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Research Article

Low COVID-19–related knowledge and access to adequate handwashing among patients with chronic diseases in rural Rwanda: a cross-sectional survey

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Background

The coronavirus disease 2019 (COVID-19) misinformation and inadequate access to hygiene and sanitation amenities could hamper efforts to contain COVID-19 spread in resource-limited settings. In this study, we describe knowledge of COVID-19 symptoms and preventive measures, sources of information, and access to adequate handwashing among patients with chronic diseases in three Rwandan rural districts during the onset of COVID-19 in Rwanda.

Methods

This was a cross-sectional survey conducted among patients who were enrolled in the HIV/AIDS, non-communicable diseases, mental health, oncology, and pediatric development programs at health facilities in Kayonza, Kirehe and Burera districts. The study sample was randomly selected and stratified by district and clinical program. Telephone-based data collection occurred between 23 April and 11 May 2020. Primary caregivers responded to the survey when the selected patient was a child under age 18 or severely ill. We defined good knowledge of COVID-19 symptoms and preventive measures as knowing that a dry cough and fever were common symptoms and social distancing or staying home and regular handwashing could prevent COVID-19 infection. Access to adequate handwashing was defined as living in a household with a handwashing station and regular access to clean water and soap. We used Fisher's exact tests and logistic regression to measure associations between the source of information and good knowledge about COVID-19 and between socio-economic characteristics and access to adequate handwashing.

Results

In total, 150 patients and 70 caregivers responded to the survey. Forty-eight (22.3%) respondents had no formal education. Sources of COVID-19 information included mass media (86.8%), local government leaders (27.3%), healthcare workers (15.9%) and social media (6.8%). Twenty-seven percent (n=59) of respondents had good knowledge of COVID-19 symptoms and preventive measures. In the adjusted analysis, getting information from news media was associated with having good knowledge about COVID-19 (adjusted odds ratio, aOR: 5.46; 95% CI: 1.43-20.75]. Seventy-nine (35.9%) respondents reported access to adequate handwashing at home, with access varying significantly by the district in favour of Kayonza (61.3%).

Conclusions

COVID-19-related knowledge and access to adequate handwashing were low among patients with chronic diseases at the beginning of the pandemic in Rwanda. Efforts to mitigate COVID-19 spread among chronic care populations may include investment in targeted COVID-19-related education and access to adequate handwashing.

The coronavirus disease 2019 (COVID-19) pandemic has been compounded by misinformation about COVID-19's source, ways to prevent infection, and effective treatment options, and this trend is expected to continue.[1–3] False information is often spread through social media platforms and must be countered by providing evidence-based information to targeted populations in a timely manner.[4] However, information dissemination is complicated because the knowledge of COVID-19 is constantly evolving in response to new scientific discoveries.[5] Even though COVID-19 is a global pandemic and misinformation is a global problem,[6,7] current evidence suggests that the level of knowledge about COVID-19 may significantly vary by residence, with rural populations being less likely to have good knowledge[8]; as well as by other socioeconomic characteristics.[9] Although patients with pre-existing comorbidities and chronic diseases face a higher risk of COVID-19-related severe complications and are consequently a high-priority group for infection prevention,[10,11] few studies on COVID-19-related knowledge have focused explicitly on this vulnerable population in high-income,[12] and low-income countries.[13,14]

In low-resource settings, individuals who possess proper knowledge of COVID-19 prevention may still be unable to act on their knowledge due to the lack of necessary resources. For example, knowledge about social distancing cannot be acted on in households with high levels of crowding, while good hand hygiene cannot be practised in settings that lack clean water and soap. While handwashing helps prevent the spread of infectious diseases, including COVID-19, it is estimated that in 2020, 640 million people had no handwashing facility at home, with 58% of them living in resource-limited settings.[15] The rural sub-Sahara African (SSA) region is of particular concern. An analysis of 77 cross-sectional surveys conducted in 33 SSA countries between 2001 and 2017 reveals that only 10% of rural populations live in improved households built with finished materials, access to improved water and sanitation, and three or fewer people per bedroom.[16] Similarly, an analysis of demographic and health surveys from 16 SSA countries suggests that between 2015-2018, only 33.5% of households have access to a handwashing place with water and soap, with even lower access among rural and poor households.[17]

