Local knowledge about medicinal plants does not influence the self-reported well-being of inhabitants of the semi-arid region of northeastern Brazil

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Ethnobotany Research and Applications 24:26 (2022)

Research

Abstract

Background: The literature gathers several pieces of evidence on the use of medicinal plants for disease treatment, showing that local knowledge about medicinal plants is a relevant reservoir of information for local health treatment. However, a direct positive correlation between this local knowledge and the perception of well-being is still unknown, as well as the potential impacts of this correlation on humans' quality of life. In this study, we hypothesized that the local knowledge of medicinal plants positively impacts well-being.

Methods: The study was conducted in six communities inside the Catimbau National Park, Northeastern Brazil, dependent on using plants to treat diseases. Local knowledge about medicinal plants and self-reporting well-being were collected by free listing and semi-structured interviews, respectively. The well-being index of each participant was calculated by summing the scores of their answers for seven questions that covered individual aspects and food and financial security. A generalized linear model was conducted to assess the relationship between the knowledge of ethnospecies and the well-being index of participants.

Results: Participants cited an average of 10.06 ethnospecies and 8.18 therapeutic targets. The mean score of the well-being index was 22.22. We found no association between the local knowledge of medicinal plants and the well-being index.

Conclusion: The local knowledge of medicinal plants is not a determining factor of local human well-being.

Keywords: happiness, ecosystem services, ethnobotany.

Manuscript received: 17/10/2022 – Revised manuscript received: 21/10/2022 - Published: 22/10/2022
http://dx.doi.org/10.32859/era.24.26.1-8

Background

The concept of well-being has changed over the years from its initial definition based purely on the economy, represented universally by the Gross Domestic Product (GDP) (Conceição & Bandura 2008). Thus, a social-ecological concept of well-being arose since the economic concept does not cover social and environmental aspects not represented by the GDP, such as educational, health, and environmental indicators (Conceição & Bandura 2008). In addition, universal indicators are not characterized as adequate instruments for measuring well-being, as they may omit forms of knowledge inherent to local well-being (Ferraro & Barletti 2016) and the subjective perception of individual well-being (Conceição & Bandura 2008). According to the Millennium Ecosystem Assessment (MA) (Assessment 2005), well-being is a state dependent on context and situation and composed of five components: basic materials for a good life, freedom of choice, health, safety, and good social relations. These components are more or less influenced by ecosystem services (ES), beneficial contributions withdrawn from the ecosystem by the population, which are grouped into four categories: supporting services (e.g., nutrient cycling, primary production), provisioning services (e.g., food, medicinal resources, and firewood), regulating services (e.g., flood, drought, and land degradation control), and cultural services (e.g., recreational and cultural benefits) (Assessment 2005).

Hence, medicinal plants perform a provisioning service for human populations, an ecosystem service provided by medicinal plants for human well-being from thousands of years ago. Accordingly, ethnobotanical studies have shown the intrinsic relationship of local and indigenous communities with medicinal plants, favoring human well-being (Ramízer & Ibarra 2015, Mckenzie *et al. 2015*). Undoubtedly, knowledge of the medicinal service provided by biodiversity is closely related to the health problems experienced by people, which can interfere with the perception of the individual's well-being (Mccarter *et al.* 2018). However, there is a lack of studies seeking evidence of an association between medicinal knowledge and self-reported well-being to confirm the individual perception of well-being concerning the repertoire of known medicinal plants. Moreover, knowing medicinal plants can contribute to financial security since treating diseases using medicinal plants can be a more economical and sometimes more accessible alternative to allopathic medicines (Vandebroek *et al.* 2004, Liwa *et al.* 2017, Reyes-García *et al.* 2013). Local knowledge about medicinal plants (LKMP) also can contribute to safe access to disease treatment, as it confers some autonomy in choosing healthcare treatments. Thus, people can use what they value, or think is most suitable for their health treatment (Liwa *et al.* 2017). In addition, LKMP fosters and strengthens social relationships between individuals, representing a source of information that allows one person to help others. Therefore, LKMP is also part of the cultural expression (Cavalli-Sforza *et al.* 1982, Zank & Hanazaki 2016).

