Research Article

Self-medication During the Coronavirus Disease 2019 Pandemic in North Central of Morocco: Prevalence, Causes, and Associated Factors

Omaima El Bouazzi [1, *], Samira Jaouhar [2, 3], Fatima Zahra Talbi [4, 5], Zainab Toujami [1, 6], Ahmed Chbihi Kaddouri [1, 7], Sidi Mohammed Raoui [1, 8] and Abdelhakim EL Ouali Lalami [1]

[1]Institute of Nursing Professions and Health Techniques of Fez (Annex Meknes), Regional Health Directorate Fez-Meknes, Meknes, Morocco
[2]Laboratory of Microbial Biotechnology and Bioactive Molecules, Faculty of Sciences and Techniques, Sidi Mohamed Ben Abdellah University, Fez, Morocco
[3]Laboratory of Health Sciences and Technologies, Hight Institute of Health Sciences, Hassan First University of Settat, Settat, Morocco
[4]Hassan First University of Settat, Sciences and Technologies, Laboratory of Biochemistry, Neurosciences, Natural Resources and Environment, Settat 26000, Morocco
[5]Laboratory of Biotechnology, Conservation and Valorization of Naturals Resources (LBCVNR), Faculty of Sciences Dhar El Mahraz, Sidi Mohamed Ben Abdellah University, Fez, Morocco
[6]Laboratory for Research in Education Sciences, Humanities and Languages (SESHUL), FSE, UM5 Rabat, Morocco
[7]Laboratory of Microbial Ecology, Cellular Interaction and Environment, Department of Biology, Faculty of Sciences, Moulay Ismail University, Meknes, Morocco
[8]Laboratory of Environment and Functional Ecology, Faculty of Sciences and Techniques, Sidi Mohamed Ben Abdellah University, Fez, Morocco

Corresponding author: Institute of Nursing Professions and Health Techniques of Fez (Annex Meknes), Regional Health Directorate Fez-Meknes, Meknes, Morocco. Email: omaima.sara2010@yahoo.com

Received 2023 May 03; **Revised** 2023 June 10; **Accepted** 2023 June 29.

Abstract

Background: Self-medication is a significant public health problem that negatively affects human health. Many Moroccans have turned to this practice as a form of prevention or treatment for the newly emerged coronavirus disease 2019 (COVID-19) worldwide.
Objectives: This study is the first research conducted in Morocco in the context of this pandemic, aiming to explore the prevalence, sources of information, causes, and risk factors of self-medication during the pandemic period.
Methods: A cross-sectional survey using a self-administered questionnaire was conducted in the city of Meknes (North Central of Morocco) from March 2022 to June 2022 to investigate the level of self-medication practices before and during the COVID-19 pandemic.
Results: The survey included 400 respondents from the general population (mean age = 34.97 ± 15.8 years). The self-medication rate was obtained as 291 (72.75%). There was a statistically significant decrease in the number of respondents practicing self-medication during COVID-19 compared to the pre-pandemic period. Most medications used for self-medication to prevent or treat COVID-19 were supplements such as vitamin C (81.10%) and zinc (74.91%), followed by acetaminophen (72.51%) and herbal products (69.41%). In the bivariate logistic regression model, age, gender, education level, self-reported health, sector of activity, and medical insurance were analyzed. Multivariate analyses showed that the youngest age group ($\leq$ 30 years) (odds ratio (OR) = 1.59; 95% confidence interval (CI): 0.96 - 2.78), university education (OR = 1.47; 95% CI: 0.87 - 2.99), and better self-reported health (OR = 2.83; 95% CI: 1.43 - 3.71) were independently associated with self-medication.
Conclusions: Self-medication was a serious health concern in Morocco during the COVID-19 pandemic. This study will be of great interest to the authorities in order to develop new pandemic management strategies, particularly self-medication awareness programs.

Keywords: Self-medication, Coronavirus Disease 2019, Prevalence, North Central of Morocco

1. Background

Coronavirus disease 2019 (COVID-19) was declared a pandemic by the World Health Organization (WHO) in March 2020, following confirmed cases in 114 countries (1, 2). By November 24, 2022, the global crisis affected 633 million people, costing over 6.5 million lives (3). In Morocco, the Ministry of Health announced the first confirmed case on Monday, March 2, 2020 (4). Since then, 1.2 million confirmed COVID-19 cases have been reported to the WHO, resulting in 16.283 deaths in all regions of the country, with different distribution. As of 15 November 2022, 55 million vaccine doses have been administered (2).

Since the beginning of this health crisis, the notion of perceived drug risk and adverse effects has changed. Fear of becoming infected with this novel virus, unknown

to the general population, prevailed over safety, giving people the impression that their only option is self-care and self-medication (1). Such a feeling of fear has increased, particularly with the high mortality rate in the absence of a specific therapy or vaccine for this disease (1, 5). The literature review indicated that anxiety and depression symptoms (16 - 28%) and self-reported stress (8%) were common reactions to the COVID-19 pandemic problems, including poor sleep quality (6). The psychological distress and fear generated by a new disease can also lead to changes in behavior. Consequently, many individuals, particularly those who feel ill, have turned to consuming various drugs, including traditional medicines, to treat or prevent a perceived COVID-19 infection without consideration for safety and effectiveness on the human body (1, 5).

Several countries, including Morocco, imposed lockdowns to control the infection and limit its spread among the population (7). Many small clinics and treatment facilities have also been closed during the COVID-19 pandemic, leaving people without common advice or urgent medical help (7). All of these factors had been conducive to self-medication.

According to the WHO, self-medication has been defined as the selection and use of drugs by individuals for the treatment of self-identified symptoms or diseases (8). Inappropriate drug use may impact human health due to multiple toxicological and pharmacological risks (1). It may also be associated with increased morbidity and mortality due to misdiagnosis and delayed search for appropriate medical advice and treatment, as well as an increased risk of drug interactions, medical expenses, medication errors, and antimicrobial resistance (9).