Although African countries initially adopted strict measures to combat COVID-19, including implementing regional and nation-wide lockdowns at the onset of the COVID-19 pandemic, these measures have gradually been relaxed to save collapsing economies.[18] In the face of these simple measures and given the continued low access to COVID-19 vaccines in low- and middle-income countries (LMICs),[19] there is a continued need to identify alternative strategies for COVID-19 prevention and to identify and remove knowledge- or resource-related barriers to infection prevention.[18] In Rwanda, where many rural and low-income families suffer from limited access to water and sanitation facilities and supplies in households,[15,17,20] the first case of COVID-19 was reported on 14 March 2020, and a nation-wide lockdown was instituted from 22 March to 3 May 2020.[21] Although two previous studies conducted among urban Rwandans living with HIV/AIDS and hotel staff in Kigali, revealed a good level of knowledge about COVID-19,[22,23] little is known about the knowledge of COVID-19 among the 83% of Rwandans who live in rural areas.[24] In addition, Rwanda is one of 28 countries in which an estimated more than 25% of the population have no handwashing facility at home.[15] This study aimed to describe knowledge of COVID-19 symptoms and preventive measures, sources of information, and access to adequate handwashing at home among patients with chronic diseases in three Rwandan rural districts during the onset of the COVID-19 pandemic in Rwanda.

METHODS

STUDY DESIGN AND SETTING

We analysed data collected from a cross-sectional survey assessing the needs of patients with chronic diseases at the start of the COVID-19 pandemic in Rwanda. Respondents were either patients or primary caregivers of patients who were enrolled in the HIV, non-communicable diseases (NCD), mental health (MH), oncology, or pediatric development clinic (PDC) programs at health facilities in Kayonza, Kirehe and Burera districts. These public-operated health facilities are located in rural areas within the catchment areas of Rwinkwavu, Kirehe and Butaro District Hospitals, which are supported by Partners In Health/Inshuti Mu Buzima (PIH/IMB), a not-for-profit organisation that has been supporting the Ministry of Health to improve health care delivery in Rwanda since 2005. At the time of the survey, a total of 24,635 patients with chronic conditions were actively followed up through the five chronic care programs at these facilities, including patients with diabetes type 1 or 2, asthma, hypertension and heart failure who received clinical care and followed up through the NCD program; patients with epilepsy, depression and other mental health disorders followed up through the MH program; and vulnerable children under five born preterm, with low birth weight and/or diagnosed with hypoxic-ischemic encephalopathy after their discharge from the neonatology care units being followed up through the PDC program.

STUDY SAMPLE AND DATA COLLECTION

The study inclusion criteria included being an active chronic-care patient with a clinical visit scheduled between March-June 2020, among the residents of Kayonza, Kirehe or Burera districts and having a telephone number recorded

in the electronic medical records (EMR) system. Study participants were randomly selected and stratified by district and clinical program. The goal was to select at least 48 patients from each clinical program so that program-specific estimates could be reported with 95% confidence intervals and +/-15% precision. However, a low proportion of patients with a valid telephone number recorded in EMR and could be reached for interviews was a limitation for the survey to achieve the planned sample sizes for all clinical programs. More details regarding the sampling process have been described elsewhere.[25] Data collection was conducted through computer-assisted telephone interviews between 23 April and 11 May 2020, towards the end of the nationwide COVID-19 lockdown. Interviews were conducted by six trained data collectors, and all data was directly recorded in REDCap.[26,27] Primary caregivers responded to the survey questions for selected patients who were younger than 18 years or who were critically ill.

