Coronavirus Disease 2019 Knowledge, Its Vaccine Uptake Intentions, and the Influence of Personality Traits among Undergraduate Pharmacy Students in a University Setting: Findings and Implications

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Abstract

Context: Coronavirus disease 2019 (COVID-19) is the greatest global health catastrophe of the century, with its vaccine hesitancy compounding the woes. Relevant stakeholders, including pharmacy students (whose education was disrupted) are important bulwarks against these catastrophes, but their COVID-19-related information are scarce. **Aims:** We assessed COVID-19 knowledge, its vaccine uptake intentions, and the influence of personality traits among pharmacy undergraduates in a Nigerian university. **Settings and Design:** This was a post-lockdown cross sectional study conducted at the Faculty of Pharmaceutical Sciences, Usmanu Danfodiyo University, Sokoto. **Subjects and Methods:** A 61-item questionnaire was used to collect data among pharmacy undergraduates who attended Usmanu Danfodiyo University, Sokoto, Nigeria, in May 2021. **Statistical Analysis Used:** Summary statistics– mean (±standard deviation), range, frequency, proportion; inferential statistics– Chi square statistics, binary logistic regression. **Results:** The response rate was 88% (168/191). The average COVID-19 knowledge score, the frequency of acceptance, and hesitancy to take COVID-19 vaccine among study participants were 42.9% (95% confidence interval [CI] = 42.1–43.7), 39.1% (95% CI = 37.3%–41.8%), and 61.9% (95% CI = 58.0%–64.2%), respectively. In addition, of the 168 study participants, 73 (43.5%) considered themselves to have high self-esteem, 67 (39.9%) were highly extroverted, 91 (54.2%) highly privately self-conscious, 96 (57.1%) highly publicly self-conscious, and 60 (35.7%) highly self-restrained, with 57 (34.0%) not believing in the existence of COVID-19. COVID-19 knowledge varied significantly by level of study (F [2,165] = 5.539; P = 0.005; η^2 = 0.06). Similarly, those with high self-esteem were twice as knowledgeable regarding COVID-19 as those with low self-esteem (odds ratio [OR]: 2.02; 95% CI: 1.08–3.78; P = 0.03) with gleaning COVID-19-related information from social media platforms predicting COVID-19 vaccine hesitancy (CVH) (OR: 0.37; 95% CI: 0.16–0.85; P = 0.02). **Conclusions:** The observed suboptimal COVID-19 knowledge was associated with participants' low level of self-esteem, and the prevalent CVH was associated with obtaining COVID-19-related information from social media platform.

Keywords: Lockdown, Nigeria, nonpharmaceutical interventions, public health emergency, risk perception, self-esteem, social media

Résumé

Contexte: La maladie du coronavirus 2019 (COVID-19) est la plus grande catastrophe sanitaire mondiale du siècle, avec ses hésitations à vacciner qui aggravent les fléaux. Les intervenants pertinents, y compris les étudiants en pharmacie (dont l'éducation a été perturbée), sont des gardiens importants contre ces catastrophes, mais leurs informations relatives au COVID-19 sont rares. **Objectifs:** Nous avons évalué les connaissances sur le COVID-19, ses intentions d'adoption du vaccin et l'influence des traits de

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personnalité chez les étudiants en pharmacie d'une université nigériane. **Configuration et conception:** Il s'agit d'une étude transversale. **Sujets et méthodes:** Un questionnaire de 61 points a été utilisé pour recueillir des données auprès des étudiants en pharmacie qui ont étudié à l'Université Usmanu Danfodiyo, Sokoto, au Nigeria, en mai 2021. **Analyse statistique Utilisé:** Résumé – moyenne (± déviation standard), gamme, fréquence, proportion; inferentiel – statistiques Chi-square, régression logistique binaire. **Résultats:** Le taux de réponse était de 88 % (168/191). Le score moyen de connaissances sur le COVID-19, la fréquence d'acceptation et l'hésitation à prendre le vaccin contre le Covid-19 parmi les participants à l'étude étaient respectivement de 42,9% (intervalle de confiance de 95 % [CI] = 42,1 à 43,7), de 39,1% (IC 95 % = 37,3% à 41,8%) et de 61,9% (IC 95% = 58,0 % à 64,2%). En outre, sur les 168 participants à l'étude, 73 (43,5%) se considéraient comme ayant une haute estime de soi, 67 (39,9%) étaient hautement extrovertis, 91 (54,2%) très conscients de soi en privé, 96 (57,1%) sont hautement conscients d'eux-mêmes en public et 60 (35,7%) sont très restreints, avec 57 (34,0%) qui ne croient pas en l'existence de COVID-19. Les connaissances sur le COVID-19 varient considérablement selon le niveau d'étude (F [2,165] = 5,539; P = 0,005; η2 = 0,06). De même, les personnes ayant une haute estime de soi étaient deux fois plus informées au sujet du COVID-19 que celles ayant une faible estime d'eux-mêmes (ratio de probabilité [OR]: 2,02; 95% CI: 1,08–3,78; P = 0,03) avec la collecte d'informations relatives au Covid-19 provenant des plates-formes de médias sociaux qui prédisaient l'hésitation au vaccin contre le COVid-19 (CVH) (OR: 0,37; 95% IC: 0,16–0,85; P= 0,02). **Conclusions:** Les connaissances sous-optimales observées sur le COVID-19 ont été associées à un faible niveau d'estime de soi des participants, et la prévalence de la HCV a été associée à l'obtention d'informations relatives au Covid-19 à partir d'une plate-forme de médias sociaux.

Mots-clés: Lockdown, Nigéria, interventions non pharmaceutiques, urgence de santé publique, perception des risques, estime de soi, médias sociaux

Introduction

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), may be regarded as the most formidable threat to humans since World War II due to its far-reaching health and socioeconomic consequences. SARS-CoV-2, one of the seven human coronaviruses, gained its global notoriety due to its ever-mutating spike protein which enhances its transmissibility among humans and evasion of their immune system.[1]

Since its index case was reported to the World Health Organization (WHO) in December 2019, over 771 million COVID-19 confirmed cases and almost 7 million deaths (including claiming hundreds of thousands of lives of health-care workers) have been reported in over 225 countries and territories globally as of November 2, 2023.[2,3] However, the actual worldwide death toll is suspected to be at least 20 million.[4] This colossal devastation prompted WHO to declare COVID-19 global outbreak as a Public Health Emergency of International Concern (PHEIC) on January 30, 2020, but by May 5, 2023 (1221 days later), its PHEIC status was dropped to be replaced by long-term COVID-19 disease management mode as recommended in the WHO's 2023–2025 Strategic Preparedness and Response Plan, indicating that SARS-CoV-2 is here to stay.[5] This recent decision was informed by the improvement in global COVID 19 severity indicators (such as intensive care unit [ICU] admission–hospitalization ratio and death– hospitalization ratio), increasing population level immunity from vaccination and infection, decreasing pressures on health systems and improved understanding of the virus, its diagnostics and therapeutics.[4,6] However, it is advisable for the global community not to let down their guards as COVID-19 is still on a rampage infecting about 6.5 million people, claiming over 52,000 lives, causing over 428,000 new hospitalizations and 8500 new ICU admissions globally between May 5, 2023, and November 2, 2023.[7] In fact, COVID-19 reportedly

claimed a life every 3 min worldwide and continues to infect hundreds of thousands of people each week.[5]