Most drugs consumed without clinical evidence for treating COVID-19 include azithromycin, hydroxychloroquine, some antiretrovirals, and calcium supplements (8). Meanwhile, zinc and vitamin D have been recommended for their intervention to strengthen the immune system and prevent the cytotoxicity of chloroquine (10). Introducing vitamin C to the treatment of COVID-19 patients was also proposed (10). The use of traditional herbs should also be considered. In Africa, they are used as alternative drugs and play a crucial role in treating diseases (8). Several studies have reported various motivations for self-medication, including previous experience with the disease, high costs of medical services, the existing bureaucracy in healthcare facilities, and low regulatory activity (11, 12). Self-medication is a serious public health problem, so we need to understand this practice and the triggers within the population.

Due to the limited studies conducted in Morocco and in order to strengthen researchers' efforts to provide more results regarding the prevalence and risk factors of self-medication during the COVID-19, we conducted the current research to study the prevalence and associated factors of self-medication practices in the Moroccan population.

2. Objectives

The findings of our study and the results of studies around the world will provide the information needed to develop awareness programs and policies to address self-medication.

3. Methods

3.1. Study Design and Sampling

The present cross-sectional survey using a self-administered questionnaire (printed copies) was conducted in the city of Meknes (North Central of Morocco) from March 2022 to June 2022 to investigate the level of self-medication practice before and during the COVID-19 pandemic. The minimum sample size of 384 was calculated using the Cochran formula for cross-sectional studies for the 95% confidence level and 5% margin of error for a general population estimated at 835695 (13). A total of 400 respondents took part in the study after the deletion of incomplete responses. A pilot test was conducted with 40 participants to check the acceptability and validity of the questionnaire. Some changes were made after the pilot testing. It should be noted that these 40 people interviewed during the pilot test were excluded from the study.

3.2. Questionnaire Design

The survey contained 20 questions in three languages, including French, Arabic, and Amazigh, as languages used in Morocco, and covered four sections. It was prepared and validated by multidisciplinary authors consisting of medical epidemiologists, pharmacologists, and microbiologists. All questionnaire sections were developed based on the data reported in the literature and contained different sections. The first and second sections included socio-demographic information and clinical features of participants, respectively. The other two sections focused on the prevalence of self-medication before and during COVID-19, the reasons behind self-medication, and adverse drug reactions. In the case of uneducated participants, the questions were read and construed. Generally, each participant took 10 - 15 minutes to respond to all questions.

3.3. Inclusion and Exclusion Criteria

The inclusion criteria included being an adult (aged ≥18 years), being consent to participate in the study, and residing in the city of Meknes. Furthermore, pregnant women and children were not included in the study.

3.4. Ethical Considerations

The present study was conducted anonymously to ensure confidentiality and reliability. The study aimed to communicate with all participants. Those who accepted to participate in our study were asked to sign a consent form. The participants were not involved in any stages of the study.

3.5. Data Analysis

The dependent variable was self-medication for COVID-19, coded as binary responses: No = 0 and Yes = 1. Independent variables consisted of socio-demographic characteristics and self-medication practices.

Data were analyzed using Stata 14 software (Corp. 2015. Stata Statistical Software: Release 14. College Station, TX: Stata Corp LP). The data of all returned questionnaires (N = 400) were entered into Excel (Windows 11, Microsoft Corporation), cleaned, coded, and exported to Stata 14. Descriptive statistics were used to characterize the sample and study variables (frequencies, percentages, means, and standard deviations [SDs]). The comparison between self-medication before and during COVID-19 was tested using the chi-square test and odds ratio (OR). A multivariate logistic regression model was used to identify factors associated with self-medication. The significance level was determined at a P-value below 0.05 with a 95% confidence interval (CI).

4. Results

The survey involved 400 respondents from the general population (mean age = 34.97 ± 15.8 years). Among the sample, 185 (46.25%) were female, with a sex ratio of (M/F) 1.16 for the male sex. Most respondents (56.25%) were under the age of 30, while the 31 - 40 age group (9.75%) and the > 60 age group (10%) were proportionally similar. A total of 240 (60%) were university graduates, and all participants (100%) were citizens of Morocco. Only 18.25% reported prior comorbid conditions, while the majority (80.75%) had medical insurance and were in good health (based on self-report) (47%). All demographic characteristics are shown in Table 1.

According to the survey, 291 (72.75%) out of 400 respondents practiced self-medication, while 109 (27.25%) did not. Moreover, the study revealed that before the pandemic, 314 (78.50%) participants had used self-medication, compared to 86 (21.50%) who had not. According to our findings, self-medication during the COVID-19 period decreased statistically significantly compared to the pre-pandemic period (P = 0.0001). In the population studied before the pandemic, self-medication risk appeared to be significantly higher than during the pandemic. The OR analysis (Table 2) revealed a greater than 1 risk ratio between the two periods of self-medication (OR= 5.23; 95% CI: 3.047 - 8.99). Therefore, self-medication was more prevalent before the COVID-19 outbreak than during the outbreak.

Figure 1 shows that most medications used for self-medication to prevent or treat COVID-19 were supplements such as vitamin C (81.10%) and zinc (74.91%), followed by acetaminophen (72.51%) and herbal products (69.41%). Anti-inflammatories were the least mentioned drug for self-medication in the COVID-19 pandemic (21.99%).

