Int J Med Rev 2024 June;11(2): 726-733

10.30491/IJMR.2024.449655.1279

INTERNATIONAL JOURNAL OF MEDICAL REVIEWS
Original Article

Acceptance, Perceptions, and Attitudes of Medical Students and the General Population on COVID-19's Existence and Vaccination: a Comparative Cross-Sectional Study

Henoch K. Ciswaka [1,2*], Ida S. Kosia [2], Fils T. Hyute [2], David N. Bayenga [2], Bless M. Lukeboka [1,2], Ben B. Ngubuta [1,2], John N. Kabamba [1,2], Philippe M. Masidi [1,3], Michael M. Bojabwa [4], Roger K. Kabuya [5]

[1] Star Research Group, Academy of Sciences and Engineering for Africa Development, Kinshasa, DR Congo
[2] Department of Biomedical Sciences, Faculty of Medicine, University of Kinshasa, Kinshasa, DR Congo
[3] Department of Pediatrics, University Clinics of Kinshasa, Faculty of Medicine, University of Kinshasa, Kinshasa, DR Congo
[4] Department of Tropical Medicine, Faculty of Medicine, University of Kinshasa, Kinshasa, DR Congo
[5] Ottawa Newcomer Health Centre, Somerset West Community Health Centre, Ottawa, Ontario, Canada

*** Corresponding Author:** Henoch K. Ciswaka, Star Research Group, Academy of Sciences and Engineering for Africa Development, Kinshasa, DR Congo. E-mail: h.k.ciswaka@gmail.com

Received March 23, 2024; **Accepted** April 6, 2024; **Online Published** June 20, 2024

Abstract

Introduction: COVID-19 has spread worldwide, affecting all continents and impacting several sectors of society. In the DRC, poor barriers to adherence and low vaccination coverage were some of the challenges faced during COVID-19. This study aimed to evaluate and compare the acceptance, perceptions, and attitudes towards the existence of COVID-19 and the vaccine between medical students and the general population.

Methods: An on-site cross-sectional survey was conducted in late 2021 among medical students and the general population of Kinshasa. A 23-item questionnaire was administered to participants for convenience sampling. The questionnaire focused on sociodemographic data, perceptions, and attitudes towards COVID-19 and vaccine acceptance. Mann-Whitney U and Pearson chi-square tests were used to determine associations between different variables, and logistic regression was used to determine the predictors of vaccine acceptance.

Results: Of the 439 respondents, 223 (50.8%) were medical students, and 181 (41.2%) were female. The median patient age was 23 years. Overall, perceptions and attitudes were better among the medical students. The acceptance rate of the free vaccine was 51.5%, higher among medical students (p <0.01). However, 6.8% of the population reported having received the vaccine. Believing that the vaccine is beneficial (OR = 4.4), accepting that the vaccine is compulsory (OR = 4.0), and believing that the existence of COVID-19 in the DRC (OR = 3.1) were the most associated with vaccine acceptance.

Conclusion: Awareness-raising actions, medical education, and access to information play crucial roles in managing health crises. More effective strategies are a priority for strengthening community engagement and adherence to health measures.

Keywords: COVID-19, Vaccine Acceptance, Perceptions, Attitudes, Medical Students, DR Congo

Introduction

The World Health Organization (WHO) declared COVID-19 a public health problem in early 2020.[1] Owing to its high mortality and rapid spread, SARS-CoV-2 affects all continents.[2] Unlike scientific predictions stating that Africa would experience a worst-case scenario during the pandemic due to limitations in terms of resources and research, it has been considered the continent least affected by COVID-19.[3] However, in the Democratic Republic of the Congo (DRC), a retrospective epidemiological analysis reported that the first two waves were more severe than the following two.[4] In late 2021 and early 2022, the country experienced the fourth wave of COVID-19, with the emergence of a new variant and the highest rates since the start of the pandemic.[5]

One of the significant challenges in managing COVID-19 in the DRC is low adherence to preventive measures, which is likely to complicate the COVID-19 pandemic at the community level.[6] The DRC is the second-largest country in Africa, with one of the largest populations on the continent. Our WorldInData reported that only 6.22 doses were administered per

100 Congolese (Figure 1).[7] A study reported that several factors, mainly low education levels and unemployment, account for this non-compliance with COVID-19 prevention measures in the DRC.[8] Several strategies, such as awareness and participation of beneficiary communities in health policy, are crucial factors in administering a new vaccine, especially in developing countries, to prevent under-vaccination or non-vaccination.[9,10] One of the barriers to implementing COVID-19 strategies in sub-Saharan Africa in general, and in the DRC in particular, was convincing people about the existence of COVID-19 in their area. Some Africans have reported that COVID-19 is a white disease.[11] This had a significant impact on the management of the pandemic.

