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HEALTH SCIENCES

Prevalence and predictors of self-medication to prevent or treat COVID-19 among undergraduate students in Southern Brazil

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Abstract: Self-medication (SM) is the practice of consuming medicines without a prescription. Despite being a potentially dangerous action, SM is practiced globally and has been highlighted during the COVID-19 pandemic. The aim of this study was to evaluate SM for the prevention or treatment of COVID-19 and the factors associated with this practice among undergraduate students in Southern Brazil. A cross-sectional study was conducted between July and November 2020 using an electronic questionnaire to collect information about the practice of SM and the associated sociodemographic characteristics, health perception, and lifestyle. We collected 1,553 responses and identified a prevalence of 14.9% for SM. The risk factors for SM were earning between BRL 2,101 and BRL 5,250, studying at a public university, and studying a distance undergraduate course. The protective factors were age above 30 years, female sex, working or participating in internships, occasionally recommending their own medications to other people, and worsening health during the pandemic. The main drugs or products used were ivermectin, vitamins C and D, tea, azithromycin, zinc, and propolis. Our data could help in the development of health education measures to reduce SM among undergraduate students and guide the population regarding the risks of this practice.

Key words: *coronavirus,* drugs, SARS-CoV-2, self-medication, students.

INTRODUCTION

COVID-19 is the disease caused by SARS-CoV-2, a coronavirus discovered at Wuhan (Hubei Province, China) in 2019 after an increase in the occurrence of community pneumonia without identified etiology (Ludwig & Zarbock 2020, Mackenzie & Smith 2020). With easy people-to-people transmission, this illness, which can cause flu-like symptoms but also could progress to a medium to severe respiratory syndrome, quickly spread through the population (Ludwig & Zarbock 2020, CDC 2020, Wu & McGoogan 2020, WHO 2020a). In a short time, COVID-19 has spread worldwide with a progressive increase in the number of cases, making the World Health Organization (WHO) declare it as a "public health emergency" in January 2020, and successively as a global pandemic in March 2020 (WHO 2020a, Zhou et al. 2020). At that time, protection measures that had already been implemented were increased, and new ones, such as the use of face masks, hand sanitization with alcohol, and social distancing, were adopted. Some workers and students were urged to work and study from home, and get-togethers and other entertainments were suspended (WHO 2020a). These behaviors and lifestyle modifications,

as well as the fear of infection or even death, together with social isolation and constant information about new infected cases and the number of deaths, have made some changes in people's health practices (Cachicatari-Vargas et al. 2022, Matias et al. 2020, Miñan-Tapia et al. 2020).

In pandemic scenarios, avoidance and fear of the healthcare system due to the viral contagion may promote self-medication (SM), that is, the use of medication by the person's own initiative, without any prescription or follow-up by a health professional (Sohrabi et al. 2020). SM reflects the urge to cure or relieve symptoms or minor health problems (WHO 1998). In Brazil, the prevalence of SM was 16.1% in a large national study (n=41,433) and 26.7% in a cohort study conducted in the southern region (Arrais et al. 2016, Bertoldi et al. 2014). Both demonstrated a positive association between female sex and SM practice. This practice has also been associated with many other factors including age, occupation, and having children, and some studies have recently reported that the COVID-19 pandemic also stimulated SM (da Silva et al. 2012, Tripković et al. 2018, Onchonga et al. 2020, Melo et al. 2021, Rafiq et al. 2021, Shrestha et al. 2022).

An important factor that contributed to SM in this period was the urgency to discover new drugs for COVID-19 and speculations involving the use of existing drugs to prevent or treat the disease. As an example, we can quote the "premature treatment," also known as "COVID-kit," recommended by the Brazilian Ministry of Health that approves the use of azithromycin and chloroquine/hydroxychloroquine in early diagnosed cases of COVID-19 (Ministério da Saúde 2020a). In this context, the investigation of medicines for COVID-19 has become a focus for the population that wants to protect itself. As soon as some studies have been published, the Brazilian government has started to support and encourage the use of azithromycin, chloroquine/hydroxychloroquine, ivermectin, nitazoxanide, and vitamins C and D to treat or even prevent the infection by SARS-CoV-2 (Melo et al. 2021, Lacerda et al. 2021). In addition, media information has a stronger impact on people's decision to use any medicine to protect themselves from the virus (Menezes et al. 2020).

It must be highlighted that an increase in the intake of unnecessary medicines can cause serious problems because of the adverse effects of the drugs and their interactions with other drugs or food (Matos et al. 2018). Therefore, although it is occasionally considered a self-care and practical solution to minor problems, SM is a dangerous practice that should not be encouraged, even in extreme situations such as COVID-19 (Domingues et al. 2015, Shrestha et al. 2022).