The participants reported using herbal products for therapeutic purposes. Various forms and uses are available for these products. Infusions constituted the majority (95.54%), followed by nasal sprays (42.08%), aerial sprays (23.27%), and massage balms (14.36%). These herbal products were predominantly composed of Eucalyptus globulus (92.57%), Mentha pulegium (75.74%), Zingiber officinale (72.28%), Citrus limon (61.39%), Thymus vulgaris (44.06%), and Rosmarius officinalis (33.06%).

Among the respondents practicing self-medication, 208 (71.48%) self-medicated when symptoms of COVID-19 developed, 43 (14.78%) practiced self-medication to prevent the apparition of symptoms, and 40 (13.74%) were confirmed positive for the COVID-19 test (polymerase chain reaction (PCR) test) (Table 3). Fatigue or asthenia (95.16%), headache (92.34%), myalgia (79.84%), cough (41.53%), fever (35.48%), and loss of smell and taste (9.27%) were common symptoms during the pandemic for which respondents used drugs. The analysis of the results also showed that the most common source of self-medication information came from websites and the media (38.83%), followed by friends and family advice (33.1%). Only 15.81% of respondents identified the pharmaceutical worker as a source of information.

Self-medication for COVID-19 was mainly due to fear of being tested positive for COVID-19 (22.68%), media impact (20.27%), and financial issues (17.87%). Other reasons reported were the distance from the healthcare institution (14.09%), fear of being quarantined (13.75%), fear of discrimination (6.19%), and fear of going to the hospital (5.15%) (Table 3).

In the bivariate logistic regression model, age, gender, education level, self-reported health, sector of activity, and

**Table 1.** Socio-Demographic Characteristics of Respondents (N = 400) [a]

Characteristics	Frequency
Gender	
Female	185 (46.25)
Male	215 (53.75)
Age (y)	34.97 ± 15.8
Age group	
≤ 30	225 (56.25)
31 - 40	39 (09.75)
41 - 50	44 (11)
51 - 60	52 (13)
> 60	40 (10)
Level of education	
No formal education	51 (12.75)
Elementary school	24 (06)
Secondary school	85 (21.25)
University education	240 (60)
Sector of activity	
Students	134 (33.50)
Healthcare	53 (13.25)
Education	26 (06.50)
Housekeeper	105 (26.25)
Retired	41 (10.25)
Other	41 (10.25)
Medical insurance	
Yes	323 (80.75)
No	77 (19.25)
Comorbidities	
Present	73 (18.25)
Absent	327 (81.75)
Self-reported health	
Excellent	69 (17.25)
Good	188 (47)
Fair	114 (28.50)
Poor	23 (05.75)
Very poor	6 (01.50)

[a] Values are presented as No. (%) or mean ± SD.

Table 2. The Self-medication Practice Before and During the Coronavirus Disease 2019 Pandemic (Odds Ratio) (N = 400)

	Self-Medication Practice During the COVID-19 Pandemic			Odds Ratio (CI 95%)	P-Value
	No	Yes	Total		
Self-medication practice before the COVID-19 pandemic				5.23 (3.047 - 8.99)	0.0001 [a]
No	48	38	86 (21.50)		
Yes	61	253	314 (78.50)		
Total	109 (27.25)	291 (72.75)	400 (100)		

Abbreviations: COVID-19: coronavirus disease 2019; CI: confidence interval.
[a] P-value is significant at < 0.05.
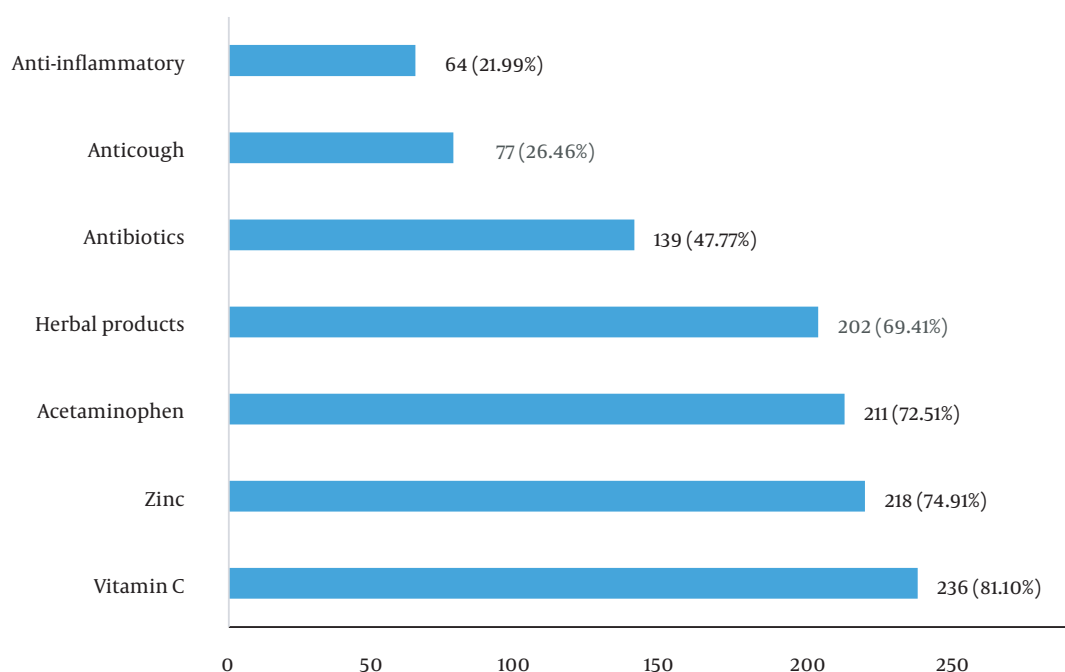
Figure 1. Drugs and supplements used for self-medication among the participants (n = 291)

medical insurance were analyzed. Multivariate analyses showed that the younger age group ($\leq$ 30 years) (OR = 1.59; 95% CI: 0.96 - 2.78), university education (OR = 1.47; 95% CI: 0.87 - 2.99), and good self-reported health (OR=2.83; 95% CI: 1.43 - 3.71) were independently associated with self-medication (Table 4).

