Traditional use of medicinal plants for respiratory diseases in Al Hoceïma (Northern Morocco): urban and protected areas

Amina Labhar[1], Yahya El-Mernissi[1], Omar Benamari[1], Aziz Zouhri[2], Karima Ait Alla[3], Fatima Afassi[1], Sanae Jahjah[3], Yahya Mfedal[4], Elyoussfi Abdellah[1], Mhamed Ahari[1], Amin Salhi[1], Hassan Amhamdi[1].*

[1]Research Unit in Applied Chemistry, FSTH, Abdelmalek Essaadi University, Tetouan, Morocco.

[2] Bioactives and Environmental Health Laboratory, Faculty of Sciences, Moulay Ismail University, B.P. 11201, Meknes, Morocco.

[3] Biology, Environment and Sustainable Development Laboratory, Higher School of Teachers (ENS), Abdelmalek Essaadi University, Tetouan 93000, Morocco.

[4] Department of Chemistry, Faculty of Science, Abdelmalek Essaadi University, Tetouan, Morocco

Abstract: Al Hoceïma, located along the Mediterranean coast of Northern Morocco, has its own unique ecological duality, featuring both an Al Hoceima national park and urban areas (AL Hoceima). Respiratory diseases are among the major health issues in the region, particularly during the cold season. To treat such diseases, the population uses two types of medicine: traditional and herbal. The objectives of the current study are to determine and compare the various medicinal plants used in treating respiratory disorders between the two ecological zones. For this study, ethnobotanical investigation was carried out from October 2025 to December 2025 through the use of structured questionnaires. Altogether, 31 plant species were documented with Lamiaceae being the most common among them. The most used part of the plant was the leaf. Regarding the informant profiles, females (67.6%) use medicinal plants more than males (32.4%) do. The traditional knowledge is low among the younger generation. Moreover, the fact that most of the plants used are wild species has generated concerns about the management and conservation of resources within the Al-Hoceima National Park. ***Keywords:*** *Al-Hoceima National Park, Medicinal plants, Al Hoceïma, Ethnobotanical survey, Traditional practices, Conservation.*

1 Introduction

Respiratory diseases are among the most serious chronic and acute conditions in the world. The World Health Organization (WHO) estimates that they cause 3.9 million deaths per year, which 7% of global mortality [1] Chronic obstructive pulmonary disease (COPD) is one of the most common causes, responsible for around 3 million deaths per year [2,3]. According to the latest report from the WHO Regional Office for Europe, over 81.7 million individuals are affected by chronic respiratory conditions, with most cases involving asthma and COPD [4]. In addition, acute respiratory infections, such as pneumonia, bronchiolitis, flu, and coronavirus infections, are a major cause of infant death and epidemics with recurring seasonal patterns and pandemic potential [5–7]. These diseases affect the entire respiratory system, such as the airways, bronchi, lungs, and alveoli. Although the mechanisms vary depending on the type of condition, they generally involve inflammation, obstruction, and tissue destruction [8]. The treatment of this disease is based on conventional medicine, including medications, oxygen therapy, respiratory rehabilitation, and vaccination [9].

However, this approach has major limits, including side effects from excessive medication and rising antibiotic resistance [10–12]. because of that, some respiratory infections, such as bacterial pneumonia, are harder to treat and increase illness and death [13–15]. While vaccinations have helped minimize the effects of various respiratory viral infections, they do not minimize the effects of other diseases, such as influenza

*Corresponding author: amina.labhar@etu.uae.ac.ma

and COVID-19 [16,17] The overuse of antibiotics for minor diseases is a problem [18].

In this respect, the use of natural remedies is a serious alternative. PAM-based preparations offer an alternative, as they are better tolerated by the body and thus cause fewer side effects. This underscores the need to sustainably use local plant resources in order to promote sustainable development and biodiversity conservation. In this context, ethnobotanical studies are needed to identify the plants traditionally used to treat respiratory diseases. Such surveys help preserve local knowledge at risk of disappearing. They also provide a scientific basis for the biological validation and development of herbal medicines.