Subregionally, Nigeria, the first country in sub-Saharan Africa and third in Africa to announce a confirmed case of COVID-19 infection, reported her index case on February 27, 2020.[4,8] Since then, the 36 states and the capital city in the country have jointly reported a total of 266,675 cases of the disease and 3155 deaths (case fatality rate of 1.2%),[4] with ongoing adverse health and socioeconomic consequences, especially among women and children.[9]

Since no confirmed therapeutics are yet available against COVID-19, COVID-19 vaccination and COVID-19 knowledge of health-care professionals (and their students) remain vital tools in the mitigation of the pandemic. For instance, COVID-19 knowledge of health-care students may determine their attitude and perceptions and ultimately determine whether they will obey nonpharmaceutical interventions including accepting to be vaccinated against the contagion.[10,11] In addition, due to their strategic position and roles, health-care providers (and health-care students) have considerable influence on the health-related behaviors (such as COVID-19 vaccine uptake intentions) of their patients, clients, and members of the public.[12,13] Thus, their COVID-19-related actions and inactions could have far-reaching consequences. Global herd immunity against COVID-19 may be achieved by vaccinating at least 70% of the global population as this is crucial in reducing COVID-19 morbidity and mortality, but the proportion vaccinated is presently 64% globally, 55% in 92 lowest-income countries and 54% in Nigeria with wide variations within and between countries.[4,14] COVID-19 vaccine hesitancy (CVH) among health-care providers, health-care students, and the general public is a major contributing factor to the nonattainment of the critical threshold required for herd immunity.[15,16] In fact, hesitancy to receive COVID-19 vaccine is reported to be as high as 47.2%–75.5% among undergraduate pharmacy students.[17,18] This sobering statistics is very worrying

and requires urgent attention. Because these students (as well as other health care students) are future frontliners in fighting epidemics and pandemics, custodians of medicines and vaccines, they may therefore serve as information providers and "change agents" to members of the public.[17-20] Generally, they are the future builders of a country.[21] Furthermore, another important factor that may threaten the control of COVID-19 transmission among university students is their personality traits.[22] These traits, which include introversion, extroversion, self-esteem, and self-consciousness, have been shown to influence behaviors and practices including vaccine acceptance and uptake and whether COVID-19-related nonpharmaceutical interventions will be obeyed.[22]

Since there is a dearth of information on pharmacy undergraduates' COVID-19 knowledge, their vaccine uptake intentions (acceptance and hesitancy), and the influence of their personality traits on these two critical aspects of the pandemic, we assessed the knowledge of COVID-19, its vaccine acceptance and hesitancy, and the role of personality traits among undergraduate pharmacy students in a university in Nigeria.

SUBJECTS AND METHODS

Study design and participants

For this post-lockdown cross sectional study involving 168 participants: the sampling frame was 199, which is the total number of students in the 3 classes and were all approached for the study participation; while 23 declined to participate, 8 students from other levels (100 and 200 levels) participated in the pilot test. Consequently, 168 undergraduate pharmacy students in 300–500 levels at Faculty of Pharmaceutical Sciences, Usmanu Danfodiyo University, Sokoto participated in the study. Sokoto state had the joint highest case fatality rate during the first COVID 19 wave in Nigeria in May 2021 when there was a relatively low severity index in the country and mass COVID 19 vaccination has not commenced.[3,8]

Questionnaire

An initial 78-item questionnaire was developed after extensive search of relevant studies in the literature, and it comprised four sections – demographic characteristics (Section A), knowledge of COVID-19 (Section B), personality traits (Section C), and belief and perception about COVID-19 and its vaccine (Section D) [Appendix A].

The questionnaire was pilot tested with 8 students randomly selected from 100-200 levels in the Faculty. The psychometric properties of the questionnaire were evaluated using face and content validity (using experts) and reliability analysis using Cronbach's alpha. These properties were evaluated using established methods,[23,24] and a 61-item questionnaire was obtained [Appendix B].

Outcome assessment/scoring methods

In summary, the average COVID-19 knowledge score was determined, and knowledge was also categorized as high ($\geq$75%), 50%–75% as moderate, and $\leq$50% as low. COVID-19 information source was reclassified into appropriate (those who receive information from medical doctors, scientists, scientific journals, and radio and television [TV] programs) and inappropriate (information from unrecognized social media platforms) sources.

COVID-19 vaccine uptake intentions refer to an umbrella term comprising both vaccine hesitancy and vaccine confidence. Vaccine hesitancy refers to rejection or reluctance to be vaccinated.[17] In this study, respondents were classified as exhibiting vaccine hesitancy or vaccine acceptance/ confidence [Appendix B].

Data collection procedure

Data collection with the pilot-tested and validated 61-item questionnaire took place simultaneously across the three classes (300–500 levels) in the Faculty of Pharmaceutical Sciences, Usmanu Danfodiyo University, Sokoto.

One hundred and seventy-six (168 for the final analysis and 8 for the pilot test) students participated, with 23 students declining.

Data analysis

The pilot test data were excluded from the final analysis, which was done with SPSS version 25.0. for Windows (IBM SPSS Statistics for Windows, 2019, Version 25.0. Armonk, NY, USA: IBM Corp.). Descriptive parameters such as frequencies, percentages, and mean ± standard deviation (SD) were used as appropriate. The outcome variables were knowledge of COVID-19 and COVID-19 vaccine acceptance and hesitancy. *t*-tests for independent samples and one-way between-groups analysis of variance were used to assess mean differences between normally distributed, homoscedastic outcome variables and categorical independent variables. The independent variables with statistically significant ($P \leq 0.05$) associations with the respective outcome variables were further entered into a binary logistic regression model. Effect size estimates were determined using Cohen's criteria for statistically significant ($P \leq 0.05$) associations.

Ethical consideration

The authors assert that all procedures contributing to the work complied with the ethical standards of the relevant national guidelines on human experimentation (including the 1964 Helsinki Declaration and its later amendments) and have been approved by the appropriate Health Research and Ethics Committee of Usmanu Danfodiyo University Teaching Hospital, Sokoto.

RESULTS

Demographic profiles of the participants

The response rate was 88% (168/191), and the mean (±SD) age of participants was 24.07 (±2.931) years. Other sociodemographic information of the participants are given in Table 1.