5. Discussion

To our knowledge, this study is the first research conducted in Morocco in the context of the COVID-19 pandemic. Self-medication is a global phenomenon that can present risks to human and community health (14, 15). Although it is approved by the WHO for minor diseases, it should be practiced cautiously (16). Our research found that self-medication for COVID-19 was prevalent at 72.75%. The prevalence of self-medication may be influenced by differences between countries regarding advertising, legislation, and the possibility of obtaining certain drugs without a prescription (17, 18). It may explain the large disparity in frequencies between countries. The Shrestha team's systematic review of self-medication practices throughout the COVID-19 pandemic indicated that out of the 14 studies examined, the mean prevalence of self-medication during COVID-19 was estimated at 44.78% globally. In 11 studies in the general community,

Table 3. Description of the Characteristics Associated with Self-medication During the Coronavirus Disease 2019 Pandemic (N = 291) [a]

Characteristics	Variables
Gender	
Male	135 (46.39)
Female	156 (53.61)
When did self-medication start?	
For prevention without symptoms	43 (14.78)
Confirmed positive test (PCR test)	40 (13.74)
When symptoms of COVID-19 developed (without biological or clinical confirmation)	208 (71.48)
Symptoms (one or more) (n = 248) [b]	
Fatigue or asthenia	236 (95.16)
Myalgia	198 (79.84)
Fever	88 (35.48)
Cough	103 (41.53)
Loss of smell and taste	23 (9.27)
Breathing difficulty	18 (7.26)
Headache/migraine	229 (92.34)
Other symptoms	36 (14.52)
Source of information	
Advice from friends or family	78 (26.80)
Websites and the media	113 (38.83)
Worker in pharmacy	46 (15.81)
Yourself	54 (18.56)
Reasons for self-medication	
Fear of going to the hospital	15 (5.15)
Fear of being tested positive for COVID-19	66 (22.68)
Financial issues	52 (17.87)
Fear of discrimination	18 (6.19)
Fear of being quarantined	40 (13.75)
Media impact	59 (20.27)
Distance from the healthcare institution	41 (14.09)
Improvement after taking drugs (n = 248) [b]	
Relief of all the symptoms	54 (21.77)
Relief of almost all symptoms	68 (27.42)
Relief of some symptoms	65 (26.21)
Relief of one symptom	30 (12.10)
Persistence of symptoms	31 (12.50)

Abbreviations: PCR: polymerase chain reaction; COVID-19: coronavirus disease 2019.

[a] Values are presented as No. (%).

[b] The question is only about individuals who have developed symptoms.

Table 4. Multivariate Analysis of the Factors Associated with Self-medication During the Coronavirus Disease 2019 Pandemic

Variables	Univariate			Multivariate		
	OR	95% CI	P-Value	AOR	95% CI	P-Value
Age (y)						
≤ 30	2.59	(0.75 - 5.38)	0.001	1.59	(0.96 - 2.78)	0.001
> 30	1.00	Reference				
Gender						
Male	0.96	(0.66 - 1.52)	0.84			
Female	0.75	(0.24 - 2.22)	0.60			
Level of education						
No formal education	1.36	(1.04 - 1.75)	0.38			
Elementary school education	1.19	(0.92 - 1.44)	0.40			
Secondary school education	1.06	(1.04 - 1.75)	0.66			
University education	1.73	(0.69 - 3.27)	0.000	1.47	(0.87 - 2.99)	0,000
Self-reported health						
Excellent	2,35	(1.36 - 4.09)	0.52			
Good	3,56	(1.85 - 6.88)	0.002	2.83	(1.43 - 3.71)	0.032
Fair	0.89	(0.31 - 2.65)	0.22			
Poor	2.23	(0.89 - 4.89)	0.13			
Very poor	1.51	(0.80 - 2.97)	0.19			
Sector of activity						
Students	2,33	(0.29 - 4.18)	0.050	1.94	(0.82 - 3.56)	0.17
Healthcare	0,19	(0.12 - 0.33)	0.36			
Education	0.87	(0.24 - 2.18)	0.63			
Housekeeper	3.08	(2.00 - 5.14)	0.87			
Retired	1.25	(0.87 - 3.13)	0.18			
Other	1.03	(0.69 - 2.16)	0.27			
Medical insurance						
Yes	1.00	Reference				
No	0.79	(0.13 - 0.88)	0.88			

Abbreviations: OR: odds ratio; CI: confidence interval; AOR: adjusted odds ratio.

the prevalence ranged from 19.3% to 88.3% (7), putting our score in the upper limit of global frequencies next to Bangladesh and Jordan, which got 88.33% and 80% in their studies, respectively (7, 19). Our study also revealed a statistically significant decrease in the number of respondents who self-medicated during COVID-19 compared to the pre-pandemic period. Self-medication is 5.23 times more likely to happen during COVID-19. Dare et al.'s study showed a considerable decline in the number of Ugandans who self-medicated before the COVID-19 pandemic compared to the COVID-19 lockdown period (20). In Kenya, the same situation was observed where the prevalence of self-medication increased from 36.2%

before the pandemic to 60.4% during the pandemic (21). The change in prevalence between the two periods (before and during the pandemic) could result from a change in people's behavior to deal with this new and unknown disease. During the lockdown, people focused more on their health because they were encouraged to practice better personal hygiene. Consequently, under stress and anxiety, they tried to protect themselves by using several types of medications and even home herbal preparations. Matthieu Grégori's study shows that the market share of self-medication increases during epidemics (22).

