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# **Use of medicinal plants for COVID-19 prevention and respiratory symptom treatment during the pandemic in Cusco, Peru: A cross-sectional survey**

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## ABSTRACT

**Background:** The burden of the COVID-19 pandemic in Peru has led to people seeking alternative treatments as preventives and treatment options such as medicinal plants. This study aimed to assess factors associated with the use of medicinal plants as preventive or treatment of respiratory symptom related to COVID-19 during the pandemic in Cusco, Peru.

**Method:** A web-based cross-sectional study was conducted on general public (20- to 70-year-old) from August 31 to September 20, 2020. Data were collected using a structured questionnaire via Google Forms, it consisted of an 11-item questionnaire that was developed and validated by expert judgment using Aiken's V (Aiken's V > 0.9). Both descriptive statistics and bivariate followed by multivariable logistic regression analyses were conducted to assess factors associated with the use of medicinal plants for COVID-19 prevention and respiratory symptom treatment during the pandemic. Prevalence ratios (PR) with 95% Confidence Interval (CI), and a P-value of 0.05 was used to determine statistical significance.

**Results:** A total of 1,747 respondents participated in the study, 80.2% reported that they used medicinal plants as preventives, while 71% reported that they used them to treat respiratory symptoms. At least, 24% of respondents used medicinal plants when presenting with two or more respiratory symptoms, while at least 11% used plants for malaise. For treatment or prevention, the multivariate analysis showed that most respondents used eucalyptus ( $p < 0.001$  for both), ginger ( $p < 0.022$  for both), spiked pepper ( $p < 0.003$  for both), garlic ( $p = 0.023$  for prevention), and chamomile ( $p = 0.011$  for treatment). The respondents with COVID-19 ( $p < 0.001$ ), at older ages ( $p = 0.046$ ), and with a family member or friend who had COVID-19 ( $p < 0.001$ ) used more plants for prevention. However, the respondents with technical or higher education used less plants for treatment ( $p < 0.001$ ).

**Conclusion:** There was a significant use of medicinal plants for both prevention and treatment, which was associated with several population characteristics and whether respondents had COVID-19.

**Keywords:** medicinal plants, COVID-19, prevention, treatment, respiratory symptoms, pandemic, Peru.

## Introduction

COVID-19 was declared a pandemic by the World Health Organization (WHO) on March 11, 2020 because of its rapid transmission and infection rates worldwide (1, 2). This disease is characterized by a progressive and severe pneumonia, and the most common symptoms are fever, dyspnea, dry cough, fatigue, headache, anosmia, and ageusia (2-4). As of May 11, 2021, more than 159 million global confirmed cases and more than 3 million deaths have been reported (5). The first confirmed case in Peru was reported on March 8, 2020 (6), and the number of cases rapidly increased despite the measures established by the Peruvian government (7, 8). In less than four months, Peru ranked second among Latin American countries, following Brazil, for the highest number of COVID-19 cases and deaths (9, 10). Multiple publications have illustrated the fragmented healthcare system in Peru, which has not been the most effective during the COVID-19 pandemic resulting in a high number of physicians' deaths (11), limited public policies (12), and detrimental effects in the mental status of the population (13-15). Furthermore, Peru has reported discrepancies in the official reports of COVID-19 deaths nationwide (16), poor execution of SARS-CoV-2 testing and reporting (17), and an increase number of COVID-19 cases in children and adolescents (7, 18).

The current pandemic generates fear in the population who seek solutions to prevent or alleviate the symptoms of the disease since they feel the only resource available to them is to self-help, self-care and self-medicate (19). Therefore, it has been reported that some people resource to self-medication (20) and others to the use of

medicinal plants (21) as potential but unproven methods to ameliorate and/or prevent symptoms related to COVID-19. The Ministry of Health in Peru published the symptomatic pharmacological treatment options for COVID-19 to control the pandemic (22). These options included the clinical use of hydroxychloroquine and ivermectin for mild cases of COVID-19 and hydroxychloroquine plus azithromycin and/or chloroquine phosphate plus ivermectin for moderate and severe cases of COVID-19 (6, 22). However, this recommendation led to self-medication reports in Peru (6, 20), which also gets accompanied with the use of medicinal plants. This practice has become increasingly common in Peru as panic spread in the general population, who anxiously wait for positive news about the prevention, treatment and vaccination (20).