Table 1: Sociodemographic profiles of the 168 participants

Characteristics (*n*=168)	Frequency (%)
Age group (years)	
18–24	107 (63.7)
25–40	61 (36.3)
Gender	
Male	108 (64.3)
Female	60 (35.7)
Accommodation	
Campus	99 (58.9)
Off-campus	69 (41.1)
Sponsorship	
Self	119 (70.8)
Third-party	49 (29.2)
Ethnic group*	
Northern Nigeria	146 (86.9)
Southern Nigeria	22 (13.1)
Lockdown location†	
Northern Nigeria	153 (91.1)
Southern Nigeria	15 (8.9)
Level of study	
300 level	57 (33.9)
400 level	51 (30.4)
500 level	60 (35.7)
Father's highest academic qualification‡	
Did not complete secondary school education	21 (12.5)
Completed secondary school education	34 (20.2)
Postsecondary school qualification	72 (42.9)
Master degree and above	41 (24.4)
Mother's highest academic qualification§	
Did not complete secondary school education	33 (19.6)
Completed secondary school education	64 (38.1)
Postsecondary school qualification	50 (29.8)
Master degree and above	21 (12.5)
Father's occupation (sector)‖ (*n*=163)	
Service-oriented	72 (44.2)
Commerce-oriented	91 (55.8)
Mother's occupation (sector)¶ (*n*=162)	
Service-oriented	46 (28.4)
Commerce-oriented	33 (20.4)
Homemaker	83 (51.2)
Main information source	
Medical doctors, scientists, and scientific journals	29 (17.3)
TV and radio programs	73 (43.5)
Social media platforms**	66 (39.3)
COVID-19 existence in Nigeria	
Yes	111 (66.1)
No	57 (33.9)

*Northern Nigeria: North Central - 47; North East - 11; North west - 88; Southern Nigeria: South East - 6; South South - 3; South West - 13, **WhatsApp, Twitter, Facebook, and YouTube, †Location during the lockdown period: North Central - 46; North East - 11; North West - 96; Southern Nigeria: South East - 3; South South - 4; South West - 8, ‡Did not complete secondary school education: Primary school leaving certificate - 10; Junior secondary school certificate examinations - 11; Completed secondary school education: Senior secondary school certificate examinations - 34; Postsecondary qualification: National Diploma - 33; Bachelor - 39; Master degree and above: Master - 23; Consultant - 1; PhD - 12; Professor - 5, §Did not complete secondary school education: Did not complete primary school education - 7; Primary school leaving certificate - 16; Junior secondary school certificate examinations - 10; Completed secondary school education: Senior secondary school certificate examinations - 64; Postsecondary qualification: National Diploma - 23; Bachelor - 27; Master degree and above: Master - 14; Consultant - 1; PhD - 4; Professor - 2, ‖Service-oriented: Education - 39; Health - 16; Power/electricity - 10; Military - 6; Lawyer - 1; Commerce-oriented: Agriculture - 33; Finance - 20; Telecommunication - 5; Oil and gas - 6; Mining - 6; Engineering - 4; Manufacturing - 9; Transportation - 4; Trading - 1; Designer - 3, ¶Service-oriented: Homemaker - 83; Education - 31; Health - 11; Power/electricity - 3; Civil servant - 1; Commerce-oriented: Agriculture - 17; Finance - 9; Telecommunication - 3; Transportation - 3; Trading - 1

Table 2: Knowledge of coronavirus disease 2019 among undergraduate pharmacy students in a Nigerian university (*n*=168)

Items	Correct options	Percentage correct answers	Percentage incorrect answers	Percentage unsure answers
1. A pandemic is an infectious disease that spreads across Nigeria	No	44.6	47.0	8.3
2. An epidemic is an infectious disease that spreads across the world	No	46.4	47.6	6.0
3. Coronavirus is another name for COVID-19	No	6.5	90.5	3.0
4. Fever, cough, ageusia, and anosmia are all symptoms of COVID-19	Yes	84.5	4.8	10.7
5. The incubation period for COVID-19 is the time between exposure to the virus and becoming infected	No	8.3	78.0	13.7
6. For a patient with symptoms for 14 days, then the patient can be discharged 27 days from the date of symptom onset	No	19.0	38.7	42.3
7. Those who had COVID-19 cannot be re-infected with the virus again	No	51.8	24.4	23.8
8. Those with COVID-19 but without symptoms cannot transmit the disease to other people	No	69.6	19.6	10.7
9. COVID-19 can be transmitted through fecal-oral route and vertical transmission	No	35.1	44.6	20.2
10. Those wearing face masks have been highly encouraged because COVID-19 cannot be transmitted through the human eyes	No	34.5	52.4	13.1
11. Lockdowns are useless as it does not reduce COVID-19 transmission	No	61.3	32.7	6.0
12. The elderly and health-care workers have the lowest risk of contracting COVID-19	No	87.5	8.9	3.6
13. Quarantine refers to the separation of persons infected with COVID-19 from others	No	11.9	3.6	84.5
14. Isolation refers to the separation of persons in contact with COVID-19 patients from others	No	13.1	76.2	10.7
15. Sokoto state is the current epicenter of COVID-19 in Nigeria	No	54.8	18.5	26.8
16. USA is the current epicenter of COVID-19 globally	Yes	56.0	14.3	29.8
17. Lagos state has the highest case fatality rate for COVID-19 in Nigeria	Yes	84.5	6.5	8.9
18. China has the highest case fatality rate for COVID-19 globally	No	38.1	38.7	23.2
19. Approved COVID-19 vaccines can cure COVID-19	No	33.9	26.2	39.9
20. Approved COVID-19 vaccines are meant for COVID-19 patients only	No	53.6	31.5	14.9
21. Herd immunity can only be achieved through vaccination	No	16.7	46.4	36.9
22. WHO has recommended a particular drug as the most effective in the treatment of COVID-19	No	31.5	31.5	36.9
Total		42.9	35.6	21.5

COVID-19=Coronavirus disease 2019, WHO=World Health Organization

Table 3: Comparison of the level of knowledge of coronavirus disease 2019 among undergraduate pharmacy students in a Nigerian university (*n*=168) according to their lockdown locations and self-esteem levels

Lockdown location	Level of knowledge low, *n* (%)	High, *n* (%)	Total, *n* (%)	*P*
Northern Nigeria	83 (96.5)	70 (85.4)	153 (91.1)	0.014*
Southern Nigeria	3 (3.5)	12 (14.6)	15 (8.9)	
Total (%)	86 (51.2)	82 (48.8)	168 (100)	
Self-esteem levels				
Low	56 (65.1)	39 (47.6)	95 (56.5)	0.020†
High	30 (34.9)	43 (52.4)	73 (43.5)	
Total (%)	86 (51.2)	82 (48.8)	168 (100)	

*Level of significance determined by Fisher's exact probability test, †Level of significance determined by Kendall's tau-b (value=0.177-small effect)

Psychometric properties of the questionnaire

The 22 items eliciting information on knowledge demonstrated good reliability (α = 0.63; 95% confidence interval [CI] – 0.54–0.71) and stability (intraclass correlation coefficient [ICC] = 0.63; 95% CI – 0.54–0.71). For the personality traits; their Cronbach's alpha (95% CI), ICC (95% CI), and mean inter item correlations (MIIC) (range) are: 10 item Rosenberg Self Esteem Scale (RSES) (α = 0.69; 95% CI: 0.61–0.76; ICC = 0.69; 95% CI: 0.61–0.76), 5 item Extroversion Scale (ES) [α = 0.56; 95% CI: 0.44–0.65; MIIC = 0.20 (0.07–0.38)], 3 item Private Self Consciousness Scale (PrSCS) [α = 0.58; 95% CI: 0.43–0.72; MIIC = 0.33 (0.13–0.51)], 2 item Public Self Consciousness Scale (PuSCS) (α = 0.55; 95% CI: 0.33–0.78; MIIC = 0.38 and 2 item