The Mediterranean climate of Morocco supports a rich flora. One such instance can be seen in the province of Al Hoceima, home to Al Hoceima National Park that is known for its plant life and ethnobotany among its communities [19]. This floral diversity, however, is threatened by the overexploitation of wild species, underscoring the need to document and promote this traditional knowledge within a framework of sustainable natural resource management. Yet this region remains poorly documented on the traditional use of respiratory medicinal plants, and no comparative study of urban and protected areas has been conducted to date. This study, therefore, aims to address this gap by conducting an ethnobotanical inventory of medicinal plants used to treat respiratory diseases in the province of Al Hoceima and by comparing practices between urban and National Park areas.

2 Materials and methods

2.1 Study Area :

Floral biodiversity is high in Morocco, especially in the north near the Mediterranean coast [20]. In our study, we considered the northern region of Al-Hoceima province, covering 3,550 km2 and located in the Central Rif. Under the influence of a Mediterranean climate (dry summers; mild winters with heavy rainfall), the region exhibits high biodiversity [21]. We collected samples from two urban areas covering 33 km2: Ajdir and Al-Hoceima. The selected rural zone, a national park founded in 2004, is located 150 km from the Strait of Gibraltar, covers 48,460 ha, and represents a highly valuable biological zone (**Fig. 1**) [22,23].

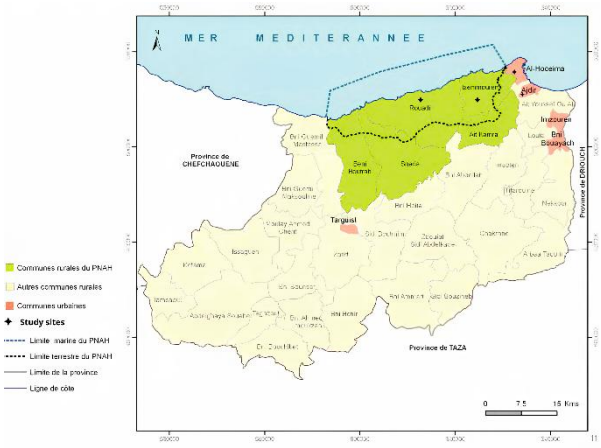

Fig. 1. Location of the study sites in the province of Al Hoceima [23]

2.2 Methodology:

An ethnobotanical investigation was conducted among 250 informants living in the province of Al Hoceima from October to December 2025, using a random sample of a structured questionnaire, along with interviews with a section on informants' socio-demographic characteristics such as age, sex, and education level. All the methods used in this investigation in the field were compatible with the references cited by Heinrich et al. [24]

The botanical identification of plants used was performed based on recognized resources, including Catalogue de la flore vasculaire du Maroc [25,26], and the IPNI (International Plant Names Index) online database (https://www.ipni.org/).

2.3 Quantitative data analysis:

The statistical results and their graphs of the ethnobotanical survey were obtained using Excel 2016 and Rstudio using the ggplot2 package. These indices used in this survey are defined as follows :

The relative frequency of citation (RCF) assesses the importance of each plant and determines its local value. It is calculated by dividing the number of informants who cited a species by the total number of informants [27].

The family use value (FUV) is used in this type of survey to assess the importance of families identified in the ethnobotanical survey by dividing the species' use value by the total number of species within each family [28].

The Informant Consensus Factor (ICF) is an index that gauges the degree of agreement regarding the knowledge of plants used for each medical condition (such as cough, asthma, and bronchitis). The computation of the ICF involves the use of the following equation [29] :

$$CFI = \frac{(Nur-Nt)}{(Nur-1)} \quad (1)$$

Nur : is the total number of applications made by the respondents for a particular condition.

Nt : is the number of plant species reported for that condition.

3 Results and discussion

3.1 Socio-demographic profile of informants:

The findings of the sociodemographic analysis of **Fig. 2** show that individuals aged over 60 constitute 46.4% of the total population, while those aged 30–60 years account for 35.6%, leaving the younger category under 30 years at 18%. This means that older people use medicinal herbs much more often than younger people; this could mean loss of tradition and culture [30].

