



BMJ Open Factors associated with adherence to COVID-19 prevention measures in the Democratic Republic of the Congo (DRC): results of an online survey

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ABSTRACT

Objectives We aimed to assess the level of adherence to COVID-19 preventive measures in the Democratic Republic of the Congo (DRC) and to identify factors associated with non-adherence.

Design A cross-sectional population-based online survey.

Settings The study was conducted in 22 provinces of the DRC. Five provinces with a satisfactory number of respondents were included in the analysis: Haut Katanga, Kasai-Central, Kasai-Oriental, Kinshasa and North Kivu.

Participants The participants were people aged ≥18 years, living in the DRC. A total of 3268 participants were included in the study analysis.

Interventions Both convenience sampling (surveyors themselves contacted potential participants in different districts) and snowball sampling (the participants were requested to share the link of the questionnaire with their contacts) methods were used.

Primary and secondary outcome measures We computed adherence scores using responses to 10 questions concerning COVID-19 preventive measures recommended by the WHO and the DRC Ministry of Health. We used logistic regression analysis with generalised estimating equations to identify factors of poor adherence. We also asked about the presence or absence of flu-like symptoms during the preceding 14 days, whether a COVID-19 test was done and the test result.

Results Data from 3268 participants were analysed. Face masks were not used by 1789 (54.7%) participants. Non-adherence to physical distancing was reported by 1364 (41.7%) participants. 501 (15.3%) participants did not observe regular handwashing. Five variables were associated with poor adherence: lower education level, living with other people at home, being jobless/students, living with a partner and not being a healthcare worker.

Conclusion Despite compulsory restrictions imposed by the government, only about half of the respondents adhered to COVID-19 preventive measures in the DRC. Disparities across the provinces are remarkable. There is an urgent need to further explore the reasons for these disparities and factors associated with non-adherence.

Strengths and limitations of this study

- This is the first online survey about COVID-19 preventive behaviour and COVID-19-like symptoms in the Democratic Republic of the Congo (DRC).
- Data were obtained from five provinces of the DRC.
- Respondents were mainly recruited from among more educated individuals who often had more access to internet and smartphones.
- Self-reports may be influenced by recall bias and social desirability.

INTRODUCTION

The COVID-19 pandemic reached sub-Saharan Africa by the end of February 2020 after it was declared a Public Health Emergency of International Concern by the WHO on 30 January 2020.¹ With high levels of poverty and generally fragile health systems, sub-Saharan Africa is facing a complex regional COVID-19 epidemic and could also become a difficult-to-control virus reservoir, from where COVID-19 may be reintroduced to other regions that may have achieved control.^{1–4} Economic and cultural conditions may contribute to perpetuating the spread of the virus in these environments.^{1–4} Generalised health system weaknesses and the lack of large-scale COVID-19 testing capacity also prevent the region from assessing the true magnitude of the pandemic at national and supranational levels and from developing a well-targeted strategy and adequate response.^{3,5}

In particular, the lack of a vaccine and effective treatment makes COVID-19 a major global threat.⁶ This has pushed countries around the world to consider the implementation of strict non-pharmaceutical interventions as a priority to fight this pandemic. Such

interventions include the (mandatory) use of face masks, physical distancing, regular handwashing and the use of hydroalcoholic solution for disinfection. These measures have proven to be effective in controlling epidemics caused by other respiratory viruses such as influenza, SARS and Middle East respiratory syndrome in China, Korea, Taiwan and other countries.⁷⁻¹¹

Public health context in the Democratic Republic of the Congo

The Democratic Republic of the Congo (DRC) has a recent history of armed civil unrest and is currently confronted with residual armed conflicts in the eastern part of the country. This country is known for its conflicts, ever-present United Nations peacekeeping missions and ongoing or recent outbreaks of vaccine-preventable diseases including measles, polio, cholera and yellow fever. The country is ranked second in Africa in terms of tuberculosis burden, is endemic for malaria and has a 1.2% HIV prevalence.² Damage to, and depletion of, the DRC's rainforests, exacerbated by war-related displacement of the population to forests, poaching, illegal lumber trade and artisanal mining, continues to precipitate episodic contact of people with animal reservoirs of other viruses including Ebola and Monkeypox.