Table 4: Comparison of coronavirus disease 2019 hesitancy and acceptance among undergraduate pharmacy students (*n*=111) according to their gender and main information source

Variables	Vaccine uptake intentions		Total, *n* (%)	*P*
	Hesitancy, *n* (%)	Acceptance, *n* (%)		
Gender				
Male	37 (33.3)	33 (29.7)	70 (63.1)	0.035*
Female	30 (27.0)	11 (9.9)	41 (36.9)	
Total (%)	67 (60.4)	44 (39.6)	111 (100)	
Main information source				
Medical doctors‡	8 (7.2)	14 (12.6)	22 (19.8)	0.009†
Programs§	26 (23.4)	19 (17.1)	45 (40.5)	
Social media‖	33 (29.7)	11 (9.9)	44 (39.6)	
Total (%)	67 (60.4)	44 (39.6)	111 (100)	

*Level of significance determined by Pearson Chi-square statistic (Phi coefficient [Gender]=0.200-small effects, †Cramer's V [main information source]=0.290-small effects), ‡Scientists, scientific journals, §TV and radio programs, ‖WhatsApp, Twitter, Facebook, and YouTube. COVID-19 vaccine acceptance and hesitancy (COVID-19 vaccine uptake intentions). COVID-19=Coronavirus disease 2019

Self Restraint Scale (SRS) (α = 0.48; 95% CI: 0.41–0.69; MIIC = 0.313) respectively.

The overall mean knowledge score of COVID-19 was 42.90% (SD = 15.12; minimum = 5; median = 40.91; maximum = 82; 95% CI = 39.57–46.23) [Table 2]. Specifically, 69.6%, 27.2%, and 1.2% of the participants had low, moderate, and high knowledge of COVID-19, respectively.

The mean (SD; 95% CI) and range scores of each personality traits are RSES (mean: 37.90%± 6.07; 95% CI: 33.68–43.25; range: 31-54); ES (mean: 64.08%± 13.81; 95% CI: 52.14–69.06; range: 12-19;); PrSCS (mean: 46.80%±3.2; 95% CI: 40.23–49.13 range: 8-13); PuSCS (mean: 61.73% ± 8.06; 95% CI: 55.38–68.51; range: 2-9); SRS (mean: 51.85%±21.6; 95% CI: 48.23–60.77; range: 2-10) respectively. Specifically, of the 168 study participants, 73 (43.5%) had high self-esteem, 67 (39.88%) were highly extroverted, 91 (54.20%) highly privately self-conscious, 96 (57.14%) highly publicly self-conscious, and 60 (35.71%) highly self-restrained.

Table 2 shows that the highest correct response score was to the questionnaire statement: "The elderly and health care workers have the lowest risk of contracting COVID 19.

Table 3 shows that the proportion of COVID-19 knowledge and its vaccine recorded by those who stayed in Northern Nigeria during the lockdown is statistically significantly different ($P < 0.05$) from those who stayed in Southern Nigeria during the same period with an effect size estimate of 0.01. Similarly, the proportion of COVID-19 knowledge and its vaccine recorded among the study participants was statistically significantly different ($P < 0.05$) when their self-esteem levels were compared with an effect size estimate of 0.02.

There was a statistically significant difference in mean knowledge score of COVID-19 when the levels of study of participants were compared with a moderate effect size estimate observed (F [2,165] = 5.539; $P = 0.005$; $\eta^2 = 0.06$).

Table 4 shows that three out of every five participants (60.4%; 67/111) that believed in the existence of COVID-19 in the study were COVID-19 vaccine hesitant. In addition, the proportion of male students who were hesitant were statistically significantly higher than their female counterpart ($P = 0.035$). Similarly, CVH is also statistically significantly higher among those who access COVID-19-related information from the social media platform than from all other information sources ($P = 0.009$).

Coronavirus disease 2019 vaccine acceptance and hesitancy (coronavirus disease 2019 vaccine uptake intentions)

Only about one-third of the study participants (26.2%; 44/168) declared their intentions to receive COVID-19 vaccine whenever it is available while the rest either would not receive the vaccine even though they believe in the existence of COVID-19 (39.9%; 67/168) or did not even believe in its existence (33.9%; 57/168).

CVH among participants was reportedly due to concerns with the short time involved in the development of the vaccines (11.9%; 8/67), conspiracy theories (25.4%; 17/67), safety concerns (19.4%; 13/67), efficacy concerns (4.5%; 3/67), and perceptions of being naturally immune (19.4%; 13/67).

The reasons reported for COVID-19 vaccine confidence include protecting self and not spreading the disease to others (27.3%; 12/44) and believing in the science and technology involved in its production (59.1%; 26/44).

Factors influencing knowledge of coronavirus disease 2019 and hesitancy to its vaccine

Participants with high self-esteem levels were two times (odds ratio [OR]: 2.02; 95% CI: 1.08–3.78; $P = 0.03$) more likely to be knowledgeable about COVID-19 and its vaccine than their low self-esteem counterparts, while those who received their information on COVID-19 from social media platforms were more likely (OR: 0.37; 95% CI: 0.16–0.85; $P = 0.02$) to be COVID-19 vaccine hesitant than those who got their information from medical doctors, scientists, and TV and radio programs.

Risk perception of contracting coronavirus disease 2019 among participants

The risk perception of contracting COVID-19 among the participants was highest among those who believe COVID-19 truly exists in Nigeria (66.1%; 111/168) and lowest among those who do not believe COVID-19 exists in Nigeria (33.9%; 57/168). The reasons reported among those who believed (and disbelieved) in the existence of the disease are detailed in Appendix C.

Perceived strategies to increase coronavirus disease 2019 vaccine acceptance

Participants reported that the following strategies would enhance COVID-19 vaccine acceptance among undergraduate pharmacy students: increased public engagement (38.7%; 43/111), government officials being the first to take the vaccines and in public (35.1%; 39/111), community and religious leaders taking it first and in public (5.4%; 6/111), COVID-19 survivors taking it first and in public (0.9%; 1/111), making it free and readily accessible (4.5%; 5/111), free with incentives (4.5%; 5/111), making it compulsory (5.4%; 6/111), not compulsory (0.9%; 1/111), evidence of local assay of its composition (2.7%; 3/111), and conduction of local clinical trials (1.8%; 2/111).

DISCUSSION

Overall, the current survey revealed a suboptimal knowledge of COVID-19 associated with participants' low self-esteem levels and high frequency of intentions to refuse its vaccination (associated with accessing COVID-19-related information from social media platform) among the sampled undergraduate pharmacy students in Nigeria.

Suboptimal knowledge of COVID-19 was observed despite the pandemic been over a year old in Nigeria. This finding is inconsistent with reports from published studies done in similar settings. For instance, knowledge of COVID-19 appeared relatively lower than that previously reported among pharmacy undergraduates in Bangladesh,[13] Egypt,[25] and Saudi Arabia[26] and among other undergraduate health-care students in Nigeria,[27] Pakistan,[28] and Vietnam.[29] It is not readily clear what factors may have accounted for this contrast, but better exposure and access to COVID-19-related information may have been contributory to the relatively higher knowledge scores reported in those studies relative to ours.[13] The lower knowledge score in our study might have been also due to the study design we employed as respondents completed the questionnaire with pens and returned it within 30 min as opposed to online methods (employed by other studies) where respondents may have had more time to seek COVID-19 information from online sources. Noteworthily, the suboptimal COVID-19 knowledge evinced by the study participants could adversely impact their capacity to educate members of their communities on COVID-19-related matters, and this may have far-reaching consequences on the role they play in the control of the pandemic.