This could be related to differences in access to health care services among generations in modern times. Other researchers have found that the most represented age groups are 40-59 years old (40%) and 60-89 years old (30%), indicating that the majority of respondents are in their middle or late years. This is consistent with our results, in which people over 60 account for 46.4%, while those under 30 account for 18% [19]. Other studies in the rural commune of Bni Hdifa, in the province of Al Hoceima, reveal that 80% of older adults used herbal medicine, compared to a declining rate of use among younger age groups, and attribute these results to the fact that older adults are more familiar with traditional herbal medicine, which has been passed down through several generations [31]. The above findings, based on research conducted in the province of Al Hoceima, can explain our findings of low usage among youth and even a risk of information loss. In terms of gender distribution, women made up 67.6%, while men accounted for 32.4%. This female predominance may reflect a traditional division of roles in the transmission of ethnomedical knowledge in the study area, as well as the fact that women focus on the home and family and make use of traditional knowledge.

Similar studies were conducted in Morocco, which found that the role played by women is predominant due to the use of medicinal plant products for household and beauty purposes [19,32–35]. Most interviewees in urban areas are more educated: 45.8% pursue an undergraduate degree, compared to 3% in rural areas. The explanation for this gap may be the lack of educational facilities in rural areas, especially in the national park. This is supported by the work of other scholars, who argue that illiteracy among users of medicinal plants impedes development efforts and leads to the exploitation of natural resources [31,36]. Similar consequences may be assumed for the contrast between urban residents (45.8%) and rural residents (3%).

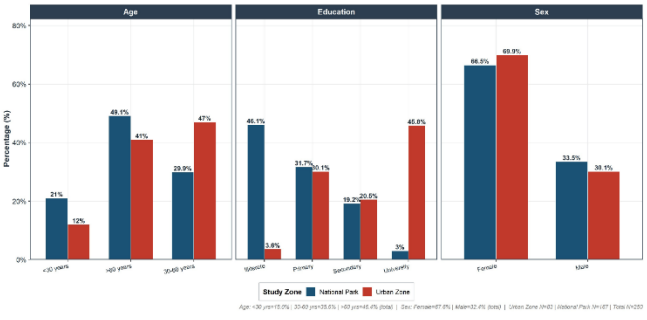

Fig. 2. Socio-demographic profile of the informants.

3.2 Floristic Inventory and Taxonomic Diversity:

The ethnobotanical survey identified the plants used by people in rural and urban areas to treat respiratory infections. According to this study, 31 species were identified across 19 botanical families (Erreur ! Source du renvoi introuvable.**).** Moreover, according to the Venn diagram (**Fig. 3**), species found in the urban habitat are also found in the rural habitat, especially in the national park. There are 16 plant species in the rural habitat, of which 15 are found in both habitats.

Analysis of species citation frequency (RCF) in the two study areas shows that the most frequently cited species, with an RCF between 0.08 and 0.1, are *Lavandula dentata* (RCF = 0.104), *Allium cepa* (RCF = 0.1), *Marrubium vulgare* (RFC = 0.092), and *Eucalyptus globulus* (RFC = 0.08). Nonetheless, a separate comparison between the two areas shows some differences (**Erreur ! Source du renvoi introuvable.**). The RFC value of *Lavandula dentata* is very high and consistent across both areas because the species is persistently used there. Regarding *Allium cepa*, although the RFC value is generally high, it is most prevalent in urban areas because home remedies are used. Some species, such as *Artemisia herba-alba* and *Zingiber officinale*, are more commonly used in urban areas due to greater market access, whereas other species found only in the national park, such as *Cistus ladanifer*, *Ceratonia siliqua*, and *Glycyrrhiza glabra*, are less commonly used. Several studies revealed that the taxon has antioxidant and antimicrobial activities, which help explain the frequent use of the species in the treatment of respiratory infections [37–41].

According to ethnobotanical research conducted in the Izarène Forest, *Lavandula dentata* has an RFC of 0.133, which is close to the value found in our study (0.104). This proves the medicinal use of *Lavandula dentata* in the treatment of respiratory infections [42].