The eastern part of the DRC has experienced a long-running Ebola virus epidemic since August 2018.^{2,4} Insecurity made the control of Ebola difficult, and the epidemic was finally halted only in late June 2020. Such a context raises concerns that COVID-19 would be very complicated to control in the DRC.^{2,4} The DRC government implemented mandatory use of face mask and physical distancing since 20 April 2020. COVID-19 mass testing is highly recommended by the government, although not sufficiently available.⁵ Other preventive measures that were implemented included closing schools, churches and all country borders; forbidding gatherings of more than 50 people; and limiting the number of passengers in public transportation. COVID-19 testing is only available in six cities, namely, Kinshasa, Matadi, Lubumbashi, Goma, Kolwezi and Mbandaka, with a very low daily testing rate of about 900 tests per day for a population of more than 89 million.^{2,12}

Understanding the feasibility of, and adherence to, non-pharmaceutical interventions for COVID-19 is essential for both health system planning and preparedness, and modelling exercises predicting the further evolution of the pandemic at national and local levels. We, therefore, aimed to assess the level of adherence to COVID-19 preventive measures in the DRC and to identify factors associated with non-adherence.

METHODS

Study setting

The DRC is the largest country in the Central African region, with an estimated population of 89 million, a total fertility rate of six children born per woman and a life expectancy of 61.6 years. The population of the DRC is

relatively young: 62.7% are between 0 and 24 years, 30.9% are between 25 and 54 years and 6.3% are aged ≥ 55 years.² The country is composed of 26 provinces and shares borders with nine countries. In terms of the operational health system structure, the DRC has 516 health zones. Totally, 46% of the population live in urban areas, with more than 10 million people living in Kinshasa alone.² Already earlier, on 18 March 2020, when there were only very few COVID-19 cases, the DRC decided to close its borders for incoming travellers and close all crowded events (churches, markets, bars, restaurants and dance clubs) where superspreading events could take place. As of July 2020, the COVID-19 epidemic in the DRC was still mainly concentrated in Kinshasa, especially in La Gombe commune and a few bordering areas. The virus had been spreading wider in the provinces, but there have been only a few confirmed cases outside Kinshasa.

Study design, population and sampling

An online population-based survey was conducted from 23 April to 8 June 2020 in 22 provinces of the DRC. This study was part of a series of surveys organised by an International Consortium (International Citizen Project COVID-19 (ICPCovid); <http://www.icpcovid.com>) in low-income countries and low/middle-income countries to monitor the degree to which people aged ≥ 18 years adhere to COVID-19 preventive measures.

A web-based online questionnaire (see online supplemental material), available at <https://www.icpcovid.com/fr/country/congo-kinshasa>, was used. The questionnaire proposed by the ICPCovid consortium was translated from English to French, adapted and pretested for use in the DRC.¹³ The link was disseminated via social media platforms such as WhatsApp. On clicking on the link, the potential participant was informed about the study objectives, data confidentiality and consent form. Mindful of the low internet penetration and mobile connections in the country (19% and 40% of the total population, respectively, as of January 2020¹⁴), we anticipated a low number of respondents to the online survey. To increase participation, one to four study assistants were used in each province to assist potential study candidates who had no access to the internet or had difficulties in filling out the form. The study assistants were recruited from among students in medical schools and the Kinshasa School of Public Health, and were trained in data collection procedures and ethics with an emphasis on COVID-19 prevention measures to be respected. Personal protective equipment and mobile internet bundles were provided to the study assistants, who were thereafter deployed to recruit potential participants. Study assistants used WhatsApp to motivate persons in their network to participate in the survey. Moreover, they were asked to interview the first 60 people they met in the street. Study assistants received financial support to cover transportation and mobile internet, but the persons interviewed did not receive any incentive. Participants' responses were either recorded by the study assistants or entered directly by the participants. Where

needed, the study assistants shared their internet access to enable participants to access the online questionnaire. Both convenience sampling (surveyors themselves contacted potential participants in different districts) and snowball sampling (the participants were requested to share the link of the questionnaire with their contacts) methods were used. The required sample size to detect the anticipated frequency of 18% of non-adherence as reported by Reuben *et al*¹⁵ with 80% power and 0.05 significance levels was calculated to be a minimum of 354 participants per province.