According to the literature, students represent a population with a higher rate of SM practices (da Silva et al. 2012, Alshahrani et al. 2019, Subashini & Udayanga 2020). A recent review suggested that the rate of general SM in students can reach 70% worldwide, establishing a global health problem that requires attention (Behzadifar et al. 2020). During the COVID-19 pandemic, students were among the populations that were most affected, especially those who needed to continue their studies via a remote learning model. According to the UNESCO, social distancing, remote classes, and *lockdown* situations directly affected 87% of students worldwide (Araújo et al. 2020, UNESCO 2020).

Therefore, with the changes promoted by the pandemic, SM behavior may have increased among students. This has already been observed in some worldwide studies that showed a high prevalence of SM (over 50%) among students early during the pandemic. In Brazil, the government encouraging the intake

of "COVID-kit," the absence of an existing vaccine, and the media's information may have contributed to the increase in SM (Miñan-Tapia et al. 2020, Saleem et al. 2021, Yasmin et al. 2022).

To this end, the aim of this study was to evaluate the prevalence of SM practices to prevent or treat COVID-19 among South Brazilian undergraduate students, the associated factors, and the most common medicines or natural products used in this practice.

MATERIALS AND METHODS

Ethical approvals

The study was approved by the Research Ethics Commitee at Universidade Federal do Rio Grande (number 4.127.866, 2020) and respected all guidelines of the "Ethics Guidelines for Internet-mediated Research," available at https://www.bps.org.uk/guideline/ethics-guidelines-internet-mediated-research. Participation in the study was entirely voluntary.

Study design

A cross-sectional study was conducted between July and November 2020 using a self-reported electronic questionnaire developed by the authors to collect information about the practice of SM during the COVID-19 pandemic and some variables related to sociodemographic characteristics, health perception, and lifestyle. It is important to highlight that no vaccine or medicine against COVID-19 was available for the population during the data collection period.

Sample and participants

The study participants were undergraduate students from South Brazil. The sample size was calculated using the number of students enrolled in undergraduate courses at higher education institutions in southern Brazil. This information was obtained from the last census conducted in 2018 by the *Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira* (National Institute of Educational Studies and Research Anísio Teixeira), available at http://portal.inep.gov.br/basica-censo-escolar-sinopse-sinopse. The sample size was calculated online through the website https://comentto.com/calculadora-amostral/ using a sample error of 5%, 95% confidence interval, and considering a heterogeneous population. A total of 1,428,267 enrolled students were identified from the census and the online calculated sample size was of 1,152 students, to each we added 10% to prevent future losses, adding up to 1,268 students.

The sample was collected for convenience. For this, an e-mail containing information about the study and an invitation to participate was sent by the project coordinator to the Universities in the southern region of Brazil. In addition, disclosure and invitation to participate were published on social media, including Instagram®, Facebook®, and WhatsApp®.

Data collection

The authors structured an online questionnaire containing questions about sociodemographic characteristics, lifestyle, and SM practices in two periods: before and during the COVID-19 pandemic. Part of the online questionnaire, specifically the sociodemographic and SM questions, was derived from the instrument utilized by da Silva et al. (2012). Conversely, the COVID-related questions were developed by the authors themselves. The questionnaire was established using the Google Forms® (Google Inc, Moutain View, California, USA) free platform to guarantee everyone access and respect COVID-19 safety guidelines for social distancing. To maintain confidentiality, the responses were anonymized. To validate the questionnaire before the survey, a pilot study was conducted

involving 12 participants from diverse knowledge areas, including healthcare, engineering, and education. These participants were not involved in the project or the construction of the questionnaire.

Inclusion and exclusion criteria

The inclusion criteria were as follows: being at least 18 years of age, living in the states of South Brazil (*Rio Grande do Sul, Santa Catarina, or Paraná*), and being enrolled in a graduate course. Students who did not live in South Brazil and those who were enrolled in other courses, such as high school, technical courses, or postgraduate programs, were excluded.

Variables

Dependent outcome

The outcome measured was the practice of SM to prevent or treat COVID-19. The questions asked were: 'Do you use any medicine to prevent the infection of COVID-19?'; "Do you use any natural product to prevent the infection of COVID-19?"; "Do you use any medicine to treat the infection of COVID-19?"; "Do you use any natural product to treat the infection of COVID-19?". The responses were collected in a dichotomous way by "yes" or "no" options.

Independent variables

The independent variables were collected as nominal variables with fixed options for each (age, gender, ethnicity, state of residence, family income, residence, type of university, college course, and occupation). Other dichotomous independent variables were collected by asking the participants about their health and habits (for example, "do you have a chronic disease?"; "do you use any continuous medication?").

