ETHNOBIOLOGY AND CONSERVATION

RESEARCH ARTICLE

Ethnobiology and Conservation, 13:29 (2 September 2024)
doi:10.15451/ec2024-09-13.29-1-13
ISSN 2238-4782 ethnobioconservation.com

Factors that influence complementarity and competition between medicinal plants and medicines of biomedical origin in an urban context

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ABSTRACT

Intermedicality is understood as a space of interaction between different medical systems in a given location, which can result in competition or complementarity. In urban environments, intermedicality is common between the biomedical system and other systems. In these scenarios, it is important to understand the therapeutic strategies used by people to treat illnesses, to identify whether the treatment systems adopted lead to competition or complementarity. Among the various factors that can influence these strategies are: people's current and past contact with the rural environment, visits to biomedical environments and socioeconomic factors (income, education and age). This study investigated the therapeutic strategies linked to the complementary or competitive use of medicinal plants and biomedical drugs in an urban environment. The study was carried out in the urban perimeter of the city of Araripina-PE, using an online form addressed to its residents. The form was made up of questions about the therapeutic strategies employed by people, with dissemination through social media and face-to-face visits to institutions and public places. The survey involved 298 residents. Generalized Linear Models, binomial family, were used to assess the effect of the predictor variables on the response variables. As a result, the best-fitting models showed that Complementarity was positively influenced by income and negatively by rural origin, and Competition was positively influenced by rural origin. This study suggests important mechanisms that may be regulating the use of medicinal plants and medicines of biomedical origin exclusively through competition or combined use of these resources in urban contexts.

Keywords: Intermedicality; Hybridization; Biomedicine; Local medical systems.

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SIGNIFICANCE STATEMENT

In urban settings, due to cultural diversity, people have access to a variety of resources and knowledge from various origins. This is especially relevant in municipalities where urban centers are close to rural areas, facilitating urban population's access to traditional resources and knowledge. Studies investigating the effect of factors related to people's origin and their contact with rural environments, as well as the influence of socioeconomic factors, on the adoption of different therapeutic strategies, are crucial for identifying the phenomenon of intermedicality in urban settings. The findings reveal that income positively influences the combined use of medicinal plants and pharmaceuticals, while rural origin of urban residents has a negative impact on this complementarity but positively affects competition, which involves exclusive use of one resource. The findings of this study reveal the importance of cultural plurality and the proximity of rural environments as influential factors in decision-making related to human health in urban contexts.

INTRODUCTION

A medical system can be defined by the perceptions, strategies, and knowledge of human groups related to human health, considering the social and cultural aspects present in these systems (Kleimnan 1978). There are various types of medical systems, including local medical systems and the cosmopolitan system (Dunn 1976). Local medical systems (LMS) are primarily structured by traditional knowledge, favoring the health of human groups using local resources, such as medicinal plants and animals, in the environments where these groups interact. The cosmopolitan medical system (CMS), on the other hand, is based on scientific principles and widely disseminated worldwide, with pharmaceuticals as its main therapeutic resource (Dunn 1976).

The contact zone between different medical systems is known as intermedicality, which reflects a space of interaction between the systems (Greene 1998; Soldati and Albuquerque 2012), including various subprocesses of hybridization (Abreu et al. 2023). In light of these subprocesses, interactions between medical systems can result in relationships of complementarity and competition (Soldati and Albuquerque 2012; Mathez-Stiefel et al. 2012; Giovaninni et al. 2011; Abreu et al. 2023). Complementary interactions may occur when resources or strategies from different systems are combined, such as the use of medicinal plants together with biomedical medicines to treat the same illness (Nascimento et al. 2018). Sequential use may also occur, where strategies from one system are used initially and, if symptoms persist, strategies from another system are adopted in the same episode (Giovaninni et al. 2011; Mathez-Stiefel et al. 2012). Conversely, competitive interactions occur when the employment of strategies from one system excludes the use of another system. An example involves the replacement of the use of medicinal plants with pharmaceuticals over time within a human group. Vandebroek et al. (2004) found that rural communities closer to primary healthcare centers had less knowledge of medicinal plants and greater knowledge of biomedical medicines, possibly due to increased access to industrial drugs.