A meta-analysis of 519 international studies, including nearly 8 million participants, reported a vaccine acceptance rate of 67.8%.[12] African populations showed varying acceptance between 6.9% and 97.9%. The same study reported that the main factors that favored vaccine hesitancy were vaccine safety and adverse effects, lack of information, and misinformation.[13] In such situations marked by information overload, medical students sometimes provide information on health issues in the population.[14] A meta-analysis reported an overall prevalence of vaccine acceptance among health science students of 68.8%.[15] To date, the highest acceptance rate in Africa (55%) was found among medical students in Sudan.[16] In a study of a sample of 600 medical students, only 37.3% were willing to be vaccinated.[17]

In the DRC, there are numerous data points on the population's attitude towards the vaccine. However, there is no available data in the literature that evaluates the position of medical students, even less than the rest of the population. Such data could be used in decision-making for medical schools and other allied fields, using a broader approach to establish public health communication strategies. This study aimed to assess the acceptance, perceptions, and attitudes around COVID-19 and the vaccine among medical students and the general population.

Materials and Methods

Study Design

The purpose of this cross-sectional study was to evaluate and compare the acceptance, perceptions, and attitudes towards the existence of COVID-19 and the vaccine between two particular groups: medical students at the Faculty of Medicine, University of Kinshasa, and the general population. It used data collected through an on-site survey conducted during the fourth wave of the COVID-19 pandemic, from December 7 to 28, 2021, to respect respecting anti-COVID-19 barrier measures.

Study Population

This study included medical students and the general population. Three inclusion criteria were considered: (1) residents of Kinshasa for the past 2 years; (2) not suffering from chronic neuropsychiatric diseases; and (3) aged 16 years or older. People under 16 years old, with chronic neuropsychiatric diseases, or living less than 2 years in Kinshasa were excluded from the study. Medical students were reached on campus and in housing near the university, while the general population was affected on the streets of the capital city of Kinshasa.

Sampling Method

For this study, a convenience sampling method was employed to select study participants. The choice of convenience sampling technique was based on limited financial resources, time constraints, and the unavailability of potential participants during the stay-at-home measures. Hence, this sampling method was employed to ensure that the most available and willing participants were recruited for the study.

Data Collection

A 23-item, self-administered questionnaire was designed after a detailed review of the literature. The questionnaire was sent to two senior researchers for evaluation and improvement. The questionnaire was distributed to the general population and medical students at the University of Kinshasa. No pilot study was carried out beforehand to test the validity of the questionnaire due to the short survey period and limited access to universities and other public spaces. However, questionnaire reliability was measured after the survey, and Cronbach's alpha was $\alpha = 0.72$. Participation was free and anonymous to preserve confidentiality. Informed consent was obtained from each participant. The name, address, or information related to participants' identities werenot collected.

Study Variables

The structured questionnaire consisted of 23 items

divided into 4 sections related to (1) socio-demographic data (gender, sex, level of education, being a medical student or not, profession); (2) perception of COVID-19 (existence of COVID-19 in the world and the DRC, believing the national pandemic coverage, knowing suffering or deceased people from COVID-19 and COVID-19-related personal history); (3) perceptions and attitudes towards COVID-19 (believing that COVID-19 exists in the world and in DRC, following and believing the national COVID-19 coverage, advising people to get vaccinated, believing that COVID-19 vaccine is beneficial for people, believing that COVID-19 vaccine is intended to affect health, thinking that COVID-19 vaccine should be mandatory, and requesting more information about the vaccine); and (4) vaccine acceptance (getting vaccinated, advising about getting vaccinated, beliefs about the vaccine, alternative treatment, suggestion on the delivery).

Statistical Analysis

The collected data were entered, stored in an encrypted Excel file, and imported into statistical software. These data were accessible only to the researchers who participated in this study. The data were imported and analyzed in R (R version 4.2.2). Incomplete questionnaires were excluded from the sample and, therefore, from the analysis. Age was the only numerical variable and was presented as median and range because it did not follow a Gaussian distribution according to the Kolmogorov-Smirnov test. Categorical variables were presented as frequencies and percentages. The participants were categorized into two groups: medical students and the general population. The Mann-Whitney U test was used to establish associations between numeric and categorical variables. Pearson's chi-squared test was used to determine the associations between the two categorical variables. Multivariate logistic regression analysis was used to determine predictors of vaccine acceptance in the study population. A p-value less than 0.05 was considered the significance level for all analyses.

