Knowledge of COVID-19 among Brazilian health care professionals and associated factors

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Abstract
Health care professional's knowledge is essential to contain epidemics. This research aimed to evaluate the knowledge of Brazilian health care professionals regarding COVID-19 to analyze whether there is a difference in knowledge between professionals in Primary Health Care and those in other levels of care or not; and to identify factors associated with knowledge. This is a cross-sectional study, including 716 participants who answered an online questionnaire between April and May 2020. Descriptive statistics, difference tests between groups, and logistic regression models were used to analyze the data. The average knowledge score was 12.42 points (out of a possible total of 15). There was no significant difference between professionals in Primary Health Care and those in other levels of care. Knowledge was associated with age, profession, perception regarding media's information quality, and hours exposed to information on COVID-19. Participants showed adequate knowledge, despite some specific gaps. Continuing education actions should prioritize younger nonmedical professionals.

Abbreviations: COVID-19 = Coronavirus disease, EIQ COVID-19 = BRASIL (EIQ-BR): Emotional Impact Questionnaire COVID-19 Brasil, GHQ-12 = General Health Questionnaire, H1N1 = influenza virus A subtype H1N1, MERS = Middle East respiratory syndrome-related coronavirus, OR = Odds Ratio, PHC = Primary Health Care, SARS = Severe Acute Respiratory Syndrome, SOC-13 = Sense of Coherence Scale, UWES-9 = Utrecht Work Engagement Scale, WHO = World Health Organization.

Keywords: coronavirus, COVID-19, cross-sectional studies, health care professionals, knowledge

1. Introduction

In late 2019, a highly pathogenic human coronavirus was detected in Wuhan, China. Named in February 2020 as SARS-Cov-2, this virus causes COVID-19.[1] In China, COVID-19 spread across the country in approximately 30 days.[2] On January 30, 2020, the World Health Organization (WHO) declared the situation to be a "public health emergency of international interest"[3] and, on March 11, 2020, COVID-19 was characterized as a pandemic event.[4] Just over a year after the first cases were detected, on January 28, 2021, 224 countries totalled 100,200,107 cases and 2,158,761 confirmed deaths.[5]

With the rapid spread of COVID-19 around the world, fast responses with a significant impact on the spread of the disease became a necessity. In such a context, health professionals' knowledge about a disease (infectious, mainly) is essential to break (or slow) its chain of transmission, since the lack of knowledge can lead to late diagnoses, ineffective treatments, and inappropriate practices in infection control.[6,7]

Despite the importance of health professionals' knowledge for the containment of infectious diseases, studies conducted in epidemics during the last 20 years, caused by viruses belonging to the family of coronaviruses, SARS (2002–2003), and MERS

(2012) demonstrated that health professionals had significant knowledge gaps.[8–13]

However, during the COVID-19 pandemic several studies in different countries suggested a different scenery, where the majority of health professionals had an adequate knowledge on the disease.[14–24] This is extremely important since it has already been shown that a good level of knowledge on COVID-19 is associated with positive attitude, and good practice toward the disease.[25] Some studies have even found that factors like age, educational level, work experience, monthly income, profession, sex, marital status, and news media were associated with COVID-19 knowledge among health professionals.[25,26]

Even though, there is no reason to doubt of Brazilian health professionals' knowledge and competence, it is well known that Brazilians were highly exposed to COVID-19 misinformation from social media and also had to struggled with conflicting information from the news and some politicians, especially Brazil's president, who constantly denied science and spread misinformation during the entire COVID-19 pandemic.[27–30]

This abundance of misinformation may have challenged the already complex process of receiving and processing information about COVID-19 by Brazilian health professionals, as can be exemplified by the indiscriminate use of hydroxychloroquine and other ineffective drugs against COVID-19 in Brazil. Already from March 2020, Brazil's president, promoted unproven drugs against COVID-19, such as hydroxychloroquine and ivermectin, as silver bullets for fighting the disease. This went on even after several credible systematic reviews with meta-analyzes of randomized controlled trials revealed no clinical benefit and even an increased risk of harm for outpatient treatment or prophylaxis of COVID-19 with hydroxychloroquine and lacking or insufficiently trustworthy evidence for ivermectin. The incessant presidential promotion of ineffective drugs against COVID-19, in conjunction with a decision from the Brazilian Federal Board of Medicine issued in April 2020 that authorized the prescription of hydroxychloroquine to early/mild COVID-19 cases, led to skyrocketing prescriptions and sales of these drugs in Brazil.[31]

Thus, the objectives of this study were to evaluate the knowledge of Brazilian health professionals on COVID-19, to analyze whether there is a difference or not in the degree of knowledge regarding COVID-19 among health professionals who work in Primary Health Care (PHC) and those who work in other health care settings, and also to identify factors associated with being well informed about COVID-19 among health professionals.

2. Methods

This cross-sectional study is an outline of a research entitled "Evaluation of the impact of the coronavirus pandemic on emotional well-being and psychological adjustment of health professionals and the general population," which is part of an international consortium composed of researchers from 26 countries. The research was authorized by the Brazilian National Research Ethics Committee (CAAE 30437120.4.0000.5411, 04/23/2020).

The study's population were Brazilian health professionals and the sample size was calculated taking into account an infinite universe, unknown prevalence (50%), 5% and 20% alpha and beta errors, respectively, and considering 5% of item nonre-sponse, leading to a minimum required sample size of 400 participants. The sampling method used was snowball sampling with multiple entry points.

Given the need for social estrangement imposed by the COVID-19 pandemic, participants were recruited via emails and social media networking sites (WhatsApp, Facebook, Instagram, Twitter, and LinkedIn) and the research questionnaire, EIQ COVID-19 BRASIL (EIQ-BR), was made available online at the following electronic address: https://cutt.ly/IMPACT_COVID-19_BRASIL. Participation in the study was voluntary, and each participant signed a virtual informed consent before answering the questionnaire.