Levels of study of participants were associated with COVID-19 knowledge. Similar to the current study, undergraduate pharmacy students in lower levels (like those in their 3rd year) have been reported to be more knowledgeable than their senior coursemates (like those in their 4th year) in a study conducted in Saudi Arabia.[26] The consistency in study findings could be due to the following similarities between the two surveys: class representatives or leaders were involved, mental status of respondents was assessed, those recruited were pharmacy students in their 2nd or 3rd year and were predominantly Muslims (due to study locations).

Self-esteem predicted the level of COVID-19 knowledge among our study participants. To the best of our knowledge, this is the first time such a finding is being reported among similar studies. This interesting finding might be attributable to the positive effect self esteem has on both pro social behaviors (like seeking knowledge of COVID 19),[30] and resilience the capacity to achieve one's goals even in the face of extremely unfavorable circumstances such as during this pandemic period.[31,32] In addition, high self-esteem has been described as a mark of self-confidence, self-belief, and self-satisfaction which all tend to favor knowledge seeking and acquisition.[33] Consequently, high self esteem may increase self-drive which will in turn lead to increased knowledge of COVID 19 and its vaccine among the study participants. This will potentially increase the tendency to abide by COVID-19 safety guidelines and reduce the risk of transmission among pharmacy students (and other health-care students) and their loved ones.

The high prevalence of vaccine hesitancy (which is considered among the top ten threats to global public health) in the current study is comparable to that reported among health-care undergraduates in Northwestern Nigeria,[19] university students in Southern Nigeria,[34] and pharmacy students in Zambia[17] but reportedly higher than that among medical students in Southern Nigeria[11] and abroad.[16] The comparable results may be partly explained by the relatively lower COVID-19 cases and deaths in Africa coupled with the survey being conducted postlockdown when a false sense of security might be high as reported by some respondents who did not believe in the existence of COVID-19 or considered themselves naturally immune. Vaccine hesitancy seemed to be more prevalent in Northern Nigeria for sociocultural reasons,[19] and this might have been contributory to the lower hesitancy prevalence reported among the medical students in Southern Nigeria.[11] Another reason could be that the risk perception of contracting COVID-19 and spreading it to loved ones is higher among medical students.[17] Encouragingly, the vaccine hesitancy among pharmacy students (and even among nonpharmacy students) seemed to improve over time.[18] It is also noteworthy to reiterate that COVID 19 vaccination is crucial to the control of COVID 19 including reducing COVID-19 associated burden on the managing health facilities. Its importance is further underscored by the possibility of reinfection of COVID-19 patients by COVID-19 (the same or different strain)

and long COVID-19 symptoms. The above further emphasize COVID-19 vaccination as a better and safer countermeasure, especially among the elderly, immunocompromised persons, and those with underlying chronic diseases. Consequently, concerted efforts should be made to vaccinate at least 70% of the general population (including pregnant women and nursing mothers) and 100% of health workers.

Pharmacy students have been reported to use social media as a major platform for accessing information on COVID-19.[18,29] The pharmacy students in this survey were no exception as social media was the second most utilized source of information on COVID-19. However, information from this channel have been tagged by some researchers as inappropriate because some sources from this platform contribute to "infodemic" and "pseudoscience" that promote inappropriate behaviors.[11,18,35] CVH among the respondents was predicted by information from social media platforms. These sources (especially those from anti-vaxxers and vaccine skeptics) provide less reliable information that are likely to cause vaccine hesitancy.[11,26] It is thus highly recommended that the relevant health and education authorities in the country such as the Federal Ministry of Health, Ministry of Education, and National University Commission develop interactive social media platforms with proactive messages that can prepare the students by providing them with accurate information and counterarguments against misinformation. Using terms like physical distancing as opposed to social distancing might also be useful as it suggests that social connections are still possible even when people are physically separated.[36] Some cultures such as those of Africa and Asia thrive on interdependence or communal relationships. This may be leveraged upon, by designing messages that promote love for one another such as those encouraging students to adhere to COVID 19 safety protocols at least for the sake of their friends and loved ones should be used. In addition, relying on social media for information might make the study participants lag behind in terms of new evidence on an ongoing and ever-changing pandemic. Such evidence is most likely to be found in scientific journals and trusted websites like those of WHO and NCDC. Consequently, this lack of currency in COVID-19-related information could hamper their ability to function effectively as "change agents" to members of the public.

As the transmission of the pandemic is still ongoing globally with unrestricted international travels and COVID-19 safety protocols relaxed, having knowledgeable and adequately equipped and prepared undergraduate pharmacy students whom in turn will make a valiant and reliable future frontline health care personnel against COVID 19 is not negotiable in order to prepare the country for the new "normal" and indeed any future pandemic.

Furthermore, majority of graduates of pharmacy and other medical schools in Nigeria either practice in private or public health-care setting at least for the first few years of their qualifications. Knowing that these students are potential change agents and therefore important assets of the health-care delivery system of any country, the knowledge gaps and vaccine hesitancy recorded in the study have implications (regarding control of COVID-19 spread) for the huge number of patients, clients, family members, and members of the community that the future pharmacy and other medical graduates will come across. Consequently, it is advisable that the curriculum of undergraduate pharmacy students is adjusted to include crises, epidemic, and pandemic management (such as allowing them to take courses related to emergency preparedness and response) so as to increase their confidence and level of preparedness when faced with similar situations in the future. This will also facilitate a seamless transition into their becoming a dependable human resource for health. Since the pandemic did not only cause disruptions in the health-care delivery system but also in the education sector, it is highly recommended that the relevant stakeholders in the education sector become proactive by making provision for virtual learning environment, a sort of emergency preparedness measure.

Limitations

The generalizability of the findings of this survey may be limited by sample size including using a single site for data collection. However, the multi-ethnic composition of the sample with respondents originating from different parts of Nigeria may mitigate any potential bias due to sample size. Thus, our finding may reflect the true situation of COVID-19 knowledge and vaccine intentions among undergraduate pharmacy students in the country where the study was conducted.

Conclusions

This survey revealed a low knowledge of COVID-19 and its vaccine uptake intentions among undergraduate pharmacy students, and self-esteem and information source were the main predictors of knowledge of COVID-19 and hesitancy to its vaccine, respectively. These findings have implications for the control of the pandemic, including the effectiveness of the public health and social measures instituted by the Nigeria Centre for Disease Control and Prevention. Thus, there is a dire need to address the gaps found in this study.

Conflicts of interests

There are no conflicts of interests.

References

1. Kurhade C, Zou J, Xia H, Liu M, Chang HC, Ren P, *et al.* Low neutralization of SARS-CoV-2 omicron BA.2.75.2, BQ.1.1 and XBB.1 by parental mRNA vaccine or a BA.5 bivalent booster. Nat Med 2023;29:344-7.