The survey tool included questions on demographic characteristics such as age, sex, educational level and occupation. Adherence to preventive measures was assessed using 10 'yes/no' questions based on the WHO and national guidelines on COVID-19 prevention. These included the following: (1) the use of face mask; (2) physical distancing; (3) coughing or sneezing in the crease of the elbow, or covering mouth and nose with a disposable handkerchief; (4) handwashing/disinfecting right after coughing or sneezing; (5) checking body temperature at least twice a week; (6) regular handwashing during the day; (7) using alcohol-based hand sanitiser during the day; (8) avoid touching face (eyes, nose, mouth); (9) disinfecting phone when getting home; and (10) staying at home when having flu-like symptoms.

Each item was scored 1 if the study participant confirmed that he/she adhered to the measure, or 0 otherwise. We computed adherence scores by summing responses to the above-mentioned 10 questions. The score ranged from 0 to 10. The Bloom's cut-off point was used to classify practices into three levels: inadequate (<6), moderate (6–8) and adequate (>8–10). Subsequently, we grouped moderate and adequate practices into one category tagged adherence, whereas inadequate practices were considered as non-adherence to COVID-19 preventive measures. We also asked questions about the presence or absence of flu-like symptoms during the preceding 14 days, the specific symptom(s) they experienced, whether they had been tested for COVID-19 and the test result.

Data management and analyses

The completed questionnaires were extracted from the secured server of the ICPCovid website and exported to a Microsoft Excel 2016 spreadsheet for cleaning and coding, and subsequently transferred to STATA V.14.1 (Stata, College Station, Texas, USA) for analysis.

During descriptive analysis, categorical variables were summarised using frequencies and proportions. Continuous variables were summarised using mean and SD if normally distributed, or median and IQR otherwise.

Multivariate analyses were performed to investigate factors associated with adherence to COVID-19 preventive measures. Our dependent variable was binary (adherence vs non-adherence to preventive measures). The association between dependent and independent variables was determined by OR or adjusted OR, with 95% CI and $p < 0.05$ to determine the statistical significance level.

We used logistic regression analysis, with generalised estimating equations, to control for correlations among study participants in the same province.¹⁶ The cluster effect was controlled for each province. All variables with a likelihood ratio p value < 0.25 in bivariate regression were included in the multivariate analysis. We selected the most performant model throughout a backward stepwise approach, based on the smallest Akaike information criterion. A priori, if a strong correlation was noticed between two independent variables, one of the two was eliminated to avoid multicollinearity. We checked multicollinearity among independent variables by estimating the variance inflation factor. All variance inflation factor values were less than 10, and multicollinearity was negligible.

We also determined the proportion of persons per province who reported a flu-like episode meeting the WHO COVID-19 diagnostic criteria and the criteria of a newly proposed COVID-19 case definition that includes anosmia/ageusia.¹⁷ We compared these data with the official number of reported confirmed COVID-19 cases in these provinces.

Patient and Public Involvement

For this study conducted within the ICPCovid consortium, the methodology for data collection and data collection tools were adapted in collaboration with local stakeholders in the DRC. Local study assistants were involved in the recruitment of participants, and the latter were also encouraged to share the survey link with their networks. The results of the study have been shared with the head of the national COVID-19 task force, and a newsletter will be disseminated via social media platforms to update the public.

RESULTS

Population characteristics

This study was conducted among 3427 participants in 22 provinces of the DRC. One respondent reported to be 3 years old; we excluded this person from the data set. The number of respondents in 17 provinces was insufficient to meet the required minimum provincial sample size of 354 participants. Therefore, the data from these provinces were excluded from the analyses and only five provinces were included: Haut Katanga, Kasai-Central, Kasai-Oriental, Kinshasa and North Kivu, with a total of 3268 participants.

The average age of the participants was 36 years (SD: 12.5), with 34.7% of participants being over 40 years of age; women represented 66.5% of participants; and 39% reported to belong to the Catholic Church community, 33.4% to the Protestant/Pentecostal Church community and 2.1% were Muslims (table 1).