Statistical analysis

Data were analyzed using SPSS version 22 (SPSS Inc., Chicago, Illinois, USA) and expressed as frequencies (absolute and relative), and the association between SM practice and demographic, health, and lifestyle variables was evaluated using the Chi-square test. The evaluation of the associated factors was performed using bi- and multivariate Poisson regression analyses with robust variance. The dependent variable, SM, was dichotomized as yes or no, and the independent variables were organized in a hierarchical model using four levels: first level (age, gender, state of residence, income, ethnicity, household members before the pandemic, and occupation), second level (university and college courses), third level (having a chronic disease, anxiety or depression, two or more diseases, using continuous medication, how they consider their own health before the pandemic, knowledge about the medicines' interactions, reading the medicines' package insert, recommending their medication to others, and knowledge about the medicines' harmful effects), and fourth level (performing social distancing, noticing health deterioration during the pandemic, and using Emergency Remote Teaching (ERT)). Associations were considered significant at $p < 0.05$, but the variables with a p-value less than 0.2 were kept in the model and the results were presented as prevalence ratio (PR) and 95% confidence interval (CI 95%).

RESULTS

Participants

A total of 1,587 responses were collected, of which 34 were excluded based on our exclusion criteria. Therefore, 1,553 valid responses were used. Among them, 232 (14.9%) students

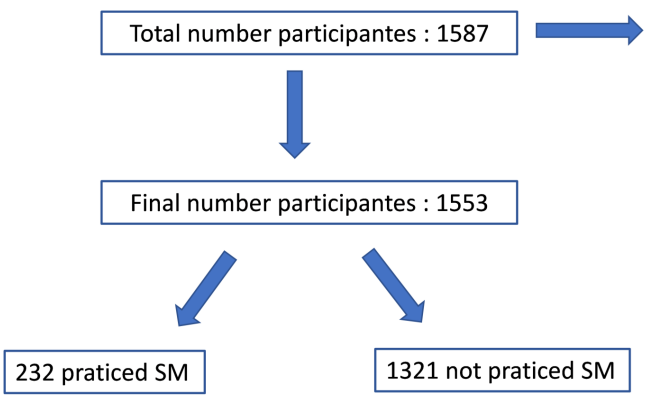

Figure 1. Number of participants of the research. SM: self-medication.

confirmed that they practiced SM to prevent or treat COVID-19 (Figure 1).

Sociodemographic characteristics of the students who practice SM to prevent or treat COVID-19

Most of the students who practiced SM were young adults (73.3%), women (75.9%), white (81.5%), received less than BRL 2.100 (40.1%), lived with family (69.8%), studied at a public university (60.3%) and in non-health courses (59.9%), and worked or participated in an internship during graduation (61.2%) (Table I). According to these findings, age (p=0.0009) and occupation (having or not having a job or internship) (p=0.0470) seem to be influencing factors related to the practice of SM.

Medications used for SM against COVID-19

According to the students' responses, 13 medicines or natural products were used for SM with the objective of preventing or treating an infection by SARS-CoV-2. Among them, the most commonly used was ivermectin (n=66), followed by vitamins C (n=25) and D (n=23). Teas (n=6), azithromycin (n=6), zinc (n=4), and propolis extract (n=3) were also mentioned, as shown in Figure 2.

Reasons related to SM practice

In total, 11 reasons were listed by the students in response to the following question: "what or who motivated you to use medication without a prescription against COVID-19?". The main reasons for SM practice were "family or friends' recommendation," "doctor or dentist's recommendation, "internet or television news," "pharmacist's recommendation," and "other health professionals' recommendations." Additionally, "recommendation from a pharmacy clerk," "information from books," "prescription of a COVID-19 positive person," "information from scientific articles," "drug with few adverse effects," and "Brazilian government influence" were stated, as shown in Figure 3.

Health and lifestyle characteristics related to SM to prevent or treat COVID-19

Most students did not have chronic diseases (57.3%), depression or anxiety (69.4%), or two or more diseases at the same time (81.5%). Moreover, the majority used continuous medicines (69.4%) and considered their own health to be good or excellent (73.3%) before the pandemic. When asked about the knowledge of adverse effects of medications, the majority claimed to know but used them anyway (60.8%); however, when asked about the interactions of medications, the predominant response was "I know about the medications' interactions and use it only when there are no interactions" (56.9%) (Table II).

Furthermore, concerning their knowledge about medications, most students who practiced

Table I. Students sociodemographic characteristics and the self-medication to prevent or treat COVID-19 (n/%).