The idiosyncrasy of the population has also focused on the use of medicinal plants, natural products or preparations, with antiviral and anti-inflammatory properties to strengthen the immune system or treat respiratory diseases (23). Countries, such as China, India, Bolivia, Morocco, Nepal, Peru and Brazil, are using traditional medicine against COVID-19 (23-32). There are approximately 50,000 plant species with medicinal uses, and the WHO has estimated that 80% of the population of developing countries use traditional medicine as their main source of medicines (33). In Europe, the clinical use of medicinal plants is approved under the directive 24/2004 for the treatment of colds (34); these treatments are accessible and available. In Latin America, the Regional Office of WHO for the Americas (AMOR/PAHO) indicates that 71% and 40% of the population of Chile and Colombia, respectively, use traditional medicine (35, 36). In Peru, a megadiverse country, the use of medicinal plants for the treatment of various conditions, such as malaise and gastrointestinal and respiratory diseases, dates from the Inca period (24, 36-39), and currently approximately 1,400 species are used for medicinal purposes in both native and urban communities (24, 36). It comes as no surprise that traditional medicine is currently being used by the Peruvian population in the context of the COVID-19 pandemic. Thus, the objective of this study was to assess factors associated with the use of medicinal plants as an

adjuvant for the treatment or prevention of respiratory symptoms during the COVID-19 pandemic in Cusco, Peru.

## **METHODS**

### *Ethical considerations*

The survey was approved by the San Antonio Abad del Cusco National University ethics committee (#007-2020-CBI-UNSAAC). The participants remained anonymous and had the option to finish the survey at any time, and their information was kept confidential. All the survey participants were well-versed on the study intentions and were required to consent before the enrollment. The participants were not involved in any of the planning, execution and reporting stages of the study.

### *Study design*

We conducted an online cross-sectional multicenter survey, which was initially evaluated by 10 expert judges using Aiken's V (40). After including the experts' observations, a pilot study was performed (from August 16 to 4) with 336 respondents in in five districts of Cusco, Peru. The pilot data was used to calculate the minimal sample size necessary for the actual study. It was determined that a minimum sample size of 1,530 was necessary to achieve a minimum percentage difference of 2.5% (49.0% versus 51.5%), a statistical power of 80%, and a confidence level of 95% (data not shown). The sample size was calculated using power analysis (41).

The actual survey consisted of an online questionnaire that was sent via WhatsApp, Messenger, and Facebook. The shared questionnaire was made anonymous ensuring data confidentiality and reliability. The survey was performed from August 31 to September 20, 2020 after approximately 9 months of lockdown and social distancing measures in Peru due to the COVID-19 outbreak. At the beginning of the survey (August 31) the number of COVID-19 confirmed cases was 652,037 and 28,944 deaths (42), while at the end of the survey (September 20) the confirmed cases

increased to 772,896 and the deaths increased to 31,474 (43). We surveyed general public who were adults of both genders aged 20 to 70 years in five districts of Cusco, Peru with high-risk COVID-19 transmission according to the Epidemiological Alert AE-017-2020 (44). The five districts were Cusco, San Jerónimo, San Sebastián, Santiago, and Wanchaq. Participants were recruited by the research team of the Universidad Nacional de San Antonio Abad del Cusco.

### *Outcomes and Covariates*

The survey (**Annex 1**) included 11 questions, 5 were demographic questions, 2 were related to the use of medicinal plants as preventive or treatment of respiratory symptoms related to COVID-19, 2 were related to the diagnosis of COVID-19 in themselves and the close environment (family and friends), and the last 2 questions related to the medicinal plants were used and to what respiratory symptom(s) they were used for. The demographic questions included sex, age, education level, occupation or professional activity and the district of residence in Cusco.

The respondents were asked to indicate if during the COVID-19 lockdown they used medicinal plants to prevent or treat respiratory symptoms related to COVID-19. Then, the respondents were asked if they were diagnosed with COVID-19, and if any family member or friend was diagnosed with COVID-19. The respondents were asked to select from a list of 17 selected medicinal plants the ones they have used to prevent or treat COVID-19 related respiratory symptoms. Finally, the respondents were asked to select the symptom(s) why they consumed any of the medicinal plants indicated on the previous question. The symptoms included cough, sore throat, fever, headache or malaise. Loss of taste or smell, nausea/vomiting and diarrhea were not included. The selected symptoms relate to the most common COVID-19 symptoms reported by the Center of Disease Control and Prevention (CDC) (45).