In addition to assessing aspects related to psychological adjustment (through the General Health Questionnaire - GHQ-12), the sense of coherence (through the Sense of Coherence Scale—SOC-13) and involvement in work (with the Utrecht Work Engagement Scale—UWES-9). EIQ-BR also obtained socio-demographic characteristics, occupational factors, COVID-19 knowledge data, and data regarding the information received on COVID-19 and preventive measures. The EIQ-BR is an auto-administered questionnaire, which has 147 questions. Of those questions, 15 are about COVID-19 knowledge, divided into basic (5 questions) and advanced (10 questions).

The first 5 questions about basic knowledge are described below, in the same order they appeared in the EIQ-BR: The incubation period of COVID-19 (between infection and symptoms) is 2 to 14 days; The most common and easy-to-observe symptoms of COVID-19 are fever, dry cough, diarrhea, and breathing difficulties; People who tested positive for COVID-19 should remain isolated; The main form of transmission is via aerosol inhalation of respiratory droplets (from people infected by the virus), although it is also transmitted by touching the eyes, nose, or mouth after touching contaminated surfaces; COVID-19 transmission begins after the onset of symptoms.

The 10 questions about advanced knowledge, also in the order they were presented in the EIQ-BR, are the following: If the conditions of the health services allow, establishing 2 differenti-ated circuits should be considered: one for patients with respiratory symptoms and another for patients with non-respiratory symptoms; If the patient is considered a suspect case of COVID-19 during screening, A-B-C-D-E (Airway, Breathing, Circulation, Disability, Exposure) should be applied as soon as possible; If the patient has acute respiratory infection without hospital admission criteria and is not part of a vulnerable group, home isolation after performing diagnostic tests for COVID-19 should be considered if possible; Infection should be suspected if there are ≥2 of the following conditions: fever, cough, dyspnea, having been in a zone of risk or contact with people diagnosed with COVID-19; during aerosol-generating procedures health care professionals should be required to use full eye protection or face shield, FFP2, or FFP3 mask and waterproof gown and long sleeve gloves; The recommended samples for the diagnosis of COVID-19 are 2: nasopharyngeal and/or oropharyngeal swab; during patient emergency transfer to an outside hospital the patient should wear a surgical mask; the radiological status of those affected by COVID-19 may range from bilateral multifocal opacities that tend to converge to complete lung opacification in more severe cases; In case of pregnant women >24 weeks gestational age, fetal well-being will be verified and the patient will remain under observation until the result of the diagnostic tests. Control of fetal well-being will be performed by echocardiography and/or cardiotocography as a function of
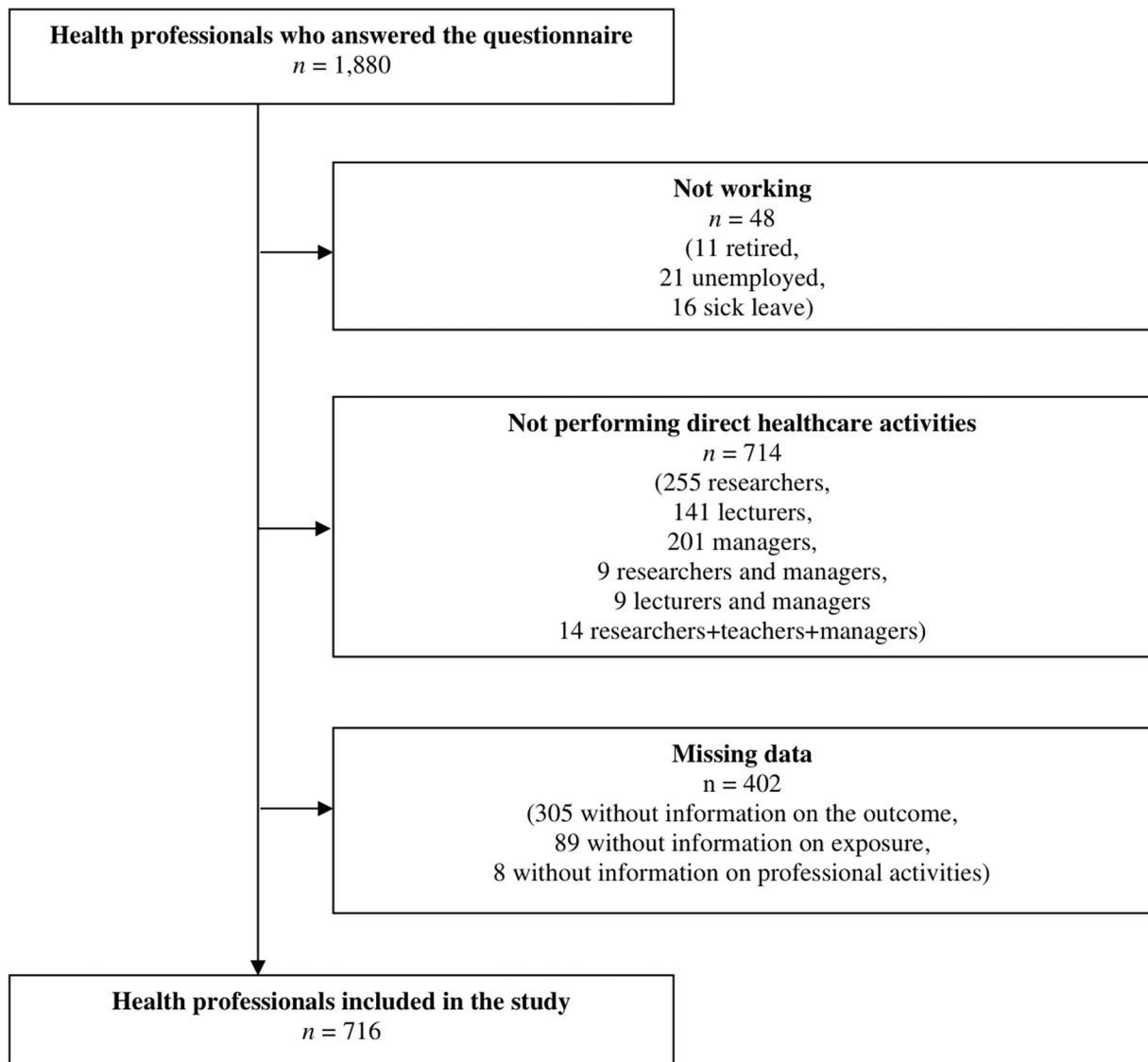
Figure 1. Study enrolment and participation flowchart.