Compliance with Ethical Standards

The study protocol was approved by the DRC National Ethics Committee (N°ESP/CE/41C/2022). Before the interview commenced, study participants provided oral informed consent. The respondents were informed by the research team about the nature of the study, its objectives, the risks and benefits incurred, the freedom to participate without prejudice, confidentiality, and the contact details of the person in charge of the study for further information if necessary. Confidentiality was respected by anonymizing the dataset. The ethical principles for the involvement of human research subjects are outlined in the Nuremberg Code and the Declaration of Helsinki.

Results

A total of 439 individuals participated in this study (response rate: 87.8%), of which 216 (49.2%) were from the general population and 223 (50.8%) were medical students. The median age was 23 years (IQR: 17-28), and most participants were between 18-27 years old. The male sex was slightly predominant, with a sex ratio of 1.4. The majority of participants had attended college (80.9%). A significant difference was found between the general population and medical students in terms of age, sex, and educational level. Table 1 shows the participants'sociodemographic characteristics.

Table 1. Sociodemographic Characteristics of the Study Population

Variables	Total, N (%)	Medicalstudents	General population	*p*
	439	223 (50.8%)	216 (49.2%)	
Age (years)				<0.001*
Median (IQR)	23 (15-75)	23 (17-30)	24 (15-75)	
Gender				0.002*
Male	258 (58.8%)	147 (57.0%)	111 (43.0%)	
Women	181 (41.2%)	76 (42.0%)	105 (58.0%)	
Educationallevel				<0.001*
None	4 (0.9%)	0	4 (100%)	
Primary	6 (1.3%)	0	6 (100%)	
Secondary	60 (13.7%)	0	60 (100%)	
University	355 (80.9%)	233 (62.8%)	132 (37.2%)	
Informal education	14 (3.2%)	0	14 (100%)	

Attitudes and Perceptions

Most participants were aware of SARS-CoV-2 in the world (88.8%, n = 390) and in the DRC (74.9%, n = 321). Between the two populations, medical students

were found to be significantly more aware of the presence of SARS-CoV-2 in the world (93.3%, n = 208 vs. 84.3%, n = 182; $p = 0.003$) and in the DRC (85.7%, n = 191 vs. 63.9%, n = 138%; $p<0.001$). Approximately half of the study population followed the national coverage of COVID-19 (52.6%). Similarly, almost half believed the national coverage of COVID-19 to be truly accurate (50.8%). However, only 33.0% followed and felt this at the same time. No significant difference was found between the two groups in terms of following and believing COVID-19 coverage. 52,6% of the study population would advise their relatives against vaccination. 27.3% of the study population thought everyone should be compulsorily vaccinated against SARS-CoV-2. 88.6% of the study population demanded that more information be provided to the community during the pandemic. Despite the availability of the vaccine and a standard treatment for COVID-19, nearly half of the population was willing to use alternative treatments to prevent or treat COVID-19 or its symptoms (38.1% for medical students versus 52.8% for the general population, $p = 0.002$). Table 2 shows the details of the study population's attitudes and perceptions regarding COVID-19 and the vaccine. Table 3 presents the data on perceptions and attitudes. Only 3% of the study population believed everyone should be compulsorily vaccinated against SARS-CoV-2. Nearly 90% of the population demanded that more information be provided to the community during the pandemic (88.6%).

Table 2. Attitudes and Perceptions of the Study Population on COVID-19 and the Vaccine

	Total	Medicalstudents	General population	*p*
	439	223 (50.8%)	216 (49.2%)	
Participants whobelieved in the presence of COVID-19 in the world	390 (88.8%)	208 (53.3%)	182 (46.7%)	0.003*
Participants whobelieved in the presence of COVID-19 in the DRC	329 (74.9%)	191 (58.1%)	138 (41.9%)	<0.001*
Participants whowereinterested in and followed national coverage of COVID-19	231 (52.6%)	120 (51.9%)	111 (48.1%)	0.611
Participants whobelieved in national COVID-19 coverage	223 (50.6%)	117 (52.5%)	106 (47.5%)	0.477
Participants whowouldadvisetheir relatives to receive the vaccine	231 (52.6%)	132 (59.2%)	99 (45.8%)	0.005*
Participants whobelievedthat the COVID-19 vaccine isbeneficial for the protection of the population	298 (67.9%)	167 (74.9%)	131 (60.6%)	0.001*
Participants whobelievedthat the COVID-19 vaccine wasintended to affect health or kill people, Africans	160 (36.5%)	60 (26.9%)	100 (46.3%)	<0.001*
Participants whothought the COVID-19 vaccine shouldbemandatory	120 (27.3%)	64 (28.7%)	56 (25.9%)	0.515
Participants whorequested more information about the vaccine	389 (88.6%)	205 (91.9%)	184 (85.2%)	0.026*