The analysis of the decrease in the number of arbitrary drug users compared to the pre-COVID-19 period could

be explained, among other things, by the number of awareness and information campaigns run daily by health authorities to train the public about the dangers of arbitrary drug use. It should also be noted that strict measures on the part of the authorities not to sell medicines arbitrarily or without a prescription have been observed. Confinement may also make access to medicines more difficult.

Generally, buying a drug is often based on pharmaceutical advice, personal experience, or parental advice. However, in the context of COVID-19, another determinant motivating self-medication was drug advertising (23). During the COVID-19 epidemic, a number of substances were popular, primarily vitamins C and D, chloroquine, hydroxychloroquine, and food supplements. Some of those treatments actually have serious side effects, like antibiotic resistance caused by overuse of antibiotics, bleeding induced by aspirin, hydroxychloroquine arrhythmia, and suppression of the immune system, possibly due to corticosteroid use (24). To our knowledge, the used doses of zinc, vitamin C, etc., were not adapted to the COVID-19 period and severity. Undoubtedly, patients have based their dosage decisions on the package leaflet or on the experience of others who have contracted the disease.

In this study, vitamin C was the most commonly used drug, with 81.10%. This is consistent with the Algerian study, where 91.40% of pharmacists found increased consumption of vitamins and nutritional supplements (23). In Togo, vitamin C, and traditional medications were also the most common (25). Vitamin C seems to help boost the immune system (26). Several teams have therefore proposed vitamin C supplementation for preventing and treating COVID-19 (27, 28). However, excessive supplementation without medical monitoring can result in adverse reactions (use cautiously in patients with a history of renal lithiasis or renal failure) (29), particularly as studies regarding the use of vitamin C in the treatment and prevention of respiratory infections are inconclusive (30). In addition, self-medication with additional minerals such as zinc is also used because of its ability to enhance innate and adaptive immunity during viral infections (31).

Acetaminophen was the third most consumed drug, equal to 72.51%. It is also a drug that is preferentially auto-medicated in Peru (32), Pakistan (33), and Guinea (6). The massive consumption of this medication may result from its availability for sale without a physician's prescription. Indeed, using vitamins as supplements or acetaminophen during pain is not considered arbitrary in many societies, such as Morocco. The misuse of acetaminophen has serious consequences (6). It is

alarming that its consumption is considered nontoxic at any dose (34). The standard oral dose of acetaminophen is 0.5 - 1 g every 4 - 6 h, up to 4 g/day, but more importantly, it has dose-related toxicity (35). Acetaminophen may induce hepatotoxicity after significant overdose (36), and serious liver injury has been observed with long-term use, even at therapeutic doses in patients with alcoholic liver disease or viral infections (37). Therefore, acetaminophen is a medication to be used cautiously, particularly because its sales have increased significantly during the COVID-19 pandemic (38).

The results also showed self-medication with herbal products to treat or prevent COVID-19. The reason may be due to the fact that the use of traditional medicines is commonplace in African culture and relatively cheaper than modern medicines (25), even if their composition is usually unknown (25). In Morocco, social media broadcasts on the use of *Syzygium aromaticum* and *Artemisia herba alba* to protect against COVID-19. The WHO is working with research institutions to select traditional medicines for investigation into the clinical efficacy and safety of COVID-19 treatment (39).

We have no information regarding the biological effects of medicinal plants on COVID-19, but their diverse secondary metabolites provide innumerable advantages (40). There are many biological effects they are capable of producing, including anti-inflammatory (*Eucalyptus globulus, Zingiber officinale, Citrus limon*), antimicrobial (*Eucalyptus globulus, Mentha pulegium, Zingiber officinale, Thymus vulgaris, Citrus limon*), antioxidant (*Eucalyptus globulus, Mentha pulegium, Zingiber officinale, Thymus vulgaris, Rosmarius officinalis*), and analgesic properties (*Eucalyptus globulus*) (40).

Moroccans have grown increasingly interested in dietary supplements and herbal products in recent years, particularly since social networking sites have contributed to the popularity of these products, particularly during the recent pandemic.

Antimalarials (chloroquine and hydroxychloroquine) were excluded from our study because Moroccan health authorities had removed them from pharmacies. The use of these drugs has been limited to the hospital environment under medical supervision due to the adverse reactions they may cause in case of abuse. The choice of hydroxychloroquine and chloroquine was based on a non-randomized study conducted in France showing positive results in treating COVID-19 patients, particularly those treated with hydroxychloroquine 600 mg/day (41).

In line with other self-medication studies, our study showed that some participants also used antibiotics. They rank fifth, with 47.77% of people who used them. Several studies show that the antibiotics most consumed

during the pandemic were amoxicillin, ciprofloxacin, azithromycin, and erythromycin (1, 6, 32, 42). According to a study conducted in Peru, one in five people took azithromycin as a preventive measure without respiratory symptoms (32). Another study showed a synergic effect of the association of azithromycin and hydroxychloroquine against the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (41). Reports also indicate potential anti-inflammatory properties of azithromycin that may reduce the progression of COVID-19 (42, 43). However, its administration in association with hydroxychloroquine was involved in elevating the QT interval (44). Consumption of hydroxychloroquine with or without azithromycin has increased cardiotoxic risks such as QT prolongation and sudden death (44).

Without any clinical or biological confirmation, self-medication was used in our context when symptoms including cough, weariness, and headaches (71.48%) that are comparable to COVID-19 symptoms first appeared. The preferred source of self-medication drugs was websites and the media. Several scientific articles were the subject of a systematic review by Shrestha et al. discovering that pharmacy accounted for 89.5% and 73.9% of the information sources in Kenya and Nigeria, respectively (7). In Pakistan, prescriptions from family or friends predominated (7). Our findings can be explained by the fact that our study has been carried out in a city where internet usage is common.

