

# Prescription for COVID-19 by non-medical professionals during the pandemic in Colombia: a cross-sectional study

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## Abstract

**Background:** The COVID-19 pandemic has led to an increase in the behavior of self-medication (SM). Given the massive release of misleading information during the pandemic, some pharmacies recommend drugs such as ivermectin, azithromycin, and hydroxychloroquine that are not useful for preventing or treating COVID-19 and could expose patients to unnecessary adverse drug reactions (ADRs), drug-drug interactions (DDIs), disease masking, and antibiotic resistance.

**Rationale:** SM with drugs advertised for COVID-19 can have consequences, and people should be aware of approved uses, potential contraindications, and ADRs. Thus, the aim of this study was to know the drug therapies including natural products and homeopathic drugs offered by Colombian pharmaceutical establishments for the prevention and treatment of COVID-19, as well as the information provided on the safe use of the product.

**Methods:** An observational, cross-sectional mystery shopping study was carried out to determine the pharmaceutical alternatives for the management of COVID-19 offered by pharmaceutical establishments (drugstores, pharmacies, homeopathic pharmacies, and nutritional supplements stores) in Colombia, and information related to the safe use of the product. The study included 482 pharmaceutical establishments from 16 Colombian departments. Data collection was done through telephone calls to each of the establishments following an interview protocol pretending to be a patient who presents symptoms related to COVID-19.

**Results:** About 57.3% (276) of the establishments recommended a product for the treatment of COVID-19 infection, 66.6% (321) asked whether the caller had COVID-19 symptoms and what they are, and 44.2% (213) suggested taking a COVID-19 test. Of 59 drugs suggested by pharmacies, the most recommended were azithromycin, ivermectin, acetaminophen, ibuprofen, and ASA (aspirin). From the establishments that recommended a product, dosage was indicated in 85.5% (236) of the pharmaceutical establishments and 14.5% (40) of the establishments reported the most common adverse effects of this substance. About 9.4% (26) of the establishments reported possible interactions of the recommended drugs and substances with food, beverages, or supplements.

**Conclusion:** Pharmaceutical establishments in Colombia seem to have significantly contributed to self-medication for COVID-19 in Colombia during the pandemic. This behavior is inappropriate, since the mild forms of the disease do not have a specific treatment.

## Plain Language Summary

### Self-medication induced by pharmaceutical establishments in Colombia during the COVID-19 pandemic

**Background:** The COVID-19 pandemic has led to an increase in the behavior of self-medication (SM). Given the massive release of misleading information during the pandemic,

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some pharmacies recommend drugs such as ivermectin, azithromycin, hydroxychloroquine among others, which are not useful for preventing or treating COVID-19 and could expose patients to unnecessary side effects and interactions with other medications. People should be aware of the approved and non-approved uses, and potential side effects of these drugs.

**Rationale:** The aim of this study was to know the drugs, including natural products and homeopathic drugs, offered by Colombian pharmaceutical establishments for the prevention and treatment of COVID-19, as well as the information provided on the safe use of the product.

**Methods:** The study was done using the mystery shopping method, collecting data through telephone calls to each of the establishments by a trained individual pretending to be a patient with COVID-19 symptoms. The study included 482 pharmaceutical establishments from 16 Colombian departments.

**Results:** Of 59 drugs suggested by pharmacies, the most recommended were azithromycin, ivermectin, acetaminophen, ibuprofen, and aspirin. The recommended dose was indicated in 85.5% (236) of the pharmaceutical establishments, and 14.5% (40) of them reported the most common adverse effects of the recommended product. About 9.4% (26) of the establishments reported possible interactions of the recommended drugs and substances with food, beverages, or supplements.

**Conclusion:** The majority of the pharmaceutical establishments included in the study promoted inadequate self-medication for COVID-19 in Colombia during the pandemic.