Table 3. Data about the Personalhistory of COVID-19

Variables	Total, N (%)	Medicalstudents	General population	*p*
	439	223 (50.8%)	216 (49.2%)	
Participants whohad met or known at least one personwhohadcaught COVID	231 (52.6%)	133 (59.6%)	98 (45.4%)	0.003*
Participants whohadknown at least one personwhohaddied of COVID	178 (40.6%)	108 (48.4%)	70 (32.4)	<0.001*
Participants whoshowedsymptoms of COVID-19 during the pandemic	315 (71.6%)	180 (80.7%)	135 (62.5%)	<0.001*
Participants whohad been tested for COVID-19	89 (20.3%)	46 (20.6%)	43 (19.9%)	0.851

COVID-19-related Personal History

More than half of the study population (52.6%) reported having known or met at least one person who suffered from COVID-19. Unlike medical students, more than half of the general population (40.4%, n = 90 vs. 54.6%, n = 118; $p = 0.003$) reported that they had never known someone suffering from COVID-19. Approximately 32% of the general population, compared to 48.4% of medical students, have witnessed the death of at least one person from COVID-19. During the COVID-19 pandemic, health authorities disseminated messages on protective measures and signs of the disease to allow the population to assess the need to be tested. In total, 71.6% of the study population reported having experienced one or more symptoms of COVID-19 (fever, cough, physical fatigue, etc.) during the pandemic. However, only 27.3% went to be tested at the COVID-19 treatment center. Table 3 shows the detailed personal

history of the participants regarding COVID-19.

Vaccination Acceptance and Coverage

The acceptance rate of the vaccine, if free, approved, and effective, was 51.5%, and vaccine hesitancy was 48.5% in the study population. Medical students showed significantly higher acceptance than the general population (p = 0.005). A free vaccine increased the acceptance rate by 95% (51.5% free vs. 26.4% paid vaccine). Only 6.8% of the study population had received this vaccine (Table 4).

Predictors of COVID-19 Vaccine Acceptance

Multivariate logistic regression was used to determine the link between vaccine acceptance and different factors related to sociodemographic data, perceptions, and attitudes towards COVID-19 the various factors. Factors favoring acceptance of the COVID-19 vaccine, if proven safe, effective, and free, were described using multivariate logistic regression analysis. Factors strongly related to vaccine acceptance included believing the vaccine is beneficial (OR = 4.406; 95%CI: 2.845-6.824, p<0.001), accepting that the vaccine is compulsory (OR = 4.037; 95%CI: 2.525-6.452, p<0.001), and believing the existence of COVID-19 in the DRC (OR = 3.133; 95%CI: 1.978-4.962, p<0.001). The details of the predictors of vaccine acceptance are presented in Table 5.

Table 4. Vaccine Acceptance and Coverage

Variables	Total, N (%)	Medicalstudents	General population	*p*
	439	223	216	
Participants whoaccept the free vaccine if provensafe and effective	226 (51.5%)	127 (57%)	99 (45.8%)	0.005*
Participants whoaccept the paying vaccine if itisproven, safe, and effective	116 (26.4%)	65 (29.1%)	51 (23.6%)	0.188
Participants whoreceived the vaccine	30 (6.8%)	11 (4.9%)	19 (8.8%)	0.109

Table 5. Predictors of COVID-19 Vaccine Acceptance

Predictionfactors	OR (95% CI)	*p*
Sex		
Female	1	<0.001
Male	1.995 (1.356-2.933)	
Being a medicalstudent		
No	1	0.020
Yes	1.563 (1.073-2.279)	
Believing in the existence of COVID-19 in the DRC		
No	1	<0.001
Yes	3.133 (1.978-4.962)	
Gettingtestedafternoticingsymptoms of COVID-19		
No	1	0.016
Yes	1.797 (1.114-2.899)	
Believingthat the vaccine isbeneficial		
No	1	<0.001
Yes	4.406 (2.845-6.824)	
Believingthat the vaccine isharmful		
No	1	<0.001
Yes	.202 (.132-.309)	
Acceptthat the vaccine iscompulsory		
No	1	<0.001
Yes	4.037 (2.525-6.452)	
Wanting to use an alternative treatment		
No	1	<0.001
Yes	.343 (.232-.506)	

Discussion

This study demonstrates the gaps in the acceptance, perception, and awareness of COVID-19 and vaccination among medical students and the general public. Furthermore, the study's worth is determined by its contribution to the context of a deficient body of literature. It also discusses the data provided in a multifaceted manner, specifically for the DRC and sub-Saharan Africa.