In scenarios of competition and complementarity, various factors can influence the adoption of different medical configurations, such as people's origins, contact between people from different locations, and socioeconomic factors (Medeiros et al. 2012; Heather 2006; Delgoda et al. 2010; Messias et al. 2015; Nascimento et al. 2018). People's origins can be an important factor, as migrants often blend practices from their place of origin with those of their new location (Medeiros et al. 2016). An example of this occurs in migration contexts where, in some cases, medicinal plants are used by migrants to preserve their cultural identity (Ceuterick et al. 2011). People from other environments, particularly rural ones, may bring with them traditional concepts and practices from their regions of origin, which may be combined with biomedical knowledge in urban environments (Medeiros et al. 2012).

Another important factor involves the interaction networks among people, through contact with other individuals or environments. Urban dynamics related to treatment selection may also be influenced by other environments. Luján and Martinez (2017) found that in an urban environment, knowledge about plants was enriched by knowledge from other environments, like mountainous regions. Ferreras et al. (2022) also present the use of medicinal plants in patients from primary healthcare centers who did not reside in rural environments but maintained a close relationship with this environment. However, there is no need for people in urban centers to have contact with rural environments to use traditional medicines. People are increasingly using different resources due to the search for more natural forms of healing, a desire for self-care, and concerns about the toxicity and effects of allopathic medicines (Olisa and Oyelola 2009). Natural product markets in urban environments also play a crucial role in introducing traditional knowledge and sustaining these practices (Ladio and Albuquerque 2014). Additionally, the use of different medical systems can vary depending on the illness, as presented

by Ferreras et al. (2022), with people in healthcare units in Esquel (Patagonia, Argentina) using medicinal plants for simple ailments and doctor-prescribed medications for more complex conditions. Given these dynamics, one might wonder what specific role direct contact with rural environments plays in therapeutic strategies within urban contexts, particularly by fostering complementary interactions between the use of medicinal plants and pharmaceutical medications.

Access to resources can also influence therapeutic choices. For example, the predominance of the use of biomedical medicines is expected in urban areas due to the greater presence of medical centers, hospitals, and pharmacies compared to rural areas (Vandebroek et al. 2004; Medeiros et al. 2016). Medeiros et al. (2016) showed that even in a rural area of northeastern Brazil, frequenting health centers negatively influenced the choice or prioritization of complementary and alternative medicine.

In addition to origin and interactions between people from urban and rural environments, socioeconomic factors such as income, education, and age also play an important role in health knowledge and seeking practices. People with low income, for example, tend to resort to low-cost therapeutic strategies, such as the natural resources characteristic of local medical systems (Delgoda et al. 2010; Silva and Barros 2021). People with higher income are more likely to use only biomedical medicines, rather than combining them with other types of treatment (Delgoda et al. 2010). Literature evidence also shows that people with higher education tend to know fewer medicinal plants and may have greater knowledge of industrial drugs (Medeiros et al. 2018; Santoro et al. 2022). These examples suggest how these factors can favor competition interactions between local medical and biomedical systems. Finally, the literature has shown that older people tend to have more knowledge about treatments due to the accumulation of experience and knowledge throughout life, suggesting complementarity between the systems (Messias et al. 2015; Santoro and Albuquerque 2020).

Many ethnobiological studies in medical systems are conducted in rural areas and focus on traditional therapeutic practices, especially the knowledge and use of medicinal plants. In urban environments, due to the cultural diversity that can converge into these environments, people have access to a variety of resources from different origins (Ferreira Junior et al. 2018). This is especially relevant in municipalities where urban centers are close to rural areas, facilitating urban population access to traditional and biomedical resources, as is the case with the municipality of Araripina in the state of Pernambuco, northeastern Brazil, which was selected for this research.

