conhecimento local sobre plantas medicinais varia em relação a fatores como: idade, sexo, educação e renda. A compreensão dessa variação permite a identificação de pontos fracos nos sistemas médicos locais, já que o acesso ao conhecimento é bem distribuído em diferentes classes sociais. As variáveis socioeconômicas podem influenciar a quantidade de plantas medicinais conhecidas e, portanto, pode haver uma variação qualitativa no repertório de plantas e doenças de diferentes grupos sociais. Assim, objetivou-se identificar se variáveis socioeconômicas influenciam o conjunto de plantas e doenças medicinais conhecidas tratadas por pessoas da comunidade rural de Boa Vista, São José de Tapera, Alagoas. Foram realizadas 33 entrevistas semiestruturadas, utilizando a técnica de listagem livre para coleta de dados. Não houve diferenças significativas entre o conhecimento de homens e mulheres do ponto de vista quantitativo. Observamos que os entrevistados mais velhos conheciam mais plantas medicinais do que os mais jovens, e houve uma diferença significativa entre as plantas medicinais conhecidas por pessoas mais velhas e mais jovens. Em relação às doenças citadas, não houve diferença entre gênero ou idade. Portanto, fazer inferências sobre aspectos qualitativo-quantitativos do conhecimento de plantas medicinais e doenças requer a compreensão da estrutura social da comunidade estudada, uma vez que pessoas com papéis sociais semelhantes tendem a ter conhecimento homogêneo.

Palavras-chave: Etnobotânica, sistemas médicos, comunidade rural, fatores Socioeconômicos.

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Introduction

Ethnobotanical studies have been developed to identify which socioeconomic variables influence knowledge and use of medicinal plants by local populations, and among the most investigated variables are age, gender, income, and education level of the interviewees (Almeida *et al.* 2011; Bapstel *et al.* 2014; Paniagua-Zambrana *et al.* 2014; Andriamparany *et al.* 2014). Results from these studies identify which social groups concentrate more information on medicinal plant knowledge and thus can direct studies that aim at bioprospecting (Albuquerque *et al.* 2014). Additionally, verifying the relationship between these factors may allow the development of conservation strategies because it accesses the best known species and that consequently can be the most used and pressured in the environment, as well as the possible groups of people who know and use most plants. This understanding can then direct public policies aimed at conservation of specific species and groups of people.

Medicinal plant knowledge and socioeconomic variables have been observed to increase with age, where generally older people cite a greater number of plants than younger people (Monteiro *et al.* 2006; Voeks 2007; Oliveira *et al.* 2012). This is generally attributed to the accumulation of experience with illness and family responsibility, which often implies having to take care of a child's health (Voeks 2007; Silva *et al.* 2010), as well as dealing with landscape changes. Older generations may have been more likely to know plants that are no longer available for younger generations (Hanazaki *et al.* 2013).

When it comes to the influence of gender on medicinal plant knowledge, some authors have found that women tend to cite more plants in local pharmacopoeias than men (Voeks 2007; Camou-Guerrero *et al.* 2008). Others have observed the opposite, that is, males stand out in relation to this type of knowledge (Giday *et al.* 2009; Albuquerque *et al.* 2011). In an overall data analysis Torres-Avilez *et al.* (2014) found no difference in medicinal plant knowledge between genders. Thus, there is a variation in local knowledge in terms of gender, which can be attributed to the division of social roles, including caring for the family's health and responsibility in collecting resources within different cultures (Howard 2006), as well as psychological causes (Buss & Schmitt 1993).

The education, associated with the income of the interviewed, are factors that can interfere in

the knowledge about medicinal plants, since less educated individuals tend to stay out of the labor market and dealing with agricultural activities, hunting and collecting medicinal plants (Dantas & Guimarães 2006; Alves *et al.* 2008). This factor provides these people with more direct contact with natural resources and, consequently, greater knowledge about them.