Our findings showed vaccine acceptance in about half of the population. Additionally, medical students showed significantly higher acceptance of the vaccine than the general population. Vaccination coverage was low. Overall, the acceptance rate was lower than that

reported in most previous studies on medical students and the general population. In the literature, the acceptance rate among medical students ranged from 22.4 to 95.6%.[16-22] In the general population, Alemayehu et al. found an estimated vaccine acceptance of 60.2% in a meta-analysis that included East African countries.[23] A Senegalese study showed higher acceptance than the study's findings (87.1%).[24] The rationale for these findings on vaccine acceptance may be based on several factors. Being young, the low risk of contracting COVID-19 as perceived by the population, the lack of information or confidence in the information provided by the government, and low socioeconomic status were determined the most common predictors of vaccine hesitancy in the world.[25] The participants' socio-demographic profile and the country's political-economic situation played a significant role in their perception of the disease and the vaccine during the pandemic. Information provided on social networks and social influence is thought to have remarkably influenced vaccine hesitancy in the general population and medical students.[18,26]

Vaccination coverage was considerably low among both the medical students and the general population, and no statistical difference was found between the two groups. This coverage was close to that of Our World In Data and one of the lowest in the world (Figure 1). Limited access to information and unawareness of vaccine efficacy and safety have played negative roles in vaccine acceptance.[13] The lack of a sufficient workforce, logistics, and limited financial resources resulting in significant limitations to full vaccine manufacturing are some of the major challenges faced by African countries.[27] Moreover, the vaccines provided by the DRC government during this study were primarily intended for healthcare workers, people aged over 55 years, and people with comorbidities.[28] In contrast, the participants in this study were primarily young, healthy, and non-caregivers, which accounts for the low vaccination coverage reported. Information overload reporting on the harmfulness of vaccines provided for developing countries was at the origin of anxiety concerning the state of health from visiting health-related information online, cyberchondria, associated with the perceived risk of the vaccine in the general population, a factor preventing vaccination coverage.[29,30]

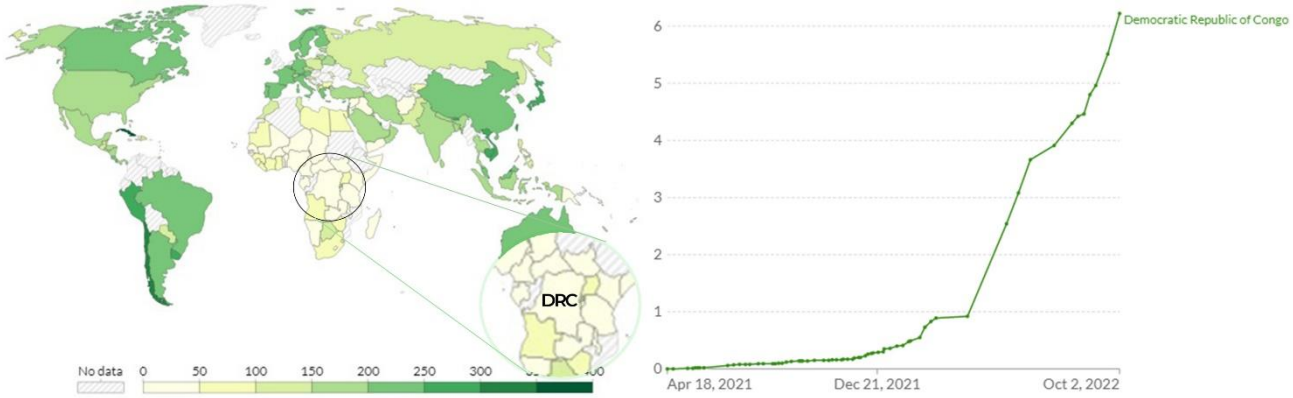

Figure 1. COVID-19 Vaccination Coverage in the DRC. DRC is one of the countries withlowest doses administered in the world (left), and has a vaccine coverageestimated at around 6% (right). (Coronavirus vaccinations in DRC, OurWorldInData.org/coronavirus, CC BY 4.0, Accessed on January 4, 2023. Reprintedwith permission from Our World In Data).