### *Statistical analysis*

Data analysis was done in STATA version 14 (Stata Corp) with a significance level set at  $p < 0.05$ . Descriptive analysis of categorical (demographic) variables was performed to show the frequency and percentage of each response. The results were summarized in unidimensional tables to identify the medicinal plants that are most used by the respondents. Chi-square test was performed in the bivariate analysis to determine the association between the studied variables. Generalized linear models were used in the multivariate analysis using the Poisson family, the log-link function, and the models for variances of robust models and the district of residence as a cluster, thereby obtaining the prevalence ratios (PR). The 95% confidence intervals (CI) and  $p$ -value  $< 0.05$  were considered as the limit of statistical significance.

## RESULTS

### *Sociodemographic characteristics of the respondents*

A total of 1,747 respondents participated in this study. The majority of the study participants were female [59.1% (1,033)], the median age was 31 years (interquartile range: 24–41 years), 29.7% (518) were university and high school students, 59.2% (1,035) had higher education, and 33.3% (582) lived in the district of Cusco. Concerning to the COVID-19 questions and use of medicinal plants, 12.2% (214) had COVID-19, 65.9% (1,151) had a family member or friend with COVID-19, 80.2% (1,401) used medicinal plants to prevent respiratory symptoms, and 71.0% (1,241) used medicinal plants to treat respiratory symptoms (**Table 1**).

### *Use of medicinal plants as preventive or treatment for respiratory symptoms*

As shown on **Table 2**, the use of medicinal plants for the prevention of respiratory symptoms was associated with gender ( $p < 0.001$ ), age ( $p < 0.001$ ), occupation ( $p < 0.001$ ), education ( $p < 0.001$ ), and whether a family member or friend had COVID-19 ( $p < 0.001$ ). However, no association was observed with the district of residence ( $p =$



0.702) and if the respondent had COVID-19 ( $p = 0.632$ ). In the case of the use of medicinal plants for the treatment of respiratory symptoms, the bivariate analysis showed that it was associated with gender ( $p = 0.013$ ), age ( $p < 0.001$ ), occupation ( $p < 0.001$ ), education ( $p < 0.001$ ), district of residence ( $p = 0.005$ ), whether the respondent had COVID-19 ( $p < 0.001$ ), and whether a family member or friend had COVID-19 ( $p < 0.001$ ). Therefore, it could be observed that in general the respondents preferably used medicinal plants as treatment of respiratory symptoms.

#### *Medicinal plants used and respiratory symptoms associated with their use as treatment options*

As shown on **Table 3**, the respondents mentioned the use of 17 medicinal plants for the treatment of COVID-19 related respiratory symptoms. The most frequently used medicinal plant was eucalyptus followed by ginger, garlic, spiked pepper, chamomile and coca. It was observed that all the medicinal plants were used for 2 or more respiratory symptoms. The bivariate statistics showed that the use of medicinal plants was associated with the occurrence of two or more symptoms (24–51%), followed by malaise (11–41%). In addition, there was a difference in consumption according to the type of symptom ( $p < 0.041$ ) for all medicinal plants except panty ( $p = 0.076$ ).

#### *Multivariate analysis of the factors associated to the use of medicinal plants*

In the multivariate analysis (**Table 4**) of the use of medicinal plants for the treatment or prevention of respiratory symptoms during the COVID-19 pandemic found a positive association with the use of eucalyptus for treatment (PR: 1.26, 95% CI: 1.16-1.37,  $p < 0.001$ ) and prevention (PR: 1.24, 95% CI: 1.15-1.35,  $p < 0.001$ ). Followed by the use of spiked pepper for treatment (PR: 1.20, 95% CI: 1.07-1.34,  $p = 0.011$ ) and prevention (PR: 1.12, 95% CI: 1.06-1.19,  $p < 0.001$ ). In addition, there is also a positive association between the use of ginger for treatment (PR: 1.13, 95% CI: 1.03-1.25,  $p = 0.011$ ) and prevention (PR: 1.08, 95% CI: 1.01-1.16,  $p = 0.021$ ), the use of garlic for

prevention only (PR: 1.06, 95% CI: 1.01-1.11,  $p = 0.023$ ), and the use of chamomile for treatment only (PR: 1.12, 95% CI: 1.03-1.23,  $p = 0.011$ ).