Not only do socioeconomic variables influence the amount of known medicinal plants, together with other subjective variables, as feelings, beliefs and values, they can cause a qualitative variation in the repertoire of plants and mentioned diseases, since the division of social roles causes different forms of contact with resources. In Nanga Jui, Indonesia, women knew more about plants from secondary vegetation because it is closer to their homes, while men knew more about primary vegetation species, since they often visit primary vegetation areas to gather resources for family support (Caniago & Siebert 1998). However, in communities where the division of labor is different, this logic may change. Understanding this qualitative variation in medicinal plant knowledge is important in the current scenario of global environmental changes, because when species diversity is associated strictly to a socioeconomic group and specific landscape, it is possible to identify fragilities in medical systems and discuss issues related to species resilience (Díaz-Reviriego *et al.* 2016).

Thus, the present study aimed to evaluate whether local knowledge on medicinal plants is influenced quantitatively by socioeconomic variables such as age, gender, income, and education, as well as qualitatively for plants and diseases cited among genders and people of different age groups in the rural community of Boa Vista, São José da Tapera, AL, northeastern Brazil. Even knowing the limitation of working only with knowledge, it was the only data that we can reliably access, because to access the effective use, we would have to recall 24 hours and we did not have the logistical conditions to do so, and without using this methodology the data of use would also be based only on the interviewed responses

Material and Methods

Study area

The study took place in the Boa Vista community that is located in the city of São José da Tapera, in the state of Alagoas, northeastern Brazil. The municipality of São José da Tapera. According

to Perfil municipal (2014), the colonization of São José da Tapera began in 1900, on the existing farm in the place where the city is located today, installing a house of commerce there. Some time later, a fair of great acceptance was created by the residents of the neighborhoods. The initiative made farmers in other municipalities aware of the fertility of local lands, encouraging them to set up properties there, started to proliferate, then houses made of clay (taperas). Then, a chapel dedicated to São José was built. They took advantage of the existence of simple buildings, naming the place after São José da Tapera. The city is located at latitude 09°33'30"S and longitude 37°22'52"W, the climate in this region is hot, semi-arid, steppe type with a rainy season in autumn/winter, and a minimum temperature of 16 °C and maximum of 37 °C (Perfil Municipal 2014). The municipality is in the mesoregion of the Alagoan *sertão* and microregion of Santana do Ipanema, and approximately 240 km from the capital Maceió (Map data 2017). The municipality exists within the Caatinga ecosystem and its population is approximately 32,455 inhabitants (IBGE 2017). The community was chosen due to logistical issues, such as transportation, in addition to the fact that its residents heavily use the local flora as a medicinal resource.

The Boa Vista community is located in a rural area 16 km from the city center, with 71 inhabitants distributed into 19 families and 43 people over the age of 18. The community is surrounded by areas of caatinga, named by the residents as *Serra*. Near the community there is a known creek called "by the *Rio do Silva*". During the rainy season, water accumulates in the creek and forms strong currents, making the community's access to the city difficult.

In terms of health services, the community has a health center that receives weekly visits from the Family Health Program (PSF) care team. The local school is located in the *Sítio Piedade* (close to the community). There is no sanitation or sanitary sewage network. The residents' main economic activity is family farming, primarily planting corn and beans, as well as raising small poultry, cattle, and breeding goats. The houses in the community are masonry with an electricity distribution network but no running water, so the residents store water in cisterns.

Data collect

Home visits were done together with the community health agent in order to explain the

objectives of the study and to invite residents over the age of 18 to participate in the study. After the visits, the residents were asked to sign the Free and Informed Consent Term (TCLE), prepared in accordance with Resolution 466/2012-CNS/CONEP and the CEP (Comitê de ética em pesquisa), under the authorization number: 3.038.231.