2. World Health Organization. The Impact of COVID-19 on Health and Care Workers: A Closer Look at Deaths. Geneva: World Health Organization; 2021. Available from: https://www.iris.who.int/handle/10665/345300. [Last accessed on 2023 Nov 08].

3. World Health Organization. WHO Coronavirus (COVID-19) Dashboard. World Health Organization; 2023. Available from: https://www.covid19.who.int/. [Last accessed on 2023 Nov 08].

4. Wise J. COVID-19: WHO declares end of global health emergency. BMJ 2023;381:1041.

5. Harris E. WHO declares end of COVID-19 global health emergency. JAMA 2023;329:1817.

6. Sarker R, Roknuzzaman AS, Nazmunnahar M, Shahriar M, Hossain MJ, Islam MR. The WHO has declared the end of pandemic phase of COVID-19: Way to come back in the normal life. Health Sci Rep 2023;6:e1544.

7. World Health Organization. Coronavirus Disease (COVID-19) Weekly Epidemiological Updates and Monthly Operational Updates. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports. [Last accessed on 2023 Nov 08].

8. Akande OW, Elimian KO, Igumbor E, Dunkwu L, Kaduru C, Olopha OO, *et al.* Epidemiological comparison of the first and second waves of the COVID-19 pandemic in Nigeria, February 2020-April 2021. BMJ Glob Health 2021;6:e007076.

9. Yeboah H, Yaya S. Health and economic implications of the ongoing coronavirus disease (COVID-19) pandemic on women and children in Africa. Reprod Health 2023;20:70.

10. Ether SA, Emon FA, Roknuzzaman A, Rakibuzzaman M, Rahman FI, Islam MR. A cross-sectional study of COVID-19-related knowledge, risk perceptions, and preventive practices among pharmacy students in Bangladesh. SAGE Open Med 2022;10:1-13.

11. Orok E, Ndem E, Daniel E. Knowledge, attitude and perception of medical students on COVID-19 vaccines: A study carried out in a Nigerian university. Front Public Health 2022;10:942283.

12. Jha SS, Paul B, Das R, Chattopadhyay B, Lahiri A. Contributing factors of willingness and hesitancy regarding acceptance of COVID-19 vaccine in primary care settings: A qualitative study in an Eastern State of India. J Educ Health Promot 2022;11:53.

13. Basheti IA, El-Hajji F, Nassar R, Thiab S, Barakat M, Basheti M, *et al.* Pharmacists' awareness of COVID-19 and perceptions of their roles, barriers, and roles of policymakers: Exploring the Middle East and North Africa (MENA). Int J Clin Pract 2021;75:e14074.

14. Punch. 60 Million Get Complete COVID-19 Vaccination. Available from: https://www.punchng.com/60-million-get-complete-covid-19-vaccination/. [Last accessed on 2023 Nov 08].

15. Lazarus JV, Wyka K, White TM, Picchio CA, Rabin K, Ratzan SC, *et al.* Revisiting COVID-19 vaccine hesitancy around the world using data from 23 countries in 2021. Nat Commun 2022;13:3801.

16. Venkatesan K, Menon S, Haroon NN. COVID-19 vaccine hesitancy among medical students: A systematic review. J Educ Health Promot 2022;11:218.

17. Mudenda S, Mukosha M, Hikaambo CN, Meyer JC, Fadare J, Kampamba M, *et al.* Awareness and acceptance of COVID-19 vaccines and associated factors among pharmacy students in Zambia. Malawi Med J 2022;34:273-80.

18. Saeed H, Ali K, Nabeel M, Rasool MF, Islam M, Hashmi FK, *et al.* Knowledge, attitudes, perceptions, and acceptance of COVID-19 vaccination among pharmacy and non-pharmacy students. Vaccines (Basel) 2023;11:176.

19. Mustapha M, Lawal BK, Sha'aban A, Jatau AI, Wada AS, Bala AA, *et al.* Factors associated with acceptance of COVID-19 vaccine among university health sciences students in Northwest Nigeria. PLoS One 2021;16:e0260672.

20. Perwitasari DA, Faridah IN, Dania H, Lolita L, Irham LM, Alim MD, *et al.* The knowledge of COVID-19 treatments, behaviors, and attitudes of providing the information on COVID-19 treatments: Perspectives of pharmacy students. J Educ Health Promot 2021;10:235.

21. Ghasemi Godarzi M, Aghamirzaee T, Aqatabar Roudbar J, Ebrahimpour S. Students' happiness and ranking of its dimensions in Mazandaran University of Science and Technology during the COVID-19 crisis. J Educ Health Promot 2023;12:300.

22. Hatabu A, Mao X, Zhou Y, Kawashita N, Wen Z, Ueda M, *et al.* Knowledge, attitudes, and practices toward COVID-19 among university students in Japan and associated factors: An online cross-sectional survey. PLoS One 2020;15:e0244350.

23. Pallant J. SPSS Survival Manual: A Step by Step Guide to Data Analysis Using IBM SPSS. Berkshire, England: McGraw-Hill Education; 2016. p. 58-61.

24. Lawshe CH. A quantitative approach to content validity. Pers Psychol 1975;28:563-75.

25. Hamza MS, Badary OA, Elmazar MM. Cross-sectional study on awareness and knowledge of COVID-19 among senior pharmacy students. J Community Health 2021;46:139-46.

26. Alrasheedy AA, Abdulsalim S, Farooqui M, Alsahali S, Godman B. Knowledge, attitude and practice about coronavirus disease (COVID-19) pandemic and its psychological impact on students and their studies: A cross-sectional study among pharmacy students in Saudi Arabia. Risk Manag Healthc Policy 2021;14:729-41.

27. Adebowale OO, Adenubi OT, Adesokan HK, Oloye AA, Bankole NO, Fadipe OE, *et al.* SARS-CoV-2 (COVID-19 pandemic) in Nigeria: Multi-institutional survey of knowledge, practices and perception amongst undergraduate veterinary medical students. PLoS One 2021;16:e0248189.

28. Noreen K, Rubab ZE, Umar M, Rehman R, Baig M, Baig F. Knowledge, attitudes, and practices against the growing threat of COVID-19 among medical students of Pakistan. PLoS One 2020;15:e0243696.

29. Le An P, Huynh G, Nguyen HT, Pham BD, Nguyen TV, Tran TT, *et al.* Knowledge, attitude, and practice towards COVID-19 among healthcare students in Vietnam. Infect Drug Resist 2021;14:3405-13.

30. Bajaj B, Robins RW, Pande N. Mediating role of self-esteem on the relationship between mindfulness, anxiety, and depression. Pers Individ Differ 2016;96:127-31.

31. Bonanno GA. Loss, trauma, and human resilience: Have we underestimated the human capacity to thrive after extremely aversive events? Am Psychol 2004;59:20-8.

32. Epstein RM, Krasner MS. Physician resilience: What it means, why it matters, and how to promote it. Acad Med 2013;88:301-3.

33. Baumeister RF, Vohs KD. Revisiting our reappraisal of the (surprisingly few) benefits of high self-esteem. Perspect Psychol Sci 2018;13:137-40.