**Keywords:** Colombia, COVID-19, medical prescriptions, pharmacies, self-medication

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## Introduction

COVID-19 is a zoonotic infection caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).<sup>1</sup> It was first reported in Wuhan (China) on 31 December 2019 and declared a public health emergency of international concern (PHEIC) on 30 January 2020.<sup>2</sup> This infection, which can be transmitted directly, by talking, coughing, or sneezing, and indirectly, through contact with different contaminated surfaces or objects, as of 27 December 2021, has generated around 272 million confirmed cases and about 5 million deaths worldwide.<sup>3</sup> Depending on risk factors such as the presence of pre-existing comorbidities, age, sex, and ethnicity, COVID-19 can cause different clinical presentations, which can range from asymptomatic infections in most cases to severe infections with sepsis, disseminated intravascular coagulation, multiorgan failure, and death.<sup>4</sup>

Although about 8.6 billion COVID-19 vaccine doses have been administered<sup>5</sup> COVID-19 has continued to expand rapidly, forcing a change in the behavior of the different affected communities. In this sense, according to the literature, the

population has assumed three types of protection measures: the first is based on preventive behaviors such as the use of masks, hand disinfection, and the administration of vaccines; the second consists of avoidance behaviors, such as social distancing, and avoiding crowds of people among others; and the third measure is the consumption of drugs or substances for preventing or treating COVID-19.<sup>6</sup>

In the third measure, it is evident that the COVID-19 pandemic has led people to increase the behavior of self-medication (SM) to take control of their health.<sup>7</sup> Considering the lack of a definitive treatment, fear of leaving the house, fear of being infected in the emergency room, and the overwhelmed healthcare systems, SM has become a primary response to illness and pharmaceutical establishments the main source of drugs and other substances for the treatment of COVID-19. Although SM can be beneficial in some cases, it is a behavior that has associated risks such as adverse drug reactions (ADRs), drug-drug interactions (DDIs), antibiotic resistance, drug misuse, and drug toxicity, with potential serious adverse outcomes.<sup>8</sup> The stress generated by lockdowns and

the disproportionate fear of being infected by the virus can cause dramatic changes in an individual behavior (excessive house cleaning, misuse of cleaning products, SM with dangerous drugs, and other products). As an example, there have been reports of increased exposure to chlorine by poison control centers because of misuse of cleaning products for food cleaning or personal hygiene.<sup>9,10</sup>

On the other hand, SM can also be beneficial for reducing the burden on the healthcare system when practiced responsibly. The use of over-the-counter (OTC) drugs in approved conditions, following the instructions of the medicine label, is part of the criteria for responsible SM according to the WHO.<sup>8</sup> However, SM during the pandemic does not usually meet these criteria, as pharmacy personnel may fail to deliver complete information for the appropriate use of a drug, wrongly suggest the use of an antibiotic, or the individual may simply not follow the label instructions. This is especially important in Colombia because the role of pharmaceutical establishments can be as important as that of doctors in terms of prescribing medicines. Often, individuals prefer to go to the pharmacies to resolve their symptoms rather than consult a doctor. This is frequently the case in Colombia because, unlike other countries, most drugs are sold as if they were OTC. For instance, it is often seen how antibiotics are recommended to individuals by pharmaceutical establishments for flu symptoms without the need for a prescription from an authorized health professional.

Some authors consider the term ‘self-prescription’ as SM with non-OTC drugs. However, for the purposes of this study, both terms were used interchangeably. Therefore, the aim of this study was to evaluate the pharmacological and non-pharmacological therapies offered by pharmaceutical establishments in Colombia for the prevention and treatment of COVID-19, the most recommended drugs/substances, and the safety information provided by the seller. In this regard, we evaluated whether the pharmacies gave information regarding the drug posology as well as potential ADRs, contraindications, and drug interactions.

## Methods

An observational cross-sectional study was carried out to determine the alternatives for the management of COVID-19 offered by pharmaceutical

establishments in Colombia, and the possible adverse effects of the recommended products. The study population were the pharmaceutical establishments such as drugstores, pharmacies, homeopathic pharmacies, and nutritional supplements stores in the main departments of Colombia, including their capitals and other towns that had the highest number of reported COVID-19 cases between July and August 2020. The inclusion criteria were that the establishments were not found in clinics and hospitals and that they serve non-hospitalized people. The exclusion criteria were hospital pharmacies or those that did not have a telephone number available.