This plant has also been documented in some areas of Morocco to treat respiratory infections together with Eucalyptus globulus (RFC = 0.125), showing that the medicinal use of Lavandula dentata against respiratory infections has proven efficacy [42–45]. Differences in the RFC values recorded in our study compared to those in other studies could be due to sample size, informant age, plant availability in the study area, and other factors.

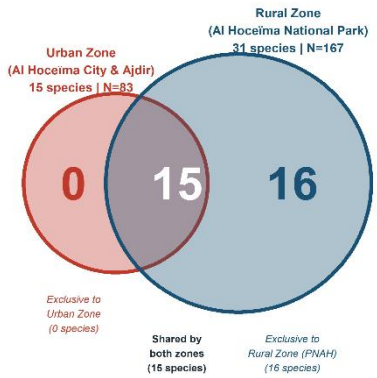

Fig. 3. Venn diagram of the distribution of medicinal plant species between study zones (urban and rural areas).

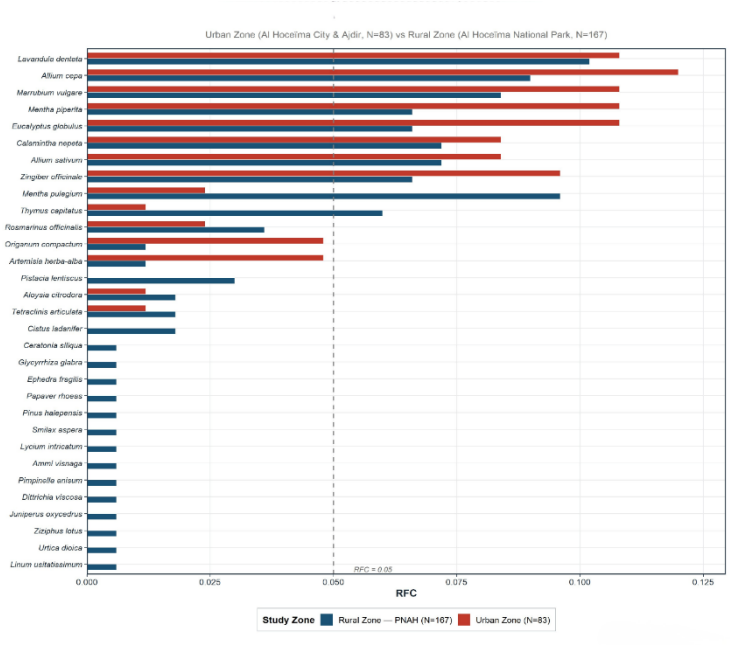

Fig. 4. Relative frequency of citation (RFC) by study zone.

Table 1. List of medicinal plants used to treat respiratory diseases in urban and rural areas.