Our analysis discovered two risk factors: Those under 30 years of age and university education. This outcome is in line with what we discovered regarding the website that served as the information's primary source. Since young college students are the biggest Internet users across all platforms, including websites, social networks, etc., numerous investigations, including Sadio et al.'s study in Togo, Janatolmakan et al.'s study in Iran, and Zhang et al.'s study in China, found the level of education to be a risk factor (25, 45, 46). Several publications also recognized gender, old age, health sector worker, insurance coverage, and rating anxiety scale as risk factors (1, 25, 32, 45, 46)

5.1. Conclusions

In Morocco, self-medication has been a serious health concern, particularly during the COVID-19 pandemic. For COVID-19-related symptoms, a number of medications were taken without the necessary scientific support. The most common supplement was vitamin C, but acetaminophen, herbal products, and antibiotics like azithromycin were also widely used. Self-medication practiced improperly can lead to a false diagnosis, serious side effects, drug interactions, drug addiction, and bacterial resistance. Our findings should be viewed

cautiously because they are not applicable to the entire Moroccan population. However, we hope that these findings will enlighten healthcare policymakers about ways to improve pharmaceutical care as they aim to save lives.

Footnotes

References

1. Wegbom AI, Edet CK, Raimi O, Fagbamigbe AF, Kiri VA. Self-medication practices and associated factors in the prevention and/or treatment of COVID-19 Virus: A Population-based survey in Nigeria. *Front Public Health*. 2021;**9**:606801. [PubMed ID: 34150693]. [PubMed Central ID: PMC8213209]. https://doi.org/10.3389/fpubh.2021.606801.

2. World Health Organization. *Allocution liminaire du Directeur général de l'OMS lors du point presse sur la COVID-19*. 2022, [updated 2022 October 19; cited 2023 January 07]. Available from: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing---19-july-2023.

3. World Health Organization. *Coronavirus (COVID-19) Dashboard*. 2023, [cited 2023 January 07]. Available from: https://covid19.who.int/.

4. M de la santé du Maroc. *[Morocco announces the registration of the first case of the new Coronavirus]*. 2020, [updated 2020 March 03; cited 2023 January 07]. French. Available from: https://www.sante.gov.ma/Pages/communiqu%C3%A9s.aspx?communiqueID=355.

5. Sujan MSH, Haghighathoseini A, Tasnim R, Islam MS, Salauddin SM, Hasan MM, et al. Self-medication practices and associated factors among COVID-19 recovered patients to prevent future infections: A web-based survey in Bangladesh. *Asian J Heal Sci*. 2022;**8**(1):36–41. https://doi.org/10.1101/2022.05.14.22275075.

6. Toure A, Camara SC, Camara A, Conde M, Delamou A, Camara I, et al. Self-medication against COVID-19 in health workers in Conakry, Guinea. *J Public Health Afr*. 2022;**13**(2):2082. [PubMed ID: 36051529]. [PubMed Central ID: PMC9425936]. https://doi.org/10.4081/jphia.2022.2082.

7. Shrestha AB, Aryal M, Magar JR, Shrestha S, Hossainy L, Rimti FH. The scenario of self-medication practices during the covid-19 pandemic: A systematic review. *Ann Med Surg (Lond)*. 2022;**82**:104482.

[PubMed ID: 36059596]. [PubMed Central ID: PMC9419440]. https://doi.org/10.1016/j.amsu.2022.104482.

8. Amuzie CI, Kalu KU, Izuka M, Nwamoh UN, Emma-Ukaegbu U, Odini F, et al. Prevalence, pattern and predictors of self-medication for COVID-19 among residents in Umuahia, Abia State, southeast nigeria: Policy and public health implications. *J Pharm Policy Pract.* 2022;**15**(1):34. [PubMed ID: 35501929]. [PubMed Central ID: PMC9058746]. https://doi.org/10.1186/s40545-022-00429-9.

9. Okoye OC, Adejumo OA, Opadeyi AO, Madubuko CR, Ntaji M, Okonkwo KC, et al. Self medication practices and its determinants in health care professionals during the coronavirus disease-2019 pandemic: Cross-sectional study. *Int J Clin Pharm.* 2022;**44**(2):507–16. [PubMed ID: 35022953]. [PubMed Central ID: PMC8754192]. https://doi.org/10.1007/s11096-021-01374-4.

10. Bourekkadi S, Heikel J, Benkirane H, Ballouk F, Bouziani A, Laamiri FZ, et al. Study of epidemiological, clinical and evolutionary characteristics of a population of patients hospitalized for COVID-19 in Morocco. *E3S Web of Conferences.* 2021;**319**. https://doi.org/10.1051/e3sconf/202131901035.

11. Nasir M, Chowdhury ASMS, Zahan T. Self-medication during COVID-19 outbreak: A cross sectional online survey in Dhaka city. *Int J Basic Clin Pharmacol.* 2020;**9**(9). https://doi.org/10.18203/2319-2003.ijbcp20203522.

12. Faqihi A, Sayed SF. Self-medication practice with analgesics (NSAIDs and acetaminophen), and antibiotics among nursing undergraduates in University College Farasan Campus, Jazan University, KSA. *Ann Pharm Fr.* 2021;**79**(3):275–85. [PubMed ID: 33098875]. [PubMed Central ID: PMC7577276]. https://doi.org/10.1016/j.pharma.2020.10.012.

13. Haut-Commissariat au Plan de la direction régionale Fès-Meknès. *Monographie de la ville de Meknès 2017.* 2017, [cited 2023 June 06]. French. Available from: https://www.hcp.ma/region-meknes/attachment/908790/.

14. Hughes CM, McElnay JC, Fleming GF. Benefits and risks of self medication. *Drug Saf.* 2001;**24**(14):1027–37. [PubMed ID: 11735659]. https://doi.org/10.2165/00002018-200124140-00002.