Adherence to individual containment measures

Non-adherence to physical distancing was reported by 1364 (41.7%) participants, with highest rates for non-adherence in Haut Katanga (79.5%) and Kasai-Oriental

Table 1 Sociodemographic characteristics of participants in the Democratic Republic of the Congo

Characteristics	Provinces, n (%)					Total, n (%)
	Haut-Katanga	Kasai-Central	Kasai-Oriental	Kinshasa	Nord-Kivu	
Total	425 (13.0)	903 (27.6)	619 (18.9)	830 (25.4)	491 (15.0)	3268 (100)
Age (years)						
18–30	156 (36.7)	247 (27.4)	297 (48.0)	382 (46.0)	218 (44.4)	1300 (39.8)
31–39	122 (28.7)	241 (26.7)	135 (21.8)	219 (26.4)	117 (23.8)	834 (25.5)
40–49	99 (23.3)	222 (24.6)	87 (14.1)	120 (14.5)	92 (18.7)	620 (19.0)
≥50	48 (11.3)	193 (21.4)	100 (16.2)	109 (13.1)	64 (13.0)	514 (15.7)
Sex						
Female	367 (86.4)	721 (79.8)	431 (69.6)	384 (46.3)	270 (55.0)	2173 (66.5)
Male	58 (13.6)	182 (20.2)	188 (30.4)	446 (53.7)	221 (45.0)	1095 (33.5)
Education						
Primary school	37 (8.7)	3 (0.3)	76 (12.3)	6 (0.7)	31 (6.3)	153 (4.7)
Secondary	225 (52.9)	758 (83.9)	359 (58.0)	233 (28.1)	152 (31.0)	1727 (52.8)
Bachelor	150 (35.3)	129 (14.3)	169 (27.3)	466 (56.1)	292 (59.5)	1206 (36.9)
Postgraduate	13 (3.1)	13 (1.4)	15 (2.4)	125 (15.1)	16 (3.3)	182 (5.6)
Belonging to health sector						
No	395 (93.0)	870 (96.3)	553 (89.3)	620 (74.7)	421 (85.7)	2859 (87.5)
Yes	30 (7.0)	33 (3.7)	66 (10.7)	210 (25.3)	70 (14.2)	409 (12.5)
Marital status						
Single	20 (4.7)	258 (28.6)	122 (19.7)	438 (52.8)	171 (34.8)	1009 (30.8)
Married/living together	405 (95.3)	645 (71.4)	497 (80.3)	392 (47.2)	320 (65.2)	2259 (69.2)
Profession						
Student	7 (1.6)	153 (16.9)	58 (9.4)	154 (18.6)	68 (13.8)	440 (13.5)
Small company owner	34 (8.0)	91 (10.1)	178 (28.8)	143 (17.2)	116 (23.6)	562 (17.2)
Public employee	77 (18.1)	43 (4.8)	66 (10.7)	190 (22.9)	59 (12.0)	435 (13.3)
No profession	242 (56.9)	542 (60.0)	225 (36.3)	190 (22.9)	137 (27.9)	1336 (40.9)
Private employee	65 (15.3)	74 (8.2)	92 (14.9)	153 (18.4)	111 (22.6)	495 (15.1)
Residency area						
Urban	256 (60.2)	737 (81.6)	548 (88.5)	596 (71.8)	467 (95.1)	2604 (79.7)
Rural	169 (39.8)	166 (18.4)	71 (11.5)	234 (28.2)	24 (4.9)	664 (20.4)
Live alone or with other people						
Live alone	6 (1.4)	89 (9.9)	23 (3.7)	43 (5.2)	27 (5.5)	188 (5.8)
Live with other people	419 (98.6)	814 (90.1)	596 (96.3)	787 (94.8)	464 (94.5)	308 (94.2)
Having a chronic disease*						
No	280 (65.9)	854 (94.6)	465 (75.1)	799 (96.3)	417 (84.9)	2815 (86.1)
Yes	145 (34.1)	49 (5.4)	154 (24.9)	31 (3.7)	74 (15.1)	453 (13.9)
Religion						
None	1 (0.2)	5 (0.6)	14 (2.3)	14 (1.7)	4 (0.8)	38 (1.2)
Protestant/Adventist	94 (22.1)	35 (3.9)	120 (19.3)	264 (31.8)	161 (32.8)	674 (20.7)
Other religion	28 (6.5)	366 (40.5)	100 (16.1)	235 (28.3)	54 (11.1)	783 (23.9)
Catholic	108 (25.4)	477 (52.8)	216 (34.9)	230 (27.7)	243 (49.5)	1274 (39.0)
Pentecostal	194 (45.6)	20 (2.2)	169 (27.3)	87 (10.5)	29 (5.9)	499 (15.3)

*Hypertension, diabetes, HIV/AIDS and cancer.