Family	Scientific_Name	Vernacular Name	FC_Urban	FC_Rural	FC_Total	RFC_Urban	RFC_Rural	RFC_Total
Amaryllidaceae	*Allium cepa*	Tabsatch	10	15	25	0.12	0.09	0.1
	Allium sativum	Tichath	7	12	19	0.084	0.072	0.076
Anacardiaceae	*Pistacia lentiscus*	Fadis	0	5	5	0	0.03	0.02
Apiaceae	*Ammi visnaga*	Khella	0	1	1	0	0.006	0.004
	Pimpinella anisum	Habat hlawa	0	1	1	0	0.006	0.004
Asteraceae	*Artemisia herba-alba*	Chih	4	2	6	0.048	0.012	0.024
	Dittrichia viscosa	Emghaman	0	1	1	0	0.006	0.004
Cistaceae	*Cistus ladanifer*	Tojatch	0	3	3	0	0.018	0.012
Cupressaceae	*Juniperus oxycedrus*	Taka	0	1	1	0	0.006	0.004
	Tetraclinis articulata	Arar	1	3	4	0.012	0.018	0.016
Ephedraceae	*Ephedra fragilis*	Amater	0	1	1	0	0.006	0.004
Fabaceae	*Ceratonia siliqua*	Kharoub	0	1	1	0	0.006	0.004
	Glycyrrhiza glabra	Erqoussous	0	1	1	0	0.006	0.004
Lamiaceae	*Calamintha nepeta*	Thminta	7	12	19	0.084	0.072	0.076
	Lavandula dentata	Lakhzama	9	17	26	0.108	0.102	0.104
	Marrubium vulgare	Maru	9	14	23	0.108	0.084	0.092
	Mentha piperita	Naanaa	9	11	20	0.108	0.066	0.08
	Mentha pulegium	F'rriyou	2	16	18	0.024	0.096	0.072
	Origanum compactum	Zaatar l-hmar	4	2	6	0.048	0.012	0.024
	Rosmarinus officinalis	Inakri	2	6	8	0.024	0.036	0.032
	Thymus capitatus	Zaatar	1	10	11	0.012	0.06	0.044
Linaceae	*Linum usitatissimum*	Zariaa katan	0	1	1	0	0.006	0.004
Myrtaceae	*Eucalyptus globulus*	Kalitous	9	11	20	0.108	0.066	0.08
Papaveraceae	*Papaver rhoeas*	Belâaman	0	1	1	0	0.006	0.004
Pinaceae	*Pinus halepensis*	Tayda	0	1	1	0	0.006	0.004
Rhamnaceae	*Ziziphus lotus*	Nbeg	0	1	1	0	0.006	0.004
Smilacaceae	*Smilax aspera*	Tanechfalt	0	1	1	0	0.006	0.004
Solanaceae	*Lycium intricatum*	Inzerki	0	1	1	0	0.006	0.004
Urticaceae	*Urtica dioica*	L-hurrayga	0	1	1	0	0.006	0.004
Verbenaceae	*Aloysia citrodora*	Louiza	1	3	4	0.012	0.018	0.016
Zingiberaceae	*Zingiber officinale*	Skinjbir	8	11	19	0.096	0.066	0.076

Analysis of the survey results revealed the dominance of the Lamiaceae family, characterized by its botanical richness (8 species) and a high FUV index of 0.066. At the same time, the FUV index is high for the Amaryllidaceae (FUV=0.088) with *Allium cepa*, or for the Myrtaceae (FUV=0.08) with *Eucalyptus*, despite the presence of 2 to 1 botanical species; this indicates that cultural importance is focused on a limited number of taxa (**Fig. 5**).

The study covers numerous families, each consisting of a single species, with an FUV ranging from 0.01 to 0.044, reflecting highly diverse medicinal knowledge not limited to a few botanical groups. Studies in the Rif region have also revealed that the Lamiaceae family is the most abundant, with 8 species [43].

This is due to the presence of secondary metabolites in species of this family, which exhibit significant pharmacological effects, explaining their use by local populations [46,47]. Other studies in the Middle East, in northern Palestine, have also recently revealed a predominance of the Lamiaceae family in the treatment of respiratory diseases, with the presence of six botanical species [48].

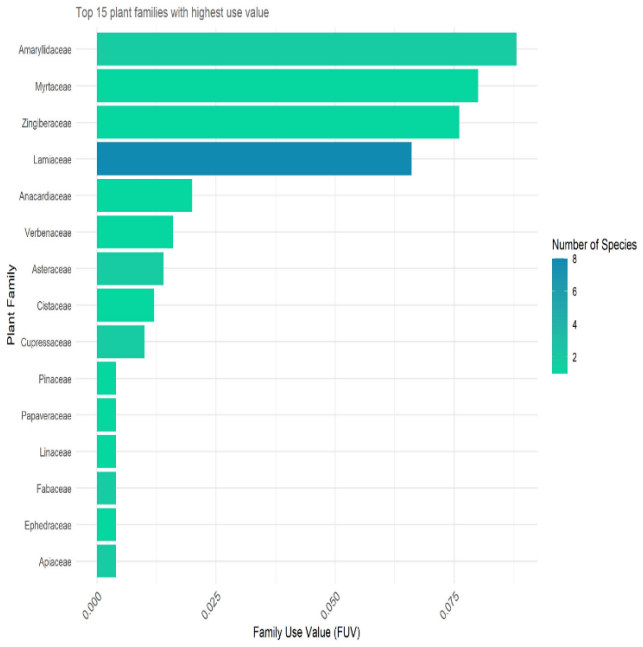

Fig. 5. Family use value (FUV) by botanical family.