Therefore, studies exploring how people's origins, their contact with individuals from rural environments, and socioeconomic factors impact their adoption of different therapeutic strategies are important for illustrating intermedicality in urban environments (Ferreras et al. 2022). Thus, this work seeks to test the following hypotheses and predictions: H1: In an urban environment, a rural origin promotes complementary use of medicinal plants and biomedical medicines; P1: People of rural origin in urban environments are more likely to report the combined use of medicinal plants and biomedical medicines. H2: In an urban environment, people's contact with rural areas favors complementary interactions in the use of medicinal plants and biomedical medicines.P2:People in urban environments who have contact with rural areas are more likely to report the complementary use of medicinal plants and biomedical medicines. H3: Visits to biomedical centers (such as pharmacies, hospitals, and health centers) favor competitive interactions between biomedical medicines and medicinal plants.P3: The more people frequent biomedical centers (pharmacies, hospitals, and health centers), the more likely they are to report using more biomedical medicines than medicinal plants. H4: Socioeconomic factors (income, age, and education) influence complementary interactions between medicinal plants and biomedical medicines in urban environments.P4.1: The higher the income, the lower the probability of people employing the combined use of medicinal plants and medicines of biomedical origin and the greater the possibility of making exclusive use of medicines of biomedical origin. P4.2:The higher the level of education, the greater the likelihood of using exclusively biomedical drugs as a therapeutic strategy.P4.3:The older the person, the greater the likelihood of using combined medicinal plants and medicines of biomedical origin as a therapeutic strategy.

MATERIAL AND METHODS

Study area

The present study was carried out within the urban perimeter of the city of Araripina-PE (Figure 1), located in the northwest of the state of Pernambuco, northeast Brazil, with coordinates 7°34'34" south and 40°29'54" west (Arruda et al. 2015). Araripina presents a predominant hyperxerophytic caatinga vegetation, with dystrophic red-yellow latosol soil type and a semiarid mesothermal climate (Cavalcante and Lopes 1994). According to the census by the Brazilian Institute of Geography and Statistics (IBGE 2023), the city has 46,908 inhabitants in the urban area and 30,394 in the rural area.

The municipality is located in the gypsum region of Araripe, with the main economic activity being the gypsum industry, whose gypsum mining serves 95%

of Brazil, thus presenting economic and social importance to the region's workers (Mergulhão et al. 2014). The average monthly salary of formal workers in the year 2020 was 1.6 minimum wages (IBGE 2023).

Araripina encompasses a total territory of 2,037.394 km², of which approximately 16.89 km² constitute urban areas for the year 2019 (IBGE 2023). The municipality demonstrates a notable proximity between urban and rural zones, facilitating access between them. Within the urban area, it is easy to find hospitals, health centres, open-air markets, as well as stores offering natural and traditional products.

Ethical aspects

Initially, the project was submitted to and approved by the municipal health department of Araripina for authorization of its implementation. The project was also submitted to and approved by the Research Ethics Committee of the University of Pernambuco under number CAAE: 57285822.0.0000.5191. Residents who agreed to participate in the research were invited to read and sign the online Informed Consent Form (ICF) before answering specific research questions.

Data collection

Data were collected through an online form on the Google Forms platform. This form contained questions about therapeutic strategies used by residents in the studied urban area. Initially, we promoted the dissemination of the form through social media (WhatsApp, Facebook, email). Subsequently, we adopted in-person approaches in the municipality, such as distributing leaflets and visiting educational institutions (Figure 2).

The questionnaire comprised four stages, all administered simultaneously, each containing questions about the healing strategies of residents in the urban area of Araripina. In the first stage, we recorded the diseases acquired by participants in the last year and how they were treated, with questions such as "Did you have any illness in the last year?" "What was this illness?" "Where did you seek help for the treatment of this illness? (Options: Did not seek help, treated myself with my own knowledge (yes or no); Sought a medical clinic/hospital (yes or no); Sought family and/or friends (yes or no); Sought a traditional healer (yes or no); Sought treatment through my religion (yes or no); Sought treatment at an open-air market (yes or no); Sought treatment at the pharmacy (yes or no); Sought treatment based on TV, magazines, newspapers, and/or radio information (yes or no); Sought treatment on the internet (yes or no); Did not treat the illness with anything, waited for it to pass (yes or no)". Another question presented was "What strategies were used until the cure of this illness was achieved?" with responses recorded in the following alternatives: Used only medicinal plants; Used only pharmacy medicines; Used medicinal plants first, stopped using them, and then used pharmacy medicines; Used pharmacy medicines first, stopped using them, and then used medicinal plants; Used medicinal plants and pharmacy medicines at the same time at some point; Used other alternative treatments that did not include either plants or pharmacy medicines; Did not use any strategy.