Stratified randomized sampling was carried out. The sample size was calculated according to equation 1, assuming a heterogeneity of 50%, a confidence interval of 95% and precision of 5%, extrapolated to a population of 19,249. Thus, the minimum sample size required is 377 pharmaceutical establishments:

$$n = \frac{NZ^2\sigma^2}{(N-1)e^2 + Z^2\sigma^2}$$

where  $N$  is the population (19,249),  $Z$  is the value obtained from the normal distribution for a confidence level of 95% (1.96),  $\sigma$  is the standard deviation of the population (0.5), and ‘ $e$ ’ is the acceptable limit of the sampling error (0.05).

The study included 482 pharmaceutical establishments from 16 Colombian departments (including their respective capitals) selected by non-probabilistic convenience sampling, using as sources the records of the chamber of commerce of the municipalities, the yellow pages, and Internet search engines. Table 1 presents the number of establishments by department.

Data collection was done through telephone calls to each of the establishments following an interview protocol designed to guarantee homogeneity in the responses of the interviewee. This interview protocol was validated through a pilot of 30 interviews. The interviewers were trained in order to act naturally when conducting the interview by pretending to be a patient who presents symptoms related to the COVID-19 disease such as general malaise, fever, cough (without dyspnea), also indicating the possibility of having a strong flu, but

**Table 1.** Number of pharmaceutical establishments by department (Colombia).

Department	Establishments (n)
Cundinamarca	102
Antioquia	80
Valle del Cauca	50
Santander	36
Huila	32
Nariño	32
Tolima	27
Norte de Santander	24
Atlántico	21
Risaralda	18
Meta	15
Bolívar	14
Caldas	9
Quindío	9
Amazonas	7
Chocó	6
Total	482

with the added risk of having been in contact with a SARS-CoV-2 positive person. The fake patient (person pretending to be suffering from symptoms related to COVID-19) started the interview by stating his or her symptoms and inquiring for a possible recommendation for the treatment of his or her symptoms. If the response to this question by the interviewee (establishment employee) was negative (No), the interview was ended thanking the employee; but if the answer was affirmative (Yes), the interviewer inquired about the dosage, possible adverse effects, and drug interactions of the recommended substance. After that, following the interview protocol, the interviewer asked whether the recommended product could be administered to pregnant women and, finally, requested recommendations for preventing COVID-19 infection. The information was included in a physical guide and tabulated for later analysis. The data were analyzed in the SPSS package (version 23) using frequency statistics.

**Table 2.** Number of products recommended by each pharmaceutical establishment to treat COVID-19.

Number of recommended medications	n (number of pharmaceutical establishments)	%
0	206	42.7
1	99	20.5
2	62	12.8
3	61	12.6
4	41	8.5
5	10	2.1
6	2	.4
7	1	.2

## Results

About 57.3% (276) of the establishments recommended a product for the treatment of COVID-19 infection. Of all the establishments, 66.6% (321) asked whether the caller had COVID-19 symptoms and what they were, and 44.2% (213) suggested taking a COVID-19 test. The number of recommended products can be seen in Table 2.

The most frequent drugs and substances suggested for the treatment of COVID-19 are shown in Table 3, differentiating between active principles, dietary supplements, homeopathic products, alternative therapies, and others. The percentages shown in Table 3 were calculated from a total of 276 the pharmacies that recommended products; the 206 pharmacies that recommended zero products were not taken into account. Of 59 active principles suggested by pharmacies, the most recommended were azithromycin, ivermectin, acetaminophen, ibuprofen, and aspirin. Nine supplements were prescribed, including vitamin C, transfer factors, and multivitamins. Of 22 alternative therapies, the most recommended were moringa, ginger, and eucalyptus. Of a total of 9 phytotherapeutic components, the most recommended were totumo, cinchona, and dragon's blood.