Initially, socioeconomic data was collected from interviewees, such as age, education, monthly income, length of residency in the area, and family size. Subsequently, we used the free-listing technique to generate a list of plant species recognized and used by interviewees for medicinal purposes (Albuquerque *et al.* 2014). The guiding question used during the free-listing of plant species was: what medicinal plants do you know? Interviewees were also asked about the use of each plant in the community.

After identifying known medicinal plants, we used the walk-in-the-woods technique with one of the interviewees from the community to collect the plants cited by the interviewees and identify the botanical name of the mentioned species (Albuquerque *et al.* 2014). All the specimens were identified by specialist and deposited with Instituto Agrônomo de Pernambuco (IPA), Recife, Pernambuco.

Data analysis

We used a GLM (generalized linear model) to verify if there were significant differences between the number of known plants in relation to variables, age, gender, income, and education, using the dredge function in the MUMIN package - R Project (Core Team 2017). Education level was divided into five categories: illiterate, incomplete elementary school, complete elementary school, incomplete secondary school, and complete secondary school. Lastly, income was divided into six categories: less than one minimum salary, one minimum salary, one and a half minimum salaries, two minimum salaries, two and a half minimum salaries, and four minimum salaries. Currently a minimum salary equal to R\$ 1,045 (about US\$ 200).

We used a PERMANOVA (Permutational Analysis of Variance) to analyze whether there were differences between the composition of plants known to men and women, as well as among older (40 years or older) or younger interviewees (40 years or younger), this age division, which is not consensual in ethnobotany, was based on

the social functions of the interviewees, since in the community people under 40 are more active and have greater contact with natural resources and older people gradually decrease this contact, according to participant observation and informal conversation. This same test was used to assess differences between the set of diseases known to men and women, and between older and younger interviewees. Diseases were classified according to the work of Staub *et al.* (2015).

The ISA test (Indicator Species Analysis) was used to identify plants that were most associated with local knowledge of women or men, as well as those associated with the knowledge of older or younger people. According with De Cáceres (2013):

“Indicator species are often determined using an analysis of the relationship between the species occurrence or abundance values from a set of sampled sites and the classification of the same sites into site groups, which may represent habitat types, community types, disturbance states, etc”. In order to find possible indicator species by gender and age, we substituted the community data matrix for a citation data matrix, where instead of the abundance values of a species in a sample site, we used the frequency of citation in a particular group of people (male and female; older and younger).

This same test was used to identify diseases (using a data matrix of cited diseases) that were most associated with women or men in the community, as well as the diseases most associated with the elderly or the young. We used R software version 3.4.3 (R core team 2017) to perform the tests, with the help of vegan packages (Oksanen *et al.* 2017) and indicpecies (De Cáceres & Lagendré 2009).

Results and Discussion

Medicinal plant diversity

From 43 people over the age of 18, a total of 33 interviewees acquainted with medicinal plants participated in the study, 17 women and 16 men between the ages of 19–39 (22 interviewees) and 40–70 (11 interviewees) years.

The medicinal plant free-listing registered 124 ethnospecies (locally classified plants) (118 species) indicated for the treatment of different types of diseases. The most representative families in this study were Fabaceae (12 species), followed by Lamiaceae (09 species), Asteraceae (07 species), and Anacardiaceae (05 species).

Intracultural variation of local knowledge on medicinal plants

The GLM results indicated that there were no significant differences in medicinal plant knowledge between men and women in the Boa Vista community (z value = -1.154; X^2 = 1.33; Confidence interval = 1; p = 0.24). As well as GLM analyzes showed that the variable income (X^2 = 6.34; confidence interval = 5; p = 0.27) and education (z value = 0.362; X^2 = 5.55; confidence interval = 4; p = 0.23) does not explain medicinal plant knowledge in the Boa Vista community. The only variable analyzed that explains the variation in knowledge is age. According with the best fit model, the greater the age the greater the number of ethnospecies cited (z value = 2.038; X^2 = 4.15; Confidence interval = 1; p = 0.04), showing that older individuals know more plants than those belonging to the younger age group.