gestational age; Cases of COVID-19 usually present severe symptoms.

All the 15 questions described above offered yes, no and I don't know as response options; and 13 questions expressed valid knowledge at the time of the research, only the last question of basic knowledge and the last of advanced knowledge were incorrect.

At the end of the data collection period (from April 23, 2020, to May 30 of the same year), 1880 health professionals had answered the questionnaire. Due to the inclusion criteria of the present study and the incomplete completion of the questionnaire, 1116 respondents were excluded (as shown in Fig. 1), thus totalling 716 participants.

In the present study, the independent variables (all obtained through the EIQ-BR) were sociodemographic factors, occupational characteristics, and variables related to the process of acquiring knowledge about COVID-19.

The sociodemographic variables were sex (dichotomous variable); age (discrete variable in complete years); marital status (categorical variable: single, married or living with a partner, separated/divorced and widowed); children (dichotomous variable: yes/no); highest education level completed (categorical variable: high school, bachelor, specialisation, master's degree, and PhD); Brazilian region of residence (categorical variable).

The occupational variables were: profession (categorical variable: nurse, doctor, and other health professions); employment relationship (categorical variable: self-employed, civil servant and private sector employee); work arrangement (categorical variable: part-time at home, part-time outside of home, full-time at home, full time outside of home, other and mixed); professional practice (categorical variable: only direct care, direct care and one more area, direct care and two more areas, and all areas - in addition to direct care activities, the other areas of activity were research, teaching and management); health care setting (dichotomous variable: PHC and specialised care); health service type (categorical variable: public, private, other and >1); risk perception (discrete scalar variable with

Participant's sociodemographic characteristics stratified by health care setting ($n = 716$).

	Primary health care n (%)	Specialized care n (%)	Total n (%)
Sex			
Male	33 (16.3)	101 (19.6)	134 (18.7)
Female	169 (83.7)	413 (80.4)	582 (81.3)
Marital status			
Single	72 (35.6)	161 (31.3)	233 (32.5)
Married	107 (53)	297 (57.8)	404 (56.4)
Separated	22 (10.9)	52 (10.1)	74 (10.4)
Widow	1 (0.5)	4 (0.8)	5 (0.7)
Children			
Yes	101 (50)	256 (49.8)	357 (49.9)
No	101 (50)	258 (50.2)	359 (50.1)
Education level[**]			
High school	24 (11.9)[†]	17 (3.3)[‡]	41 (5.7)
Bachelor	48 (23.7)[†]	115 (22.4)[†]	163 (22.8)
Specialisation	89 (44.1)[†]	198 (38.5)[†]	287 (40.1)
Master's degree	24 (11.9)[†]	115 (22.4)[‡]	139 (19.4)
Ph.D.	17 (8.4)[†]	69 (13.4)[†]	86 (12)
Brazilian region			
North	1 (0.5)	11 (2.1)	12 (1.7)
Northeast	12 (5.9)	42 (8.2)	54 (7.5)
Midwest	18 (8.9)	54 (10.5)	72 (10.1)
Southeast	144 (71.3)	342 (66.6)	486 (67.9)
South	27 (13.4)	65 (12.6)	92 (12.8)

	Primary health care Median (min-max)	Specialized care Median (min–max)	Total Median (min–max)
Age[*]	37 (19-65)	38 (21-73)	38 (19–73)

[*] $P < .05$ according to Mann–Whitney U test.
[**] $P < .05$ according to χ^2 test with Bonferroni correction; [†]/[‡]: Percentages followed by these symbols are significantly different at 5%.

minimum value of 9 and maximum of 90); and, finally, four variables related to the number of years of experience in each of the 4 areas of professional practice (categorical variables: 0 up to 5 years, from 5 up to 10 years, >10 years).

Finally, the variables related to COVID-19 information acquisition process were: information sources (categorical variable: social media and friends/family, traditional, official, other, two sources, three sources, four sources, all sources and does not seek information - traditional platforms include online or printed newspapers, radio and television; official platforms include websites of official institutions or scientific societies; other platforms includes Google and/or other search engines, applications, scientific articles and other sources of information); specific information for the prevention of COVID-19 received by the employer (dichotomous variable: yes/no); clarity and accuracy of employer information (discrete scalar variable with a minimum value of 0 and a maximum of 10); hours per day exposed to COVID-19 information (categorical variable: up to 1 hour, >1 up to 4 hours, >4 up to 8 hours and >8 hours); fact-checking (dichotomous variable: yes/no); and, finally, 4 variables related to how participants considered the accessibility, quantity, quality, and usefulness of news media COVID-19 information (categorical variables: very low, low, moderate, high, and very high).