The second set of questions involved pre-selected diseases based on their occurrence rate in the municipality, if any of them occurred in the last year, and how they were treated. The selection of pre-established diseases was based on an epidemiological study conducted by Medeiros et al. (2010) in the city of Araripina. This study took place in one of the districts of the municipality, considering the significant gypsum production in the region and the potential health risks associated with this activity. Among the symptoms/diseases most mentioned by participants in this study were "eye irritation", "nosebleeds", and "coughing". Questions were then presented based on these symptoms/diseases, and if the participant in our study indicated acquiring any of them in the last year, we proceeded with the same questions presented in the first stage regarding strategies for healing.

Finally, the fourth stage consisted of collecting socio-economic information from participants, including origin, contact, monthly family income, education level, age, and gender. Regarding origin and contact, we asked if participants were born in rural areas, if they have contact with people living in rural areas (farm, countryside, rural community), and if yes, what is the frequency of contact.

Data analysis

To assess whether origin and contact with urban environment, age, education, and income affect interactions of complementarity or competition between medicinal plants and biomedical-origin medicines, we employed General Linear Models (GLM), Binomial family. We checked the adequacy of the models using the Kolmogorov-Smirnov test to assess the normality of residuals, as well as verified the homogeneity of variance in the models and overdispersion in the data using the DHARMa package in R (version 4.3.2). We also applied the Variance Inflation Factor (VIF) to check for evidence of multicollinearity among the predictor variables of the models. In the models, for each disease episode, we considered as dependent variables (i) the occurrence of competition strategy (yes or no), in the case where the participant indicated using exclusively

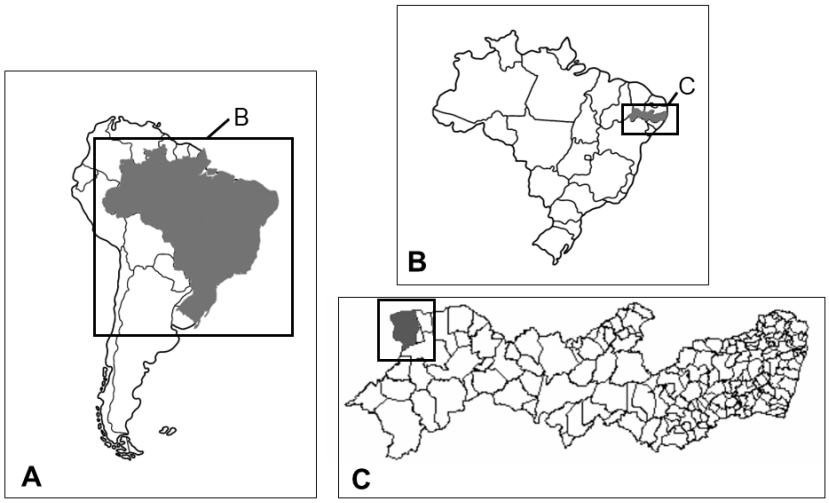

Figure 1. Study Area. Location of the municipality of Araripina, state of Pernambuco, Northeast Brazil.

Figure 2. Digital leaflet and leafleting in the urban centre of the Municipality of Araripina, Pernambuco, Northeast Brazil.

medicinal plants or pharmaceuticals to treat the disease; and (ii) the occurrence of complementarity strategy (yes or no), in the case where the participant performed combined or sequential use of medicinal plants and pharmaceuticals. We used as independent variables (i) the origin (place of birth) of the participant in a rural environment (yes or no); (ii) the participant's contact with people living in a rural environment, measured by the frequency at which the person interacts with individuals from that environment, following the following scale: 0 - no longer has contact, 1 - twice a year, 2 - every three months, 3 - once a month, 4 - twice a month, and 5 - every week; (iii) the monthly family income, measured in categories based on the minimum wage of the year 2022 (less than one minimum wage, up to one minimum wage, 1-3 minimum wages, and above 3 minimum wages); (iv) the participant's education level, measured in categories (incomplete primary education, complete primary education, incomplete secondary education, complete secondary education, incomplete higher education, and complete higher education); (v) the participant's age; (vi) the search for biomedical structures (pharmacy, medical clinic, hospital) (yes or no). When conducting correla-

tion tests between the predictor variables, we observed that socioeconomic factors are significantly and positively correlated. In this sense, we excluded the age and education of the participants, keeping only income in the final models. All analyses were performed in the R environment, version 4.3.2 (R Core Team 2023).