DEFINITION OF KEY VARIABLES

Our analysis focused on describing the knowledge about COVID-19 symptoms, infection preventive measures and access to resources necessary to act on this knowledge among survey respondents at the beginning of the COVID-19 pandemic in Rwanda. The survey that provided data for this study included several open-ended knowledge-related questions. Data collectors assessed whether participants' responses included material from several pre-defined categories. A single response could include materials from multiple categories. Respondents who had heard of COVID-19 were asked, *"What do you know about COVID-19* with response options including: (a) COVID-19 is a contagious disease; (b) most people get a minor illness from COVID-19; (c) COVID-19 can be lethal; (d) older people are at higher risk from COVID-19; (e) people with pre-existing diseases are at higher risk from COVID-19; (f) fever is a common symptom, or (g) a dry cough is a common symptom. Survey respondents were also asked if they knew how to protect themselves against COVID-19. If yes, respondents were requested to free-list ways they should protect themselves and others from COVID-19 infection with response options including (a) washing hands; (b) staying home; (c) covering one's mouth and nose with a cloth/mask; (d) coughing or sneezing with a tissue; (e) coughing or sneezing inside the elbow and (f) cleaning frequently touched surfaces daily. Survey respondents were also asked to provide their sources of information about COVID-19, with response options including (a) friends and relatives; (b) health care workers; (c) local leaders; (d) religious leaders; (e) social media and (f) radio, TV and newspapers (Note: the survey tool didn't specify whether the reported source was radio or TV or newspaper, or 2 or 3 of them, however, with the national distribution of households with radio (77.8%) TV set (12.4%) and access to the internet (23.8%),[28] it should be understood that radio was the source of information for the majority of respondents when mass media (radio, TV and newspapers) was selected. For these three questions, interviewers were instructed NOT to read these options, but to use "anything or anywhere else" as a probe for exhausting the respondent's response. And "other" option was also included to record the information that was not captured in the pre-identified categories. In this study, we defined *"good knowledge about COVID-19 symptoms and infection prevention measures"* as knowing: (a) dry cough and fever as common symptoms of COVID-19, and (b) social distancing or staying home and washing hands as preventive measures. The knowledge of mask use to prevent COVID-19 infection was not included in the definition of this composite outcome due to the inconsistencies in the global literature regarding its benefits at the time of the survey.[29] In Rwanda, while mandatory use of masks in public premises was communicated on 19 April, 2020,[30] nation-wide implementation of facemasks only started after the national lockdown was relaxed on 4 May, 2020[21] – when data collection for this study was almost concluded. However, we did assess how the proportion of participants with good knowledge about COVID-19 changed when we included covering one's mouth and nose with a cloth/mask as part of the outcome definition.

The cross-sectional survey also collected data on access to hygiene and sanitation resources using yes or no questions. Survey respondents were asked if their households regularly had access to clean water, soap and hand sanitiser as essential supplies for infection prevention/control. Respondents were also asked if their households had a station for handwashing and whether that place always had water and soap or not. For this analysis, *"access to adequate handwashing"* was defined as the respondent's reported living in a household with a handwashing station and regular access to water and soap.[31,32] *"Crowding in the household"* was assessed by asking each respondent to report on the total number of individuals who live in his/her household and the number of bedrooms in the house, with "crowding" defined as living in a household with more than three people per bedroom.[16] *"Socioeconomic status"* was measured using the 2015 Rwandan Government's Ubudehe categorisation of households - a four-level categorisation ranging from 1 (poorest) to 4 (richest).[33] Category 1 included people who belong to families that do not own a house and struggle to afford basic needs, while category 3 included households with members with a full-time job or famers who can go beyond subsistence farming.