There was also a negative association between the use of wira wira for treatment (PR: 0.9, 95% CI: 0.82-0.98,  $p = 0.016$ ) and prevention (PR: 0.89, 95% CI: 0.85-0.93,  $p < 0.001$ ) and the use of panty for treatment only (PR: 0.87, 95% CI: 0.78-0.97,  $p = 0.009$ ). Therefore, eucalyptus, spiked pepper, ginger, and chamomile were the most used for the treatment of respiratory symptoms, whereas panty and wira wira were the least used. As for prevention, eucalyptus, spiked pepper, ginger, and garlic were the most used, whereas wira wira was the least used.

Regarding the adjustment of demographic variables and the use of medicinal plants for the treatment or prevention of respiratory symptoms, it is important to mention that there was a positive association between age and prevention (PR: 1.00, 95% CI: 1.00-1.01,  $p = 0.046$ ). Precisely, older respondents used more medicinal plants for prevention. There was also a positive association between the respondents diagnosed with COVID-19 and the use of medicinal plants for treatment (PR: 1.22, 95% CI: 1.11-1.34,  $p < 0.001$ ); precisely, those with COVID-19 used more medicinal plants for prevention. There was also a positive association between the respondents with a family member or friend diagnosed with COVID-19 and the use of medicinal plants for treatment (PR: 1.11, 95% CI: 1.06-1.17,  $p < 0.001$ ) and prevention (PR: 1.08, 95% CI: 1.04-1.13,  $p < 0.001$ ), but the respondents used fewer plants for treatment if they had a technical or higher education (PR: 0.89, 95% CI: 0.83-0.95,  $p < 0.001$ ).

## DISCUSSION

Regarding the prevention of COVID-19 respiratory symptoms, this study showed that 80.2% of the population of Cusco, Peru, used medicinal plants for this purpose. Comparatively, a study conducted in a population of the state of Querétaro in Mexico showed that the main conditions treated with medicinal plants were asthma (18.42%), bronchitis (2.6%), flu (5.2%), congestion in the respiratory tract (10.5%), sore throat

(21%), throat infection (15.7%), pneumonia (5.2%), sinusitis (10.55%), cough (55.2%), and tuberculosis (2.6%) (46). Additionally, there are populations in many regions of the world that are using medicinal plants for the prevention of COVID-19, because these plants are more readily available than Western medicine. In this regard, a study performed in the Moroccan population has mentioned medicinal plants similar to those reported in this study, such as eucalyptus, garlic, onion, ginger, thyme, turmeric, and rosemary (47).

Regarding the use of medicinal plants for the treatment of COVID-19 respiratory symptoms, 29.0% of the respondents did not use any plant, whereas 71.0% did. One of the most relevant clinical manifestations of COVID-19 is the great damage on the respiratory tract, causing respiratory distress that can lead to death, and for this reason, effective and non-invasive treatments are required (48). This includes the use of medicinal plants, which were revalued during this pandemic to manage the COVID-19 symptoms, because plants are a source of plant metabolites with antiviral activity (49). In this context, a study carried out in Bolivia evaluated eucalyptus, wira wira, and chamomile for their antibacterial, anti-inflammatory, and fungicidal properties (23). Alternatively, it has been reported that diet supplementation with probiotics and nutraceuticals play a fundamental role in the treatment of respiratory symptoms, because many products produce an immune response to respiratory viruses in addition to their regulatory activity for the inflammation caused by COVID-19 (50). The therapeutic use of medicinal plants has increased in many Latin American countries over time (51). Our study reported that 80% of the respondents used medicinal plants when they or their family member or friend had COVID-19, which correlates to previous reports (52).