A total COVID-19 knowledge score was calculated by summing the score for each knowledge question. Therefore,

correct answers were coded as one, whereas incorrect answers and "I don't know" were coded as zero. Since the EIQ-BR has 15 questions about COVID-19 knowledge, the maximum total knowledge score was 15 points. In addition to the total COVID-19 knowledge score, a basic COVID-19 knowledge score (maximum of 5 points) and an advanced COVID-19 knowledge score (maximum of 10 points) were calculated.

We analyzed participant's characteristics using descriptive statistics. We also compared COVID-19 knowledge between health professionals who worked in PHC and those who worked in other health settings using the nonparametric Mann–Whitney U test, since the research data did not show a normal distribution.

Finally, we used logistic regression modelling to quantify associations between independent variables and COVID-19 knowledge. Thus, simple logistic regression models were performed for each of the independent variables, estimating odds ratio (OR) and the respective 95% confidence intervals (95% CI). The independent variables that achieved P value ≤ 0.25 in these analyses were included in a multiple logistic regression model.

To insert these independent variables in the multiple model we used the forward stepwise selection procedure; in this model only variables that obtained a P value $< .05$ (2-tailed) were considered statistically significant. Model fit was assessed using the Hosmer and Lemeshow goodness-of-fit test. It should be noted that

Table 2

Participant's occupational characteristics stratified by health care setting (*n* = 716).

	Primary health care *n* (%)	Specialized care *n* (%)	Total *n* (%)
Profession**			
Nurse	23 (11.4)†	132 (25.7)‡	155 (21.6)
Physician	55 (27.2)†	88 (17.1)‡	143 (20)
Others	124 (61.4)†	294 (57.2)†	418 (58.4)
Employment relationship**			
Self-employed	15 (8.9)†	141 (30.6)‡	156 (24.8)
Civil servant	122 (72.2)†	235 (51)‡	357 (56.7)
Private sector	32 (18.9)†	85 (18.4)†	117 (18.5)
Work arrangement**			
Mixed	11 (5.9)†	45 (9.1)†	56 (8.2)
Part-time at home	12 (6.5)†	54 (10.8)†	66 (9.7)
Part-time outside of home	35 (18.9)†	127 (25.5)†	162 (23.7)
Full-time at home	12 (6.5)†	44 (8.8)†	56 (8.2)
Full time outside of home	99 (53.5)†	195 (39.2)‡	294 (43)
Other	16 (8.7)†	33 (6.6)†	49 (7.2)
Professional practice**			
Only care activities	156 (77.2)†	336 (65.4)‡	492 (68.7)
Care and 1 more area	39 (19.3)†	129 (25.1)†	168 (23.5)
Care and 2 more areas	5 (2.5)†	37 (7.2)‡	42 (5.9)
All areas	2 (1)†	12 (2.3)†	14 (2)
Care experience			
0 up to 5 y	63 (31.2)	129 (25.1)	192 (26.8)
From 5 up to 10 y	41 (20.3)	103 (20)	144 (20.1)
>10 y	98 (48.5)	282 (54.9)	380 (53.1)
Research experience**			
0 up to 5 y	196 (97)†	460 (89.4)‡	656 (91.6)
From 5 up to 10 y	4 (2)†	27 (5.3)†	31 (4.3)
>10 y	2 (1)†	27 (5.3)b	29 (4.1)
Teaching experience**			
0 up to 5 y	194 (96)†	458 (89.1)‡	652 (91)
From 5 up to 10 y	3 (1.5)†	19 (3.7)†	22 (3.1)
>10 y	5 (2.5)†	37 (7.2)‡	42 (5.9)
Management experience			
0 up to 5 y	188 (93.1)	481 (93.6)	669 (93.4)
From 5 up to 10 y	6 (3)	12 (2.3)	18 (2.5)
>10 y	8 (3.9)	21 (4.1)	29 (4.1)
Health service type**			
Public	145 (71.8)†	243 (47.3)‡	388 (54.2)
Private	32 (15.8)†	185 (36)‡	217 (30.3)
Other	2 (1.0)†	3 (0.6)†	5 (0.7)
>1	23 (11.4)†	83 (16.1)†	106 (14.8)

	Primary health care Median (min–max)	Specialized care Median (min–max)	Total Median (min–max)
Risk perception	59 (10–89)	59 (23–88)	59 (10–89)

** $P < .05$ according to χ^2 test with Bonferroni correction; †/‡: Percentages followed by these symbols are significantly different at 5%.

1 respondent was excluded from the analysis of factors associated with COVID-19 because she answered that she did not seek information on COVID-19.

The dependent variable of the logistic regression models was the total COVID-19 knowledge score. For this purpose, this variable was dichotomized (above and below the mean percentage of correct answers) as described in previous studies.[32–34] In the present study, the mean percentage of correct answers regarding the total COVID-19 knowledge was 82.77%. Thus, participants with a lower percentage of correct answers than 82.77% were considered to have a total COVID-19 knowledge below the average (reference category).

All the analyses described above were performed using the IBM Corp. Released 2019 SPSS Statistics for Windows (Version 26.0, IBM Corp., Armonk, NY)

3. Results

Among the 716 health professionals included in the analysis, 28.2% (202) worked in PHC and 71.8% (514) in other health

Table 3

Participant's COVID-19 information acquisition process characteristics stratified by health care setting (n = 716).