In relation to the no significance of the gender variable in explain the medicinal plant knowledge, a study by Almeida *et al.* (2011) conducted in three rural communities in northeastern Brazil, a similar result was observed. Moreover, the authors connected this result to the fact that in the communities there was no division of roles and both men and women participated in collecting medicinal plants. The latter allowed both to have contact with medicinal plants and thus shared a similar knowledge, which shows that the distribution of knowledge in some cultures is associated with the social role exercised by people, regardless of gender (Pfeiffer & Butz 2005; Torres-Avilez *et al.* 2014).

Therefore, we believe that the homogeneity found between men and women in relation to medicinal plant knowledge reflects the type of occupation of the Boa Vista residents. Most interviewees work in agriculture and all are responsible for the collection of forest resources, as it was observed in the field and reported by the interviewees. These roles provide them with similar experiences with medicinal plants, thus, allowing both men and women to know similar quantities of plants. In the same way, we can attribute the lack of relation between income and medicinal plant knowledge to the interviewees occupation in the community, since most of the livelihood comes from agriculture and government assistance. There is no division of labor in plant collection, which can enable contact with similar resources, and consequently, a better distribution of knowledge within the community.

In our study, education was not a good predictor of medicinal plants knowledge. Similar results were found in a study by Messias *et al.* (2015), where the authors observed that medicinal plant knowledge did not depend on the interviewees' education level. However, the lack of influence of education on medicinal plant knowledge is not standard. There are studies developed by several researchers that show a significant relationship between educational level and the number of known medicinal plants. For example, Gyday *et al.* (2009) found that literate people knew fewer herbal medicines than illiterate people, and the authors emphasized that this result may be due to the increasing interference of modernization. Medeiros *et al.* (2014) argue that greater or lesser knowledge and/or use of these resources may be associated with other factors such as income and occupation. For the authors, people who have jobs in agriculture and forestry would have greater ease with natural resources, so they may have more knowledge on these resources. However, since there is no such variation in the Boa Vista community, the medicinal plant knowledge was homogenous in terms of the interviewees' education level.

Following the GLM results, the only socioeconomic variable that explained the knowledge of medicinal plants was age. This finding is corroborated by other studies on variation in knowledge due to age (Almeida *et al.* 2011; Silva *et al.* 2011; Hanazaki *et al.* 2013). Although interviewees have similar social roles and knowledge is well distributed among genders, it may increase with age due to several factors, such as the progress of globalization that affects young people more directly, causing their lack of interest in herbal medicines, which has been found in other ethnobotanical studies (Voeks & Nyawa 2001; Quinlan & Quinlan 2007). Additionally, older generations are more likely to be affected

by certain diseases than younger people, which may also contribute to greater medicinal plant knowledge (Voeks & Leony (2004), even if their contact with natural resources decreases over time.

In addition to the GLM results, we also performed a PERMANOVA test. We aimed to evaluate possible differences in relation to the plant species used between gender and age groups. There were no significant differences related to the diversity of medicinal plants known to men and women (DF = 32, F = 1.034, R² = 0.03, p = 0.40), reinforcing our previous data that shows homogeneity of knowledge among gender. This result is also supported by the ISA test, in which no plant was strongly associated with men's knowledge, and from the 124 reported species only four species were associated with women's knowledge and among them only one is native from Brazil (*Mesosphaerum pectinatum* (L.) Kuntze) (Tab. 1), indicating an influence of exotic species on the medicinal repertoire of men and women, as pointed out by Santos *et al.* (2014) in another semi-arid region. This fact may be associated with changes in the landscape that provides greater dependence on the collection of medicinal plants in anthropogenic areas, such as backyards and other cultivation areas (Silva *et al.* 2018).

