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Original article

Self-medication practices during the COVID-19 pandemic among the adult population in Peru: A cross-sectional survey

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ABSTRACT

Self-medication impacts both negatively and positively the health of people, which has become evident during the COVID-19 pandemic. The study aimed to assess the prevalence of self-medicated drugs used for respiratory symptoms, as COVID-19 preventive, for its symptoms or once tested positive. To determine the perception of symptom relief and demographic variables that promote self-medication in Peru. We performed a cross-sectional, analytical, multicenter study in 3792 study respondents on the use, the reason for use, and perception of relief after the use of six drugs during the quarantine period. An online questionnaire was developed, pretested and submitted to the general public. Multivariable logistic regression was used to ascertain factors that influence an individual's desire to self-medicate, associations were considered significant at $p < 0.05$ and using region (coast, mountain and jungle) as cluster group. The majority of respondents self-medicated with acetaminophen for respiratory symptoms and mainly because they had a cold or flu. It was observed that all the surveyed drugs (acetaminophen, ibuprofen, azithromycin, penicillin, antiretrovirals and hydroxychloroquine) were consumed for various symptoms including: fever, fatigue, cough, sneezing, muscle pain, nasal congestion, sore throat, headache and breathing difficulty. Over 90% of respondents perceived relief of at least one symptom. Multivariable logistic regression showed that older people have a higher frequency of antiretroviral self-medication, respondents who currently have a job had a higher frequency of penicillin self-medication, and that respondents from the Andes consumed less acetaminophen, while the ones from the rainforest consumed it more. There were significant percentages of self-medication, including drugs without sufficient scientific evidence. Age, region where one lived and job status were variables associated with self-medication frequency. Continuous awareness and sensitization about the risks of self-medication are warranted.

1. Introduction

The COVID-19 pandemic has triggered a general lock-down in most of the world, leaving the general sense that the only resource that people has is to self-help, self-care and self-medicate (Matias et al., 2020). The latter gets worsened with the infodemic of fake news that accompanied the COVID-19 pandemic (Tasnim et al., 2020; Alvarez-Risco et al., 2020), and the vast exposure in the news related to any study (*in vitro*, pre-clinical or clinical) that sheds

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light into a possible preventive or treatment option (Mallhi et al., 2020). This has resulted in the self-medication of various prescription drugs that have no confirmed clinical efficacy against SARS-CoV-2 (Mallhi et al., 2020). Some of them include the antimalaria drug hydroxychloroquine (Hasan et al., 2020), the antibiotic azithromycin (Molina et al., 2020), the non-steroidal anti-inflammatory drug (NSAID) ibuprofen (Sodhi et al., 2020) and the antiretrovirals lopinavir and ritonavir (Lim et al., 2020). Because of the lack of monitoring, these drugs could cause a shortage of these drugs for patients that need them for approved conditions (Jaffe, 2020), a direct impact in the price of these drugs (Busari et al., 2020), and jeopardize peoples' health due to their known adverse events (Mallhi et al., 2020; Rojas et al., 2020).

Peru is among the top 5 countries in the world in reported COVID-19 cases, and second in Latin America, only after Brazil (Dong et al., 2020a). On September 20, 2020 Peru reported 768,895 COVID-19 cases with a 4.08% lethality rate (MINSA, 2020d). As Peru becomes a new epicenter of the pandemic in Latin America multiple publications have illustrated its fragmented healthcare system, which has not been the most effective during the COVID-19 pandemic resulting in a high number of physicians' deaths (Gonzales-Tamayo et al., 2020b) and detrimental effects in the mental status of healthcare workers (Yáñez et al., 2020e). Furthermore, Peru has reported discrepancies in the official reports of COVID-19 deaths nationwide (Yáñez et al., 2020c), poor execution of SARS-CoV-2 testing and reporting (Yáñez et al., 2020b), and an increase number of COVID-19 cases in children and adolescents (Yáñez et al., 2020a, Yáñez et al., 2020d). The Ministry of Health in Peru was prompt in publishing COVID-19 symptomatic pharmacological treatment options to try to control de pandemic (MINSA, 2020c). This included the use in the clinical setting of hydroxychloroquine and ivermectin for mild COVID-19 cases; and hydroxychloroquine plus azithromycin and/or chloroquine phosphate plus ivermectin for moderate and severe COVID-19 cases (MINSA, 2020c, Rojas et al., 2020). It comes as no surprise that self-medication has become common in Peru as panic became generalized among the general public who is anxiously waiting for any positive news regarding the prevention and treatment of this viral infection. This becomes aggravated since Peru occupies the fifth place in the world for COVID-19 confirmed cases (Dong et al., 2020a), and it currently is the country with the highest mortality rate (MenaFN, 2020).