Variable	Yes	No	p-value*
Age (years)			0.0009
18 – 29	170 (73.3)	1196 (90.5)	
30 or plus	62 (26.7)	125 (9.5)	
Gender			0.4231
Male	56 (24.1)	389 (29.4)	
Female	176 (75.9)	932 (70.6)	
Ethnicity			>0.9999
White	189 (81.5)	1081 (81.8)	
Non White	43 (18.5)	240 (18.2)	
State of Residence			0.5715
Paraná	71 (30.6)	380 (28.8)	
Rio Grande do Sul	75 (32.3)	514 (38.9)	
Santa Catarina	86 (37.1)	427 (32.3)	
Income (Real)			0.4009
Until BRL 2,100	93 (40.1)	439 (33.2)	
Between BRL 2,101 – BRL 5,250	77 (33.2)	551 (41.7)	
Up to BRL 5,251	62 (26.7)	331 (25.1)	
Living			0.9672
Alone	37 (15.9)	204 (15.4)	
With roommates	33 (14.2)	197 (14.9)	
With family	162 (69.8)	920 (69.9)	
University			0.0733
Private	92 (39.7)	371 (28.1)	
Public	140 (60.3)	950 (71.9)	
Graduation area			0.6668
Health	93 (40.1)	561 (42.5)	
Non health	139 (59.9)	760 (57.5)	
Occupation			0.0470
Just study	90 (38.8)	702 (53.1)	
Work/Internship	142 (61.2)	619 (46.9)	
Total	232	1,321	

***Chi-square test.**

SM did not use two or more medications at same time (65.9%) and, when asked about "reading the medications' package insert," the response was "always" (49.1%). In contrast, the majority admitted to occasionally recommend their own medications to others (71.1%) (Table II).

To evaluate the relationship between SM and the pandemic lifestyle changes, the proportion of students who respected social distancing and only left their houses for essential purposes, such as to go to the pharmacy or supermarket (59.9%), was verified. Most students continued living with their families (87.1%) and received their classes via ERT (75.0%) but noticed a deterioration in their own health status during the pandemic (59.5%) (Table II).

Analysis of factors associated with SM

The results of the Poisson regression analysis (bi- and multivariate) are presented in Table III. In the bivariate analysis, the variables age over 30 years ($p<0.003$), having a job or participating in an internship ($p<0.000$), having a chronic disease ($p<0.036$), occasionally recommending medications to others ($p<0.000$), going out to work but avoiding crowds and gatherings ($p<0.005$), and noticing health deterioration during the pandemic ($p<0.000$) were observed as protective factors against the practice of SM to prevent or treat COVID-19. In contrast, the variables having an income between BRL 2,101 and BRL 5,250 ($p<0.036$) and studying at a public university ($p<0.001$) were determined as risk factors associated with SM practice to prevent or treat COVID-19.

In the adjusted analysis, the following variables were identified as protective factors against the practice of SM to prevent or treat COVID-19: having an age of 30 years or older

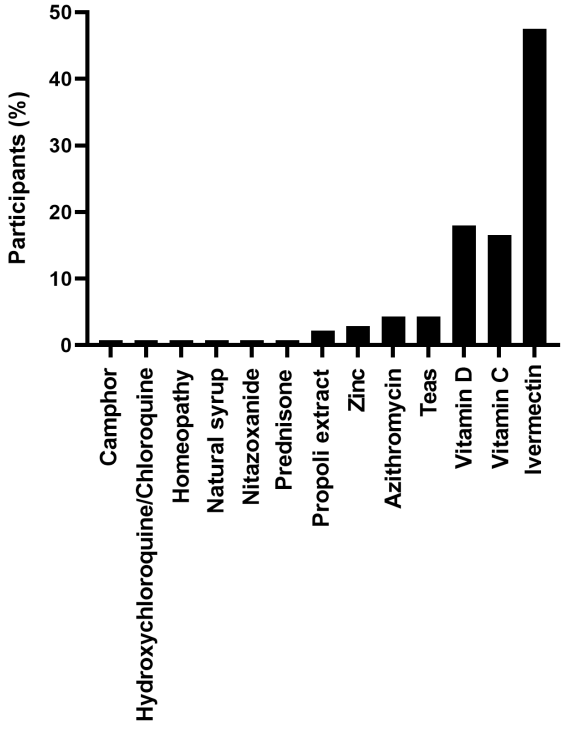

Figure 2. Medications chosen by undergraduate students who practiced self-medication to prevent or treat COVID-19, denoted as percentages.

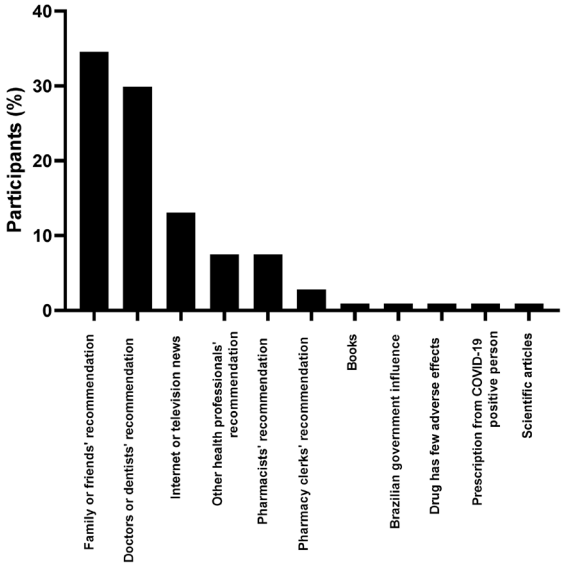

Figure 3: Main reasons stated by undergraduate students to support their decision to practice self-medication to prevent or treat COVID-19, denoted as percentages.