Of these drugs and recommended substances, the dosage was indicated in 85.5% (236) of the pharmaceutical establishments and 14.5% (40) of the

**Table 3.** Suggested substances for treating COVID-19.

Substance	<i>n</i>	%
Drugs		
Azithromycin	91	32.97
Ivermectin	75	27.17
Acetaminophen	56	20.29
Ibuprofen	38	13.77
Phenylephrine combinations	32	11.6
ASA (aspirin)	20	7.25
Naproxen	11	3.99
Dexamethasone	9	3.26
Cetirizine	8	2.90
Diclofenac	6	2.17
Minocycline	6	2.17
Acetylcysteine	5	1.81
Clarithromycin	5	1.81
Chloroquine	5	1.81
Hydroxychloroquine	5	1.81
Loratadine	5	1.81
Antibiotic	4	1.45
Dexamethorphan	4	1.45
Betamethasone	3	1.09
Analgesics	2	0.72
Dietary supplements		
Vitamin C	50	18.12
Transfer factors	14	5.07
Multivitamin	12	4.35
Vitamin D	8	2.90
Vitamin D3	2	0.72
Vitamins	2	0.72
Phytotherapeutics		
Totumo	4	1.45

*(Continued)***Table 3.** (continued)

Substance	<i>n</i>	%
Quina	3	1.09
Dragon's blood	2	0.72
Homeopathic products		
Homeopathic treatment	15	5.43
Aconitum napellus	1	0.36
Anas barbariae	1	0.36
Arsenicum album	1	0.36
Alternative therapies		
Moringa	24	8.70
Lime	7	2.54
Ginger	6	2.17
Eucalyptus	3	1.09
Other		
Oral rehydration salts	4	1.45
Liquids	2	0.72

The percentages in this table were calculated based on the number of pharmaceutical establishments that recommended a drug or substance ( $n=276$ ). Only the most frequently recommended products were included in the table.

establishments reported the possible adverse effects of these products, but only 7.6% (21) mentioned these side effects specifically, including allergies and cardiovascular side effects. Regarding the frequency of possible side effects, 5.8% (16) reported that they almost never occur and 4.0% reported that they were common. About 90.2% of the establishments did not report this frequency.

About 9.4% (26) of the establishments reported possible interactions of the recommended drugs and substances with food, beverages, or supplements; of these, 80.8% (21) mentioned the substances with which there would be possible interactions: 71.4% (15) mentioned interactions with alcohol, 9.5% (2) indicated interactions with dairy products, and 9.5% (2) indicated interactions with antidepressants. Among the clinical consequences of interactions mentioned were allergies, rash, and poisoning.



About 8.7% (24) of the establishments that recommended substances or drugs for COVID-19 requested information regarding the medical history of the caller, and in 66.7% (16) of these cases, they established some risks related with the medical history of the customer, mainly the risk of exacerbating hypertension. In addition, 10.9% (30) of the establishments recommending treatments inquired whether the consultant had a history of kidney, liver, or heart problems. Of these, 80.0% (24) recommended taking the medication while 13.3% (4) suggested not taking it.

Regarding prevention of COVID-19, 13.9% (67) of the establishments asked about COVID-19 symptoms in a family member and 31.7% (153) recommended substances, actions, or medications to prevent contagion by COVID-19. Of these, the dose was indicated in 58.2% (89) of the establishments. In 59.5% (91) of the establishments suggesting preventive treatments, these substance and medication recommendations were given for supposedly pregnant women and posology was indicated in 95.6% (87) of these cases.

In total, 17 active principles, 9 dietary supplements, 6 alternative therapies, 3 homeopathic products, 1 phytotherapeutic product, 7 biosafety measures, and 11 non-classifiable indications were indicated. Table 4 presents the recommended components, drugs, and substances, along with the number of establishments that indicate them and the corresponding frequency.

In 9.8% (15) of the establishments that gave recommendations, possible adverse events of the recommended drugs or substances were explained. Some of the adverse events explained in the case of pregnant women were affectation or harm to the newborn or risk due to the stage of pregnancy (8 of these establishments; 53.3%), and in 13% (2) it was mentioned that the intervention would not affect the offspring. In six establishments (40%), it was indicated that the risk is common.

In 84 facilities, the drugs were said to be safe for pregnant women and in 108 that they were not safe.