	Primary health care n (%)	Specialized care n (%)	Total n (%)
Information sources			
Social media and friends/family	4 (2)	13 (2.5)	17 (2.4)
Traditional	3 (1.5)	12 (2.3)	15 (2.1)
Official	4 (2)	15 (2.9)	19 (2.7)
Other	4 (2)	4 (0.8)	8 (1.1)
2 Sources	24 (11.9)	89 (17.3)	113 (15.8)
3 Sources	44 (21.8)	115 (22.3)	159 (22.2)
4 Sources	66 (32.6)	127 (24.7)	193 (26.9)
All sources	53 (26.2)	138 (26.8)	191 (26.7)
Do not seek information	0 (0)	1 (0.2)	1 (0.1)
Employer information			
Yes	141 (83.4)	375 (81.3)	516 (81.9)
No	28 (16.6)	86 (18.7)	114 (18.1)
Hours/day exposed to COVID-19 information[**]			
Up to 1 h	30 (14.9)[†]	110 (21.4)[‡]	140 (19.5)
Beyond 1 up to 4 h	81 (40.1)[†]	244 (47.5)[†]	325 (45.4)
Beyond 4 up to 8 h	53 (26.2)[†]	93 (18.1)[‡]	146 (20.4)
>8 h	38 (18.8)[†]	67 (13)[‡]	105 (14.7)
Fact-checking			
Yes	190 (94.1)	480 (93.4)	670 (93.6)
No	12 (5.9)	34 (6.6)	46 (6.4)
News media COVID-19 information accessibility[**]			
Very low	1 (0.5)[†]	8 (1.6)[†]	9 (1.3)
Low	5 (2.5)[†]	26 (5.1)[†]	31 (4.3)
Moderate	53 (26.2)[†]	88 (17.1)[‡]	141 (19.7)
High	84 (41.6)[†]	214 (41.6)[†]	298 (41.6)
Very high	59 (29.2)[†]	178 (34.6)[†]	237 (33.1)
News media COVID-19 information quantity			
Very low	2 (1)	2 (0.4)	4 (0.6)
Low	7 (3.5)	7 (1.3)	14 (2.0)
Moderate	32 (15.8)	62 (12.1)	94 (13.1)
High	67 (33.2)	180 (35)	247 (34.5)
Very high	94 (46.5)	263 (51.2)	357 (49.8)
News media COVID-19 information quality			
Very low	11 (5.4)	31 (6)	42 (5.9)
Low	32 (15.8)	89 (17.3)	121 (16.9)
Moderate	123 (60.9)	278 (54.1)	401 (56)
High	30 (14.9)	94 (18.3)	124 (17.3)
Very high	6 (3)	22 (4.3)	28 (3.9)
News media COVID-19 information usefulness[**]			
Very low	6 (3)[†]	15 (2.9)[†]	21 (2.9)
Low	28 (13.8)[†]	63 (12.3)[†]	91 (12.7)
Moderate	114 (56.4)[†]	255 (49.6)[†]	369 (51.6)
High	50 (24.8)[†]	145 (28.2)[†]	195 (27.2)
Very high	4 (2)[†]	36 (7)[‡]	40 (5.6)

	Primary health care Median (min–max)	Specialized care Median (min–max)	Total Median (min–max)
Clarity and accuracy of employer information	7 (1–10)	8 (1–10)	8 (1–10)

[*] $P < .05$ according to Mann–Whitney U test.
[**] $P < .05$ according to χ^2 test with Bonferroni correction; Percentages followed by different letters are significantly different at 5%.

settings. Tables 1 to 3 present sociodemographic characteristics, occupational factors, and characteristics regarding participants' COVID-19 information acquisition process, stratified by health care setting.

Regarding participants' knowledge about COVID-19, the median score in the basic questions was 5.00 points (interval 0–5). There was no statistically significant difference ($P = .621$) between PHC (median score 5.00, interval 3–5) and specialized care professionals (mean score 5.00, interval 0–5). The median score in the advanced questions was 8.00 (interval 0–10). Once more, there was no statistically significant difference ($P = .965$) between PHC (median score 8.00, interval 3–10) and specialized care professionals (median score 8.00, interval 0–10).

Table 4

Correct answers to EIQ-BR's COVID-19 knowledge questions, stratified by level of care and total (*n* = 716).

	Primary health care	Specialized care		Total
	n (%)	*n* (%)	*P*	*n* (%)
Basic question 1[*]	197 (97.5)	481 (93.6)	.034	678 (94.7)
Basic question 2[*]	182 (90.1)	469 (91.2)	.631	651 (90.9)
Basic question 3[**]	202 (100)	510 (99.2)	.581	712 (99.4)
Basic question 4[**]	200 (99)	506 (98.4)	.733	706 (98.6)
Basic question 5[*]	185 (91.6)	475 (92.4)	.710	660 (92.2)
Advanced question 1[*]	177 (87.6)	450 (87.5)	.978	627 (87.6)
Advanced question 2[*]	80 (39.6)	215 (41.8)	.586	295 (41.2)
Advanced question 3[*]	165 (81.7)	415 (80.7)	.772	580 (81)
Advanced question 4[*]	194 (96)	485 (94.4)	.360	679 (94.8)
Advanced question 5[*]	187 (92.6)	450 (87.5)	.053	637 (89)
Advanced question 6[*]	157 (77.7)	382 (74.3)	.342	539 (75.3)
Advanced question 7[*]	177 (87.6)	445 (86.6)	.709	622 (86.9)
Advanced question 8[*]	171 (84.7)	408 (79.4)	.106	579 (80.9)
Advanced question 9[*]	105 (52)	246 (47.9)	.321	351 (49)
Advanced question 10[*]	155 (76.7)	419 (81.5)	.148	574 (80.2)

EIQ-BR = Emotional Impact Questionnaire COVID-19 Brasil.

[*] *P value* according to χ^2 test.

[**] *P value* according to Fisher exact test.

Finally, the median total COVID-19 knowledge score was 13.00 points (interval 0–15). And, as it occurred in the basic and advanced questions, when comparing the mean total COVID-19 knowledge score obtained by the participants who worked in PHC (median score 13.00, interval 8–15) and those who worked in specialised care (median score 13.00, interval 0–15) there was no statistically significant difference ($P = .918$).

Table 4 presents the distribution of correct answers in each of the questions about COVID-19 knowledge.