This self-medication trend has been reported to have increased worldwide based in the number of Google searches since the pandemic started (Onchonga, 2020). This global trend has caused a tremendous medical challenge (Hughes et al., 2001; Mandal, 2015) because the various prescription drugs currently approved for COVID-19 symptoms carry adverse drug reactions (Onchonga et al., 2020). Furthermore, there is high risk of incorrect dosage, improper route of administration, longer use than intended, improper storage, risk of dependency to abuse, and increased prevalence of pathogenic resistance to drugs (Onchonga et al., 2020, Menary et al., 2011). Even though, self-medication intention is common worldwide it has only been reported in South Arabia (Mansuri et al., 2020) and Kenya (Onchonga et al., 2020). However, these studies assessed the prevalence of self-medication but did not surveyed what drugs where actually consumed. In this way, we designed this cross-sectional study to investigate the pattern of self-medication among the general public in Peru during the COVID-19 pandemic. The objectives of this study were to assess the prevalence of self-medicated drugs used for respiratory symptoms, as COVID-19 preventive, for its symptoms or once tested positive. To determine the perception of symptom relief and if there are any demographic variables that promote self-medication in Peru. The results would inform healthcare policy makers on the measures to improve in Peru as they strive to save lives.

2. Methods

2.1. Study design

We conducted an online cross-sectional multicenter survey, which was initially evaluated by experts from different provinces of Peru based on the Delphi method (Varela-Ruiz et al., 2012). After including the experts' observations, a pilot study was performed (from May 25 to June 3) with 480 respondents in all the 25 provinces of Peru. The pilot data was used to calculate the minimum sample size necessary for the actual study. It was determined that a minimum sample size of 3,138 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 (Walker et al., 2017).

The actual survey consisted of an online questionnaire in Google surveys that was sent via WhatsApp, Messenger, and Facebook, and it was configured to submit an email at the end of the survey so that investigation group can eliminate duplicate answers. The shared questionnaire was made anonymous ensuring data confidentiality and reliability. This survey was shared in Spanish, as this is the official language in Peru. The survey was performed from June 5 to 17 after approximately 3 months of lockdown and social distancing measures in Peru due to the COVID-19 outbreak. At the beginning of the survey (June 5) the number of COVID-19 confirmed cases was 187,400 and 5,162 deaths (MINSA, 2020a), while at the end of the survey (June 17) the confirmed cases increased to 240,908 and the deaths increased to 7,257 (MINSA, 2020b). We surveyed general public who were adults (over 18 years old) in the 25 Peruvian provinces. Participants were recruited through the COVID-19-GIS-Peru network. Grupo de Investigación en Salud (GIS) stands for Health Research Group, a network of investigators that include physicians, health professionals and students performing COVID-19 social epidemiological studies in Peru and Latinamerica (Mejia et al., 2020a; Mejia et al., 2020b; Mejia et al., 2020c; Mejia et al., 2020d; Mejia et al., 2020e; Araujo-Banchon et al., 2020; Yáñez et al., 2020c).

2.2. Outcomes and covariates

The survey (**Annex 1**) included 11 questions, 7 were demographic questions and 4 questions related to self-medication of drugs to prevent and treat respiratory symptoms: drug selection, reasoning for self-medication, symptoms they were looking to improve, and if any of the drugs improved those symptoms. The demographic questions included city where they live, gender, age, marital status, education level, job status, and type of job.

The respondents were asked to indicate if during the COVID-19 lockdown they consumed any of the following drugs: acetaminophen, ibuprofen, azithromycin, hydroxychloroquine, penicillin, antiretrovirals (lopinavir, ritonavir, remdesivir, and others), or any other drug (open question) for respiratory symptoms. The selection of drugs was based on the COVID-19 symptom treatment options approved in Peru at the time (MINSA, 2020c) and based on the drugs reported by the media to be viable treatment options. The respondents were asked to select the reason to use of these drugs from a 7-item list that included: had a cold/flu, no symptoms, COVID-19 prevention, had COVID-19 symptoms, COVID-19 positive, consume the drug regularly, other reason (open question).

The respondents were then presented with an 11-item list that included the most common COVID-19 symptoms reported by the Center of Disease Control and Prevention (CDC) (CDC, 2020). The respondents were asked to select the symptom(s) why they consumed any of the drug(s) indicated on the previous question. The

symptoms included fever, fatigue, cough, muscle ache, nasal congestion, sore throat, headache, breathing difficulty. Sneezing was included since it is a usual cold or flu symptom that often gets confused with a COVID-19 symptom. No symptom and other symptom (open question) was also included. Loss of taste or smell, nausea/vomiting and diarrhea were not included. Loss of smell (anosmia) was still debated as a COVID-19 symptom at the time of the preparation of the survey. Even though anosmia was reported in some COVID-19 patients as early as April, it is until June 2020 when concrete scientific reports and reviews were published (Meng et al., 2020).

Finally, the respondents were asked to indicate any symptom improvement after drug intake using the 5-item Likert scale with the following options: improved all symptoms, improved most of the symptoms, improved a few of the symptoms, improved only one symptom, did not alleviate any of the symptoms.

2.3. Statistical analysis

Data analysis was done in STATA version 14 (Stata Corp) with a significance level set at $p < 0.05$. The instrument consistency was assessed using the Kuder–Richardson Formula 20 (KR-20) (Tschannen et al., 2020) for the dichotomous variable of either using (or not) any of the assessed drugs during the lockdown in Peru. The instrument validity was assessed with the known-groups validity approach by fitting multivariate analysis (Jones et al., 2018) to estimate the preference of self-medication for the surveyed drugs using sex, age, marital status, job status, educational status, and region as control variables. Univariate statistics was performed using frequencies and percentages for categorical variables. For analytical statistics, adjusted prevalence ratios (aPR) and 95% confidence intervals (CI) were obtained using generalized linear models (GLM), with Poisson family, log-link function, robust models and using region (coast, mountain and jungle) as cluster group.