15. Bennadi D. Self-medication: A current challenge. *J Basic Clin Pharm.* 2013;**5**(1):19–23. [PubMed ID: 24808684]. [PubMed Central ID: PMC4012703]. https://doi.org/10.4103/0976-0105.128253.

16. World Health Organization. *The Role of the pharmacist in self-care and self-medication : Report of the 4th WHO Consultative Group on the Role of the Pharmacist, The Hague, The Netherlands.* 1998, [updated 1998 August 26-28; cited 2023 January 07]. Available from: https://apps.who.int/iris/handle/10665/65860.

17. Leelavanich D, Adjimatera N, Broese Van Groenou L, Anantachoti P. Prescription and non-prescription drug classification systems across countries: Lessons learned for Thailand. *Risk Manag Healthc Policy.* 2020;**13**:2753–68. [PubMed ID: 33273873]. [PubMed Central ID: PMC7705273]. https://doi.org/10.2147/RMHP.S281629.

18. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gotzsche PC, Ioannidis JP, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: Explanation and elaboration. *BMJ.* 2009;**339**:b2700. [PubMed ID: 19622552]. [PubMed Central ID: PMC2714672]. https://doi.org/10.1136/bmj.b2700.

19. Elayeh E, Akour A, Haddadin RN. Prevalence and predictors of self-medication drugs to prevent or treat COVID-19: Experience from a Middle Eastern country. *Int J Clin Pract.* 2021;**75**(11). e14860. [PubMed ID: 34516713]. [PubMed Central ID: PMC8646359]. https://doi.org/10.1111/ijcp.14860.

20. Dare SS, Eze ED, Echoru I, Usman IM, Ssempijja F, Bukenya EE, et al. Behavioural Response To Self-Medication Practice Before and During Covid-19 Pandemic in Western Uganda. *Patient Prefer Adherence.* 2022;**16**:2247–57. [PubMed ID: 36034331]. [PubMed Central ID: PMC9400814]. https://doi.org/10.2147/PPA.S370954.

21. Onchonga D, Omwoyo J, Nyamamba D. Assessing the prevalence of self-medication among healthcare workers before and during the 2019 SARS-CoV-2 (COVID-19) pandemic in Kenya. *Saudi Pharm J.* 2020;**28**(10):1149–54. [PubMed ID: 32837218]. [PubMed Central ID: PMC7426227]. https://doi.org/10.1016/j.jsps.2020.08.003.

22. Gregori PM. *[The dematerialization of the sale of drugs: Economic impact on the profession and on the patient] [thesis].* Brasília, Brazil: Faculty of Pharmacy, Lorraine University; 2016. French.

23. Boudia F, Dali A, Mekaouche F, Fetati H, Senhadji I, Chaib H. Self-medication and pharmaceutical advice during the COVID-19 pandemic in Oran. *J Health Sci.* https://doi.org/10.5281/zenodo.4657569.

24. Kim MS, An MH, Kim WJ, Hwang TH. Comparative efficacy and safety of pharmacological interventions for the treatment of COVID-19: A systematic review and network meta-analysis. *PLoS Med.* 2020;**17**(12). e1003501. [PubMed ID: 33378357]. [PubMed Central ID: PMC7794037]. https://doi.org/10.1371/journal.pmed.1003501.

25. Sadio AJ, Gbeasor-Komlanvi FA, Konu RY, Bakoubayi AW, Tchankoni MK, Bitty-Anderson AM, et al. Assessment of self-medication practices in the context of the COVID-19 outbreak in Togo. *BMC Public Health.* 2021;**21**(1):58. [PubMed ID: 33407321]. [PubMed Central ID: PMC7787400]. https://doi.org/10.1186/s12889-020-10145-1.

26. Martens PJ, Gysemans C, Verstuyf A, Mathieu AC. Vitamin D's Effect on Immune Function. *Nutrients.* 2020;**12**(5). [PubMed ID: 32353972]. [PubMed Central ID: PMC7281985]. https://doi.org/10.3390/nu12051248.

27. Grant WB, Lahore H, McDonnell SL, Baggerly CA, French CB, Aliano JL, et al. Evidence that Vitamin D supplementation could reduce risk of influenza and COVID-19 infections and deaths. *Nutrients.* 2020;**12**(4). [PubMed ID: 32252338]. [PubMed Central ID: PMC7231123]. https://doi.org/10.3390/nu12040988.

28. Sarkar C, Mondal M, Torequl Islam M, Martorell M, Docea AO, Maroyi A, et al. Potential Therapeutic Options for COVID-19: Current Status, Challenges, and Future Perspectives. *Front Pharmacol.* 2020;**11**:572870. [PubMed ID: 33041814]. [PubMed Central ID: PMC7522523]. https://doi.org/10.3389/fphar.2020.572870.

29. Lanham-New SA, Webb AR, Cashman KD, Buttriss JL, Fallowfield JL, Masud T, et al. Vitamin D and SARS-CoV-2 virus/COVID-19 disease. *BMJ Nutr Prev Health.* 2020;**3**(1):106–10. [PubMed ID: 33230499]. [PubMed Central ID: PMC7246103]. https://doi.org/10.1136/bmjnph-2020-000089.

30. King DE, Matheson E, Chirina S, Shankar A, Broman-Fulks J. The status of baby boomers' health in the United states: The healthiest generation? *JAMA Intern Med.* 2013;**173**(5):385–6. [PubMed ID: 23381505]. https://doi.org/10.1001/jamainternmed.2013.2006.

31. Mudenda S, Witika BA, Sadiq MJ, Banda M, Mfune RL, Daka V, et al. Self-medication and its Consequences during & After the coronavirus Disease 2019 (COVID-19) Pandemic: A Global Health Problem. *European Journal of Environment and Public Health.* 2020;**5**(1). https://doi.org/10.29333/ejeph/9308.