Given the results of the second and ninth advanced questions, both with <50% of correct answers, we decided to run a post hoc analysis using the χ^2 test to evaluate whether there was a difference in these questions regarding participants' education level or profession. In relation to the second advanced question, there was no significant difference regarding education level ($P = .147$) and profession ($P = .637$). However, in relation to the 9th advanced question, even though there was no significant difference regarding education level ($P = .598$), we did find a significant difference regarding profession ($P < .001$)—68% of the physicians, 58% of the nurse,s and only 38.8% of the other health professionals answered this question correctly.

Tables 5 to 7 present the results of simple logistic regression models in which the outcome was total COVID-19 knowledge.

Table 5

Results of the simple logistic regression analysis for sociodemographic factors associated with total COVID-19 knowledge.

	OR	OR (95% CI)	*P*
Sex (ref.: male)			
Female	1.164	0.799–1.696	.428
Age	1.031	1.017–1.045	<.001
Marital status (ref.: single)			
Married	1.631	1.179–2.257	.003
Separated	1.980	1.155–3.394	.013
Widow	0.758	0.124–4.623	.764
Children (ref.: yes)			
No	0.656	0.488–0.883	.005
Education level (ref.: high school)			
Bachelor	1.575	0.790–3.140	.197
Specialisation	1.680	0.869–3.248	.123
Master's degree	1.838	0.910–3.714	.090
Ph.D.	1.278	0.605–2.699	.521
Brazilian region (ref.: North)			
Northeast	3.047	0.844–10.995	.089
Midwest	1.185	0.344–4.084	.788
Southeast	1.779	0.557–5.685	.331
South	1.595	0.472–5.396	.452

CI = confidence interval, OR = odds ratio.

	OR	OR (95% CI)	P
Profession (ref.: others)			
Nurse	2.186	1.476–3.237	<.001
Physician	3.483	2.316–5.239	<.001
Employment relationship (ref.: self-employed)			
Civil servant	1.281	0.893–1.837	.178
Private sector	1.448	0.923–2.274	.108
Health care setting (ref.: primary health care)			
Specialised care	1.109	0.800–1.538	.534
Work arrangement (ref.: mixed)			
Part-time at home	0.659	0.333–1.307	.233
Part-time outside of home	0.842	0.465–1.528	.573
Full-time at home	0.556	0.273–1.133	.106
Full-time outside of home	0.975	0.556–1.711	.930
Others	1.473	0.670–3.237	.335
Professional practice (ref.: only care activities)			
Care and 1 more area	1.151	0.808–1.640	.435
Care and 2 more areas	1.124	0.595–2.123	.720
All areas	1.124	0.384–3.286	.831
Care experience (ref.: 0 up to 5 y)			
From 5 up to 10 y	1.149	0.746–1.772	.528
>10 y	1.959	1.378–2.784	<.001
Research experience (ref.: 0 up to 5 y)			
From 5 up to 10 y	0.752	0.336–1.547	.439
>10 y	1.136	0.534–2.418	.740
Teaching experience (ref.: 0 up to 5 y)			
From 5 up to 10 y	1.482	0.613–3.582	.382
>10 y	1.890	0.965–3.700	.063
Management experience (ref.: 0 up to 5 y)			
From 5 up to 10 y	1.676	0.622–4.518	.308
>10 y	1.862	0.836–4.149	.128
Health service type (ref.: public)			
Private	0.847	0.607–1.181	.327
Others	0.559	0.092–3.384	.527
>1	1.940	1.224–3.074	.005
Risk perception	0.995	0.981–1.009	.500

CI = confidence interval, OR = odds ratio.

The result of the multiple logistic regression model (Table 8) showed that COVID-19 total knowledge was associated with age, profession, perception regarding COVID-19 information quality of the news media and hours per day exposed to COVID-19 information. The Hosmer and Lemeshow Goodness-Of-Fit Test indicated an adequate fit of the multiple model ($\chi^2 = 7.577$, 8 degrees of freedom and $P = .476$).

4. Discussion

The results of this research, which reflects the participant's knowledge level at the data collection period (between the 17th and 22nd epidemiological weeks of 2020–period in which Brazil went from 58,388 cases and 4016 confirmed deaths to 498,319 cases and 28,834 confirmed deaths, values far from the 21,849,137 cases and 608,671 confirmed deaths on the 4th of November 2021[35]), demonstrate that the majority of the participants had an adequate level of knowledge about COVID-19.

In the present study, the total knowledge median score was 13.00 points (out of a possible total of 15 points), that is, a correct answer percentage of 86.7%. Although our results differ from a study that assessed COVID-19 knowledge of

health professionals from around the world (but with a concentration of 68% of participants in Asia), in which respondents had inadequate knowledge, even in relation to basic knowledge, such as modes of transmission, incubation period, and treatment strategies,[36] the findings are consistent with that of similar research conducted in several countries, such as Saudi Arabia,[14] China,[15] Egypt,[16] Ethiopia,[17] India,[18] Jordan and Palestine,[19] Pakistan,[20,21] Sierra Leone,[22] Uganda,[23] and Vietnam.[24]

Despite the similarity of the results, they should not be interpreted as a knowledge spectrum common to all professionals evaluated in these researches, since these studies used different questionnaires for collecting data, were performed at different times of the pandemic (despite the fact that data collection was carried out during the first semester of 2020 on all of them) and included health professionals who worked at different health care settings.

Despite the urgent need imposed by the pandemic to learn more about SARS-Cov-2 and COVID-19, little was known in the first months of 2020. In an article published online on March 12, 2020, which aimed to summarize what was known about COVID-19, the authors concluded that "So far, we know

Table 7

Results of the simple logistic regression analysis for COVID-19 information acquisition process factors associated with total COVID-19 knowledge.