Upon observing the data, 35 participants reported having had some illness and some pre-established symptom in the last year. Of these, eight participants reported both an illness and one of the three symptoms highlighted in the previous epidemiological study. It can be assumed they were referring to the same therapeutic episode, as the dates and therapeutic strategies coincided (for example, a participant reported having had COVID-19 three months prior to the interview, as well as the symptom of cough, and used the same therapeutic strategies). Therefore, these episodes were recorded as a single event. In total, 169 disease episodes were included in the analysis, including diseases from the last year reported by the participants and one episode with all three diseases/symptoms.

RESULTS

General results

The research had a total of 304 responses. Of these, 298 individuals (98%) chose to participate in the survey, while 6 individuals (2%) chose not to participate. Among those who chose to participate, 217 individuals (72.8%) reside in the urban area of Araripina, 43 individuals (14.4%) in rural areas, 31 individuals (10.4%) did not disclose their location or did not allow identification, and 7 individuals (2.4%) reported living in another city. Of the participants, there were 75 who did not report any illness in the last year or any of the three proposed therapeutic episodes. Therefore, for analysis, we considered only the responses of individuals who claimed to be from the urban area and who reported having had some illness or pre-established symptom in the last year.

A total of 142 individuals participated in the survey, of whom 68 (47.8%) reported having had some illness episode in the last year. Within this group, 35 individuals also stated that in addition to some therapeutic episode, they also had one of the three proposed symptoms (cough, nosebleeds, or eye irritation), totaling up to two therapeutic episodes per participant for the survey. On the other hand, the remaining 74 (52.2%) participants out of the total of 142 stated that they had not experienced any illness in the last year, but reported having one of the three aforementioned symptoms/diseases in the last year, which adds up to one therapeutic episode per participant.

The socioeconomic data are presented in Table 1. Regarding the diseases mentioned by the 68 individuals, those with the highest prominence were: Covid-19, with 20 mentions (29.4%); anxiety and flu, each with 4 mentions (5.8%) (see Table 2). Regarding the pre-established symptoms/diseases mentioned in the survey, cough was the most mentioned, with 68 responses (66%), followed by eye irritation, with 30 responses (29.1%), and nosebleeds, with 5 responses (4.8%).

The respiratory diseases mentioned, such as Covid-19 and cough, may be related to the fact that the data were collected during the Covid-19 pandemic (September 2022).

Regarding the sources of assistance sought by individuals, the following was observed: in 55 therapeutic episodes (32.1%), individuals chose not to seek help and treated themselves based on their own knowledge; in 79 episodes (46.6%), they sought assistance from a medical clinic/hospital or pharmacy; and in 16 episodes (10%), they sought help from family and/or friends (Table 3). In the case of those who mentioned seeking help from another person, it was observed that the majority (60.4%) indicated that the person belonged to the urban area, followed by 7.3% indicating that the person belonged to the rural area, while 32.2% did not respond to this question.

The predominant strategies in the episodes addressed in this research were as follows: in 82 episodes (49%), only pharmaceuticals were employed; in 33 episodes (20%), there was simultaneous use of medicinal plants and biomedical medications; and in 18 episodes (10%), only medicinal plants were used (see Table 4). Regarding the contact with individuals from rural environments and the origin of the participants, the majority (36.2%) originated from urban areas and reported interactions with individuals from rural environments (92%) (see Table 5).