(71.4%) (table 2). Face masks were not used by 1789 (54.7%) participants, with a high percentage of non-users in Kasai-Central (89.3%), Kasai-Oriental (83.2%) and Haut Katanga (81.9%). In contrast, the percentage of non-users of face masks was low in the city of Kinshasa (5.2%) and North Kivu (15.7%) (table 2).

Regular handwashing was not practised by 501 (15.3%) participants. The non-adherence to this measure differed between provinces: 57.2% in Haut Katanga, 21.5% in Kasai-Oriental, 5.3% in the city of Kinshasa, 8.6% in North Kivu and 4.3% in Kasai-Central (table 2). Not using hand gels was reported by 1573 (48.1%) participants:

Table 2 Adherence to preventive measures

	Haut-Katanga (n=425)	Kasai-Central (n=903)	Kasai-Oriental (n=619)	Kinshasa (n=830)	Nord-Kivu (n=491)	Total (n=3268)
Physical distancing 1.5–2 m, n (%)						
No	338 (79.5)	359 (39.8)	442 (71.4)	166 (20.0)	59 (12.0)	1364 (41.7)
Yes	87 (20.5)	544 (60.2)	177 (28.6)	664 (80.0)	432 (88.0)	1904 (58.3)
Use of face mask, n (%)						
No	348 (81.9)	806 (89.3)	515 (83.2)	43 (5.2)	77 (15.7)	1789 (54.7)
Yes	71 (16.7)	41 (4.5)	87 (14.1)	764 (92.0)	389 (79.2)	1352 (41.4)
NA*	6 (1.4)	56 (6.2)	17 (2.7)	23 (2.8)	25 (5.1)	127 (3.9)
Coughing or sneezing in the crease of the elbow, n (%)						
No	315 (74.1)	223 (24.7)	372 (60.1)	153 (18.4)	71 (14.5)	1134 (34.7)
Yes	110 (25.9)	680 (75.3)	247 (39.9)	677 (81.6)	420 (85.5)	2134 (65.3)
Coughing by covering mouth/nose with a disposable handkerchief, n (%)						
No	323 (76.0)	863 (95.6)	510 (82.4)	279 (33.6)	106 (21.6)	2081 (63.7)
Yes	102 (24.0)	40 (4.4)	109 (17.6)	551 (66.4)	385 (78.4)	1187 (36.3)
Temperature measurement, n (%)						
No	350 (82.4)	845 (93.6)	514 (83.0)	525 (63.3)	164 (33.4)	2398 (73.4)
Yes	75 (17.6)	58 (6.4)	105 (17.0)	305 (36.7)	327 (66.6)	870 (26.6)
Regular handwashing, n (%)						
No	243 (57.2)	39 (4.3)	133 (21.5)	44 (5.3)	42 (8.6)	501 (15.3)
Yes	182 (42.8)	864 (95.7)	486 (78.5)	786 (94.7)	449 (91.4)	2767 (84.7)
Use of alcohol-based hand sanitiser, n (%)						
No	82 (19.3)	848 (93.9)	308 (49.8)	224 (27.0)	111 (22.6)	1573 (48.1)
Yes	343 (80.7)	55 (6.1)	311 (50.2)	606 (73.0)	380 (77.4)	1695 (51.9)
Avoid touching mouth, eyes and nose, n (%)						
No	337 (79.3)	287 (31.8)	420 (67.9)	239 (28.8)	105 (21.4)	1388 (42.5)
Yes	88 (20.7)	616 (68.2)	199 (32.1)	591 (71.2)	386 (78.6)	188 (57.5)
Disinfect phone, n (%)						
No	388 (91.3)	865 (95.8)	466 (75.3)	478 (57.6)	258 (52.5)	2455 (75.1)
Yes	23 (5.4)	24 (2.7)	93 (15.0)	272 (32.8)	181 (36.9)	593 (18.1)
NA†	14 (3.3)	14 (1.6)	60 (9.7)	80 (9.6)	52 (10.6)	220 (6.7)
Stay at home in the case of influenza symptoms, n (%)						
No	350 (82.4)	192 (21.3)	346 (55.9)	179 (21.6)	210 (42.8)	1277 (39.1)
Yes	75 (17.6)	711 (78.7)	273 (44.1)	651 (78.4)	281 (57.2)	1991 (60.9)

*Do not go out of the house.

†Do not own phones.

93.9% in Kasai-Central, 49.8% in Kasai-Oriental, 19.3% in Haut Katanga, 27.0% in Kinshasa and 22.6% in Nord Kivu (table 2).