In 7.8% (12) of the establishments recommending preventive treatments, possible interactions of suggested drugs and substances were reported

with alcoholic beverages (41.7%, 5), dairy products (8.3%, 1), and moringa (8.3%, 1). In 50.0% (6) of these establishments, it was reported that these interactions could cause harm to the baby (in the case of pregnant women), 8.3% (1) explained the possibility of intoxication was reported, the same as for hypertension. In 12.4% (19) of the establishments that recommended preventive treatments, it was indicated that the recommended medications could generate risks for pregnant women: 42.1% (8) of these indicated possible effects on the baby, 26.3% (5) mentioned complications in pregnancy, and 10.5% (2) indicated adverse effects. In 15.0% (23) of the establishments, it was asked whether the pregnant woman had a history of kidney, liver, or heart problems. After knowing the medical history, 91.3% (21) of them advised not to take the recommended medication and the others suggested consuming it with caution.

## Discussion

SM is a common behavior that has increased during the pandemic due to fear of contracting the virus in hospital settings, overwhelmed healthcare systems, misleading information about drugs that may be effective in COVID-19 and, especially in Colombia, the uncontrolled sale of almost all medications.<sup>11</sup> In Colombia, existing regulations ruling the sale of prescription medicines are not complied with in all cases, for instance, different laws establish that antimicrobials are medicines that require a medical prescription and that pharmaceutical establishments should confirm that the prescription has been provided by a qualified health worker.<sup>12,13</sup> Despite this, we found that azithromycin was recommended to treat (32.97%) and prevent (5.88%) COVID-19 by pharmaceutical establishments without prior medical consultation and without asking for a prescription. Needless to say, beyond the potential interactions and ADRs this drug can have, it also contributes to antimicrobial resistance. The prescription of medicines is a scientific and legal act, and there are specific authorized personnel who can perform it. In Colombia, the Ministry of Health states that the prescription of medicines should be made in writing, with a previous evaluation of the patient and registration of their diagnosis in the clinical history by authorized health professionals.<sup>14</sup> Taking this into consideration, pharmaceutical establishments cannot prescribe medicines as

**Table 4.** Most common recommendations for the prevention of contagion by Covid-19.

Type of substance recommended	Substance	<i>n</i>	%
Drugs	Azithromycin	9	5.88
	Acetaminophen	8	5.23
	Ivermectin	8	5.23
	ASA (aspirin)	6	3.92
	B Complex	6	3.92
Dietary supplements	Vitamin C	25	16.34
	Multivitamins	13	8.50
	Transfer factors	11	7.19
	Cod liveroil emulsion	4	2.61
	Vitamin D	3	1.96
Alternative therapies	Moringa	2	1.31
	Ganoderma	1	0.65
	Lentinula	1	0.65
Homeopathic products	Arsenicum	1	0.65
	<i>Vincetoxicum hirundinaria</i>	1	0.65
Phytotherapeutics	Propolis	3	1.96
Biosafety measures	Use of face masks	27	17.65
	Preventive isolation	18	11.76
	Handwashing	7	4.58
	Quarantine	3	1.96
	Social distancing	2	1.31
	Take SARS-CoV-2 test	2	1.31
Other	Hot drinks (with herbs/substances)	15	9.80
	Attending the doctor	7	4.58
	Self-care	5	3.27
	Hydrate	4	2.61

SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

The percentages in this table were calculated based on the number of pharmaceutical establishments that recommended a drug or substance ( $n=276$ ).

they do not have the capacity to evaluate a patient, establish a diagnosis, and make a legal clinical history that supports the prescription.

Among the drugs most recommended by the pharmaceutical establishments were azithromycin, ivermectin, acetaminophen, and ASA.