32. Quispe-Canari JF, Fidel-Rosales E, Manrique D, Mascaro-Zan J, Huaman-Castillon KM, Chamorro-Espinoza SE, et al. Self-medication practices during the COVID-19 pandemic among the adult population in Peru: A cross-sectional survey. *Saudi Pharm J.* 2021;**29**(1):1–11. [PubMed ID: 33519270]. [PubMed Central ID: PMC7832015]. https://doi.org/10.1016/j.jsps.2020.12.001.

33. Yasmin F, Asghar MS, Naeem U, Najeeb H, Nauman H, Ahsan MN, et al. Self-medication practices in medical students During the COVID-19 pandemic: A cross-sectional analysis. *Front Public Health.* 2022;**10**:803937. [PubMed ID: 35356012]. [PubMed Central ID: PMC8959567]. https://doi.org/10.3389/fpubh.2022.803937.

34. Esan DT, Fasoro AA, Odesanya OE, Esan TO, Ojo EF, Faeji CO. Assessment of self-medication practices and its associated factors among undergraduates of a private university in Nigeria. *J Environ Public Health.* 2018;**2018**:5439079. [PubMed ID: 30671097]. [PubMed Central ID: PMC6317103]. https://doi.org/10.1155/2018/5439079.

35. Roberts E, Delgado Nunes V, Buckner S, Latchem S, Constanti M, Miller P, et al. Paracetamol: Not as safe as we thought? A systematic literature review of observational studies. *Ann Rheum Dis.* 2016;**75**(3):552–9. [PubMed ID: 25732175]. [PubMed Central ID: PMC4789700]. https://doi.org/10.1136/annrheumdis-2014-206914.

36. Prescott LF. Therapeutic misadventure with paracetamol: Fact or fiction? *Am J Ther.* 2000;**7**(2):99–114. [PubMed ID: 11319578]. https://doi.org/10.1097/00045391-200007020-00007.

37. Day RO, Graham GG, Whelton A. The position of paracetamol in the world of analgesics. *Am J Ther.* 2000;**7**(2):51–4. [PubMed ID: 11319573]. https://doi.org/10.1097/00045391-200007020-00002.

38. Romano S, Galante H, Figueira D, Mendes Z, Rodrigues AT. Time-trend analysis of medicine sales and shortages during COVID-19 outbreak: Data from community pharmacies. *Res Social Adm Pharm.* 2021;**17**(1):1876–81. [PubMed ID: 32482587]. [PubMed Central ID: PMC7245321]. https://doi.org/10.1016/j.sapharm.2020.05.024.

39. Chebat A. PLant poisoning during the covid-19 pandemic [Intoxications par les plantes durant la pandémie du COVID-19]. *Toxicol Maroc.* 2020;**44**(14). French.

40. EL Alami A, Fattah A, Chaiti A. Medicinal plants used for the prevention purposes during the Covid-19 pandemic in Morocco. *J Anal Sci Appl Biotechnol.* 2020;**2**(1):4–11. https://doi.org/10.48402/IMIST.PRSM/jasab-v2i1.21056.

41. Gautret P, Lagier JC, Parola P, Hoang VT, Meddeb L, Mailhe M, et al. Hydroxychloroquine and azithromycin as a treatment of COVID-19: Results of an open-label non-randomized clinical trial. *Int J Antimicrob Agents.* 2020;**56**(1):105949. [PubMed ID: 32205204]. [PubMed Central ID: PMC7102549]. https://doi.org/10.1016/j.ijantimicag.2020.105949.

42. Ayosanmi OS, Alli BY, Akingbule OA, Alaga AH, Perepelkin J, Marjorie D, et al. Prevalence and correlates of self-medication practices for prevention and treatment of COVID-19: A systematic review. *Antibiotics (Basel).* 2022;**11**(6). [PubMed ID: 35740214]. [PubMed Central ID: PMC9220378]. https://doi.org/10.3390/antibiotics11060808.

43. Khezri MR, Zolbanin NM, Ghasemnejad-Berenji M, Jafari R. Azithromycin: Immunomodulatory and antiviral properties for SARS-CoV-2 infection. *Eur J Pharmacol.* 2021;**905**:174191. [PubMed ID: 34015317]. [PubMed Central ID: PMC8127529]. https://doi.org/10.1016/j.ejphar.2021.174191.

44. Mercuro NJ, Yen CF, Shim DJ, Maher TR, McCoy CM, Zimetbaum PJ, et al. Risk of QT Interval Prolongation Associated With Use of Hydroxychloroquine With or Without Concomitant Azithromycin Among Hospitalized Patients Testing Positive for Coronavirus Disease 2019 (COVID-19). *JAMA Cardiol.* 2020;**5**(9):1036–41. [PubMed ID: 32936252]. [PubMed Central ID: PMC7195692]. https://doi.org/10.1001/jamacardio.2020.1834.

45. Janatolmakan M, Naghipour A, Khatony A. Prevalence and reasons for self-medication for prevention of COVID-19 among the adult population in Kermanshah-Iran. *Nurs Open.* 2023;**10**(6):3946–53. [PubMed ID: 36813745]. [PubMed Central ID: PMC10170942]. https://doi.org/10.1002/nop2.1653.

46. Zhang A, Hobman EV, De Barro P, Young A, Carter DJ, Byrne M. Self-medication with antibiotics for protection against COVID-19: The role of psychological distress, knowledge of, and experiences with antibiotics. *Antibiotics (Basel).* 2021;**10**(3). [PubMed ID: 33668953]. [PubMed Central ID: PMC7996601]. https://doi.org/10.3390/antibiotics10030232.