Table II. Characteristic of health and pandemic behavior and self-medication to prevent or treat COVID-19 (n/%).

Variable	Yes	No	p-value*
Having a chronic disease			0.2461
Yes	99 (42.7)	465 (35.2)	
No	133 (57.3)	856 (64.8)	
Use continue medicine			0.3447
Yes	71 (30.6)	323 (24.5)	
No	161 (69.4)	998 (75.5)	
Having depression and/or anxiety			0.6265
Yes	62 (26.7)	312 (23.6)	
No	170 (73.3)	1009 (76.4)	
Having two or more diseases at same time			0.4515
Yes	43 (18.5)	193 (14.6)	
No	189 (81.5)	1128 (85.4)	
Health before Pandemic			0.6079
Bad	13 (5.6)	42 (3.2)	
Regular	49 (21.1)	302 (22.9)	
Good/Excellent	170 (73.3)	977 (74.0)	
Know about medications' adverse effects			0.6234
No	8 (3.4)	63 (4.8)	
Yes but use at same way	141 (60.8)	847 (64.1)	
Yes and use it only when the doctors prescribes for me	83 (35.8)	411 (31.1)	
Use two or more medication at same time			0.4466
Yes	79 (34.1)	384 (29.1)	
No	153 (65.9)	937 (70.9)	
Know about medications' interactions			0.9698
No	76 (32.8)	435 (32.9)	
Yes but use at same way	24 (10.3)	125 (9.5)	
Yes and use it only when there are no interaction	132 (56.9)	761 (57.6)	
Read medications' package insert			0.4807
Never	11 (4.7)	88 (6.7)	

Table II. Continuation.

Sometimes	107 (46.1)	636 (48.1)	
Always	114 (49.1)	597 (45.2)	
Recommends its medication to others			0.0765
Never	58 (25.0)	491 (37.2)	
Sometimes	165 (71.1)	795 (60.2)	
Always	9 (3.9)	35 (2.6)	
Fulfilling social distancing			0.1962
No	11 (4.7)	42 (3.2)	
Go out to work but avoid crowds and get together	82 (35.3)	334 (25.3)	
Only go out to do essential things	139 (59.9)	945 (71.5)	
Living			0.9682
Alone	20 (8.6)	102 (7.7)	
With roommates	10 (4.3)	51 (3.9)	
With family	202 (87.1)	1168 (88.4)	
Having Emergency Remote Teaching (ERT)			0.9479
Yes	174 (75.0)	959 (72.6)	
No	56 (24.1)	347 (26.3)	
My course was already by distance	2 (0.9)	15 (1.1)	
Realize health decrease during the Pandemic			0.1552
Yes	138 (59.5)	653 (49.4)	
No	94 (40.5)	668 (50.6)	
Total	**232**	**1,321**	

***Chi-square test.**

(p<0.000), being female (p<0.024), having a job or participating in an internship (p<0.004), occasionally recommending medications to others (p<0.000), and noticing health deterioration during the pandemic (p<0.000). Moreover, the variables residing in the state of Rio Grande do Sul (p<0.030), having an income between BRL 2,101 and BRL 5,250 (p<0.016), studying at a public university (p<0.019), and studying a distance graduate course (p<0.041) were identified as risk factors for SM to prevent or treat COVID-19.

DISCUSSION

This research was conducted during the COVID-19 pandemic to investigate whether there are predisposing factors that impact the decision of undergraduate students to practice SM to protect themselves against COVID-19 or

treat an existing infection. Our study showed that 14.9% of students practiced SM to prevent or treat COVID-19. In the general population, some studies have demonstrated a higher rate of SM using unproven medicines for COVID-19 as observed in Togo (34.2%), Nigeria (41.0%), and Jordan (80.4%) (Onchonga et al. 2020, Bakoubayi et al. 2021, Wegbom et al. 2021). In the Nigerian study, it was demonstrated that most of those who practiced SM (87.8%) had attained tertiary education, suggesting a relationship between the education level and the decision to use these medicines against COVID-19 (Subashini & Udayanga 2020). Another study conducted by healthcare workers in Kenya demonstrated that those with a university diploma practice more SM (Onchonga et al. 2020). In agreement with these findings, a Peruvian study conducted only on healthcare students found that 51.3% practiced SM using drugs speculated to treat COVID-19 (Matias et al. 2020).