Peru gets divided into three geographic regions because the Andes Mountains, these regions are the Coast (Costa), the Peruvian Andes (Sierra), and the Jungle (Selva) (WHO, 2013). This geographical division is accompanied with marked differences in access, roads, urbanization, population distribution, health and education services. This results in marked differences in health conditions with the coast, Andes and rainforest having the under-5 mortality rate at 26%, 39% and 42%, respectively (WHO, 2013). This is in part due to different behaviors toward urgency for medical treatment and the prevalence of pharmacological use. In order to assess differences in our study we used region as a cluster group.

2.4. Ethical approval

The survey was approved by the Universidad Privada Antenor Orrego ethics committee (#0209–2020-UPAO). 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.

3. Results

3.1. Sociodemographic characteristics of the respondents

The survey was sent to 6,000 people in the 25 provinces of Peru in order to achieve the minimum sample size of 3,138 calculated based on power analysis. Out of the 6,000 surveys sent online, we received 3,792 responses indicating a 63.2% response rate. Most participants were female (2066 [54.5%]), aged 18 to 85 years, single (3046 [80.3%]), had a bachelor degree or higher (2850 [75.2%]), had a job (1219 [32.1%]) and the predominant job industry was healthcare (315 [25.8%]) as shown in Table 1. The obtained KR-20 values for the dichotomous variable of either using (or not) any of the assessed drugs during the lockdown in Peru was > 0.7.

3.2. Non COVID-19 related reasons for self-medication

As shown on Table 2, the majority of respondents did not self-medicate (2526 [66.6%]) with any of the surveyed drugs (acetaminophen, ibuprofen, azithromycin, hydroxychloroquine, penicillin or azithromycin). Out of the 3792 respondents, it was observed that 1023 respondents reported that they consumed acetaminophen during lockdown, while 281 consumed ibuprofen, 182 azithromycin, 87 penicillin, 60 antiretrovirals and 28 hydroxychloroquine. For all the drugs the main reason for consumption was because the person reported they had a cold or flu. It was observed that a portion of respondents self-medicated because other reasons. For instance, 178 and 75 respondents consumed acetaminophen and ibuprofen, respectively for other reasons, which could be attributed to their broad use as pain relievers and antipyretics. Similarly, for the antibiotics azithromycin and penicillin it was reported that 16 and 28 people, respectively consumed them for other reasons. To a lower extent it was reported that 2 people used the anti-malarial drug hydroxychloroquine for other reasons. We also surveyed if these drugs were consumed regularly, and it was observed that 76 people consumed acetaminophen, 26 ibuprofen, 15 azithromycin, 6 penicillin, 5 antiretrovirals and 3 hydroxychloroquine. Even more concerning, was to observe that people in Peru consumed these drugs without any symptom. For instance, 17 consumed acetaminophen, 7 ibuprofen, 3 azithromycin, 2 hydroxychloroquine, 1 penicillin

Table 1
Socio-demographic characteristics of respondents during the COVID-19 lockdown in Peru.

Socio-demographic variable	N (%)
Gender	
Male	1726 (45.5)
Female	2066 (54.5)
Age (years)[a]	23 (20–29)
Marital status	
Single	3046 (80.3)
Married	498 (13.1)
In a domestic partnership	188 (5.0)
Divorced	39 (1.0)
Widowed	21 (0.6)
Education level	
No studies	3 (0.1)
Primary school	7 (0.2)
Highschool	566 (14.9)
Associate	366 (9.6)
Bachelor	2626 (69.3)
Postgraduate	224 (5.9)
Work industry	
Food	69 (5.7)
Commerce	124 (10.2)
Construction	64 (5.3)
Education	214 (17.6)
Housekeeper	19 (1.6)
Entertainment	13 (1.1)
Police/Armed forces	78 (6.4)
Healthcare	315 (25.8)
Transportation	22 (1.8)
Tourism	11 (0.9)
Telecommunications	45 (3.7)
Other	245 (20.2)

[a] Median and interquartile range.

Table 2
Self-medication, reason and respiratory symptom improvement with various drugs during the COVID-19 lockdown in Peru.