DATA ANALYSIS

We used frequencies and percentages to describe respondents' socioeconomic characteristics, knowledge about COVID-19, source of information, and access to adequate handwashing. We used Fisher's exact tests to measure the associations between each covariate and outcomes. We used a multivariable logistic regression model built using backwards stepwise to investigate the socioeconomic characteristics of study participants that were significant predictors of having good knowledge of COVID-19 symptoms and its infection preventive measures, with the final model including all variables with a p-value<0.20 and the participant's level of education variable which would be forced into the model, regardless of the *P*-value. Then, we fit a model to assess the association between each reported

source of information about COVID-19 and having good knowledge of COVID-19 symptoms and its preventive measures, with each model being adjusted for all variables retained in the final model as socioeconomic predictors of good COVID-19 knowledge. We also used Fisher's exact tests and a multivariable logistic regression model built using backwards stepwise to assess whether socioeconomic factors, including the district of residence, respondent's level of education and household socioeconomic status, were associated with having access to adequate handwashing at home – variables with a P-value<0.20 were retained in the final reduced model. Wald tests were used to calculate p-values for each variable in the logistic regression models and all data were analysed using Stata v.15.1 (Stata Corp, College Station, TX, USA).

ETHICS

This study was approved by Partners In Health/ Inshuti Mu Buzima Research Committee and all involved clinical programs had umbrella protocols approved by the Rwanda National Ethics Committee (RNEC) ((MH: 196/RNEC/2020; NCD: 910/RNEC/2019; HIV: 015/RNEC/2020; Oncology: 805/RNEC/2019 and PDC: 713/RNEC/2019). Selected patients were contacted via phone numbers as recorded in the EMR system, explained the purpose of the survey and ethics and invited to participate voluntarily. The interview was only conducted after receiving the oral informed consent from the participant – which could be immediately started or scheduled at a later time which was convenient for the participant. Primary caregivers were survey respondents in the case of children under 18 or critically-ill patients.

RESULTS

In total, 220 patients from five chronic care programs participated in this study (Table 1). Fifty patients (22.7%) were from the NCD program, 49 (22.3%) from the HIV/AIDS program, 47 (21.4%) from the PDC program, 43 (19.6%) from the MH program and 31 (14.1%) from the oncology program. Among the respondents, 150 (68.2%) were patients themselves, while 70 (31.8%) were caregivers who responded on behalf of children or severely ill patients. Of the 70 respondents who were caregivers, 47 (67%) reported for children in the PDC program, 20 (29%) reported on behalf of patients in the mental health program, and the remaining three reported on behalf of patients from oncology or HIV programs. In terms of geographical location, 80 (36.4%) survey respondents were from the Kirehe district, 75 (34.1%) from Kayonza and 65 (29.6%) from Burera. Forty-eight (22.3%) survey respondents reported no formal education, while the highest level of education was primary education for 123 (55.9%) respondents. Thirty-eight respondents (17.3%) were in the lowest socioeconomic category (Ubudehe category 1), while 82 (37.3%) were in Ubudehe category 2 and 98 (44.6%) in category 3.

Of the 220 respondents, 218 (99.1%) had heard of COVID-19. The most commonly reported knowledge about COVID-19 included the knowledge that COVID-19 was a contagious disease (n=150, 68.2%), that coughing (n=114, 51.8%) and fever (n=104, 47.3%) were common symptoms, that COVID-19 could cause death (n=66, 30.0%), and that people with pre-existing diseases were at a higher risk of severe illness from COVID-19 (n=26, 11.8%). In total, 217 (98.6%) respondents could name at least one COVID-19 prevention measure. The most commonly reported preventive measures against the COVID-19 infection included social distancing or staying home (n=175, 79.6%), handwashing (n=161, 73.2%), wearing a face mask (n=87, 39.6%) and cleaning frequently touched surfaces (n=40, 18.2%). Reported sources of information on COVID-19 included news outlets (radio, TV and newspapers, n=191, 86.8%), local government leaders (n=60, 27.3%), health-care workers (n=35, 15.9%) and social media platforms (n=15, 6.8%). Although many respondents reported having regular access to clean water (n=193, 87.7%), fewer reported having a handwashing station (n=131, 59.8%) or soap (n=118, 53.6%) in their households. For household crowding, 21 (9.6%) respondents reported living in a household with more than three people per bedroom.