Of all the participants, 2455 (75.1%) reported that they did not disinfect their phones when they get back home. The proportions of those who did not disinfect phones in each province were 95.8% in Kasai-Central, 91.3% in Haut-Katanga, 75.3% in Kasai-Oriental, 57.6% in Kinshasa and 52.5% in North Kivu (table 2).

Participants' characteristics associated with non-adherence

Of the 3268 analysed responses, 1972 (60.3%) had an adherence score of less than 6, considered as poor adherence to the COVID-19 preventive measures.

The multivariate analysis revealed that participants without university education had higher odds for

non-adherence to the COVID-19 preventive measures (OR=2.43, 95% CI=2.08 to 2.84). Similarly, participants who lived with one or more housemates were more likely to adhere poorly to the preventive measures (OR=1.13, 95% CI=1.05 to 1.83) compared with those who were living alone. Being students/jobless and living with sexual partner (either married or cohabiting) were also associated with non-adherence to COVID-19 preventive measures (table 3).

The proportion of suspected and confirmed COVID-19 infected respondents per province

The proportion of suspected and confirmed COVID-19 infected respondents was the highest in Haut-Katanga but very low in Kasai Central and Nord Kivu (table 4). Only 3 (3.1%) out of 93 persons meeting a COVID-19 WHO

Table 3 Factors associated with poor adherence to COVID-19 preventive measures in the Democratic Republic of the Congo

Factor	Crude OR (95% CI)	Adjusted OR (95% CI)
≥University	1	1
≤Secondary	2.99 (2.51 to 3.56)	2.43 (2.08 to 2.84)
Male	1	1
Female	1.51 (1.33 to 1.71)	1.14 (0.99 to 1.30)
Live alone	1	1
Live with other(s)	1.67 (1.33 to 2.09)	1.39 (1.06 to 1.83)
Student/jobless	1	1
Private employee	0.61 (0.53 to 0.71)	0.76 (0.66 to 0.88)
Public employee	0.44 (0.37 to 0.53)	0.69 (0.57 to 0.86)
Single/separated	1	1
Married/partner	1.13 (1.00 to 1.28)	1.20 (1.03 to 1.40)
Healthcare worker	1	1
Not healthcare worker	2.55 (2.15 to 3.01)	1.85 (1.52 to 2.27)
With a chronic disease	1	1
No chronic disease	0.90 (0.76 to 1.06)	1.03 (0.86 to 1.23)

clinical case definition including anosmia/ageusia were tested positive for SARS-CoV-2.

DISCUSSION

Our study found an overall non-adherence to preventive measures of 60.3% among adults in the DRC. COVID-19 preventive behaviour varied between the provinces. Physical distancing, which has demonstrated its efficacy in reducing viral transmission,^{8,9} was well observed only in Kinshasa, North Kivu and Kasai-Central, with non-adherence rates of 20%, 12% and 40%, respectively. This finding was expected in the city of Kinshasa, which as the capital of the country has the highest number of COVID-19 cases and was allocated more human, logistical and financial resources than other provinces. The low non-adherence to physical distancing in North Kivu may be explained by the experience of the recent Ebola

epidemics.^{2,4,18} Kasai-Central also experienced an Ebola epidemic, but it was a very small one.

Respondents from the Ebola-stricken provinces of North Kivu and Kasai-Central also frequently observed hand hygiene. During all Ebola epidemics in the DRC, handwashing was strongly encouraged given that it was the most affordable preventive strategy, even though running water is scarcely available in some areas.¹⁸ Provinces that had not yet been exposed to Ebola, such as Haut-Katanga and Kasai-Oriental, were often non-adherent to regular handwashing. It is important to ensure that lessons learnt in North-Kivu with Ebola are shared with other provinces to prepare them for the emergence and re-emergence of epidemics that require similar preventive measures.^{4,19} The Ebola model should be seen as an important achievement of the DRC and should be used as a tool to enhance disease prevention and control of future epidemics, not only in the DRC but also elsewhere.^{4,19}

Hand sanitiser use was very low in the two provinces of Kasai. Poverty in these provinces could explain the unavailability of hand sanitisers. Overall, only 18.1% of the participants reported that they disinfected their phones. This information does not seem to be relayed by communicators who raise awareness to fight COVID-19.