Variables	Acetaminophen	Ibuprofen	Azithromycin	Hydroxychloroquine	Penicillin	Antiretrovirals
Use during lockdown						
Yes	1023 (27.0%)	282 (7.4%)	182 (4.8%)	28 (0.7%)	87 (2.3%)	60 (1.6%)
No	2769 (73.0%)	3510 (92.6%)	3610 (95.2%)	3764 (99.3%)	3705 (97.7%)	3732 (98.4%)
Reason						
Cold or flu	675 (66.0%)	162 (57.6%)	98 (53.9%)	14 (50.0%)	60 (68.9%)	41 (68.3%)
No symptoms	17 (1.7%)	7 (2.5%)	3 (1.7%)	2 (7.2%)	1 (1.2%)	1 (1.7%)
COVID-19 preventive	6 (0.6%)	1 (0.4%)	7 (3.9%)	3 (10.7%)	2 (2.3%)	4 (6.7%)
COVID-19 symptoms	65 (5.4%)	9 (3.2%)	23 (12.6%)	1 (3.6%)	1 (1.2%)	3 (5.0%)
COVID-19 positive	6 (0.6%)	1 (0.4%)	8 (4.4%)	3 (10.7%)	1 (1.2%)	1 (1.7%)
Consume it regularly	76 (7.4%)	26 (9.2%)	15 (8.2%)	3 (10.7%)	6 (6.9%)	5 (8.3%)
Other reason	178 (17.3%)	75 (26.7%)	28 (15.4%)	2 (7.1%)	16 (18.3%)	5 (8.3%)
Symptom improvement						
All symptoms improved	482 (47.1%)	136 (48.4%)	79 (43.4%)	12 (42.9%)	41 (47.1%)	36 (60.0%)
Many symptoms improved	287 (28.0%)	66 (23.5%)	56 (30.8%)	7 (25.0%)	30 (34.5%)	18 (30.0%)
Some symptoms improved	96 (9.4%)	34 (12.1%)	27 (14.8%)	6 (21.4%)	6 (6.9%)	5 (8.3%)
One symptom improved	135 (13.2%)	34 (12.1%)	11 (6.0%)	1 (3.6%)	7 (8.0%)	0 (0.0%)
No improvement	23 (2.3%)	11 (3.9%)	9 (5.0%)	2 (7.1%)	3 (3.5%)	1 (1.7%)

and another one antiretrovirals. It needs to be acknowledged that the same respondent could have used more than one drug at the same time.

3.3. COVID-19 related reasons for self-medication

On our survey we included three reasons for drug use related to COVID-19: as a preventive, presence of symptoms, and confirmed case. When these three reasons were combined it was observed that the drug with the highest self-medication was acetaminophen with 77 respondents, azithromycin (38), ibuprofen (11), antiretrovirals (8), hydroxychloroquine (7) and penicillin (4). It was observed that as a COVID-19 preventive, 7 respondents self-medicated with azithromycin, 6 with acetaminophen, 4 with antiretrovirals, 3 with hydroxychloroquine, 2 with penicillin and 1 with ibuprofen. When COVID-19 symptoms were present, the trend changed with acetaminophen been the drug with the highest self-medication (65), followed by azithromycin (23), ibuprofen (9), antiretrovirals (3), hydroxychloroquine (1) and penicillin (1). We also surveyed the self-medication use when diagnosed as COVID-19 positive and it was observed that 8 people used azithromycin, 6 acetaminophen, 3 hydroxychloroquine, and 1 person for ibuprofen, penicillin and antiretrovirals (**Table 2**).

3.4. Respiratory symptoms attributed to self-medication

Fig. 1 shows the distribution of respiratory symptoms for which the respondents self-medicated with the various drugs we surveyed. The respiratory symptoms we surveyed for were fever, fatigue, cough, sneezing, muscle pain, nasal congestion, sore throat, headache and breathing difficulty. We also surveyed if the respondents self-medicated without any symptom. It was observed that for all the symptoms, except breathing difficulty, the most self-medicated drug was acetaminophen. In the case of fever, 568 respondents indicated that they consumed at least one of the drugs we surveyed for. For fatigue 145 respondents, 273 for cough, 323 for sneezing, 368 for muscle pain, 291 for nasal congestion, 488 for sore throat, 707 for headache, 60 for breathing difficulty, and 119 without any symptom. In the case of fever, the predominant drugs consumed were acetaminophen (404 [71%]) followed by ibuprofen (74 [13%]). For fatigue, 80 (55.2%) used acetaminophen followed by ibuprofen 24 (16.6%); for cough 137 (50.2%) consumed acetaminophen and 46 (16.8%) azithromycin. In the case of sneezing, often confused as a COVID-19 symptom, the most used drug for this symptom was acetaminophen (188 [58.2%]) followed by azithromycin (46 [14.2%]). For muscle pain the most consumed drugs were the analgesics acetaminophen (235 [63.8%]) and ibuprofen (82 [22.3%]), similar situation was observed for sore throat: acetaminophen (259 [53.1%]) and ibuprofen (93 [19.1%]) and for headache: acetaminophen (561 [79.3%]) and ibuprofen (97 [13.7%]). For nasal congestion, 166 (57.0%) used acetaminophen and 49 (16.8%) azithromycin; while for breathing difficulty 22 (36.7%) used azithromycin and 17 (28.3%) acetaminophen. It became alarming that 119 respondents consumed the surveyed drugs without any symptom with the following distribution: acetaminophen (36 [30.3%]), ibuprofen (36 [30.3%]), azithromycin (22 [18.5%]), penicillin (12 [10.1%]), antiretrovirals (8 [6.7%]) and hydroxychloroquine (5 [10.1%])

3.5. Perception of symptom improvement after self-medication

The majority of respondents indicated that they perceived that at least one symptom improved with the use of acetaminophen (1000 [97.7%]), ibuprofen (270 [96.1%]), azithromycin (173 [95.0%]), penicillin (84 [96.5%]), antiretrovirals (59 [98.3%]) and hydroxychloroquine (26 [92.9%]) (Table 2). However, this could have been attributed to the combined use of more than one of these drugs or the combination of other drugs that were not assessed in this study. It was observed that a portion of respondents self-medicated because other reasons, which could be attributed to the broad application of the surveyed drugs. For instance, acetaminophen and ibuprofen are widely used as pain relievers and antipyretics. Similarly, azithromycin and penicillin are antibiotics that are consumed for various conditions, and in the case of the anti-malarial drug hydroxychloroquine is also used for lupus and rheumatoid arthritis (Jaffe, 2020).