When analyzing the set of medicinal plants and age using a PERMANOVA test, we observed that there were significant differences between the set of medicinal plants known to older and younger people (DF = 32; F = 2.216; R² = 0.06; p = 0.01). This indicates a certain degree of heterogeneity between plants known to older and younger people, which shows that not only the quantity of plants cited were different among age groups but also the plants cited were different. When using the ISA test, a total of 12 plants were found more associated with older generations (Tab. 2), plants that are mainly associated with diseases that affect older

Table 1 – Plants most associated with local knowledge of women according to the analysis of indicator species (ISA) in the community of Boa Vista, São José da Tapera, AL, Brazil. P value referring to ISA analysis.

Local name	Scientific Name	Voucher	Stat	p Value
Manjeriçã	<i>Ocimum americanum</i> L.	Dantas, JIM 92948	0.67	0.03
Sambacaiã	<i>Mesosphaerum pectinatum</i> (L.) Kuntze	Dantas, JIM 929562	0.64	0.02
Erva-doce	Not collected	-	0.56	0.02
Camomila	Not collected	-	0.50	0.04

Table 2 – Plants most associated with local knowledge of older generations (older than 40 years) according to the analysis of indicator species (ISA) in the community of Boa Vista, São José da Tapera, AL, Brazil. P value referring to ISA analysis.

Local name	Specie	Voucher	Therapeutic indications	Stat	Valor de p
Mastruz	<i>Chenopodium ambrosioides</i> L.	Dantas, JIM 92962	Healing, stomach pain, injury, gastritis, hemorrhoid, broken bone, blow, bump, worm, cough	0,78	0,002
Catingueira	<i>Poincianella pyramidalis</i> (Tul.) L. P. Queiroz	Dantas, JIM 92944	Burning in the vagina, bellyache, diarrhea, urine pain, inflammation, cough.	0,77	0,016
Barbatimão	Not collected	-	Spinal pain, inflammation, urinary tract infection, inflammation in the uterus, blows.	0,64	0,016
Babosa	<i>Aloe vera</i> (L.) Berm.F	Dantas, JIM Infertile	Cancer, fever, gastrites	0,61	0,025
Seriguela	<i>Spondias purpurea</i> L.	Dantas, JIM 92947	Diarrhea, bellyache	0,61	0,033
Melancia	Not collected	-	Fever, flu, sexual impotence, urinary tract infection, high blood pressure	0,60	0,010
Pau-para-tudo	Not collected	-	Spinal pain, body aches, gastritis, rheumatism, all diseases.	0,57	0,024
Quina-quina	Not collected	-	Healing surgery, fever, flu, sinusite.	0,57	0,038
Cipó-de-alento	Not collected	-	Spinal pain, stroke, inflammation of the kidney.	0,52	0,027
Coentro	Not collected	-	Headache, migraine, fever, flu	0,52	0,032
Girassol	Not collected	-	Cholesterol, smoker, fever, dizziness	0,52	0,032
Romã	<i>Punica granatum</i> L.	Dantas, JIM 92697	Sore throat, cholesterol, hoarseness.	0,52	0,029

generation, such as high cholesterol, rheumatism, sexual impotence, among others. However, no plant had a strong association with younger generations, which reinforces the idea that contact with different diseases may lead to a differentiated repertoire of medicinal plants among the elderly. The set of plants that were strongly associated with the older generations varied among local name of secondary (*Chenopodium ambrosioides* L; *Aloe vera* (L.) Berm.F; *Punica granatum* L.) and primary forest areas (*Poincianella pyramidalis* (Tul.) L.P. Queiroz; *Spondias purpurea* L). The latter indicates that older people's knowledge is associated with several types of vegetation and is not only restricted to native species that young people have difficulty accessing due to environmental changes. This is different from Hanazaki *et al.* (2013) with the idea of shifting baseline syndrome.