	OR	OR (95% CI)	P
Information sources (ref.: social media and friends/family)			
Traditional	1.333	0.327–5.434	.688
Official	1.222	0.327–4.565	.765
Other	0.296	0.046–1.908	.200
2 Sources	1.161	0.418–3.228	.775
3 Sources	1.074	0.394–2.926	.889
4 Sources	1.203	0.445–3.252	.715
All sources	1.019	0.377–2.752	.971
Employer information (ref.: yes)			
No	0.847	0.578–1.242	.396
Clarity and accuracy of employer information	1.051	0.994–1.111	.079
Hours/day exposed to COVID-19 information (ref.: up to 1 h)			
Beyond 1 up to 4 h	0.962	0.647–1.430	.848
Beyond 4 up to 8 h	1.518	0.948–2.429	.082
More than 8 h	1.889	1.119–3.190	.017
Fact-checking (ref.: yes)			
No	1.277	0.693–2.353	.434
News media COVID-19 information accessibility (ref.: very low)			
Low	2.273	0.504–10.253	.286
Moderate	1.268	0.327–4.918	.731
High	1.683	0.443–6.394	.445
Very high	1.519	0.398–5.797	.541
News media COVID-19 information quantity (ref.: very low)			
Low	1.667	0.135–20.578	.690
Moderate	4.231	0.424–42.201	.219
High	4.410	0.452–43.003	.202
Very high	3.337	0.344–32.390	.299
News media COVID-19 information quality (ref.: very low)			
Low	1.830	0.886–3.778	.102
Moderate	2.397	1.237–4.643	.010
High	2.755	1.332–5.698	.006
Very high	2.400	0.902–6.389	.080
News media COVID-19 information usefulness (ref.: very low)			
Low	1.228	0.475–3.175	.672
Moderate	1.437	0.596–3.467	.420
High	1.310	0.532–3.227	.557
Very high	1.488	0.515–4.301	.463

CI = confidence interval, OR = odds ratio.

relatively little about COVID-19 [. . .]".[3] Since then, the effort to learn more about COVID-19 has resulted in an exponential growth in research and, consequently, in articles published about it. If on March 10, 2020 the number of articles published on COVID-19 was just over two thousand, 77 days later that number was already >36,000.[37]

Table 8

Results of the multiple logistic regression analysis of variables associated with total COVID-19 knowledge.

	OR	OR (95% CI)	P
Age	1.033	1.018–1.048	<.001
Profession (ref.: others)			
Nurse	2.169	1.421–3.311	<.001
Physician	3.788	2.453–5.848	<.001
News media COVID-19 information quality (ref.: very low)			
Moderate	3.144	1.550–6.379	.002
High	3.524	1.620–7.668	.001
Very high	3.037	1.076–8.574	.036
Hours/day exposed to COVID-19 information (ref.: up to 1 h)			
>8 h	1.788	1.016–3.146	.044

CI = confidence interval, OR = odds ratio.

For several reasons, this unprecedented speed in the production of information has proved to be a challenge for all involved in fighting the pandemic.[38] The first is the phenomenon known as information overload,[39] which may lead to misinterpretation of information, delay in the processing of information, acceptance of low-quality information and withdrawal of appropriate and necessary information from the search.[40] Another phenomenon experienced by health professionals[41] and that has been worrying the WHO, because it can cause individuals to stop seeking information on COVID-19, is pandemic fatigue.[42]

In addition, the enormous amount of COVID-19 information shared via social media makes it difficult to identify truthful information, which can lead to the rapid dissemination of incorrect information.[43] It is assumed that health professionals are able to reliably distinguish high- and low-quality information; however, the results of a 2017 study suggest that they are not able to reliably assess the quality of open educational resources based on social media, blogs, and podcasts.[44] At this point, it is important to note that our results show that only 2.4% of the participants sought information only through social media and/or between friends and family, whereas 75.8% did it through ≥3 information sources.

Another problem is that most scientific articles are published in English, which can be a barrier to access information directly from the source and/or for its interpretation among health professionals whose native language is not English[45] as in the case of Brazilians.

Finally, health care professionals on the front line during the COVID-19 pandemic have experienced not only pandemic fatigue, but an exhaustive experience due to high workloads and massive use of personal protective equipment, permeated by mental health problems such as anxiety, depression, insomnia, and stress,[41,46,47] which negatively affect the acquisition of new knowledge.[48]

Although this study's results indicate that most of the participants were able to overcome these difficulties, it should be highlighted that in 2 advanced questions the percentage of correct answers was <50%.

The first is about the use of the A-B-C-D-E method during possible COVID-19 positive cases screening. This method is suggested by WHO in an adaptation of its publication "Clinical Care for Severe Acute Respiratory Infection" to COVID-19[49] and in another article.[50]

The second was about pregnant care, which is worrying, given that a historical cohort analyzing data on 8207 pregnant women and 83,205 nonpregnant women, found an increase in the risk of admission to ICU and in the need for mechanical ventilation in pregnants with COVID-19 of 50% and 70%, respectively.[51] Another study, conducted in Brazil, found a number of COVID-19-related deaths of pregnant or postpartum women 3.4 times higher than the total number of COVID-19-related maternal deaths worldwide.[52] It is worth noting that, despite the controversies that arose during the first year of the pandemic, the most current evidence suggests an increase in the risk of maternal morbidity and mortality related to COVID-19.[53–55]

An important and positive result of the present work is the lack of statistically significant difference of knowledge (basic, advanced, and total) between PHC and specialised care professionals. As infection control programs are rare in the PHC services of the Brazilian Unified Health System,[56] this result is contradictory to the finding of a study where health professionals who worked in services with an infection control program had greater knowledge about MERS than those who worked in services that did not have this type of program.[11]