The respondents had the option to indicate any other drug that they used for respiratory symptoms and various drug classes were reported such as antihistamines (cetirizine, chlorphenamine, loratadine), nonsteroidal anti-inflammatory drugs (NSAIDs) (naproxen, diclofenac), antibiotics (amoxicillin), corticosteroids (dexamethasone), analgesics (metamizole), flu medicine (not specified), vitamin supplements (vitamin C), and others (ginger, garlic, honey, onion, lemon, eucalyptus and sodium bicarbonate). Regarding the total responses for other drugs, the most frequent was cetirizine (13%) followed by chlorphenamine (9%), and naproxen (7%).

3.6. Multivariate analysis of the factors prompting respondents to self-medication

In the multivariate analysis (**Table 3**), it was observed that older respondents had a higher frequency of antiretroviral self-

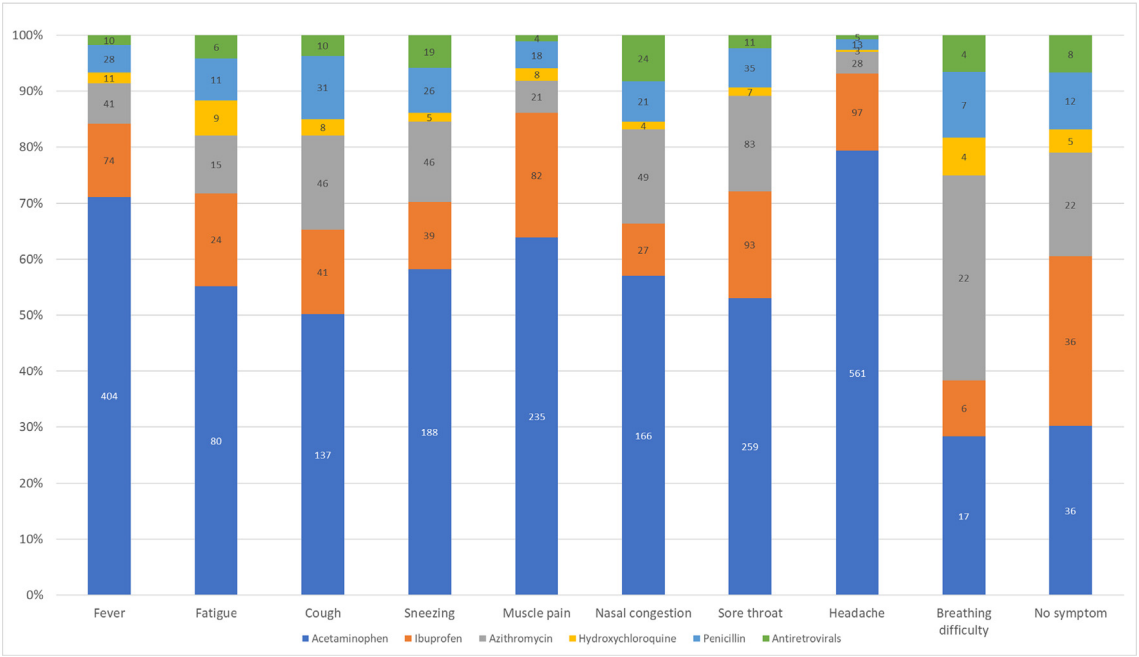

Fig. 1. Respiratory symptom distribution for self-medication of various drugs during the COVID-19 lockdown in Peru.

Table 3
Multivariate analysis of the factors associated with the self-medication of various drugs during the COVID-19 lockdown in Peru.

Variables	Acetaminophen	Ibuprofen	Azithromycin	Hydroxychloroquine	Penicillin	Antiretrovirals
Sex	0.574	0.988	0.911	0.433	0.299	0.563
Age (years)*	0.542	0.445	0.380	0.908	0.207	(+) 0.043
Single marital status	0.787	0.448	0.070	0.671	Not converge	0.175
Currently have a job	0.500	0.740	0.109	0.141	(+) 0.028	0.891
At least Bachelor's degree	0.602	0.740	0.206	0.627	0.845	0.742
Region of Peru						
Coast	This category served as a comparison					
Andes	(−) 0.001	0.353	0.055	0.877	0.537	0.347
Rainforest	(+) 0.012	0.146	0.992	Not converge	Not converge	Not converge

The dependent variable corresponds to the sum of respondents who used the drugs as a preventive, presence of symptoms, and confirmed case.
The reported p-values were obtained by generalized linear models, with the Poisson family, log link function, and robust models.
p-values < 0.05 have a sign that indicates whether there was a positive or negative association with the dependent variable.
* This variable was taken quantitatively.