In view of the suboptimal adherence to physical distancing in the majority of our study sites, it is very important to promote universal face masking as a compensatory preventive measure.²⁰ Unfortunately, overall non-adherence to mask use was also high in this study (54.7%). In Kinshasa and North Kivu, there were fewer non-users of face masks, 8% and 19.8%, respectively. However, we do not know whether those who reported wearing face masks did so consistently. We speculate that the higher use of face mask in Kinshasa is explained by a higher perceived risk of COVID-19 infection, especially in the community of La Gombe than in the other provinces. Moreover, respondents were mainly university graduates, and 89 were medical students, who were probably well informed about the COVID-19 epidemic. Also, economic constraints in buying face masks might be less of a burden for university graduates. Observed face mask use in

Table 4 Proportion of suspected and confirmed COVID-19 infected respondents per province

	Haut-Katanga (n=425)	Kasai-Central (n=903)	Kasai-Oriental (n=559)	Kinshasa (n=810)	Nord-Kivu (n=488)	Total (n=3058)
Meeting WHO case definition,* n (%)	116 (27)	20 (2)	60 (10)	12 (1)	3 (1)	211 (6)
Meeting new case definition†, n (%)	128 (30)	20 (2)	69 (11)	17 (2)	7 (1)	241 (7)
Anosmia, n (%)	9 (2)	1 (<1)	2 (<1)	9 (1)	3 (1)	24 (1)
Ageusia, n (%)	33 (8)	1 (<1)	16 (3)	14 (2)	5 (1)	69 (2)
Tested for COVID-19, n (%)	7 (2)	0	2 (<1)	24 (3)	2 (<1)	35 (1)
Positive	2 (29)	0	1 (50)	0	0	3 (9)
Negative	5 (71)	0	1 (50)	0	0	32 (91)

*Individuals with fever AND at least one respiratory symptom (dry cough, productive cough, shortness of breath, sore throat, coryza). Contacts/epidemiological links not taken into consideration.

†Individuals with (fever OR anosmia/ageusia) AND at least one respiratory symptom (dry cough, productive cough, shortness of breath, sore throat, coryza). Contacts/epidemiological links not taken into consideration.

suburban areas of Kinshasa is reported to be much lower, and there are anecdotal reports that people with a mask are often verbally abused. This may be related to misconceptions fuelled by rumours and fake news. In such areas, many people do not believe COVID-19 is present in the DRC and that it is all a plot 'to get donor money'.⁴

In Kasai-Central, Kasai-Oriental and Haut Katanga, the use of face mask was very low, 10.7%, 16.8% and 18.1%, respectively. An explanation could be that these poor provinces, in contrast with Kinshasa and North Kivu, did not receive a lot of support from international organisations in terms of face mask distribution as well as streamlined training for healthcare workers to improve health promotion. The reasons for the low use of face mask in Haut-Katanga, which is one of the richest provinces in the DRC, warrant further investigation. It may be that the population in this province is not convinced that COVID-19 is a serious health problem. A survey in April 2020 among sellers and customers frequenting the food sections of 10 public markets in three large cities in this province showed that preventive practices were rarely in place. Moreover, 88% of the persons interviewed had no confidence in the government's ability to manage the pandemic. Only 30% of participants had correct knowledge of COVID-19%, and 98% were concerned about the increase in food insecurity associated with the lockdown measures.²¹

In North Kivu, the reported use of face mask was fairly high (79.2%). However, during surveys conducted in May 2020 in Bukavu (South Kivu), practically no mask use was observed despite repeated recommendations from the health authorities and good awareness of the importance of these measures among the local population.²²

The official reports that showed higher COVID-19-related morbidity and mortality in Kinshasa may have motivated the people in Kinshasa to wear face masks. A modelling study suggested that proper use of face mask is able to reduce the risk of COVID-19 transmission by 79%.¹¹ Therefore, it is important to identify the reasons for not using face masks and to strengthen the confidence of the population in effective preventive measures through local communication.¹⁹ We recommend subsidising the local manufacturing of masks to avoid stock shortages.²³ A public-private partnership initiative could increase the availability of masks, for example, in Haut-Katanga, by involving mining companies.^{4,24}

The postconflict context followed by current political vicissitudes in the DRC makes the situation vulnerable with regard to the spread of COVID-19. For example, by the end of June 2020 and early July 2020, there were political demonstrations in Kinshasa as well as in other cities of the country such as Lubumbashi and Mbuji-Mayi, related to the legislative proposals on the reform of the judicial system in the DRC. These demonstrations took place while the country was still in a state of emergency, and COVID-19 preventive measures were rarely observed by protesters. There is a huge need to strengthen adherence

with these protective measures against COVID-19, for fear that the virus becomes difficult to control in the DRC.²⁴

A low education level was associated with non-adherence. Several studies have demonstrated the association between low levels of education and the non-adoption of preventive behaviour.^{25 26} Therefore, community sensitisation should target the less educated, address them in their local language and use local role models and teachers.