Some studies have already been developed to highlight the importance of ES for local communities (Bullock *et al.* 2018, Fagerholm *et al.* 2016, Jones *et al.* 2019, Mckenzie *et al.* 2015). However, studies on the association of well-being with LKMP are scarce. Reyes-García *et al.* (2008) assessed whether a high educational degree or a high level of knowledge on traditional medicine is complementary to or substitute for improved well-being. These authors found a positive influence of the knowledge of useful plants on body mass index (BMI) and that schooling and traditional human capital operate independently concerning human well-being. However, these authors did not use self-reported measures of well-being, which may generate little robustness to their results, considering that people with below-average BMI can report a better state of well-being than people with above-average or average BMI.

We questioned in this study whether LKMP would be associated with a better state of subjective, self-reported well-being. Based on this question, we propose to evaluate hypothesis H1: LKMP positively affects well-being. It is expected that people who cite a high number of medicinal-plant ethnospecies, therapeutic targets, and body systems treated by plants show a higher index of self-reported well-being than people with less knowledge of these elements. Thus, we questioned if LKMP would be associated with a better state of subjective, self-reported well-being. Based on this question, we propose to assess if LKMP positively affects human well-being.

Materials and methods

Study area

The study was carried out in the Catimbau National Park (PARNA Catimbau), an area of environmental preservation created in 2002. This park is located in the State of Pernambuco, between the geographical coordinates 8°29'01.7"S and 37°20'08.3"W, covering 62,294.10 ha over the municipalities of Buíque, Tupanatinga, and Ibimirim.

The creation of the PARNA Catimbau demanded land expropriation, generating socio-environmental conflicts. The land expropriation process has not yet been completed (Gonçalves *et al.* 2021, Specht *et al.* 2018), remaining several local communities, with approximately 109 houses and 212 individuals of legal age, within the PARNA Catimbau. Despite these conflicts, several ecological and ethnobiological studies have already been developed by members of our group inside PARNA Catimbau (Freire *et al.* 2015, Gonçalves *et al.* 2021, Specht *et al.* 2018). Therefore, an established rapport facilitated data collection. Moreover, the communities inside PARNA Catimbau made this environmental protection unit a suitable area to answer the question of this study. These local communities are settled far from urban centers and depend heavily on provisioning services from the forest (Freire *et al.* 2015). For instance, there are no hospitals, medical clinics, or drugstores inside these communities, restricting access to biomedicine for health care for a population that is in large part below the poverty line (Specht *et al.* 2019), which in turn increases the search of medicinal resources from the forest. In addition, visits by health agents or on-site doctor visits are carried out monthly or during health promotion campaigns periodically conducted by the NGO Amigos do Bem. This NGO has supported families in the PARNA Catimbau since 2005, promoting doctor visits, dental treatment, and medicine distribution (Freire *et al.* 2015).

The prevailing climate in the study region is the semi-arid BSh type, according to the Köppen classification. The total rainfall varies between municipalities, but overall, the annual average is less than 700 mm. The average annual temperature fluctuates around 23ºC.

We selected six communities inside the PARNA to conduct the research: Sítio Igrejinha, Breus, Dor de dente, Muquém, and Açude Velho, totaling 109 residences. The main labor occupation of the six communities is agriculture, though most of the income comes from goat farming. Some families also receive financial support from NGOs and Bolsa Família Program from the Brazilian government. Most of the residences in the six communities are not made of masonry, and there are no sewage, sidewalks, and asphalted streets (Gonçalves *et al.* 2021, Specht *et al.* 2019).