medication (aPR: 1.07; 95% CI: 1.00–1.14; p-value: 0.043) when adjusted for gender, marital status, job status, and educational level. It was also observed that respondents who currently have a job had a higher frequency of penicillin self-medication (aPR: 8.86; 95% CI: 1.27–61-93; p-value: 0.028) when adjusted for gender, age, marital status, and level of education. The region (coast, Andes and rainforest) was used a cluster group with the consumption of drugs in the coast used as the category for comparison. It was observed that for acetaminophen, the respondents from the Andes consumed it less (aPR: 0.47, 95% CI: 0.29–0.74, p-value: 0.001), while the respondents from the rainforest consumed more acetaminophen (aPR: 2.68, 95% CI: 1.24–5.79, p-value: 0.012). There were no other significant differences in consumption of the other drugs between regions of Peru.

4. Discussion

Self-medication is more common in countries where healthcare systems tend to be less effective because of long waiting time in healthcare facilities, difficulty in obtaining physicians' appointments, insufficient stock of essential medicines, delay in attention and insufficient amount of available beds/space in healthcare facilities (Meena et al., 2016). Even before the pandemic Peru already reunited all these characteristics (Alvarez-Risco et al., 2016; Alvarez-Risco et al., 2018), which became more evident during the COVID-19 pandemic exposing Peru's fragmented and underfunded healthcare system (Gonzales-Tamayo et al., 2020a). Most of the respondents in our study were healthcare workers that during the lockdown have been the first respondents exposed to higher risk of becoming infected with COVID-19 (Ing et al., 2020). The long hours at work under difficult and stressful circumstances (Bogren et al., 2020) have caused an increase in anxiety, distress and overall psychological burden in healthcare workers in Peru (Yáñez et al., 2020e). These conditions have been reported to trigger self-medication in order to face work-related stress, pressure, discomfort and anxiety (Omolase et al., 2007; Barros et al., 2009). The general public is also under stress, anxiety and distress conditions as Peru reports a high number of physician deaths because of COVID-19 (Gonzales-Tamayo et al., 2020a) and has recently became the country with the highest mortality in the world (MenaFN, 2020; Yáñez et al., 2020c).

Our study reported that acetaminophen was the drug most consumed with higher use in the rainforest and lower in the Andes

when compared to the coast of Peru. Acetaminophen has also been reported to be a drug that is preferentially self-medicated in Ethiopia (Shafie et al., 2018) and Brazil (Barros et al., 2019) for chronic pain. It has been reported that acetaminophen is widely used by health science major students in Nigeria as a pain reliever (Esan et al., 2018). However, it is alarming that its consumption is believed to be non-toxic regardless of the dose (Esan et al., 2018). Acetaminophen standard therapeutic oral dose is 0.5–1 g every 4–6 h to a maximum of 4 g/day, but more importantly it has a dose-dependent toxicity (Roberts et al., 2016). Acetaminophen can cause hepatoxicity after major overdose (Prescott, 2000), and severe liver damage has been observed with long-term use even at therapeutic doses in patients with alcoholic liver disease or viral infections (Day et al., 2000). Furthermore, it has been reported that long-term consumption of acetaminophen carries a potential risk factor for chronic renal failure (McLaughlin et al., 1998), cardiovascular, gastrointestinal and even mortality (Roberts et al., 2016). Therefore, acetaminophen is a drug to consume with caution especially considering that its sales has increased significantly during the COVID-19 pandemic (Romano et al., 2020).

Ibuprofen was the second drug most consumed (7.4%) in our study even though it has been reported that this NSAID increases the risk of developing thromboembolism in COVID-19 patients (Arjomandi Rad et al., 2020). Furthermore, it has been proposed that it could worsen the course of COVID-19 infection (Yang et al., 2020; Favalli et al., 2020; Fang et al., 2020), but more evidence is still needed (Torjesen, 2020). It also needs to considered that ibuprofen alone or in combination with acetaminophen could mask the fever during COVID-19 infection causing a delay in diagnosis and treatment (Favalli et al., 2020; Torjesen, 2020).