3.3 Preparation methods and plant parts used :

Fig. *6* shows the ways in which medicinal plants used for respiratory diseases are prepared. According to our results, the highest percentages of medicinal plants are prepared as decoctions (41.3%) and infusions (38.2%). The least popular preparations include powders, syrups, and fumigations, which were used by only 0.4% of the respondents. Many studies confirm our results [44,49,50]

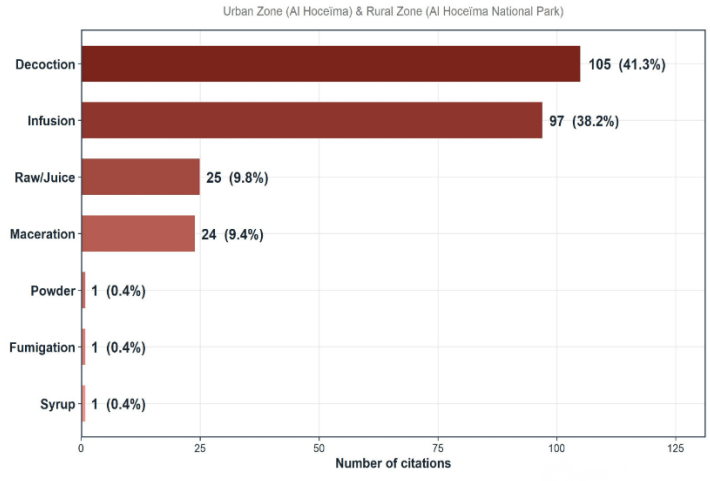

Fig. 6. Preparation methods of plants used for respiratory diseases.

The results on the most commonly used parts of medicinal plants, as stated by informants, are presented in **Fig. *7***. According to the results, the leaves of medicinal plants are the most commonly used parts (60%), followed by bulbs (16.9%) and flowers (8.1%). Other studies conducted in Morocco and other regions have also indicated the dominance of leaf use [51–54]. This can be attributed to the high phytochemical content in leaves, as well as the ease and accessibility of the part throughout the year, unlike the fruit or flower parts of the plant [19,43].

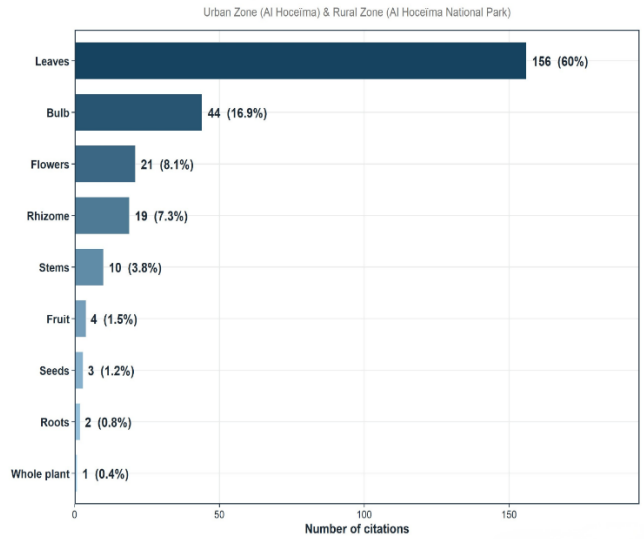

Fig. 7. Plant part used in the treatment of respiratory system diseases.