At the time of this research, vaccines were not yet available, and no medicines had been approved for the prevention or treatment of coronavirus infection. However, numerous studies were published, and some already existing drugs, such as azithromycin, chloroquine/hydroxychloroquine, and ivermectin, had their use encouraged (Baracaldo-Santamaría et al. 2022). In Brazil, the promotion of the use of these drugs was intensified, and the easy accessibility of obtaining medications from pharmacies and the internet may have contributed to SM (Bessel et al. 2003, Delgado & Vriesmann 2018).

It is supposed that the tendency of the students to practice SM could be caused by the higher education level and the concurrent ability to consult information sources such as social media and news websites (Subashini & Udayanga 2020). Furthermore, students were among the most affected populations by the COVID-19 pandemic because of the suspension of traditional in-person classes, particularly in Brazil because of the precarious internet access among the public (Pragholapati 2020, CNS 2020). In this context, literature has suggested that the delay in finding an appropriate treatment or preventive measure, accompanied with the influence of government, religion, and social media, contribute to the practice of SM (UNESCO 2020, WHO 2020a).

In this study, we found that students aged 30 years or older had a lower prevalence of SM, indicating that aging may protect against this practice. In addition to the older age, the possibility of having some disease, the use of one or more regular medications, and the concern of suffering from adverse effects could be factors discouraging the practice of SM (Ruiz-Padilla et al. 2021).

Our findings also demonstrated that the prevalence of SM was lower in women than in men. Some studies associated SM with female gender, which was confirmed in a recent review that showed that women practice more SM (Habeeb & Gearhart 1993, Shankar et al. 2002, Onhonga et al. 2020). However, it is important to consider that women are usually attentive to their health and, consequently, would be more willing to practice SM (Sapkota et al. 2010). In addition, the COVID-19 pandemic may have changed some behaviors due to the necessity to find some self-benefit, which helps explain our results. Some studies have demonstrated that during the pandemic, more women lost their jobs and were, simultaneously, overloaded with their children being away from school and concerned about the family's health (Carli 2020, Pinho-Gomes et al. 2020). Furthermore, the influence of government statements seems to be more pronounced in men, causing adherence to the consumption of medications to prevent or treat COVID-19 (The Lancet 2020, Lapper 2021).

Table III. Crude and adjusted Poisson test of risk and protect factors related to self-medication to prevent or treat COVID-19.

Level	Variables	Crude analysis (Exp B, 95% CI)	p-value	Adjusted analysis (Exp B, 95% CI)	p-value
1	Age (years)		0.003*		0.000*
	18 – 29	1		1	
	30 or plus	0.763 (0.689–0.846)		0.770 (0.695–0.853)	
1	Gender		0.083		0.024*
	Male	1		1	
	Female	0.962 (0.921–1.005)		0.952 (0.912–0.994)	
1	State of Residence		0.136		0.061
	Paraná	1		1	
	Rio Grande do Sul	1.036 (0.985–1.089)		1.052 (1.002–1.105)	
	Santa Catarina	0.988 (0.934–1.044)		1.004 (0.950–1.061)	
1	Income (Real)		0.036*		0.016*
	Until BRL 2,100	1		1	
	Between BRL 2,101 – BRL 5,250	1.063 (1.013–1.116)		1.060 (1.010–1.112)	
	Up to BRL 5,251	1.021 (0.963–1.082)		0.998 (0.942–1.058)	
1	Occupation		0.000*		0.004*
	Just college	1		1	
	Work/Internship	0.918 (0.880–0.957)		0.940 (0.901–0.981)	
2	University		0.001*		0.019*
	Private	1		1	
	Public	1.088 (1.034–1.144)		1.065 (1.010–1.122)	
3	Have a chronical disease		0.036*		0.104
	Yes	0.953 (0.910–0.997)		0.965 (0.923–1.007)	
	No	1		1	
3	Recommends its medication to others		0.001*		0.000*
	Never	1		1	
	Sometimes	0.926 (0.889–0.964)		0.921 (0.886–0.959)	
	Always	0.889 (0.764–1.036)		0.882 (0.762–1.021)	
4	Having Emergency Remote Teaching (ERT)		0.708		0.041*
	Yes	1		1	
	No	1.017 (0.971–1.066)		0.966 (0.919–1.015)	
	My course was already by distance	1.042 (0.875–1.242)		1.242 (1.004–1.536)	
4	Fulfilling social distancing		0.005*		0.136

Table III. Continuation.