Data collection, contingency tables, and statistical analysis

The LKMP and self-reported well-being index (WBI) were collected using the free listing and structured interviews. Data collection followed protocols of research on knowledge about medicinal plants and well-being developed by the National Institute of Science and Technology, Ethnobiology, Bioprospecting and Nature Conservation in the Catimbau area (Silva *et al.* 2020, Specht *et al.* Sousa et al. 2022, Sousa *et al.* 2022), of which the authors of this study contributed to database creation. Data was gathered between 2017 and 2020, with one individual interviewed per residence in one of the three visits conducted to access the resident's local knowledge. After the third visit, the residence was eliminated from the sample if the resident was absent or insisted on interviewing at another time. Ninety-eight individuals were interviewed out of a total of 109 households. Then, interviews were sorted, selecting only participants who answered the questions in both protocols, knowledge of medicinal plants, and well-being, resulting in a final sample of 49 participants.

The well-being protocol contained seven questions covering individual aspects and food and financial security since they are fundamental to assessing human well-being. Table 2 shows the seven questions assessing the participant's well-being perception. Overall, how do you feel emotionally? 2. How would you say your health is on a scale from 0 to 10, with 0 representing extremely bad and 10 very well? 3. How do you rate your current health concerning five years ago? 4. Do you know how to prepare folk remedies? 5. Was your last 12 months' income covering your food expenses? 6. Was your last 12 months' income covering your health care expenses? 7. Are you happy living in this community? Each question had answer options with odd scores (1, 3, 5, 7) for better differentiation of the chosen answer. The highest scores reflected better health, financial conditions, and social interaction than the lowest scores. These scores were established in the well-being protocol, and the WBI of each participant was calculated by summing the scores of each of their answers for the seven questions.

The structured interviews and free listing assessed the LKMP of the participants by asking if they were aware of any medicinal plant and its use (therapeutic target). Therapeutic targets were classified into body systems based on the International Statistical Classification of Diseases and Related Health Problems 10th Revision- ICD-10 (2019). Therapeutic targets of a religious nature were classified in the category of Spiritual Diseases. Subsequently, each participant's body system treated by medicinal plants was counted.

As two of our variables are correlated, we opted for one generalized linear model (GLM) with just the dependent variable -number of ethnospecies- since including correlated variables in a GLM can affect the effective size (Winter 2013). In addition, the number of ethnospecies is a measure of local knowledge widely used in ethnobiological studies. The statistical test was performed using the R software (Team 2019).

Table 1. Values of Spearman's coefficient for the correlation between the dependent variables.

	Ethnospecies	Therapeutic targets	Number of body systems
Ethnospecies	1		
Therapeutic targets	0.89***	1	
Number of body systems	0.82***	0.92***	1

***= p<0.001.

Results

The WBI ranged from 13 to 31 points (mean=22.22, SD=4.49). Table 2 shows the mean scores and standard deviation of WBI for each of the seven questions. The ethnospecies cited by the participants ranged from 0 to 31 (mean 10.06; SD=7.63), therapeutic targets from 0 to 27 (mean=8.18; SD=6.25), and body systems treated by medicinal plants from 0 to 11 (mean= 4.63; SD=2.87).

On average, participants cited 10.06 ethnospecies of medicinal plants (SD=7.63, Maximum=31, Minimum=0). The five most cited species were: **European plum** (*Prunus domestica* L.), 56 times; **quixabeira** (*Sideroxylon obtusifolium* (Roem. & Schult.) T.D.Penn. subsp. *obtusifolium*), 41; **aroeira** (*Schinus terebinthifolius* Raddi*),* 39; **mastuz** (*Lepidium* sp.), 38; and **papaconha** (*Pombalia sp.*), with 27 citations. The five plants with the most uses were: **mastruz**, with 19 therapeutic targets; **European plum** (*P. domestica* L.), 18; **quixabeira** (*S. obtusifolium* (Roem. & Schult.) T.D.Penn. subsp. *obtusifolium*), 14; **aloe** (*Aloe vera* (L.) Burm. f.), 13; and **velame-branco** (*Mandevilla* sp.), with 12 targets. The five most cited classes of body system affections were: diseases of the respiratory system, 251 times; symptoms, signs, and clinical findings not classified in other disease classes, 131; diseases of the digestive system, 112; diseases of the genitourinary system, 59; and diseases of the skin and subcutaneous tissue, with 56 citations. Only 12 people did not know how to prepare herbal remedies.