Factors that explain the likelihood of competition or complementarity between medicinal plants and pharmaceuticals in urban environments

Our developed models to assess the factors shaping complementarity strategies indicated that origin in rural environments significantly and negatively influenced the likelihood of complementarity occurring between medicinal plants and biomedical-origin medications. Conversely, income positively affected the likelihood of complementarity occurring. The remaining predictor variables did not exert a significant effect on complementarity (Table 6).

Regarding competition, we observed that only the variable of origin in rural environments significantly and positively explained the likelihood of competition occurring between medicinal plants and biomedical-origin medications. The other remaining predictor

Table 1. Socioeconomic data of research participants regarding gender, age, income, and education.

Socioeconomic data	Categories	Quantities	%
Gender	Male	37	26.5
	Female	105	73.5
Age	18 to 25 years	45	32.2
	26 to 33 years	52	36.7
	34 to 41 years	22	15.2
	42 to 49 years	11	7.9
	50 to 57 years	5	3.3
	58 to 65 years	2	1.1
	No response	5	3.3
Income	Below minimum wage(<$218.02)	36	24.8
	One minimum wage (=$218.02)	32	22.6
	From one to three minimum ages ($218-$654.05)	47	33.3
	(Above $654.05)	25	18.2
	No response	2	1.1
Education	Incomplete Primary Education	6	4
	Complete Primary Education	12	8.5
	Incomplete Secondary Education	11	8
	Complete Secondary Education	43	30.5
	Incomplete Higher Education	29	20.3
	Complete Higher Education	40	27.6
	No response	1	1.1

variables did not provide significant explanation for competition (Table 7).

DISCUSSION

Our results indicate that participants' rural origin did not favors the combined use of medicinal plants and biomedical medications, as proposed in our hypothesis. Instead, it increased the likelihood of competition between resources. Our findings contradict few studies evaluating people's origin in the concurrent use of two medical systems. For instance, a study assessing the complementary use of medicinal plants with biomedical medications in the Argentine Patagonia revealed that individuals from urban areas tended to combine both medical systems, while those from rural areas tended to adhere to traditional practices and showed reluctance to combine medicinal plants with biomedical medications, opting exclusively for the use of medicinal plants (Ferreras et al. 2022).Recent studies reveal the combined use of medicinal plants in rural-urban environments, as presented by Molares et al. (2024), where these residents used medicinal plants as an essential part of their medical system, either as a first option for common illnesses or to complement the effects of allopathic medicine. Casagrande et al. (2023) point out that all interviewees from a community in the metropolitan area of Porto Alegre, RS, preferred to start treatment with medicinal plants before resorting to biomedical treatment, due to tradition, low costs, or fewer side effects. However, 62% of the interviewees used medicinal plants and biomedical drugs simultaneously, associating them with treatments typically diagnosed by biomedicine, such as diabetes and hypertension, which require lifestyle changes (Casagrande et al. 2023).

The variable "contact with rural environment" was

Table 2. Diseases occurred in the last year mentioned by the participants in the urban center of Araripina, Pernambuco, Brazil.

Doença	Quant.	%
Covid-19	20	29.4
Anxiety	4	5.8
Flu	4	5.8
Gastritis	3	4.4
Allergy	2	4.4
Rhinitis	2	2.9
Sinusitis	2	2.9
Labyrinthitis	1	1.4
Common cold	1	1.4
Hyperthyroidism	1	1.4
Thrombophilia during pregnancy	1	1.4
Intestinal infection	1	1.4
Thyroid disorder	1	1.4
Herniated disc	1	1.4
Depression	1	1.4
Endometriosis	1	1.4
Kidney stones	1	1.4
Lung infection	1	1.4
Throat crisis	1	1.4
Spinal deviation	1	1.4
Diabetes	1	1.4
Syphilis	1	1.4
Nervous gastritis	1	1.4
Cervical cancer	1	1.4
PCOS (Polycystic Ovary Syndrome)	1	1.4
No response	13	19.1

found to be insignificant in our research for the complementary use of resources. This lack of significance may be attributed to the fact that urban individuals are naturally more exposed to biomedicine, which tends to be predominant in these areas, even though they still have contact with individuals from rural environments. Despite this, medicinal plants are used by urban populations, regardless of their connection to official medicine, just as pharmaceutical products are incorporated into local medical systems (Abreu et al. 2023).