34. Olawade DB, Wada OZ, Odetayo A, Akeju OO, Asaolu FT, Owojori GO. COVID-19 vaccine hesitancy among Nigerian youths: Case study of students in Southwestern Nigeria. J Educ Health Promot 2022;11:244.

35. Phalswal U, Pujari V, Sethi R, Verma R. Impact of social media on mental health of the general population during COVID-19 pandemic: A systematic review. J Educ Health Promot 2023;12:23.

36. Bavel JJ, Baicker K, Boggio PS, Capraro V, Cichocka A, Cikara M, *et al.* Using social and behavioural science to support COVID-19 pandemic response. Nat Hum Behav 2020;4:460-71.

Appendix A: Knowledge, Attitudes and Perception of COVID-19 among Students of UDUS Questionnaire

SECTION A SOCIODEMOGRAPHIC CHARACTERISTICS

(Select only one option by stating or underlining or ticking [√] the most applicable option to you)

Faculty/Department: /Level:

Accommodation: Campus (staying within the school perimeter or fence)/Off campus (staying with older people [free]/renting an apartment)

Sponsorship: Self-sponsored (self or parents/others)/Sponsored (FGN/State Govt/Oil and gas comp/NGO)/Others (specify)……………………………………………………….

1. Age (years):   2. Gender: Male/Female
3. Geopolitical zone of your ethnic group: North Central/North East/North West/South East/South South/South West
4. Geopolitical zone of residence between March and December 2020: North Central/North East/North West/South East/South South/South West
5. Father's highest academic qualification: Professor/PhD/Consultant/Master/Graduate/National Diploma/SSCE/Others (specify)……………………………………
6. Mother's highest educational qualification: Professor/PhD/Consultant/Master/Graduate/National Diploma/SSCE/Others (specify)……………………………………
7. Father's occupation (sector): Education - public/private; Health - public/private; Agriculture - public/private; Finance - public/private; Telecommunication - public/private; Oil and gas - public/private; Power/electricity - public/private; Transportation - public/private; Others (specify) - …………………………… public/private
   [Kindly underline BEREAVED if father has passed on]
8. Mother's occupation (sector): Education - public/private; Health - public/private; Agriculture - public/private; Finance - public/private; Telecommunication - public/private; Oil and gas - public/private; Power/electricity - public/private; Transportation - public/private; Others (specify) - …………………………… public/private
   [Kindly underline BEREAVED if mother has passed on]

SECTION B KNOWLEDGE AND ATTITUDES TOWARDS COVID-19

(Select only one option by underlining or ticking [√] the most applicable option to you)
1. An infectious disease that spreads across Nigeria is a pandemic.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
2. An infectious disease that spreads across the world is an epidemic.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
3. Coronavirus is another name for COVID-19.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
4. Fever, cough, ageusia and anosmia are all symptoms of COVID-19.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
5. The incubation period for COVID-19 is the time between exposure to the virus and becoming infected.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
6. For a patient with symptoms for 14 days, then the patient can be discharged 27 days from the date of symptom onset.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
7. Those who had COVID-19 cannot be re-infected with the virus again.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
8. Those with COVID-19 but without symptoms cannot transmit the disease to other people.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
9. COVID-19 can be transmitted through fecal-oral route and vertical transmission.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
10. Wearing face masks have been highly encouraged because COVID-19 cannot be transmitted through the human eyes
    Completely disagree/Disagree/Not sure/Agree/Completely agree
11. Lockdowns are useless as it does not reduce COVID-19 transmission.
    Completely disagree/Disagree/Not sure/Agree/Completely agree
12. The elderly and health-care workers have the lowest risk of contracting COVID-19.
    Completely disagree/Disagree/Not sure/Agree/Completely agree

13. Quarantine refers to the separation of persons infected with COVID-19 from others.
    Completely disagree/Disagree/Not sure/Agree/Completely agree
14. Isolation refers to the separation of persons in contact with COVID-19 patients from others.
    Completely disagree/Disagree/Not sure/Agree/Completely agree
15. WHO has NOT been notified of any COVID-19 case in North Korea
    Completely disagree/Disagree/Not sure/Agree/Completely agree
16. According to NCDC only one state in Nigeria has NOT reported any COVID-19 case.
    Completely disagree/Disagree/Not sure/Agree/Completely agree
17. Sokoto state is the current epicenter of COVID-19 in Nigeria.
    Completely disagree/Disagree/Not sure/Agree/Completely agree
18. USA is the current epicenter of COVID-19 globally.
    Completely disagree/Disagree/Not sure/Agree/Completely agree
19. Lagos state has the highest case fatality rate for COVID-19 in Nigeria
    Completely disagree/Disagree/Not sure/Agree/Completely agree
20. China has the highest case fatality rate for COVID-19 globally.
    Completely disagree/Disagree/Not sure/Agree/Completely agree
21. Approved COVID-19 vaccines can cure COVID-19.
    Completely disagree/Disagree/Not sure/Agree/Completely agree
22. Approved COVID-19 vaccine is indicated/meant for COVID-19 patients.
    Completely disagree/Disagree/Not sure/Agree/Completely agree
23. Herd immunity can only be achieved through vaccination.
    Completely disagree/Disagree/Not sure/Agree/Completely agree
24. WHO has recommended a particular drug as the most effective in the treatment of COVID-19.
    Completely disagree/Disagree/Not sure/Agree/Completely agree
25. What is your main source of information on COVID-19.
    (Select only one option)
    a. Medical doctors, scientists, and scientific journals
    b. TV programs and news releases
    c. Social media platforms (WhatsApp, Twitter, Facebook, etc.)
    d. YouTube
    Others (specify)………………………………………….

SECTION C PERSONAL ATTRIBUTES

(Select only one option by underlining or ticking [√] the most applicable option to you)
1. I am a quiet person and don't talk too much.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
2. I am a sociable person.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
3. I am a talkative.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
4. I am an outgoing person.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
5. I am a cheerful person.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
6. I feel that I'm a person of worth, at least on an equal plane with others.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
7. I feel that I have a number of good qualities.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
8. All in all, I am inclined to feel that I am a failure.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
9. I am able to do things as well as most other people.
   Completely disagree/Disagree/Not sure/Agree/Completely agree
10. I feel I do not have much to be proud of.
    Completely disagree/Disagree/Not sure/Agree/Completely agree
11. I take a positive attitude toward myself.
    Completely disagree/Disagree/Not sure/Agree/Completely agree

12. On the whole, I am satisfied with myself.
Completely disagree/Disagree/Not sure/Agree/Completely agree
13. I wish I could have more respect for myself.
Completely disagree/Disagree/Not sure/Agree/Completely agree
14. I certainly feel useless at times.
Completely disagree/Disagree/Not sure/Agree/Completely agree
15. At times I think I am no good at all.
Completely disagree/Disagree/Not sure/Agree/Completely agree
16. COVID-19 or not, if invited for a wedding I will not hesitate to attend.
Completely disagree/Disagree/Not sure/Agree/Completely agree
17. COVID-19 or not, for my trusted friends I do not bother with observing COVID-19 protocols.
Completely disagree/Disagree/Not sure/Agree/Completely agree
18. I try to realize what type of person I am.
Completely disagree/Disagree/Somewhat disagree/Not sure/somewhat agree/Agree/Completely agree
19. I often try to understand my heart.
Completely disagree/Disagree/Somewhat disagree/Not sure/somewhat agree/Agree/Completely agree
20. I always keep an eye on myself.
Completely disagree/Disagree/Somewhat disagree/Not sure/somewhat agree/Agree/Completely agree
21. I am often concerned with what others think of me.
Completely disagree/Disagree/Somewhat disagree/Not sure/somewhat agree/Agree/Completely agree
22. When I take some decisions I always think about other people's evaluation.
Completely disagree/Disagree/Somewhat disagree/Not sure/somewhat agree/Agree/Completely agree

SECTION C BELIEF AND PERCEPTION OF COVID-19

1. COVID-19 does not exist in Nigeria (Select only one option)
Completely disagree/Disagree/Not sure/Agree/Completely agree
2. State reason (s) for your response in Question 1 above:
....