Table 2. Self-reported well-being degree of participants residing in the Catimbau National Park, Pernambuco.

Question	**Alternative answers**	**Score**	**Quantity of responses**	**Mean ± SD**
Overall, how do you feel emotionally?	a) extremely bad	1	10	4.31 ± 2.02
	b) very bad	3	06	
	c) well	5	24	
	d) very well	7	09	
How would you say your health is on a scale of 0 to 10, with 0 representing extremely bad and 10 very good?	0-2	1	13	5.08 ± 1.52
	3-5	3	21	
	6-8	5	15	
	9-10	7	0	
How do you rate your current health concerning five years ago?	a) worst	1	24	2.63 ± 1.76
	b) equal	3	10	
	c) better	5	15	
Do you know how to prepare folk remedies?	a) no	1	12	2.51 ± 0.87
	b) yes	3	37	
Was your last 12 months' income covering your health care expenses?	a) insufficient	1	19	2.31 ± 1.12
	b) sufficient	3	28	

	c) more than enough	5	02	
Was your last 12 months' income covering your food expenses?	a) insufficient	1	14	2.59 ± 1.15
	b) sufficient	3	31	
	c) more than enough.	5	04	
Are you happy living in this community?	a) no	1	05	2.79 ± 0.61
	b) yes	3	44	

The model did not show a positive association between the knowledge of ethnospecies and the WBI (Table 3). Thus, we reject the hypothesis that the knowledge of ethnospecies positively impacts the participants' well-being.

Table 3. Generalized linear model for the association between knowledge of ethnospecies and self-reported well-being of participants residing in the Catimbau National Park, Pernambuco.

Variable	**Estimate**	**Sts.Error**	**T-value**	**Pr(>|t|)**	**AIC**
WEI Model ~ No. of cited ethnospecies					
Intercept	22.57661	1.07772	20.949	< 2E-16***	291
Ethnospecies	-0.03500	0.08569	-0.408	0.685	

(WEI = local human well-being index, ***=p<0.001,**=p<0.01, *=p<0.05).

Discussion

Despite reported evidence of the positive association between ES and human well-being (Assessment 2005), we did not detect the same association between self-reported well-being and the LKMP. Even as ES more or less influences the five components of well-being, a set of ES is needed to impact each component of human well-being (Assessment 2005). Thus, adding other knowledge related to plant utilities (food, timber, fuel etc.) may be associated with better self-reported well-being. Hence, it is worth mentioning that our results do not diminish the importance of plants since they are a source of health treatment for several traditional or indigenous populations (Assessment 2005, Caillon *et al.* 2017, Mccarter *et al.* 2018, Sterling *et al.* 2017), though showing that LKMP does not associate with self-reported WBI.

Although the LKPM can benefit all components of human well-being, people's experience is linked to the use of medical resources and the perception of its efficiency in treating the disease. Thus, people can report having LKMP though not using it for health care and, consequently, not acquiring the health benefits to have a sense of well-being. On the other side, LKMP can contribute to fostering and strengthening social relationships between individuals, representing a source of information that allows the person to help others. However, people may possess medical knowledge and not share it, thus not acquiring the benefits of good social relations. This scenario suggests the importance of adding measures of the use and sharing of LKMP in further studies on the correlation between LKMP and self-reported well-being.

The uses of medicinal plants fall within the provisioning category of ES, having differential degrees of influence among the components of well-being (Assessment 2005). For example, provisioning ES interact more intensely with the "material goods for a good life" than with the "good social relations" component of well-being (Assessment 2005). Our WBI calculation did not assign a similar number of questions to each component of human well-being as established by the MA. Thus, assigning different weights to the questions according to the components of well-being was impossible. This approach should be considered in further studies since medicinal plants are more important for the -health- component than for the -good social relations- component of human well-being.