The variable "visit to medical clinics, hospitals, and health posts" also proved insignificant for competitive use between medicinal plants and biomedical medications. In urban areas, characterized by the presence of pharmacies, medical clinics, and hospitals, healthcare professionals tend to prescribe allopathic medications when consulted. When seeking hospitals, medical clinics, and pharmacies, people may opt less for non-allopathic strategies, as biomedicine is the predominant treatment exposed to individuals in these locations. However, this was not observed in our study, where this variable was not significant for the proposed uses. Seeking these environments may be associated with the credibility conveyed by healthcare professionals, past positive experiences, or the expectation of efficacy through seeking these treatments. People who do not seek help in hospitals, health centers, or phar-

Table 3. Person or place sought by participants for the treatment of the therapeutic episode in the urban center of Araripina, Pernambuco, Brazil.

Person/Place sought for treatment	Quant.	%
Did not seek help, treated myself with my own knowledge	55	32.1
Sought a medical clinic/hospital and pharmacy	79	46.6
Sought family and friends	16	10
Did not seek help, waited for it to pass	11	6.5
Sought help on the internet	6	3.6
Sought help in my religion	1	0.5
No response	1	0.5

Table 4. Strategies employed for the treatment of the therapeutic episodes by residents of the urban centre of Araripina, Pernambuco, Brazil.

Strategy	Quant.	%
Only pharmaceuticals	82	49
Combined use of medicinal plants and pharmaceuticals	33	20
Only medicinal plants	18	10
Sequential use of medicinal plants and pharmaceuticals	15	8.8
No strategy	14	8.4
Other types of strategies that did not involve these resources	3	1.7
No response	4	2.3

macies for various reasons may not be looking for these environments because this option is presented in conflict with other strategies. This may occur, for example, when complementary or traditional medicine is underestimated or opposed to allopathic medicine (Medeiros et al. 2016; Ferreras et al. 2022), thus conveying treatment insecurity to the individual, who may then choose not to use any treatment. This competition can become even more complex in environments of cultural pluralism, where various treatment approaches of different origins may coexist but may compete for space.

Regarding income, our results do not support the initial hypothesis that income negatively influences resource complementarity, but rather the opposite, it positively influences it. Studies associating low income with combined medication use generally justify the result by the fact that medicinal plants are more financially accessible, easy and cheap to cultivate depending on the location or serve to prolong the drug's effect (Delgoda et al. 2010; Silva and Barros 2012; Casagrande et al. 2023). Almeida et al. (2010), investigating therapeutic knowledge in three communities in Paraíba, found that in two out of three communities, individuals with higher incomes had greater knowledge of medicinal plants. Griz et al. (2017) point out that individuals with higher incomes were associated with the use of medicinal plants due to access to them.

In our research, having financial resources can facilitate access to medicinal plants and may be associated with the proximity of rural areas to the urban center of Araripina. Considering only income, even if people do not have much knowledge about medicinal plants, there is still easy access to them due to the proximity to rural areas. Similarly, Molares et al. (2024) report that suppliers of medicinal plants for Esquel, Patagonia, live 70 to 200 km from the urban center but maintain connections with city residents, which helps make these plants available in local stores.

LIMITATIONS

The study examines illness contexts temporally proximate to individuals and includes only certain

Table 5. Contact and origin of research participants, residents of the urban centre of Araripina, Pernambuco, Brazil.

Contact/Origin	Category	Quant.	%
Contact with individuals residing in rural environments	Yes	155	92
	No	14	8
Frequency of contact with individuals residing in rural environments	Every week	89	53
	Once a month	29	17
	Twice a month	19	11.2
	Every three months	14	8.2
	Twice a year	12	6.8
	No contact	6	3.8
Origin	Urban environment	61	36
	Rural environment	56	33
	No response	52	31
Longer duration of residency	Urban environment	66	39
	Rural environment	51	30
	No response	52	31

Table 6. Effect of origin in rural environment, frequency of contact with individuals living in rural environment, income, and visit to biomedical centers on the occurrence of complementarity interactions between medicinal plants and pharmaceuticals by residents of the urban center of Araripina, Northeast Brazil.