Twenty-seven percent (n=59) of participants had good knowledge about the COVID-19 symptoms and its infection preventive measures (Table 2). When we included knowledge of mask-wearing in the definition of our composite outcome, only 26 (11.8%) respondents had a good level of knowledge about COVID-19. Among the socioeconomic characteristics of study participants, reporting good knowledge of COVID-19 symptoms and its infection preventive measures significantly varied by the district of residence, with participants from the Burera district being more likely to have good COVID-19 knowledge [adjusted odds ratio, aOR=2.84; 95% confidence interval, CI=1.19-6.77] compared to Kayonza district. In addition, even if not statistically significant, lower odds of having good COVID-19 knowledge were observed among study participants from the Kirehe district [aOR: 0.46; 95% CI: 0.19-1.09] compared to participants from the Kayonza district. For the association between each source of information about COVID-19 and having good knowledge of COVID-19 symptoms and its infection preventive measures, after adjusting for the district of residence, level of education and patient's clinical program, increased odds of having good COVID-19 knowledge were associated with reporting news outlets as the source of information [aOR: 5.46; 95% CI: 1.43-20.75] (Table 3). No other sources of information were significantly associated with having good COVID-19 knowledge.

Regarding access to adequate handwashing, 79 (35.9%) respondents reported having a handwashing station with regular access to water and soap (Table 4). In the univariate analysis, access to adequate handwashing was significantly associated with the district of residence, level of education, and socioeconomic class (Ubudehe category). In the final logistic regression model, only the district of residence and household's socioeconomic class remained significantly associated with access to adequate handwashing at home. Lower odds of having access to adequate handwashing at home were observed among participants from Burera (aOR: 0.09; 95% CI: 0.03-0.21) and Kirehe (aOR: 0.31; 95% CI:

Table 1. Socioeconomic characteristics of study participants, self-reported source of information and knowledge of COVID-19 symptoms and its infection preventive measures, access to sanitation and hygiene supplies and crowding in households, N=220 unless otherwise indicated

Variables	n (%)
Patient's clinical program	
HIV	49 (22.3)
Non-communicable Disease (NCD)	50 (22.7)
Mental Health (MH)	43 (19.6)
Pediatric Development Clinic (PDC)	47 (21.4)
Oncology	31 (14.1)
Survey respondent	
Patient him/herself	150 (68.2)
Caregiver	70 (31.8)
Respondent's district of residence	
Kayonza	75 (34.1)
Kirehe	80 (36.4)
Burera	65 (29.6)
Household's socioeconomic class (Ubudehe category)	
1	38 (17.3)
2	82 (37.3)
3	98 (44.6)
Unknown	2 (0.9)
Respondent's highest level of education	
No formal education	48 (21.8)
Primary	123 (55.9)
Secondary or higher	44 (20.0)
Missing data	5 (2.3)
Reported knowledge about COVID-19*	
A contagious disease	150 (68.2)
Coughing is a common symptom	114 (51.8)
Fever is a common symptom	104 (47.3)
It can cause death	66 (30.0)
People with pre-existing diseases are at higher risk	26 (11.8)
Old people are at higher risk	7 (3.2)
Most people get a minor illness from COVID-19	3 (1.4)
Other	5 (2.3)
Reported knowledge of COVID-19 infection preventive measures*	
Social distancing or staying home	175 (79.6)
Washing hands	161 (73.2)
Using a mask	87 (39.6)
Cleaning of frequently touched surfaces	40 (18.2)
Coughing or sneezing inside the elbow	14 (6.4)
Coughing or sneezing with a tissue	12 (5.4)
Other	1 (0.5)
Reported source of information about COVID-19*	
News outlets (radio, TV, newspapers, etc.)	191 (86.8)
Local leaders	60 (27.3)

Health care workers	35 (15.9)
Friends and relatives	29 (13.2)
Social media	15 (6.8)
Other	4 (1.8)
Access to hygiene and sanitation supplies*	
Handwashing station	131 (59.8)
Water	193 (87.7)
Soap	118 (53.6)
Hand sanitiser	2 (0.9
Number of people per bedroom in the household	
≤3 people	199 (90.4)
More than 3 people	21 (9.6)

*It was possible for one study participant to know multiple things about COVID-19, have multiple sources of information about COVID-19 and access to multiple hygiene and sanitation supplies.