As for the socio-educational factors associated with the use of medicinal plants for the prevention of respiratory symptoms, our study reported that female respondents (83.1%) used them. This correlates to previous studies where women are more versed in the properties of medicinal plants (53) and that they typically use medicinal plants to

take care of the health of their family members (54, 55). Therefore, probably in most populations, women are those who transmit the traditional domestic knowledge from generation to generation (56). Sigal obtained different results in a study performed in 2005 on the role of gender in the use and management of medicinal plants in indigenous communities of India, as it was found that both females and males had the knowledge and appreciation of their use (57). The study of Biniam et al. found a greater tendency for women to use medicinal plants than men (58). This relevant role of women is not only in medicinal plants but also in food safety practices (59). This factor is relevant in the current context of the COVID-19 pandemic, and it is relevant to focus on females as an important element for the prevention and rational treatment of patients with COVID-19.

Regarding the significant association between the use of medicinal plants with primary and secondary education, this is explained by the fact that those with professional training are more likely to use a scientifically validated treatment, abandoning the use of medicinal plants. It has been reported that elder and low education people could be at higher risk of disease complications because they prefer the use of medicinal plants over the adherence to pharmacological treatment (60). This could potentially be riskier for patients with COVID-19.

For the treatment of COVID-19 respiratory symptoms, 24 to 51% of respondents in our study used medicinal plants when there were more than two symptoms and 11 to 41% when they presented malaise. There are studies describing the ethnomedicinal use during the COVID-19 pandemic of different communities and cultures around the world, especially in Asian countries, such as India, China, Japan, and Pakistan and some parts of Africa (61). COVID-19 symptoms develop with inflammation and hemotoxicity, which could suggest that blood-purifying plants with anti-inflammatory, antioxidant, and antiviral properties could be considered as candidates for the treatment of COVID-19 (62). There are also herbal remedies, such as those made from *Uncaria tomentosa* or cat's claw, a climbing vine that grows in the Peruvian jungle,

which is used to stimulate the immune system (61). The most used plants in our study included eucalyptus, turmeric, garlic, lemon balm, and geranium. It has been reported that eucalyptus is an effective antiviral agent against SARS-CoV-2 for its eucalyptol content, which was assessed in molecular docking studies (61). Moreover, it has been reported that jensenone, a compound obtained from the essential oil of eucalyptus exhibits antiviral effect against the main protein of SARS-CoV-2 (61). Additionally, garlic exhibited an inhibitory effect on SARS-CoV-2 replication; thus, it is a promising agent against COVID-19 (63). A similar effect was found for palillo, a curcumin extracted from turmeric (63), as determined by molecular docking studies (61). A meta-analysis study performed on medicinal plants suggested that plants, such as turmeric, can be used as a prophylaxis against SARS-CoV-2 according to docking studies that suggest its use; therefore, more trials should be carried out (62). Another study was performed on natural molecules from plants with antiviral properties such as rosemary and cinnamon, reporting that they present low toxicity, and abundant active ingredients that can be used against viral infections (64). There are also other studies on medicinal plants, such as ginger, whose rhizome has been used to alleviate fever and other COVID-19 symptoms in Africa (65).

Peru is one of the countries that have a wide pantry of medicinal plants that are one of the main alternatives in health care to prevent and treat various diseases. In different countries, there is also a worldwide wealth of knowledge, theories, and practices on the use of plants as natural medicines for the treatment of diseases. Medicinal plants have been used since prehistoric times – a tradition that has been passed down from generation to generation. The World Health Organization (WHO) considers the Natural and Traditional Medicine, which includes treatment with medicinal plants, as the most natural, safe, effective, and affordable medicine (66). The use of medicinal plants for respiratory conditions has also been reported in various parts of the world from China (29), India (27), Saudi Arabia (67) to Mexico (68) and Ecuador (69). However, it needs to be acknowledged that the ethnopharmacological use of medicinal plants for prevention

or treatment of respiratory symptoms related to COVID-19 still needs to be evaluated in clinical settings in order to have solid evidence of their effectiveness and to isolate compounds with potential pharmacological use.

## **LIMITATIONS OF THE STUDY**

The limitations of this study included the fact that the results cannot be extrapolated to the entire Peruvian population. The objective of this study was to determine the association between the use of medicinal plants and the treatment or prevention of respiratory symptoms in the population of the five districts of Cusco, one of the most important cities in Peru. However, this study is the first to investigate this association in this population; therefore, this could become a basis for other studies that could cover a larger population from all over the country.