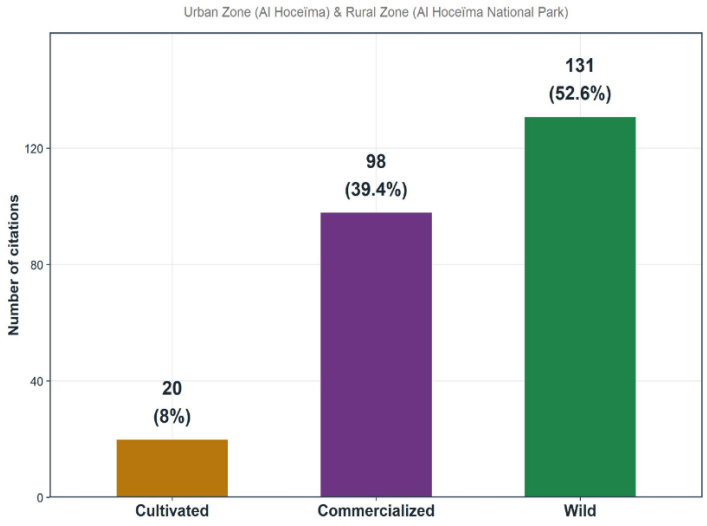

Fig. 8. Status of medicinal plants in Urban and rural zones.

3.4 Status of medicinal plants in Urban and rural zones :

Fig. *8* presents the status of medicinal plants used by informants. Analysis of the results shows that wild collection predominates (52.6%), followed by commercially available plants (39.4%) and cultivated plants (8%). These results indicate significant pressure on natural resources within the national park, as well as low levels of domestication of these plants, which pose a risk of genetic erosion for the most heavily utilized taxa and necessitate encouraging cultivation to preserve the wild gene pool. As this study highlights, the lack of agricultural utilization noted in our study is concerning, given that a lack of targeted management measures is often the cause of the decline of exploited medicinal species [55].

3.5 Informant Consensus (ICF) by respiratory disease category :

Analysis of the ICF index by category of respiratory diseases shows that all five categories have values above 0.8, indicating a strong cohesion of knowledge within the population and highlighting a very robust traditional medical system [34,56,57]. According to the **Fig. *9*** coughing has the highest score, with an ICF of 0.841, as it is a very common condition and the population already has a well-established repertoire of remedies to treat it [34,43,58]. Regarding asthma (0.815) or bronchitis (0.818), their values are nearly as high as those for cough. This stability in the index indicates that, for chronic diseases, the population shares the same species due to perceived efficacy [59]. Based on these ICF results, traditional medicine in the study region is not random but is standardized through collective use [59].

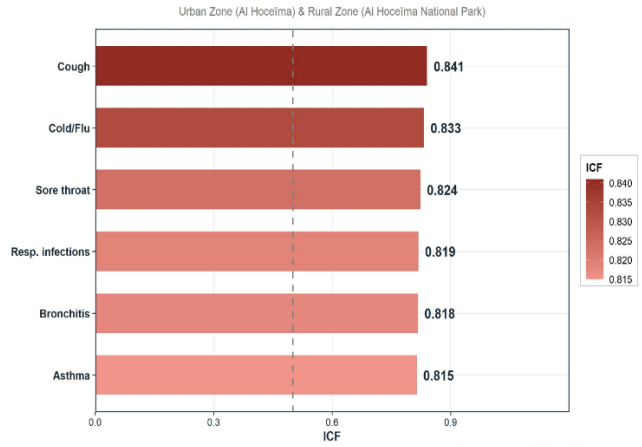

Fig. 9. Informant consensus factor (ICF) by disease category.

4 Conclusion

Our ethnobotanical survey identified 31 species from 19 botanical families used to treat respiratory diseases in the province of Al Hoceima, in both rural and urban areas. According to the ICF index, the most common respiratory conditions (cough, asthma) are subjects of strong therapeutic consensus across the population. Furthermore, Lavandula dentata stands out for its high and stable relative citation frequency (RFC) across both settings, reflecting its well-established, widespread use. Women are the demographic group that uses medicinal plants the most. On the other hand, the youth below the age of 30 years use medicinal plants minimally, suggesting a potential threat to the erosion of indigenous knowledge. Regarding the preparation methods, decoction and infusion are the dominant types, and the plant parts used are mostly leaves. Our study has also shown that wild plant species are over-exploited, indicating a need for specific conservation efforts. The findings have provided valuable information to the pharmacopeia and natural resource development in the region.

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