	No	0.909 (0.791–1.045)		0.903 (0.794–1.207)	
	Go out to work but avoid crowds and get together	0.921 (0.874–0.971)		0.961 (0.907–1.017)	
	Only go out to do essential things	1		1	
4	Realize health decrease during the Pandemic		0.005*		0.000*
	Yes	0.942 (0.903–0.982)		0.927 (0.889–0.966)	
	No	1		1	

***p-value statistically significant.**

Receiving an intermediate income was associated with a higher prevalence of SM. This finding was also identified in a Jordanian study (Alshogran et al. 2018) and may be explained by a hypothesis suggested in another Brazilian SM report, which stated that free access to medication decreases the practice of SM (Schmid et al. 2010). People who have a higher monthly income can buy over-the-counter and even prescription-only medications to relieve their symptoms. Moreover, a cross-sectional study conducted on students demonstrated a high prevalence of SM among those with private health insurance (Galato et al. 2012). It is important to highlight that Brazil has a free public health system that dispenses medications on prescription and involves a multidisciplinary team.

Studying at a public university was identified as a risk factor for SM practice, likely due to the difficulties facing public university students in accessing classes remotely. In addition, private universities generally showed a faster response to the pandemic than that of public ones by implementing ERT, which may have promoted a feeling of anxiety among the students (Miñan-Tapia et al. 2020).

Recommending medications to other people also appears to be a protective factor. This finding is unexpected but may reflect the interest of people to receive medical consultation and being assured of their own treatment before indicating it to others. Furthermore, no differences were noticed between the students who had classes via ERT and those who did not; however, those who were already receiving remote classes were identified as a risk group. People who go out for work or obligation but avoid crowds and unnecessary gathering were found to be less able to practice SM, and this result may possibly be affected by the condition of having a job.

Moreover, noticing health deterioration is also a condition that may reduce SM according to our findings. In agreement, an Egyptian study conducted on students demonstrated a higher rate of SM among those who rated their current health condition as "good," showing that being concerned over personal health may influence the search for medical care (Helal & Abou-ElWafa 2017). As people notice a poor quality of health, they tend to look for health services or even stop using some medications to preserve their health from more damage.

The consumption of medications has changed during the pandemic. As our results show, several medicines have gained attention with the emergence of COVID-19. In this context, we identified the use of ivermectin, vitamins C and D, azithromycin, zinc, and some variable teas and propolis extracts for COVID-19 prevention or treatment. A Nigerian research study has

shown an increase in the sales of vitamin C, zinc, azithromycin, and hydroxychloroquine, among others (Osaigbovo et al. 2020). The same scenario and drugs were identified in a study performed on medical students, which showed azithromycin as the most used medicine, followed by doxycycline (another antibiotic), ivermectin, and hydroxychloroquine. The use of chloroquine and vitamin C for SM was also highly common among workers during the pandemic (Bakoubayi et al. 2021, Johora et al. 2021). In Brazil, the use of chloroquine/hydroxychloroquine and azithromycin, known as the "COVID-19 kit," was encouraged by the Health Ministry and the Government, which prompted the population to use these medications, among others, in a wrong way (Ministério da Saúde 2020b). This was further highlighted when the students mentioned the influence of the Brazilian government among the reasons urging them to practice SM.

In addition, it should be noted that even seemingly harmless substances like vitamins can cause harm when taken unnecessarily. Vitamin C, for example, possesses antioxidant, immunomodulatory, and anti-inflammatory mechanisms, which led to its consideration for COVID-19 prevention in certain individuals. While a few studies have been conducted on the use of vitamin C against COVID-19, no specific protocol has been established. Regarding vitamin D, some positive findings have been observed when used in the early stages of COVID-19, but larger-scale studies are still needed. However, it is important to recognize that both vitamins can have adverse effects, such as kidney injuries, hepatic problems, and others (Baracaldo-Santamaría et al. 2022, Shah et al. 2022).

The potential for adverse effects becomes even more significant when considering other medications, such as antibiotics. Despite COVID-19 being a viral infection, antibiotics were prescribed in some cases to address secondary respiratory infections or due to other therapeutic properties of the drugs. Azithromycin, in particular, was widely used in the treatment of COVID-19, especially in early cases. One protocol involved a 14-day regimen of once-daily azithromycin at a dosage of 500 mg, which is considerably higher than the typical 3 to 5-day course (Patel et al. 2021). Utilizing antibiotics in this manner can promote bacterial resistance and disrupt the balance of the patients' microbiota, leading to potentially dangerous side effects (Sachdev et al. 2022).

Anticipated consequences of using ivermectin included the development of resistance. A Brazilian study predicted a correlation between increased ivermectin consumption during the COVID-19 pandemic and the risk of a scabies outbreak (Oliveira-Filho et al. 2021). Ivermectin, an antiparasitic drug, has exhibited inhibitory properties against coronaviruses, but its effectiveness in patients remains uncertain based on clinical trials (Baracaldo-Santamaría et al. 2022). Furthermore, apart from its lack of proven efficacy and the potential for resistance, the use of ivermectin has been associated with adverse effects such as diarrhea and abdominal pain in patients (Pedroso et al., 2021).