African populations have the particularity of adhering to traditional beliefs and religions. We found that, in the general population, few participants were convinced of the presence of COVID-19 in the DRC. Approximately half of the study population did not show interest in or follow the national coverage of the pandemic in the country. Although data on the population's interest in national coverage is lacking for most countries, this disinterest is likely to be linked to the low adherence of the population to information from government and health experts at the expense of misleading information from traditions, religions, and fake news on mass media, making them believe that COVID-19 is a divine punishment to the earth for their sins.[31] Traditional caregivers and religious leaders, who were hardly involved in COVID-19 management, took

advantage of this critical period to attract the population and ensure their health and well-being during the pandemic. In addition to the non-fatal clinical manifestations similar to influenza, cyberchondria developed among most people and was likely to be a barrier to community engagement and the uptake of screening in the case of symptoms and self-perception as a person potentially affected by COVID-19.[30] Several African countries have recorded significant morbidity and mortality rates. However, the DRC was among the countries least affected by the COVID-19 pandemic. Knowing someone who has died from the disease is important for people to become aware of the problem and improve community engagement in the COVID-19 pandemic. More than half of the participants in the study (52.6%) have known at least one person who suffered from COVID-19, and only 40.6% have known at least one person who died from the disease during the pandemic.

Multivariate logistic regression was used to determine the link between vaccine acceptance and different factors related to sociodemographic data, perceptions, and attitudes towards COVID-19. Among the predictors of COVID-19 vaccine acceptance, accepting that the vaccine is mandatory was strongly associated with vaccine acceptance, despite the lack of evidence of vaccine safety and efficacy.[33,34] The belief that the vaccine is not harmful and the existence of coronavirus in the DRC were considered the determining factors for vaccine acceptance. Literature has shown that vaccine acceptance was low in populations –that doubted the efficacy and safety of the vaccine.[34] Medical students also showed a positive perception of the vaccine, supporting the idea that COVID-19 exists and that the vaccine should be mandatory for everyone.

Limitations

Our study had several limitations. First, it recruited a small number of medical students and the general population through convenience sampling. The convenience sampling technique was chosen based on limited resources, time constraints, and the unavailability of potential participants due to limited access to public spaces during the pandemic. Consequently, the sample could not be representative, and it would be difficult to extrapolate the results to the entire population. Second, statistical validation of the questionnaire was not performed, given that no pilot study was conducted on a subgroup of the target population due to the pandemic and the short period of the survey. Compared with the general population, all medical students had higher levels of education. This could account for the fact that medical students have a significantly higher level of education than the general population, which would constitute a selection bias. Finally, memory and social desirability biases could also have influenced participants' self-reports. A qualitative study on a larger sample to examine the economic, social, cultural, and emotional aspects of the perception of the pandemic by the population through random or stratified sampling could provide richer and nuanced information to better address the factors linked to vaccine hesitancy.

Conclusion

Owing to the COVID-19 pandemic's profound effects, multidisciplinary efforts continue to be a top priority. The DRC is a context that is rarely addressed by mainstream research; thus, this study researched several facets of the actual issue, throwing light on significant results and contributing to the existing body of knowledge. It provides practical, targeted, and comparative insights into how medical students and the general public view COVID-19 and its vaccine and how they accept it. Although medical students showed better attitudes and perceptions than the general population about COVID-19 and the vaccine, this study highlighted that vaccine acceptance in both groups was low, which is not only a community problem in managing the COVID-19 pandemic but also a flaw in medical education. Improving access to education and information is crucial to vaccine acceptance. The effective involvement of religious and traditional leaders as key opinion leaders to minimize infodemic effects during such crises is a vital aspect of communication. A qualitative or mixed-method study with a larger sample size, considering the personal views of both medical students and the general population about COVID-19 and the vaccine, could appropriately provide more accurate information for specific policies and strategies to overcome vaccine hesitancy.

Conflict of Interest

The authors declare no conflicts of interest.

Acknowledgement

We would like to express our appreciation to the Academy of Sciences and Engineering for Africa

Development for providing materials and other resources to accomplish this study. We are also grateful to Felix Wandera from Kenya for reviewing our final manuscript.