It is worth noting that specific factors influencing human well-being (Hoorn 2008, Mcgillivray 2007) can fluctuate significantly over time. This research shows the transient self-reported well-being of the participants, not considering its variations over time. Thus, if interviewees were experiencing a recent illness, even at the moment of the interview, they could assign a low score to their health, resulting in a low WBI. In addition, the LKMP recovered

from the six communities studied may not represent the full knowledge of an individual since participants may not express all of their LKMP for not remembering it or feeling shy to do it during the interview. The partial communication of LKMP by the participants may result from the influence of different factors, such as the presence of third parties during the interview, and/or social factors like the interviewee's age, as reported by Meireles, Albuquerque, and Medeiros (2021). One way to circumvent such influences would be to perform annual repetitions of the survey in the area.

Studies on human well-being use two types of measures, objective and subjective. Objective measures are based on observable factors, such as sociodemographic and economic features, and subjective measures on information expressed by the participants of a survey about their feelings and sensations (Hoorn 2008, Mcgillivray 2007). Although there is usually a divergence between what people perceive and the reality regarding well-being, these two types of measures are equally accepted and not mutually excluding (Conceição & Bandura 2008, Hoorn 2008, Mcgillivray 2007). In our study, we chose subjective measures to associate well-being with LKMP. However, the WBI may not have accessed all the dimensions of individual well-being. Therefore, further studies must add objective measures that can improve the evaluation of the representation of the local well-being of a population. For example, some studies have shown the correlation between social factors and human subjective well-being (Conceição & Bandura 2008). Hence, these factors should be considered in more detail for further studies on the correlation between local knowledge and well-being.

Conclusion

The present study aimed to quantify the relevance of considering the LKMP for assessing the perception of people's well-being, showing that this local knowledge is not a determining factor for the well-being of the studied communities. However, scientific studies on the association of medicinal knowledge with self-reported well-being are still embryonic and, consequently, had limitations arising from the formulated questions and the metric used to calculate well-being. Thus, further studies require improvements to understand the multiple dimensions of human well-being better. Some of these improvements regard incorporating other evaluation metrics than those used in this study, more questions to assess the perception of well-being, improved forms of data collection considering more than one round of surveys to minimize the effect of memory lapses and/or transient fluctuations in the well-being of the participants.

Declarations

List of abbreviations: LKMP: Local knowledge of medicinal plants. WBI: Wellness Index. ES: Ecosystem Services. MA: Millennium Assessment. PARNA: National Park. BMI: Body Mass Index.

Ethical approval and participants' consent: The study was submitted to the Ethics and Research Committee of the Federal University of Pernambuco, which approved it under registration number CAE: 40412318.4.0000.5207. All interviewees were informed about the aim of the study and asked to sign the Informed Consent Form to meet the legal aspects of research involving humans, following the current legislation of the Conselho Nacional de Saúde, Ordinance No. 510/2016.

Consent to publication: Not applicable.

Availability of data and materials: The data generated for this study are available upon request.

Competing interests: The authors have no conflict of interest.

Funding: Capes, CNPq (CNPq: 303504/2018-8), and Fundação de Amparo à Ciência e Tecnologia do Estado de Pernambuco (FACEPE). Instituto Nacional de Ciência e Tecnologia (INCT) - Ethnobiologia, Bioprospecção e Conservação da Natureza, certified by CNPq and supported by the (FACEPE) (issue No: APQ-0562-2.01/17).

Author contributions: Bruno Melo de Sousa conducted fieldwork, statistical analysis, and manuscript writing. Ulysse Paulino de Albuquerque, study design and writing of the manuscript. Elcida de Lima Araújo, writing of the manuscript.

Acknowledgments

We thank all the participants for collaborating with the survey and the team of the Laboratory of Ecology and Evolution of Socioecological Systems (LEA) for their support in data analysis.

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