Intracultural variation of diseases treated by medicinal plants

There were no significant differences between the number of diseases treated by men and women (DF = 32, F = 1.105, R² = 0.03, p = 0.37). This result demonstrates a certain degree of knowledge homogeneity among the genders in the studied community. This result is also supported by the ISA test, where no disease had a strong association with the knowledge of men. There were only two diseases of 103 cited in the community associated with the knowledge of women, which were inflammation, in a generic way, because we do not investigate deeply the types of inflammation by local people (Stat 0.58; p = 0.04) and dysentery (Stat 0.50; p = 0.04). In the region, dysentery mainly affects children,

who are socially cared for by the maternal figure, thus being able to justify the greater knowledge associated with women.

The absence of significant differences between men and women in relation to the types of diseases treated by medicinal plants may be associated with the fact that most of the mentioned diseases are common between both genders. For example, diseases related to the digestive, respiratory, and genitourinary systems can affect both women and men, and diseases such as diarrhea, influenza, and urinary infection were the most treated by medicinal plants in the Boa Vista community. Moreover, the lack of division of social roles in the community provides homogeneity in learning about medicinal plants for the treatment of diseases. It is common to find different plant and disease repertoires in communities where there is a division of social roles between men and women related to health care, since women take responsibility for the their children's health, they come in contact with different plants and diseases than man (Voeks 2007; Silva *et al.* 2010).

There were also no significant differences between the set of diseases treated by medicinal plants mentioned by older and younger people (DF = 32; F = 1.642; R² = 0.05; p = 0.06). When using the ISA test, there were a total of six diseases associated with older generations (Tab. 3); however, there were no diseases strongly associated with younger generations. Diseases strongly associated with older people are not only more frequent in this group of people, but can also affect younger

people, since they are parasitic diseases, abdominal distension, sore throats, among others. However, the fact that older people generally know more about plants and diseases (Voeks 2007; Oliveira *et al.* 2012), they may also tend to know more about the most common diseases in the community. Thus, it would be interesting to investigate the frequency of diseases among the age groups, because if these diseases affect older people more often, this would justify the fact that they are mentioned more by this group. However, we did not obtain this data due to logistical difficulties in the study.

The fact that there are no quantitative and qualitative differences in the repertoire of medicinal plants of men and women in the community, may be associated with the non-division of social functions associated with the collection of plants. But one factor that drew the researchers' attention was the 4 species in common to the two groups (*Ocimum americanum* L; *Mesosphaerum pectinatum* (L.) Kuntze; *Pimpinella* sp; *Matricaria* sp.), 3 were exotic, a curious fact to be investigated in future works. As it was also to be expected quantitatively, the elders showed greater knowledge about medicinal plants, but an important contribution of this work was to verify that there are groups of plants and specific diseases for older people, indicating that there are several factors associated with the transmission of intergenerational knowledge, that may be associated with contact with natural resources and diseases over time. In addition, we believe that accessing these variations

Table 3 – Diseases most associated with local knowledge of older generations (older than 40 years) according to the analysis of indicator species (ISA) in the community of Boa Vista, São José da Tapera, AL, Brazil.

Disease	Description	Stat	P-value
Swollen belly	Disease caused by intestinal disorder and may cause abdominal distention.	0.685	0.038
Parasites	Disease caused by intestinal parasites and includes a large group of microorganisms, where helminths and protozoa are the most common.	0.674	0.001
Backpain	A disease that can cause back pain and may increase with age.	0.603	0.009
Diabetes	Metabolic disturbance that presents with high blood sugar levels, caused by deficiency in the production and/or action of insulin or both.	0.522	0.033
Sore throat	Upper respiratory tract disease, which may be caused by a variety of environmental agents.	0.522	0.025
Hoarseness	Dysphonia or alteration in the tone of voice caused by functional or organic disorders of the vocal tract.	0.522	0.030

in knowledge is an important tool in bioprospecting studies, as they can focus on specific groups of people when seeking certain knowledge about medicinal plants.

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