Azithromycin was the most recommended treatment, even though many studies have failed to show its efficacy in COVID-19 as monotherapy.<sup>15,16</sup> Furthermore, although SARS-CoV-2 infection implies an increased risk of acquiring a bacterial coinfection, the decision to start an antibiotic therapy in COVID-19 patients should be made by the treating physician based on clinical outcome, imaging and laboratory results. It is not recommended for the prevention or as a routine treatment for all COVID-19 patients.<sup>17,18</sup>

For its part, ivermectin has shown contradictory results. It has been evaluated in a Cochrane systematic review where the authors concluded that with the available evidence, they were uncertain about the efficacy and safety of ivermectin to treat or prevent COVID-19,<sup>19</sup> and more evidence is needed to adequately analyze the role of this drug in COVID-19. Therefore, it should not be administered or sold as an OTC drug. We found that more than a quarter of the pharmaceutical establishments in Colombia recommended ivermectin for the treatment of COVID-19 and more than 5% did so for preventing the illness, even though ivermectin is not in the list of OTC drugs stated by the Colombian government.<sup>20</sup> SM with this compound could lead to ADRs such as abdominal pain, diarrhea, taste alterations, ataxia, orthostatic hypotension, increased transaminases, and vertigo.<sup>21,22</sup>

Similarly, ASA has been proposed as a potential therapy in patients with SARS-CoV-2 infection because of the associated risk of coagulopathy seen in some cases of COVID-19. Evidence remains variable: some studies demonstrate a reduced risk of severe COVID-19 with the use of ASA;<sup>23</sup> however, most studies show no effect on mortality.<sup>24,25</sup> Hemorrhagic complications and thrombocytopenia in COVID-19 patients have also been documented, so the risk of bleeding when using antithrombotic therapy in patients with COVID-19 should be carefully evaluated.<sup>25-27</sup>

Other studies have identified some of the same drugs as the most commonly self-medicated drugs during the pandemic. Quincho-Lopez *et al.* performed a systematic review in order to assess SM to prevent or manage COVID-19, finding that the most common used drugs were antibiotics, chloroquine, hydroxychloroquine, acetaminophen,

vitamins, ivermectin, and ibuprofen.<sup>27</sup> Furthermore, cross-sectional surveys have found that the reasons for SM in COVID-19 are emergency illness, proximity to the pharmacy, and long distance to the healthcare facility, and the contributing factors were fear of discrimination, fear of being in quarantine, and fear of infection. The most used drugs were acetaminophen, ibuprofen, azithromycin, penicillin, hydroxychloroquine, and antiretrovirals.<sup>28,29</sup> The use of antimicrobial medications recommended by the pharmaceutical establishments in this study, such as ivermectin, azithromycin, minocycline, clarithromycin, hydroxychloroquine, and chloroquine, can cause important DDIs, however, they were only mentioned to the individual purchasing the drug by a minority of the pharmaceutical establishments in this study. For instance, the use of azithromycin combined with rifabutin, amiodarone, cisapride, or hydroxychloroquine could cause QTc interval prolongation, potentially leading to ventricular arrhythmias, and if prescribed, the physician should check for other QTc interval prolonging drugs the patients may be taking to adequately monitor this adverse effect, and to evaluate for possible DDIs.<sup>30,31</sup> Furthermore, gastrointestinal distress, hepatotoxicity, and hypersensitivity reactions have also been described with the use of azithromycin.<sup>32</sup> Hydroxychloroquine and chloroquine also increase the risk of QTc prolongation and should not be co-administered with antiarrhythmics (class IA, III), tricyclic antidepressants, macrolides, antifungals, quinolones, or antipsychotics, because they may lead to ADRs such as fatal arrhythmias (*Torsades de pointes*).<sup>33</sup> Furthermore, there have been reports of cases of elevated liver function tests (LFT) and fulminant liver failure.<sup>34</sup>

Vitamins A, C, and D aid various membrane functions such as membrane integrity, gap junction communication, and membrane repair and have also been implicated in regulation of IFN (interferon) production. Furthermore, vitamin D has been associated with immunomodulatory activities with a potential to regulate the immune response to viral respiratory tract infections. Reduced risk of respiratory tract infections has been linked with adequate levels of vitamin D;<sup>35</sup> however, the risk reduction benefit from vitamin D supplementation has only been seen in vitamin D deficient individuals. This information could be extrapolated and applied for the prevention of COVID-19, although more studies are needed.