Another limitation is bias occurred as a result of the cross-sectional study design to determine definitive cause and effect associations. Similarly, the responders performed a self-reported assessment in an online data collection platform, which could lead to under or over-reporting and the data collector has not ability to verify or validate.

## **CONCLUSION**

The current study reported an association between the use of medicinal plants and the treatment or prevention of the respiratory symptoms related to COVID-19, and the most used plants were eucalyptus, ginger, chamomile, and garlic. Moreover, it was determined that the study population used a greater number of plants for disease prevention when the respondent was older and if they or a friend or family member had contracted COVID-19.

## **SUPPORTING INFORMATION**

None

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## DATA AVAILABILITY STATEMENT

The data set generated for the current study is available upon request.

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## COMPETING INTERESTS

The authors declare that they have no conflict of interests.

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## TABLES

**Table 1.** Socio-demographic characteristics of respondents that used medicinal plants for the treatment or prevention of respiratory symptoms during the COVID-19 pandemic in Cusco, Peru.

Variable	N	%
<b>Gender</b>		
Female	1033	59.1%
Male	714	40.9%
<b>Age (years)<sup>a</sup></b>	31	24-41
<b>Occupation or professional activity</b>		
Housewife	195	11.1%
Self-employed	386	22.1%
Public sector	323	18.5%
Private sector	243	13.9%
Student	518	29.7%
Other	82	4.7%
<b>Education</b>		
No education	33	1.9%
Primary	58	3.3%
Secondary	328	18.8%
Technical	293	16.8%
University	1035	59.2%
<b>District of residence</b>		
Cusco	582	33.3%
San Jerónimo	272	15.6%
San Sebastián	332	19.0%
Santiago	278	15.9%
Wanchaq	283	16.2%
<b>Diagnosed with COVID-19</b>		
No	1533	87.8%
Yes	214	12.2%
<b>Family member or friend diagnosed with COVID-19</b>		
No	596	34.1%
Yes	1151	65.9%
<b>Prevention for respiratory symptoms</b>		
Did not use plants for prevention	346	19.8%
Used plants for prevention	1401	80.2%
<b>Treatment of respiratory symptoms</b>		
Did not use plants for treatment	506	29.0%
Used plants for treatment	1241	71.0%

<sup>a</sup>Median and interquartile range.



**Table 2.** Use of medicinal plants as preventive or treatment for respiratory symptoms during the COVID-19 pandemic in Cusco, Peru.

Variable	Used medicinal plant as preventive		p-value		Used medicinal plant as treatment		p-value
	No	Yes			No	Yes	
<b>Gender</b>							
Female	175 (16.9%)	858 (83.1%)	<0.001		276 (26.7%)	757 (73.3%)	0.013
Male	171 (24.0%)	543 (76.0%)			230 (32.2%)	484 (67.8%)	
<b>Age (years)*</b>	28 (23-39)	31 (24-42)	<0.001		28 (23-40)	32 (25-42)	<0.001
<b>Occupation or professional activity</b>							
Housewife	18 (9.2%)	177 (90.8%)	<0.001		34 (17.4%)	161 (82.6%)	<0.001
Self-employed	70 (18.1%)	316 (81.9%)			93 (24.1%)	293 (75.9%)	
Public sector	58 (18.0%)	265 (82.0%)			82 (25.4%)	241 (74.6%)	
Private sector	38 (15.6%)	205 (84.4%)			63 (25.9%)	180 (74.1%)	
Student	152 (29.3%)	366 (70.7%)			210 (40.5%)	308 (59.5%)	
Other	10 (12.2%)	72 (87.8%)			24 (29.3%)	58 (70.7%)	
<b>Education</b>							
No education	10 (30.3%)	23 (69.7%)	<0.001		10 (30.3%)	23 (69.7%)	<0.001
Primary	7 (12.1%)	51 (87.9%)			11 (19.0%)	47 (81.0%)	
Secondary	42 (12.8%)	286 (87.2%)			61 (18.6%)	267 (81.4%)	
Technical	46 (15.7%)	247 (84.3%)			72 (24.6%)	221 (75.4%)	
University	241 (23.3%)	794 (76.7%)			352 (34.0%)	683 (66.0%)	
<b>District of residence</b>							
Cusco	122 (21.0%)	460 (79.0%)	0.702		200 (34.4%)	382 (65.6%)	0.005
San Jerónimo	59 (21.7%)	213 (78.3%)			76 (28.0%)	196 (72.0%)	
San Sebastián	63 (19.0%)	269 (81.0%)			81 (24.4%)	251 (75.6%)	
Santiago	51 (18.4%)	227 (81.6%)			67 (24.1%)	211 (75.9%)	
Wanchaq	51 (18.0%)	232 (82.0%)			82 (29.0%)	201 (71.0%)	
<b>Had COVID-19</b>							
No	301 (19.6%)	1232 (80.4%)	0.632		474 (30.9%)	1059 (69.1%)	<0.001
Yes	45 (21.0%)	169 (79.0%)			32 (15.0%)	182 (85.0%)	
<b>Family member or friend diagnosed with COVID-19</b>							
No	158 (26.5%)	438 (73.5%)	<0.001		225 (37.8%)	371 (62.2%)	<0.001