	Intercept	NULL	Origin in rural environment	Frequency of contact with individuals residing in rural environments	Income	Visit to a medical clinic/hospital and pharmacy
Estimate	-2.3851		-1.0017	0.1389	0.5568	0.1449
Std.	0.8107		0.4448	0.1490	0.2232	0.4389
Error z value	-2.942		-2.252	0.932	2.494	0.330
Pr(>|z|)	0.00326**		0.02433*	0.35118	0.01264*	0.74131
Df			1	1	1	1
Deviance Resid.			5.7884	2.1709	6.5777	0.1093
Df Resid.		117	116	115	114	113
Dev.		143.48	137.69	135.52	128.94	128.83
Pr(<Chi)			0.01613*	0.14065	0.01033*	0.74094

therapeutic targets in Araripina. Nevertheless, when delving into intermedicality, complementarity, and competition among medicinal plants within a medical system, the structural and temporal intricacies should be more pronounced. The competition and complementarity dichotomy between local and biomedical systems may be much more continuous than we can measure, and the fact that one type of strategy is chosen over another does not necessarily represent a mutual exclusion of medical systems, although it may

Table 7. Effect of origin in rural environment, frequency of contact with individuals living in rural environment, income, and visit to biomedical centers on the occurrence of competition interactions between medicinal plants and pharmaceuticals by residents of the urban center of Araripina, Northeast Brazil.

	Intercept	NULL	Origin in rural environment	Frequency of contact with individuals residing in rural environments	Income	Visit to a medical clinic/hospital and pharmacy
Estimate	0.17785		0.93812	0.06964	-0.32009	0.66980
Std.	0.67256		0.40487	0.13131	0.20471	0..40420
Error z value	0.264		2.317	0.530	-1.564	1.657
Pr(>|z|)	0.7914		0.0205*	0.5959	0.1179	0.0975
Df			1	1	1	1
Deviance Resid.			6.6252	0.2182	2.5514	2.7743
Df Resid.		117	116	115	114	113
Dev.		156.88	150.25	150.03	147.48	144.71
Pr(<Chi)			0.01005*	0.64040	0.11020	0.09579

represent a context of prioritising one system over another. Furthermore, intermedicality can be more likely in some therapeutic targets than in others. However, we emphasize that the perspective we take here demonstrates clues about how the two systems can interact at different points, sometimes considering exclusion and sometimes complementarity.

CONCLUSION

It was possible to observe that rural background increased the competitive consumption between medicinal plants and biomedical medications. On the other hand, income positively influenced the complementarity of medicinal plants and biomedical medications in urban settings. This demonstrates that, even in urban environments dominated by biomedicine, but with proximity to rural areas, the use of medicinal plants can be present and complementary.

Through the obtained results, we verify that the proximity between the rural and urban areas of Araripina may cause urban dwellers to have greater access frequency to both the environment and the people from rural areas, potentially facilitating access to traditional practices in the region. Scenarios of intermedicality are increasingly visible in urban environments because they present a diversity of cultures that may correlate, thus requiring more attention to practices involving the complementary or competitive use of resources from different medical systems for treatments/cures, as some combinations may even be harmful to human health. In addition to the attention that should be given to the knowledge and use of traditional strategies in these environments, reconciling possible public policies that facilitate and improve access to healthcare for populations.

ACKNOWLEDGMENT

We would like to thank all the residents of Araripina who participated in the research and helped in disseminating the online form in the municipality. The authors would like to express gratitude to the PDPG FACEPE 18/2020 Grant for providing a master's scholarship to the first author and the National Council for Scientific and Technological Development (CNPq, Universal Call, Grant Number: 432622/2018-7).

DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

CONTRIBUTION STATEMENT

Conceived of the presented idea: WSFJ, FRS. Carried out the experiment: BMO.

Carried out the data analysis: WSFJ.
Wrote the first draft of the manuscript: BMO.
Review and final write of the manuscript: FRS, BMO, WSFJ.
Supervision: WSFJ, FRS.

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Received: 26 February 2024
Accepted: 28 August 2024
Published: 02 September 2024

Editor: Ulysses Albuquerque