Students/jobless participants were more likely to be non-adherent. The reasons may be that companies and other public workplaces enforced the implementation of preventive measures by making face masks and physical distancing compulsory as required by the government for fear of sanctions.⁷⁻⁹ Participants who were married or living with a partner had higher odds for non-adherence compared with those who were single. The reason for this is unclear.

Only a minority of the participants who reported symptoms suggesting COVID-19 infection were tested. It is recommended to further decentralise COVID-19 testing in the DRC and to prioritise those who are living in households with people over 60 years of age to reduce COVID-19 transmission in those families to prevent COVID-19-related mortality.^{27 28}

Respondents who were healthcare workers reported good preventive behaviour, most likely because they were already well aware and trained to observe preventive measures for COVID-19 and other diseases. In addition, healthcare personnel are responsible for training and raising awareness among the patients/communities and are expected to show a good example to the patients.^{29 30}

Our study has several limitations. First, our study respondents cannot be considered to be representative of the general population living in the provinces where the survey was done. Indeed, respondents were mainly recruited from among more educated individuals who often had more access to the internet and smartphones. Moreover, self-reports may be influenced by recall bias and social desirability. Also, the fact the questionnaire was completed over a 6-week period in a context of a rapidly changing COVID-19 landscape may render the interpretation of our findings and comparisons across provinces difficult. However, more than 80% of the recruitment occurred during the last 3 weeks of the data collection after the research assistants were included in the process. During these last 3 weeks, data collection took place simultaneously in all the provinces. Another limitation is that we did not ask why certain people did not adhere to the preventive measures. We also did not investigate the role of psychological variables that may affect adherence with preventive measures, such as the perceived difficulty of doing so, boredom and self-control.³¹ The fact that relatively few persons in Kinshasa reported flu-like symptoms is in contrast with the high number of COVID-19 cases officially reported in the capital. The reason for this could be that most respondents were living outside the most affected area of Kinshasa (La Gombe) and because

persons living in Kinshasa were the first to complete the questionnaire at an early phase of the epidemic.

Despite the fact that preventive measures in the DRC are not followed by large parts of the population, the pandemic seems not to be progressing. As of 23 October, the cumulative number of COVID-19 cases was 11 096, with 19 new cases identified in 24 hours and only 304 cumulative deaths.³² These low numbers cannot be explained by the still limited COVID-19 testing capacity in the DRC. Indeed, hospitals in the DRC have not reported huge numbers of hospitalised patients with COVID-19 symptoms. With the exception of South Africa, in many sub-Saharan African countries, an epidemic peak of COVID-19 infections comparable as in Europe, USA or South America was never observed, and currently a decrease in the number of new infections is being observed. By October, Africa, which makes up 17% of the global population, had recorded just 3.5% of COVID-19 deaths.³³ Many hypotheses have been proposed to explain this low COVID-19-related morbidity and mortality in sub-Saharan Africa, such as under-reporting of cases, early effective strict lockdown measures, the young age of the population, previous exposure to other coronaviruses, a strong immune system because of frequent exposure to pathogens, and climatological and genetic factors; however, a clear explanation is still lacking.³⁴

CONCLUSION

The level of adherence to preventive measures against COVID-19 among respondents in this survey was suboptimal, despite the compulsory guidelines instituted by the DRC government. Regional disparities in the implementation of these measures are remarkable. There is an urgent need to further explore the reasons for these disparities to implement an effective response and reinforce COVID-19 prevention. To this end, community engagement and involvement should be strongly encouraged as the key to success. We recommend implementing public-private partnerships, peer support approaches and positive deviance to reverse the current trends of non-adherence. Moreover, future research should investigate why the frequent non-adherence to preventive measures in the DRC, as reported in this study, has not resulted in a relatively higher COVID-19 disease burden and mortality like in Europe and the Americas.

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