Regarding the consumption of the antibiotic azithromycin, one in five respondents who consumed it reported that they consumed it without having any respiratory symptom, as a preventive measure or because they thought they would have COVID-19. In an *in vitro* study, the combination of azithromycin and hydroxychloroquine showed a synergistic effect against SARS-CoV-2, and it was also reported on the possible anti-inflammatory properties of azithromycin, which could improve the disease progression (Damle et al., 2020; Andreani et al., 2020). However, its administration in combination therapy with hydroxychloroquine has been implicated in the elevation of the QT interval (Mercuro et al., 2020). Given the limited data available to ensure the efficacy of combination therapy, the American Society for Infectious Diseases recommends that the hydroxychloroquine/ chloroquine plus azithromycin combination be limited to clinical trials (Mercuro et al., 2020; Bhimraj et al., 2020). Regarding the self-medication of hydroxychloroquine, our study reported that one in four respondents who consumed it said that it was without symptoms, as a preventive measure or because they developed COVID-19 symptoms. The combined use of hydroxychloroquine and azithromycin was publicly endorsed by President Trump, which caused self-medication causing several reports of severe poisoning in Nigeria and USA (Busari et al., 2020). This public endorsement triggered various *in vitro* and *in vivo* studies that reported a decrease in viral load and mitigation in the cytokine storm in critically ill patients with SARS-CoV-2 (Gautret, Lagier, Parola, Hoang, Meddeb, Mailhe, et al., 2020). Similarly, various studies reported the positive use of hydroxychloroquine and azithromycin for treatment in hospitalized COVID-19 patients (Yao et al., 2020; Gautret et al., 2020a; Gautret et al., 2020b; Million et al., 2020). However, the consumption of hydroxychloroquine with or without azithromycin caused an increase in cardiotoxic risk such as QT prolongation, torsades de pointes, and sudden death in hospitalized patients with COVID-19 (Mercuro et al., 2020; Chorin et al., 2020; Ramireddy et al., 2020). Even though, the literature alerts about the possible risks with the combination of azithromycin and hydroxychloroquine it is recommended in Peru for moderate and severe COVID-19 cases in a clinical setting since May 2020 (MINSA, 2020c, Rojas et al., 2020). For mild COVID-19 patients, hydroxychloroquine is recommended at a dose of 400 mg orally every 12 h for the first day, and 200 mg orally every 12 h for 6 days (MINSA, 2020c). In the case of moderate to severe COVID-19 patients, hydroxychloroquine is recommended at a dose of 200 mg orally every 8 h for 7 –10 days, or hydroxychloroquine + azithromycin at a dose regimen of 200 mg orally every 8 h for 7–10 days (hydroxychloroquine) + 500 mg orally on the first day and then 250 mg every 24 h for 5 days (MINSA, 2020c). However, on September 7, 2020 the ex-Minister of Health of Peru, Victor Zamora requested for ivermectin, hydroxychloroquine and azithromycin to be removed from the official COVID-19 treatment in Peru (RPP, 2020). It was during his administration that their use was approved, but his recent request was based on the lack of efficacy and increased risk that has been observed over the last few months (RPP, 2020).

Regarding the consumption of antiretrovirals, our study reported that one in six respondents consumed them without symptoms, as a preventive measure or because they thought they had COVID-19. Our multivariate analysis indicated that older people tend to have a higher consumption of antiretrovirals. This could be caused because the perception that any antiretroviral would have a positive effect against the viral COVID-19 infection. However, liver damage has been observed in COVID-19 patients (Velarde-Ruiz Velasco et al., 2020). Considering that antiretrovirals list liver damage as a common adverse effect (Alonso-Bello et al., 2018; Mallolas et al., 2003), it would make them inappropriate for use in COVID-19 patients. Their use is relevant for other pathologies, but a recent review has determined that there is no clear evidence of the beneficial effects of antiretrovirals in the prevention of COVID-19 (Ford et al., 2020; Dong et al., 2020b). More research is still needed to determine the cost and benefit of antiretrovirals for COVID-19.

Our study reported that 19 people self-medicated with penicillin without having symptoms, as a preventive measure or because they thought they would have COVID-19. It becomes interesting that penicillin was used because it lacks scientific information that supports its use for COVID-19. However, its use could be partially attributed to a lack of general knowledge about COVID-19 symptoms (Gomez Tejeda et al., 2020) and lack of information on what drugs to take (Huaroto et al., 2020). More research is needed in order to determine the effect of penicillin in COVID-19 patients.

The respondents indicated that they perceived an improvement in respiratory and COVID-19 symptoms after self-medication with these drugs alone or in combination. However, this could have been due to a placebo effect or because the symptoms were mild or because the majority of COVID-19 patients recover due to its lethality rate of less than 5% (MINSA, 2020d). Even though, some of these drugs in Peru do not need prescription (acetaminophen and ibuprofen), the others (azithromycin, hydroxychloroquine, penicillin and antiretrovirals) require prescription. Therefore, the pharmaceutical care system needs to be revised in Peru to prevent people to obtaining prescription-drugs so easily or in the black market. According to the World Health Organization (WHO) (WHO, 2000), it is important in a healthcare system to provide personal assessment to patients during pharmaceutical care as an important strategy to provide guidance in the use of Over-the-counter (OTC) and prescription drugs (Tong et al., 2019).

The study had as a limitation that the results cannot be extrapolated to the entire Peruvian population since a random or multilevel sampling has not been carried out for this purpose. Also, cross-sectional studies do not permit an establishment of a clear

cause and effect. The objective of this article was to report the frequencies of use and find some statistical associations; however, this report becomes the first study in such a large population in Peru, which could serve as a basis for other research.

5. Conclusion

Self-medication is a significant health issue in Peru, especially during the COVID-19 pandemic. Various drugs were used for respiratory and COVID-19 related symptoms without sufficient scientific evidence. Acetaminophen was the most consumed drug, but there was also a significant use of antibiotics (penicillin and azithromycin), hydroxychloroquine, and even antiretrovirals. People in Peru consumed them as COVID-19 preventives, to treat suspected symptoms and even after a COVID-19 positive diagnosis. Acetaminophen consumption was associated with the region where one lived, antiretrovirals consumption was associated with the age of the respondent, and penicillin consumption was higher in people currently working. Continuous awareness and sensitization about the risks of self-medication are warranted. Our results should be taken with care and not interpreted as a recommendation to self-medicate nor to use these drugs thinking that they will improve symptomatology. Always seek medical help and consultation before consuming any drug. We hope these results would inform healthcare policy makers on the measures to improve pharmaceutical care as they strive to save lives.