0.16-0.62) districts compared to participants from Kayonza district. Compared to relatively wealthy (Ubudehe category 3) households, lower odds of access to adequate handwashing at home were observed among study participants living in poor households in Ubudehe category 2 (aOR: 0.37; 95% CI: 0.18-0.74] and Ubudehe category 1 (aOR: 0.63; 95% CI: 0.26-1.51).

DISCUSSION

In this study, we described COVID-19-related knowledge and the available resources needed to act on this knowledge among patients or caregivers to patients with chronic diseases during the onset of COVID-19 in Rwanda. Our findings reveal that only approximately one in four respondents (26.8%) possessed a comprehensive knowledge of COVID-19 symptoms and infection preventive measures. Our findings suggest much poorer knowledge about COVID-19 among rural patients with chronic diseases compared to the findings from two studies on COVID-19-related knowledge, attitudes and practices (KAP) among hotels' staff and HIV patients receiving clinical follow-up at a hospital in Kigali City.[22,23] There are several reasons for this discrepancy. First, the KAP studies for hotels' staff and HIV patients were conducted three and four months after our study was completed, respectively, and proper knowledge about COVID-19 could have grown over this time. Second, these two KAP studies were conducted among urban Rwandans, who are more likely to have had better access to information than our rural respondents – this is consistent with other studies in SSA that found a significantly lower level of knowledge about COVID-19 among rural populations than urban populations.[8,9] Third, our survey employed open-ended questions, whereas the KAP studies used multiple-choice questions, which could have resulted in participants guessing the correct answer.[34] We found that participants who reported the news outlets (radio, TV and newspapers) as sources of information were more likely to have good knowledge than their counterparts who did not use news outlets. Similar associations between reporting mass media as the source of information and having improved knowledge about COVID-19 have been found elsewhere in SSA.[8] Although these chronic care patients should have regular clinical visits at health facilities, relatively few respondents cited healthcare providers as a source of COVID-19-related knowledge. This finding suggests that healthcare providers could be an underutilised source for providing education on COVID-19 symptoms and infection prevention. However, it can be explained by the fact that this study was conducted during a nation-wide lockdown, limiting the interaction between patients and their healthcare providers. As the fight against COVID-19 continues, integrating education on COVID-19 symptoms and preventive measures in the routine care at health facilities could contribute to improving the knowledge of COVID-19 among chronic care patients. Surprisingly, our findings did not show an association between educational level and knowledge of COVID-19 symptoms and infection preventive measures. The lack of association between educational level and COVID-19 knowledge may be explained by the fact that this study was conducted in the early days of the COVID-19 pandemic and during a nation-wide lockdown in Rwanda when the source of information about COVID-19 was almost common for study participants (radio and/or local government leaders) and there was still limited education on COVID-19. In addition, this study was conducted in rural settings where only one in five participants had a secondary or higher level of education. In other studies, the educational level was reported to be associated with the COVID-19 knowledge among sub-Sahara African populations,[9,35] including urban Rwanda.[23]

We also observed low access to adequate handwashing (35.6%), defined as living in a household with a handwashing station with regular access to water and soap. This finding is consistent with previous reports on disproportionate low proportions of households with access to water, soap and sanitation facilities in rural Rwanda.[15,17,20] Access to adequate handwashing was significantly associated with the geographical location (district of residence) and the household's socioeconomic class (Ubudehe category), with