3. COVID-19 vaccines: (Select only one option)
a. I do not believe in it and not willing to take it.
b. I do not believe in it but willing to take it.
c. I believe in it and willing to take it.
d. I believe in it but not willing to take it.
4. State reason (s) for your response in Question 3 above:
....

5. If COVID-19 is not real, what would make you believe it is real?
....

6. If COVID-19 is real, what should government do to make more people believe it is?
....

7. If COVID-19 vaccine is useful, what should government do to encourage its uptake?

……

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……

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………

APPENDIX B: QUESTIONNAIRE DEVELOPMENT AND VALIDATION PROCESS

Questionnaire development and validation

An initial 78-item questionnaire was developed after extensive search of relevant studies in the literature, and it comprised four sections – demographic characteristics, knowledge of COVID-19, personality traits, and belief and perception about COVID-19 and its vaccine. The section on personality traits was based on validated instruments including Rosenberg Self-Esteem Scale, Extroversion Scale, and Self-Consciousness Scales.[22]

The psychometric properties of the questionnaire and the personality traits were evaluated with face and content validity and reliability analysis using Cronbach's alpha.

Face validity

The face validity was assessed by three senior colleagues with relevant experience in the research area. They ranked the importance/relevance of each item and items scoring 1.5 and below were removed from the questionnaire.[23]

Content validity

The Content validity of the resulting 71-item questionnaire was assessed by seven experts. Quantitatively, the Lawshe model was used to determine the content validity ratio (CVR) and items for which the CVR is <0.99 were removed.[24] Qualitatively, the experts also suggested some modifications including rephrasing and reordering (change of item sequence). These processes resulted in the final 61-item questionnaire.

Reliability

The reliability of the scales and items related to knowledge were evaluated using internal consistency and stability methods. Cronbach's alpha coefficient of 0.7 was considered adequate for items with scale 10 and above.[23] For scales with items <10, the mean inter-item correlation coefficient was used and values within 0.2–0.4 were considered adequate.[23] Intraclass correlation coefficient (ICC) was used to determine the temporal stability of scales with items of 10 and above. ICC with values of 0.7 was considered acceptable.[23]

The final version of the 61-item questionnaire had four sections: A – demographics comprised 11 items, B – 23 items related to knowledge; C –22 items elicited information on personality traits; and D – 6 items comprised two close- and four open-ended questions on belief and perception about COVID-19 and its vaccine.

Pilot testing of the questionnaire was done with eight pharmacy undergraduates and the outcome were used to further improve the resulting 61-item questionnaire but excluded from the final analysis.

Outcome assessment/scoring methods

In summary, most items in Sections B-D required close-ended responses on a five-point ordinal scale (completely disagree to completely agree) while items assessing self-consciousness (Section C) used a seven-point ordinal scale (completely disagree to completely agree). Only 4 items in Section D were open-ended.

During data preprocessing, some items in Section B (knowledge) were reversed using the largest scale + 1 – so that high value means more of the characteristic of interest. Knowledge was reclassified into correct, incorrect and unsure options to determine average knowledge score and also to high or low using the median value as cutoff for *t*-test and logistic regression.[22] Similarly, a score of ≥75% was designated as high, 50%–75% as moderate, and ≤ 50% as a low level of knowledge. The main source of information about COVID-19 was reclassified into appropriate (those who receive information from medical doctors, scientists, scientific journals, and radio and television [TV] programs) and inappropriate (information from unrecognized social media platforms) sources. All items which were negatively worded in Section C were reversed so that the valence of all items was the same. In the four previously validated personality scales (extroversion, Rosenberg Self-esteem, Self-restraint, and Private/Public Self-Consciousness Scales), the respective median values were used as cutoff to categorize each scale into high and low.[22] Lastly, the item in Section D that focused on believe in the existence of COVID-19 in Nigeria was reclassified so that those who completely disagree, disagree and not sure were assessed as "not believing or doubting."

COVID-19 vaccine uptake intentions refer to an umbrella term comprising both vaccine hesitancy and vaccine confidence. Vaccine hesitancy refers to rejection or reluctance to be vaccinated.[17] In this study, respondents who selected the options of "I do not believe in COVID-19 vaccine and not willing to take it" (complete rejection) and "I believe in COVID-19 vaccine but not willing to take it" (partial rejection) were classified as exhibiting vaccine hesitancy. In addition, respondents who do not believe in the existence of COVID-19 in Nigeria were also regarded as vaccine hesitant. Respondents who expressed the belief in COVID-19 vaccines and willing to take it were classified as exhibiting vaccine acceptance or confidence.

APPENDIX C: RISK PERCEPTION

Risk perception of contracting COVID-19 among participants

The risk perception of contracting COVID-19 among the participants was highest among those who believe COVID-19 truly exists in Nigeria (66.1%; 111/168) and lowest among those who do not believe COVID-19 exists in Nigeria (33.9%; 57/168). The reasons reported among those who believed in the existence of the disease in the study ranged from contracting COVID-19 by the participants (0.9%; 1/111), family members (6.3%; 7/111; [siblings-2; "my people"-4; "my relatives"-1]), friends (12.6%; 14/111), meeting patients who recovered from COVID-19 (5.4%; 6/111), reports from NCDC (16.2%; 18/111), and TV (28.8%; 32/111). Perceived nonexistence of the pandemic according to the respondents are mainly due to doubts of the daily reported figures (number of cases and deaths) (33.3%; 19/57) and not having ever seen a COVID-19 patient (or the corpse) physically or on live TV (33.3%; 19/57). Other reasons included crowd-attracting places ("super spreader" places) such as markets were never closed in some states (3.5%; 2/57), never having obeyed any safety protocols and yet did not contract the disease (3.5%; 2/57), knowing someone that was wrongly diagnosed of the disease (1.8%; 1/57), inclination to link all deaths within this period to the pandemic (1.8%; 1/57), and believing that the prevalence and death toll could have been much more due to the poor state of health-care delivery in the country (1.8%; 1/57).

The respondents who perceived nonexistence of COVID-19 infection in the study reported that they would only believe the disease exists if they are infected (3.5%; 2/57), someone close to them is infected (3.5%; 2/57), meeting an infected person (35.1%; 20/57), massive inexplicable deaths (8.8%; 5/57), and better pandemic-related information (5.3%; 3/57).

Perceived strategies to increase COVID-19 vaccine acceptance.