Yes	188 (16.3%)	963 (83.7%)			281 (24.4%)	870 (75.6%)	
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The p-values were obtained with chi-square tests and the sum of ranges (for age). The descriptive values for age are the median (interquartile ranges).

**Table 3.** Percentage of the use of medicinal plants for the treatment of respiratory symptoms during the COVID-19 pandemic in Cusco, Peru

Medicinal plant		N	Two or more symptoms	Cough	Sore throat	Malaise	Fever	Headache	Other symptoms	p-value
Common name	Scientific name									
Eucalyptus	<i>Eucalyptus globulus</i> Labill.	989	48%	20%	6%	17%	1%	1%	7%	<0,001
Ginger	<i>Zingiber officinale</i> Roscoe	927	46%	17%	20%	11%	1%	0%	5%	0,001
Garlic	<i>Allium sativum</i> L.	838	46%	21%	16%	11%	0%	0%	6%	<0,001
Spiked pepper	<i>Piper aduncum</i> L.	661	50%	13%	10%	17%	1%	1%	8%	0,001
Chamomile	<i>Matricaria recutita</i> L.	642	38%	3%	8%	32%	2%	6%	11%	<0,001
Coca	<i>Erythroxylum coca</i> Lam.	474	42%	7%	14%	23%	1%	4%	9%	0,040
Peperine	<i>Minthostachys acris</i> Schmidt-Leb.	451	32%	10%	6%	32%	1%	3%	16%	<0,001
Oregano	<i>Origanum vulgare</i> L.	346	26%	11%	7%	37%	1%	1%	16%	<0,001
Rosemary	<i>Rosmarinus officinalis</i> L.	298	24%	8%	5%	41%	3%	4%	15%	<0,001
Panty	<i>Cosmos peucedanifolius</i> Wedd	211	41%	30%	6%	15%	1%	0%	7%	0,076
Lemon balm	<i>Melissa officinalis</i> L.	166	27%	7%	6%	31%	1%	4%	24%	0,013
Thyme	<i>Thymus vulgaris</i> L.	164	35%	9%	5%	36%	2%	0%	12%	<0,001
Sage	<i>Salvia officinalis</i> L.	146	42%	15%	4%	21%	3%	1%	13%	<0,001
Keto-keto	<i>Gnaphalium</i>	126	40%	25%	6%	13%	4%	2%	10%	0,010

	<i>spicatum</i> Lam.									
Geranium	<i>Geranium</i> L.	106	26%	12%	10%	29%	5%	1%	17%	0,004
Asmachilca	<i>Aristeguietia</i> <i>gayana</i> wedd.	102	51%	10%	4%	17%	1%	1%	16%	0,014
Wira wira	<i>Ganaphalium</i> <i>dombeyanum</i> DC.	83	40%	15%	6%	19%	2%	1%	17%	0,014

The p-values were obtained based on the chi-square test.