Table 2. Socioeconomic predictors of having good knowledge of COVID-19 symptoms and its infection preventive measures

Variables	Having good knowledge of COVID-19 symptoms and its infection preventive measures		Final reduced model[a]	
	Yes, n (%)	p-value[†]	aOR[1] [95% CI[2]]	p-value[‡]
Overall	59 (26.8)	-		
Type of survey respondent		0.033		
Patient	47 (31.3)			
Caregiver	12 (17.1)			
District of residence		<0.001		0.001
Kayonza	18 (24.0)		ref	
Kirehe	10 (12.5)		0.46 [0.19-1.09]	
Burera	31 (47.7)		2.84 [1.19-6.77]	
Respondent's level of education		0.358		0.995
No formal education	17 (35.4)		ref	
Primary	30 (24.4)		0.99 [0.41-2.37]	
Secondary or higher	12 (27.3)		1.03 [0.36-2.95]	
Household's socioeconomic class (Ubudehe category)		0.791		
1	12 (31.6)			
2	21 (25.6)			
3	26 (26.5)			
Patient's clinical program		0.017		0.065
Non-communicable diseases (NCD)	17 (34.0)		ref	
HIV/AIDS	20 (40.8)		1.38 [0.57-3.38]	
Mental Health	9 (20.9)		0.56 [0.20-1.52]	
Pediatric development clinic (PDC)	6 (12.8)		0.48 [0.15-1.49]	
Oncology	7 (22.6)		0.36 [0.12-1.08]	

[†]p-value from the Fisher's exact tests of the association between each variable and the patient/caregiver's knowledge of COVID-19 and its infection preventive measures.
[a]The multivariable model included only variables with a p-value<0.20, however the respondent's level of education was forced into the final model regardless of its p-value.
[1]aOR, adjusted odds ratio
[2]CI, confidence interval
[‡]p-value from Wald tests for each variable retained in the final reduced model.

participants from Burera district and/or relatively poor households being the most vulnerable. The lack of access to adequate handwashing facilities underscores the fact that in low-resource settings, knowledge about COVID-19 prevention will not be enough to enable individuals to protect themselves from infection. This situation is of particular concern for vulnerable people, such as the patients with chronic diseases, who need particular protection against COVID-19 infection given their elevated risk of severe illness and death from COVID-19.[36] The government of Rwanda has collaborated with other non-governmental organisations and the private sector to establish handwashing facilities in public premises like bus parks,[37] markets and health facilities, however as our findings suggest, more need to be done to support access to handwashing at home in rural settings.

This study has several limitations. First, this study was a cross-sectional study conducted during the onset of the COVID-19 in Rwanda. We expected that knowledge about COVID-19 improved over time such that the level of knowledge reported here is an underestimate of current knowledge levels. Second, because we assessed knowledge using open-ended questions and the interview time was limited for a phone-based survey,[38] we expect that we could only

Table 3. Assessing the association between self-reported source of information about COVID-1 and the patient/ caregiver's good knowledge of COVID-19 symptoms and its infection preventive measures

Factors	Univariate analysis of the association between each source of information and having good knowledge about COVID-19		Logistic regression results	
	Having good knowledge about COVID-19, n (%)	p-value†	aOR[1] [95% CI[2]]	p-value‡
Overall	59 (26.8)	-		
Reported "news outlets" (radio, TV, newspaper) as the source of COVID-19 information		0.041		**0.013**
No	3 (10.3)		**ref**	
Yes	56 (29.3)		**5.46 [1.43-20.75]**	
Reported "Local leaders" as the source of COVID-19 information		>0.999		0.487
No	43 (26.9)		ref	
Yes	16 (26.7)		0.76 [0.34-1.66]	
Reported "Health care workers" as the source of COVID-19 information		0.535		0.313
No	48 (26.0)		ref	
Yes	11 (31.4)		0.62 [0.25-1.57]	
Reported "Relatives or friends" as the source of COVID-19 information		0.177		0.388
No	48 (25.1)		ref	
Yes	11 (37.9)		1.52 [0.59-3.93]	
Reported "Social media" as the source of COVID-19 information		0.365		0.391
No	57 (27.8)		ref	
Yes	2 (13.3)		0.48 [0.09-2.56]	

†p-value from the Fisher's exact tests of the association between each source of information and the patient/caregiver's knowledge of COVID-19 and its infection preventive measures.