As it is clear that prioritizing the hospital-centric model in the fight against the pandemic is an inadequate approach, the degree of knowledge presented by PHC health professionals found in this study is encouraging, since PHC should be considered essential to the front line of the fight against COVID-19.[57] Characteristics such as first-contact accessibility, family- and community-oriented care, better knowledge of the area and local resources, and continuous, comprehensive, and coordinated care make PHC capable of acting in different phases of COVID-19 response, such as health surveillance (through notification, detection, and follow-up of cases), care for users with COVID-19 (through early identification of signs and symptoms, monitoring and management of mild cases in home isolation, referral to specialized care of those in need, and monitoring and management of sequelae presented by cured patients) and social support for vulnerable groups (through coordinated actions with local leaders, equipment and institutions).[57]

Regarding the factors associated with total COVID-19 knowledge, each year of age represented a 3.3% greater chance of having above average knowledge. A possible explanation for this finding is that, in addition to the greater knowledge accumulated throughout their careers, professionals with more years of life have contact with a greater number of professionals from different areas facilitating the search for up-to-date information on emerging topics and, still, the comparison with previous experiences (eg, the experience of the H1N1 pandemic) facilitate the consolidation of learning and the establishment of links between theory and practice. It should be noted that other studies do not corroborate this result.[16,23]

Regarding profession, when compared to other health professionals, nurses and physicians presented an increased chance of having knowledge above the average of 116.9% and 278.8%, respectively. Several studies that evaluated COVID-19 knowledge of health professionals also found that physicians are the professional category with the highest level of knowledge.[15,16,20,22,36] A possible explanatory hypothesis for this result may be related to the greater focus on infectious diseases that the training of physicians has.[36] Thus, it is necessary that continuing education on COVID-19 have a greater focus on nonmedical health professionals.

Another variable that was associated with total COVID-19 knowledge above the average was the positive perception regarding the quality of information presented by the media. During the data collection period, media coverage of the pandemic was intense[58] and often counted on the participation of well-known researchers and health professionals, thus conferring legitimacy and reliability to the disclosed information.[59] Thus, this association may be explained by the participants with greater knowledge and therefore recognize the information of high quality shared by the news media.

When discussing the role of the press in the COVID-19 pandemic in Brazil, it is not possible to avoid observing its role in the political polarisation of the country. By giving way to 2 contradictory versions, that of the experts and that of the Republic's President, admittedly a negationist leadership,[58–61] and even considering them as equivalent on certain occasions (as in the case of "vertical isolation"), the media allowed for the dissemination of false information and strengthened the Federal Government's denialist project, creating fertile ground for increased political polarisation around COVID-19.[59]

Finally, being exposed for >8 hours a day to information on COVID-19 increased the chance of having knowledge above the average by 73%. However, it is important to note that excessive exposure to information on COVID-19 may be linked to symptoms of psychological distress[62] and mental fatigue among health professionals.[63] Thus, since it has already been shown that having access to up-to-date and accurate information can act as a protective factor for mental health[62] and the need for health professionals to be constantly updated, it is essential to make use of tools that facilitate the process of acquiring relevant, reliable, and recent information on COVID-19 by health professionals.[63–65]

It is important to highlight some limitations of this study. As snowball sampling is not based on a random selection, it is not possible to ensure that the participants are broadly representative of the study's population. The fact that participants were recruited through snowball sampling on the internet may also have led to some self-selection bias, as professionals with greater interest in the subject may have participated in a greater proportion than others. Since the questionnaire was applied online, some respondents may have consulted additional sources of information when they had doubts. Therefore, the results obtained may be overestimated. It should be noted, however, that these limitations were determined by the constraints due to travel restrictions and distancing guidelines for controlling the spread of COVID-19. The absence of a standardized, validated, translated, and adapted to several languages questionnaire that evaluates health professionals' knowledge on COVID-19 makes it difficult to compare with other studies. Due to EIQ-BR's characteristics, participants could only position themselves through the alternatives yes, no, and do not know. We also want to point out that Brazil is a very large country with evident differences between geographical areas, so the generalization of the results should be taken with caution and studies should be carried out throughout the country.

Finally, another limitation of this and other research that evaluated the knowledge about COVID-19 is that this knowledge evolves rapidly, so the results obtained by cross-sectional studies are limited to the period in which the information was obtained, thus highlighting the need for serial studies on the knowledge of health professionals.

Despite these limitations, the obtained results provide important information on the knowledge of Brazilian health professionals about COVID-19, being, as far as the authors could identify, the first nationwide study on the subject and, also, the first to specifically assess the knowledge of PHC professionals. To determine that this was the first study on this subject in Brazil, we conducted a search of Google, Google Scholar, and PubMed using the following keywords "covid-19," "knowledge," "healthcare professionals," "healthcare workers," "Brazilian" and "Brazil." In addition, the relatively high sample size and the inclusion of health professionals from different professional categories, who work in the 3 levels of health care, both in public and private health services, in all regions of Brazil (despite the over-representation of those from the Southeast region contribute to the external validity of the findings).

As conclusions, our results suggest that, in this sample of Brazilian health professionals, we detected adequate knowledge about COVID-19, despite the existence of some gaps in specific aspects that should be the focus of continuing education. In relation to PHC professionals, there was no statistically significant difference in knowledge when compared to professionals who work in other levels of health care, which reaffirms and reinforces the importance of PHC to enhance COVID-19 response. Finally, age, profession, positive perception of the quality of the information disseminated by news media, and being exposed to >8 hours daily to COVID-19 information were associated with a greater chance of having a total knowledge about COVID-19 above the average. Therefore, actions that favor the acquisition of reliable, high-quality information about COVID-19 among health professionals should aim more at nonmedical health professionals and younger professionals.

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