References

1. Cucinotta D, Vanelli M. WHO declares COVID-19 a pandemic. Acta Biomedica. 2020;91(1):157-60. doi:10.23750/abm.v91i1.9397
2. Zahid MN, Perna S. Continent-wide analysis of COVID 19: Total cases, deaths, tests, socio-economic, and morbidity factors associated to the mortality rate, and forecasting analysis in 2020–2021. Int J Environ Res Public Health. 2021;18(10):5350. doi:10.3390/ijerph18105350
3. Bwire G, Ario AR, Eyu P, Ocom F, Wamala JF, Kusi KA, et al. The COVID-19 pandemic in the African continent. BMC Med. 2022;20(1):167. doi:10.1186/s12916-022-02367-4
4. Otshudiema JO, Folefack GL, Nsio JM, Mbala-Kingebeni P, Kakema CH, Kosianza JB, et al. Epidemiological comparison of four COVID-19 waves in the Democratic Republic of the Congo, March 2020–January 2022. J Epidemiol Glob Health. 2022;12(3):316-27. doi:10.1007/s44197-022-00052-6
5. Bhatia G, Dutta PK, McClure J. Congo-Kinshasa: The latest figures, graphs, and maps on the evolution of the coronavirus. Reuters. Available from: https://www.reuters.com/graphics/world-coronavirus-tracker-and-maps/fr/countries-and-territories/democratic-republic-of-the-congo/. [accessed Jun 25, 2023].
6. Ditekemena JD, Nkamba DM, Muhindo HM, Siewe JN, Luhata C, Van den Bergh R, et al. Factors associated with adherence to COVID-19 prevention measures in the Democratic Republic of the Congo (DRC): results of an online survey. BMJ Open. 2021;11(1):e043356. doi:10.1136/bmjopen-2020-043356
7. Ditekemena JD, Nkamba DM, Mutwadi A, Mavoko HM, Siewe Fodjo JN, Luhata C, et al. COVID-19 vaccine acceptance in the Democratic Republic of Congo: a cross-sectional survey. Vaccines. 2021;9(2):153. doi:10.3390/vaccines9020153
8. Our World In Data. Democratic Republic of Congo: Coronavirus Pandemic Country Profile. Available from: https://ourworldindata.org/coronavirus/country/democratic-republic-of-congo. [accessed Jun 22, 2023]
9. Cobos Mucoz D, Monzyn Llamas L, Bosch-Capblanch X. Exposing concerns about vaccination in low-and middle-income countries: a systematic review. Int J Public Health. 2015;60:767-80. doi:10.1007/s00038-015-0715-6
10. Lewin S, Hill S, Abdullahi LH, de Castro Freire SB, Bosch-Capblanch X, Glenton C, et al. 'Communicate to vaccinate' (COMMVAC). building evidence for improving communication about childhood vaccinations in low-and middle-income countries: protocol for a programme of research. Implement Sci. 2011;6:125. doi:10.1186/1748-5908-6-125
11. Cirhigiri JD.In DR Congo, the challenge is convincing people that coronavirus exists. Heinrich Böll Stiftung. 2020. https://us.boell.org/en/2020/08/17/dr-congo-challenge-convincing-people-coronavirus-exists
12. Wang Q, Hu S, Du F, Zang S, Xing Y, Qu Z, et al. Mapping global acceptance and uptake of COVID-19 vaccination: A systematic review and meta-analysis. Commun Med. 2022;2(1):113. doi:10.1038/s43856-022-00177-6
13. Ackah BB, Woo M, Stallwood L, Fazal ZA, Okpani A, Ukah UV, Adu PA. COVID-19 vaccine hesitancy in Africa: a scoping review. Glob Health Res Policy. 2022;7(1):21. doi:10.1186/s41256-022-00255-1
14. Fakorede O, Uakkas S, El Omrani O, Janusonyte E. Medical Students and Youth-Led Efforts against Infodemic. Int J Infect Dis. 2022;116:S48-9. doi:10.1016/j.ijid.2021.12.117
15. Patwary MM, Bardhan M, Haque MZ, Sultana R, Alam MA, Browning MH. COVID-19 vaccine acceptance rate and its factors among healthcare students: A systematic review with meta-analysis. Vaccines. 2022;10(5):806. doi:10.3390/vaccines10050806
16. Raja SM, Osman ME, Musa AO, Hussien AA, Yusuf K. COVID-19 vaccine acceptance, hesitancy, and associated factors among medical students in Sudan. Plos One. 2022;17(4):e0266670. doi:10.1371/journal.pone.0266670
17. Kanyike AM, Olum R, Kajjimu J, Ojilong D, Akech GM, Nassozi DR, et al. Acceptance of the coronavirus disease-2019 vaccine among medical students in Uganda. Trop Med Health. 2021;49(1):37. doi:10.1186/s41182-021-00331-1