[1]aOR, adjusted odds ratio from multivariable logistic regression models of the association between each source of information and having good knowledge about COVID-19. Each model was adjusted for the district of residence, level of education and patient's clinical program.

[2]CI, confidence interval

‡p-value from Wald tests for each model.

capture respondents' most salient COVID-19 - related knowledge. This limitation could also result in an underestimation of the true level of COVID-related knowledge. However, data collectors were trained to probe participants to more fully assess COVID-related knowledge, and this open-ended format is less vulnerable to bias due to participants guessing the correct answer, which can occur in multiple-choice style assessments. Third, the survey didn't collect data on the gender and age of respondents who were not patients (32% of respondents). Therefore, while the existing literature suggests an association between age, gender and the level of knowledge about COVID-19 in SSA,[9] this information was not available to be included in our analysis.

CONCLUSIONS

Poor knowledge of COVID-19 symptoms and preventive measures and inadequate access to handwashing among patients with chronic diseases and their caregivers are contextual factors which could pose a challenge to ongoing efforts to contain the spread and reduce the harm of COVID-19 in rural Rwanda. Our study findings suggest the need for increased education on COVID-19 for chronic care patients through effective channels and increased economic support with the provision of supplies like soap and hand sanitisers to vulnerable families to enable access to adequate handwashing and cleaning at home. In addition, as the fight against the COVID-19 pandemic continues, we also recommend further research to explore the impact of the ongoing national communication and health promotion

Table 4. Factors associated with the patient's access to adequate handwashing at home, defined as having a handwashing station and regular access to water and soap in the household

	Reported having access to adequate handwashing at home		Final reduced model[a]	
Factors	**Yes, n (%)**	**p-value†**	**aOR[1]] [95% CI[2]]**	**p-value‡**
Overall	79 (35.9)	-		
District of residence		<0.001		<0.001
Kayonza	46 (61.3)		ref	
Kirehe	25 (31.2)		0.31 [0.16-0.62]	
Burera	8 (12.3)		0.09 [0.03-0.21]	
Respondent's level of education		0.007		
No formal education	10 (20.8)			
Primary	45 (36.6)			
Secondary or higher	23 (52.3)			
Household's socioeconomic class (Ubudehe category)		0.009		0.019
1	12 (31.6)		0.63 [0.26-1.51]	
2	21 (25.6)		0.37 [0.18-0.74]	
3	46 (46.9)		ref	

†p-value from the Fisher's exact tests of the association between each variable and access to adequate handwashing at home.
[a]The model included only variables with a p-value<0.20
[1]aOR, adjusted odds ratios from the multivariable logistic regression analysis of the factors associated with access to adequate handwashing at home.
[2]CI, confidence interval
‡p-value from Wald tests for each variable in the model.

strategies on COVID-19-related knowledge among the same population in Rwanda.

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AUTHORSHIP CONTRIBUTIONS

AN, DAB, VKC and GU conceived and designed the study. AN led data analysis and literature search, wrote the first draft of the manuscript and updated subsequent versions of the paper with co-author comments and inputs. DAB supported data analysis. DAB, FK, CM, AN, GN, PU, JG, SG, JPU, EN, VKC and GU contributed to the interpretation of results, revised the manuscript, suggested policy implications from the findings and edited the final draft.

COMPETING INTERESTS

The authors completed the Unified Competing Interest form at http://www.icmje.org/disclosure-of-interest/ (available upon request from the corresponding author), and declare no conflicts of interest.

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