**Table 4.** Multivariate analysis of the use of medicinal plants for the treatment or prevention of respiratory symptoms during the COVID-19 pandemic in Cusco, Peru

Medicinal Plant		For treatment	For prevention
Common Name	Scientific Name		
Eucalyptus	<i>Eucalyptus globulus</i> Labill.	1.26 (1.16-1.37) p<0.001	1.24 (1.15-1.35) p<0.001
Ginger	<i>Zingiber officinale</i> Roscoe	1.13 (1.03-1.25) p=0.011	1.08 (1.01-1.16) p=0.021
Garlic	<i>Allium sativum</i> L.	p=0.121	1.06 (1.01-1.11) p=0.023
Coca	<i>Erythroxylum coca</i> Lam.	p=0.517	p=0.596
Peperina	<i>Minthostachys acris</i> Schmidt-Leb.	p=0.207	p=0.263
Spiked pepper	<i>Piper aduncum</i> L.	1.20 (1.07-1.34) p=0.002	1.12 (1.06-1.19) p<0.001
Chamomile	<i>Matricaria recutita</i> L.	1,12 (1.03-1.23) p=0.011	p=0.0151
Rosemary	<i>Rosmarinus officinalis</i> L.	p=0.167	p=0.211
Oregano	<i>Origanum vulgare</i> L.	p=0.126	p=0.817
Lemon balm	<i>Melissa officinalis</i> L.	p=0.130	p=0.697
Geranium	Geranium, L.	p=0.526	p=0.428
Thyme	<i>Thymus vulgaris</i> L.	p=0.157	p=0.063
Panty	<i>Cosmos peucedanifolius</i> Wedd	0.87 (0.78-0.97) p=0.009	p=0.908
Keto-Keto	<i>Gnaphalium spicatum</i> Lam.	p=0.080	p=0.262
Sage	<i>Salvia officinalis</i> L.	p=0.0519	p=0.431
Wira Wira	<i>Ganaphalium dombeyanum</i> DC.	0.90 (0.82-0.98) p=0.016	0.89 (0.85-0.93) p<0.001
Asmachilca	<i>Aristeguietia gayana</i> wedd.	p=0.742	p=0.466
Adjustment variables			
Age (Years)*		p=0.054	1.00 (1.00-1.01) p=0.046
Male		p=0.708	p=0.105
Technical or higher education		0.89 (0.83-0.95) p<0.001	p=0.106
Had COVID-19 diagnosis		1.22 (1.11-1.34) p<0.001	p=0.472
Family member or friend diagnosed with COVID-19		1.11 (1.06-1.17) p<0.001	1.08 (1.04-1.13) p<0.001

\*The variable age was considered quantitatively.

# **ANNEX 1.** Survey to assess the use of medicinal plants in the prevention and treatment of respiratory symptoms during the COVID-19 pandemic.

## **Demographic data**

1. **Sex:** Male ( ) Female ( )
2. **Age:** \_\_\_\_\_ (years)
3. **Education level:** No education ( ) Primary ( ) Secondary ( ) Technical ( ) University ( )
4. **Occupation or professional activity:** Housewife ( ) Self-employed ( ) Public sector ( ) Private sector ( ) Student ( ) Other ( )
5. **District in Cusco where you live:** Cusco ( ) San Jerónimo ( ) San Sebastián ( ) Santiago ( ) Wanchaq ( )
6. **Do you use medicinal plants to prevent respiratory symptoms related to COVID-19 during the lockdown?** Yes ( ) No ( )
7. **Do you use medicinal plants to treat respiratory symptoms related to COVID-19 during the pandemic?** Yes ( ) No ( )
8. **Have you been diagnosed with COVID-19?** Yes ( ) No ( )
9. **Have a family member or friend been diagnosed with COVID-19?** Yes ( ) No ( )
10. **Which medicinal plan have you used to prevent or treat respiratory symptoms related to COVID-19 during the pandemic?**

<b>Medicinal plant</b>	<b>Yes</b>	<b>No</b>
Eucalyptus		
Ginger		
Garlic		
Coca		
Peperine		
Spiked pepper		
Chamomile		
Rosemary		
Oregano		
Lemon balm		
Geranium		
Thyme		
Panty		

Keto-keto		
Sage		
Wira Wira		
Asmachilca		

**11. What symptom(s) did you use the above-mentioned plants for?**

Medicinal plant	Malaise	Cough	Headache	Sore throat	Fever	Other
Eucalyptus						
Ginger						
Garlic						
Coca						
Peperine						
Spiked pepper						
Chamomile						
Rosemary						
Oregano						
Lemon balm						
Geranium						
Thyme						
Panty						
Keto-keto						
Sage						
Wira Wira						
Asmachilca						