18. Saied SM, Saied EM, Kabbash IA, Abdo SA. Vaccine hesitancy: Beliefs and barriers associated with COVID-19 vaccination among Egyptian medical students. J Med Virol. 2021;93(7):4280-91. doi:10.1002/jmv.26910
19. Lucia VC, Kelekar A, Afonso NM. COVID-19 vaccine hesitancy among medical students. J Public Health. 2021;43(3):445-9. doi:10.1093/pubmed/fdaa230
20. Botello-Hern6ndez E, Garcia-Espinosa P, Ruiz-Padilla JP, Torres-Hern6ndez G, Fernandez-Garza LE. Medical students' perception towards the COVID-19 pandemic in Mexico: distance learning, assisting hospitals, and vaccination. Int J Med Stud. 2021;9(1):33-6. doi:10.5195/ijms.2021.935
21. Ngoyi JM, Mbuyu LK, Kibwe DN, Kabamba LN, Umba EK, Tambwe PN, et al. Covid-19 vaccination acceptance among students of the higher institute of medical techniques of Lubumbashi, Democratic Republic of Congo. Revue de l'Infirmier Congolais. 2020;4(2):48-52.
22. Bolatov AK, Seisembekov TZ, Askarova AZ, Pavalkis D. Barriers to COVID-19 vaccination among medical students in Kazakhstan: development, validation, and use of a new COVID-19 Vaccine Hesitancy Scale. Hum Vaccin Immunother. 2021;17(12):4982-92. doi:10.1080/21645515.2021.1982280
23. Alemayehu A, Demissie A, Yusuf M, Gemechu Lencha A, Oljira L. Covid-19 vaccine acceptance and determinant factors among general public in East Africa: a systematic review and meta-analysis. Health services research and managerial epidemiology. 2022. doi:10.1177/23333928221106269
24. Soares P, Rocha JV, Moniz M, Gama A, Laires PA, Pedro AR, et al. Factors associated with COVID-19 vaccine hesitancy. Vaccines. 2021;9(3):300. doi:10.3390/vaccines9030300
25. Pires C. Global predictors of COVID-19 vaccine hesitancy: A systematic review. Vaccines. 2022;10(8):1349. doi:10.3390/vaccines10081349
26. Lewandowsky S, Ecker UK, Seifert CM, Schwarz N, Cook J. Misinformation and its correction: Continued influence and successful debiasing. Psychol Sci Public Interest. 2012;13(3):106-31. doi:10.1177/1529100612451018
27. Lawal L, Aminu Bello M, Murwira T, Avoka C, Yusuf Ma'aruf S, Harrison Omonhinmin I, et al. Low coverage of COVID-19 vaccines in Africa: current evidence and the way forward. Hum Vaccin Immunother. 2022;18(1):2034457. doi:10.1080/21645515.2022.2034457
28. GAVI Alliance. Government of the Democratic Republic of Congo, UNICEF & WHO. COVID-19-COVAX: Over 1.7 million doses of COVID-19 vaccine have arrived in the DRC. Common Press Spouse. 2021.
29. Ahorsu DK, Lin CY, Alimoradi Z, Griffiths MD, Chen HP, Broström A, et al. Cyberchondria, fear of COVID-19, and risk perception mediate the association between problematic social media use and intention to get a COVID-19 vaccine. Vaccines. 2022;10(1):122. doi:10.3390/vaccines10010122
30. Honora A, Wang KY, Chih WH. How does information overload about COVID-19 vaccines influence individuals' vaccination intentions? The roles of cyberchondria, perceived risk, and vaccine skepticism. Comput Human Behav. 2022;130:107176. doi:10.1016/j.chb.2021.107176
31. Osei-Tutu A, Affram AA, Mensah-Sarbah C, Dzokoto VA, Adams G. The impact of COVID-19 and religious restrictions on the well-being of Ghanaian Christians: The perspectives of religious leaders. J Relig Health. 2021;60(4):2232-49. doi:10.1007/s10943-021-01285-8
32. Osborne J, Paget J, Giles-Vernick T, Kutalek R, Napier D, Baliatsas C, et al. Community engagement and vulnerability in infectious diseases: A systematic review and qualitative analysis of the literature. Soc Sci Med. 2021;284:114246. doi:10.1016/j.socscimed.2021.114246
33. Cochrane Emergency and Critical Care Group, Graca C, Ghosn L, Evrenoglou T, Jarde A, Minozzi S, et al. Efficacy and safety of COVID-19 vaccines. Cochrane Database Syst Rev. 1996;2023(3). doi:10.1002/14651858.CD015477
34. Lazarus JV, Wyka K, White TM, Picchio CA, Gostin LO, Larson HJ, et al. A survey of COVID-19 vaccine acceptance across 23 countries in 2022. Nat Med. 2023;29(2):366-75. doi:10.1038/s41591-022-02185-4