We found that very few of the interviewed establishments recommended vitamin D supplementation, although as previously stated it may be beneficial in patients with a documented deficiency. Nevertheless, its administration should not be a decision made lightly as it has the potential for toxicity causing confusion, recurrent vomiting, abdominal pain, polyuria, and polydipsia.<sup>36</sup>

For its part, vitamin C aids innate immune cells in their differentiation, migration, and their overall function.<sup>37–39</sup> It further stimulates the production of interferon gamma and has antimicrobial activities.<sup>39</sup> Vitamin C deficiency has also been associated with increased risk and severity of respiratory infections.<sup>37,38</sup> It supports epithelial barrier integrity, fibroblast migration, and collagen synthesis; has antioxidant properties; and helps to maintain innate immune cell activities (proliferation, differentiation).<sup>37</sup> However, there is insufficient evidence to recommend either for or against the use of vitamin C for the treatment of COVID-19.<sup>40</sup>

Studies evaluating the supplementation of vitamins A, B, C, D, and E in patients with COVID-19 admitted to the intensive care unit have been held, with results showing improved inflammatory markers and lower rate of prolonged hospitalization.<sup>40</sup> On the other hand, a randomized controlled clinical trial examining the effect of vitamin C on severity or duration of COVID-19 symptoms in patients receiving outpatient care was stopped early because of futility.<sup>41</sup> Despite this, we found the dietary supplements most recommended by pharmaceutical establishments were vitamins, especially vitamin C (almost 20%).

Regarding homeopathic treatment and alternative therapies, Solange *et al.* performed a repertorization (cross-referencing existing symptoms in the homeopathic repertoire to obtain the most suitable medicine) and proposed *Cinchona officinalis* (*China officinalis*) as a suitable medicine for COVID-19. Other homeopathic medicines were also suggested for the management of acute symptoms (*Ferrum phosphoricum*, *Gelsemium*, *Justicia adhatoda*, *Senega*, among others).<sup>42</sup> However, we found that pharmaceutical establishments in Colombia recommended *Anas barbariae* and *Arsenicum album*, along with *Aconitum napellus*, which has modulatory activity on the sodium voltage-dependent channels and has been associated with fatal arrhythmias.<sup>43–45</sup> Therefore, homeopathic medicines should also be prescribed by authorized health workers.

Finally, it is important to state that SM is a broad concept that represents a complex behavior and involves practices beyond the prescription by non-medical professionals. For instance, sharing medications among family and friends, re-use of old prescriptions, use of leftover medicines, and the use of non-conventional medicine (home remedies, handmade medications) are also examples of SM. It also has socioeconomic implications that make SM more common in developing countries where it is used as a low-cost alternative to consulting a doctor.<sup>46–48</sup> Here, for research purposes we considered SM as the use of medications prescribed by non-medical professionals, because this behavior implies the treatment of self-recognized illnesses or symptoms, that correspond with the definition of SM provided by the WHO.<sup>8</sup> Nonetheless, the definition of SM has not reached a consensus in the scientific community and has much broader implications that are beyond the scope of this review.

The limitations of this study are that the establishments were found based on the information on the Internet or in local directories, so those who did not appear in these media could not be part of the study. This also implies that there were regions in which no pharmaceutical establishments were included. Furthermore, pharmaceutical establishments can vary depending on whether they are drugstores, health food stores, or homeopathic stores, but it was not possible to obtain a sufficiently wide sample of each of them, so they were treated in general as pharmaceutical establishments.

### Conclusion

In conclusion, pharmaceutical establishments have contributed in some form to SM in Colombia, recommending drugs that were advertised at the onset of the pandemic. Many of the drugs recommended have controversial evidence and are not recommended for the prevention or treatment of COVID-19. Among the most recommended medications by the pharmacies were antibiotics, analgesics, antiparasitic, vitamins, and some homeopathic products. The recommendation and selling of drugs not based on up-to-date evidence, and to individuals without obtaining their medical history, can expose patients to unnecessary ADRs and DDIs.

### Ethics approval and consent to participate

Not applicable

### Consent for publication

All authors have consented to the publication of this article

### Author contributions

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### Availability of data and materials

The data presented in this study are available on request from the corresponding author. The data are not publicly available to protect the privacy of the pharmaceutical establishments involved in this study.

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