Although less frequently mentioned by students in this study, it is important to note that the use of chloroquine/hydroxychloroquine, apart from not demonstrating benefits in the treatment of COVID-19 (Moraes et al. 2022), can lead to significant adverse effects such as cardiac arrhythmias, heart failure, and cardiomyopathy (Gagnon et al. 2022). Furthermore, when used in combination, such as with azithromycin, the drugs can potentially result in cardiac adverse drug reactions (Gérard et al. 2020). It is crucial to consider not only the individual effects of these

drugs but also their potential interactions and associated risks.

In this context, the drugs used off-label or for self-medication against COVID-19 have not demonstrated significant benefits that justify their consumption and the associated risks of adverse effects. It is important to note that the practice of SM is generally associated with an increased occurrence of adverse effects (Montastruc et al. 2016), and during the COVID-19 outbreak, this incidence has been observed to rise. Adverse effects such as medication errors and overdoses have been prominently reported, but the potential for long-term consequences remains uncertain, and the true impact may only become apparent in the future years (Gras et al. 2021).

Furthermore, it is crucial to note that no drug had received official approval for use in the prevention or treatment of COVID-19 worldwide during the time of this research, which further contributes to self-medication practices among individuals seeking to protect themselves (WHO, 2020b). Currently, there are specific drugs available for the treatment of COVID-19, accompanied by established protocols that aim to ensure both efficacy and safety. Additionally, the Brazilian population has shown a high adherence rate to vaccination, with 80% of the population receiving at least one dose and 50% receiving at least three doses (ANVISA 2023a, b).

Although the most declared reason for SM practice was family or friends' recommendation, this reason has not been sufficiently investigated or reported in the literature, and it is not entirely clear why family or friends encourage others to take medications without prescription. Apart from the Brazilian COVID-19 scenario, people in general were exposed to much information and declarations in favor of the use of medicines against COVID-19, and this may help explain the influence of other people on students' decisions (Lacerda et al. 2021).

Following the influence of family or friends, the recommendations of doctors or dentists were the most cited by students. In addition, recommendation by pharmacists and other health professionals was also mentioned. Given that SM is defined as the use of medications without a formal prescription, the recommendations of health professionals and prescribers are also dangerous practices. During the COVID-19 pandemic, the Brazilian Health Minister published a regulation to establish an experimental protocol against COVID-19, which may be a reason for health professionals encouraging experimental SM practices (Ministério da Saúde 2020b).

An "infodemic" situation can also be considered as one of the reasons for SM practice given the influence of "internet or television news" declared by the students. Infodemic is defined as rampant spread of information during a specific event, such as the COVID-19 pandemic. The insights of drugs that are proposed to treat or heal, the numbers of infected cases and deaths, and the chaos of isolation may promote SM among students (Melo et al. 2021). Another important factor is the ability to easily acquire some of these medications in Brazil, as some of them do not require individual prescriptions and others are sold as over-the-counter drugs.

CONCLUSION

This study was the first large-scale research that analyzed the patterns of SM practice among Brazilian students during the COVID-19 pandemic. Our data showed a lower rate of SM practice to prevent coronavirus infection or to treat symptoms related to the illness according to worldwide findings.

The need for an urgent resource against the coronavirus infection can contribute to the dissemination of erroneous information that fomented SM and this deserves attention due to the problems related to this practice. Our data showed ivermectin and vitamins C and D as preferred medications and it is important to highlight that even these drugs are ordinary, it also can cause adverse effects, intoxications, and long-term problems.

Family or friends' recommendation was the most cited reason for SM practice in this research and it also contribute to the occurrence of adverse effects and health injuries by the use not supervised by a professional. SM practice can damage the health of the population and congest health systems specially in moments as the COVID-19 pandemic and for this is not encourage.

Finally, it is important to remark that this study was performed using convenience sampling, which might limit the ability of the data to represent the entire population. However, the findings can help the development of health education activities that can contribute to reduce the practice of SM and promote the dissemination of information on the rational use of medicines.

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De Souza K.B. and Hort M.A. participated in the conceptualization of the project. De Souza K.B., Wyse E.L., Nasre-Nasser R. Arbo B.D., Veber A.P. and Hort M.A. participated in the development of the research instrument, data collection, and analysis. De Souza K.B., Silva-Júnior FMR and Hort MA performed statistical analysis. Hort M.A supervised the project. De Souza K.B. wrote the draft of the manuscript, and Veber A.P., Muccillo-Baisch A.L., Arbo B.D., and Hort M.A. corrected the final text. All authors approved the final version of the manuscript.