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Author contributions

Data filtering: JFQC, EFR, DM, JMZ, KMHC, SECE, HGP; Statistical analysis: JFQC, EFR, DM, JMZ, KMHC, SECE, HG, JAY, CRM; Writing: AAR, JAY, CRM; Review of manuscript: AAR, JAY, CRM.

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Data sharing statement

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

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Annex 1. Survey to assess the use of drugs in the prevention and treatment of respiratory symptoms during the COVID-19 pandemic

Demographic data

1. **City where you live:** _____
2. **Sex:** Male () Female () I prefer not to say ()
3. **Age:** _____ (years)
4. **Marital status:** Single () Married () Domestic partnership () Divorced () Widowed ()
5. **Education level:** No studies () Primary () High School () Associate () Bachelor () Postgraduate ()
6. **Do you currently work?**
7. **If you work, indicate the industry:** Food () Commerce () Construction () Education () Housekeeper () Entertainment () Police/Armed forces () Healthcare () Transportation () Tourism () Telecommunications () Other:_____

About the use of drugs against respiratory symptoms during the COVID-19 lockdown

8. Indicate if you use any of these drugs during the COVID-19 lockdown

Drug	Did you use it?	
Paracetamol / Acetaminophen	Yes ()	No ()
Ibuprofen	Yes ()	No ()
Azithromycin	Yes ()	No ()
Hydroxychloroquine	Yes ()	No ()
Penicillin	Yes ()	No ()
Antiretroviral (Lopinavir, Ritonavir, Remdesivir, etc.)	Yes ()	No ()
Another drug *(please specify)* _____	Yes ()	No ()

9. Indicate the reason why you used the drugs you did during the COVID-19 lockdown

The reasons are numbered from 1 to 7

1. I had a cold/flu
2. I used it without having any symptom
3. I used it as a preventive for COVID-19
4. I had COVID-19 symptoms and self-medicated
5. I was positively diagnosed with COVID-19 and self-medicated to treat it
6. I consumed it regularly because other reasons
7. Other (please specify)

Check only one option for each drug you used

Drug	Why did you consume this drug?
Paracetamol / Acetaminophen	1 () 2 () 3 () 4 () 5 () 6 () 7 ()
Ibuprofen	1 () 2 () 3 () 4 () 5 () 6 () 7 ()
Azithromycin	1 () 2 () 3 () 4 () 5 () 6 () 7 ()
Hydroxychloroquine	1 () 2 () 3 () 4 () 5 () 6 () 7 ()
Penicillin	1 () 2 () 3 () 4 () 5 () 6 () 7 ()
Antiretroviral	1 () 2 () 3 () 4 () 5 () 6 () 7 ()
Another drug: _____	1 () 2 () 3 () 4 () 5 () 6 () 7 ()

10. Indicate the symptom(s) for which you use the drugs you did

Symptoms are numbered 1–11

1. Fever
2. Fatigue
3. Cough
4. Sneezing
5. Muscle pain
6. Nasal congestion
7. Sore throat
8. Headache
9. Breathing difficulty
10. I used this drug even though I did not have any of the previous symptoms
11. Other (please specify the symptom)

You can check more than one symptom

Drug	What symptom(s) did you use this drug for?
Paracetamol / Acetaminophen	1 () 2 () 3 () 4 () 5 () 6 () 7 () 8 () 9 () 10 () 11 ()
Ibuprofen	1 () 2 () 3 () 4 () 5 () 6 () 7 () 8 () 9 () 10 () 11 ()
Azithromycin	1 () 2 () 3 () 4 () 5 () 6 () 7 () 8 () 9 () 10 () 11 ()
Hydroxychloroquine	1 () 2 () 3 () 4 () 5 () 6 () 7 () 8 () 9 () 10 () 11 ()
Penicillin	1 () 2 () 3 () 4 () 5 () 6 () 7 () 8 () 9 () 10 () 11 ()
Antiretroviral	1 () 2 () 3 () 4 () 5 () 6 () 7 () 8 () 9 () 10 () 11 ()
Another drug: _____	1 () 2 () 3 () 4 () 5 () 6 () 7 () 8 () 9 () 10 () 11 ()

11. Indicate if you perceived the use of these drugs alleviated your symptoms

Options are numbered from 1 to 5

1. I perceive that it alleviated **all** the symptoms
2. I perceive that it alleviated **most** of the symptoms
3. I perceive that it alleviated a **few** of the symptoms
4. I perceive that it alleviated only **one** symptom
5. I perceive that it **did not alleviated** any of the symptoms

Check only one option

DRUGS	Did this drug alleviated your symptoms?
Paracetamol / Acetaminophen	1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( )
Ibuprofen	1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( )
Azithromycin	1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( )
Hydroxychloroquine	1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( )
Penicillin	1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( )
Antiretroviral	1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( )
Another drug: _____	1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( )

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