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Community health workers' knowledge, attitudes, and perceptions of risk for COVID-19: A cross-sectional survey in Haiti, Malawi and Rwanda

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ABSTRACT

Background: Community health workers (CHWs) are a trusted source of health care information for rural communities in many low- and middle-income countries. This became particularly relevant during the COVID-19 pandemic when individuals had restricted access to facilities and required sufficient knowledge to prevent infection. This paper assesses CHWs' level of knowledge, attitudes, and risk awareness towards COVID-19 and willingness for and concerns about vaccination against COVID-19 among CHWs in Rwanda, Malawi and Haiti.

Methods: Between June 2023 and October 2023, we surveyed 525 CHWs – 175 CHWs per country in Haiti, Malawi, and Rwanda – affiliated with 54 health care facilities. Data on CHWs' demographics, COVID-19 knowledge, attitudes, risk perceptions, and vaccine intention were collected. Participants indicated on a Likert scale their perception of COVID-19 in terms of its risk-worry-severity-control. We analyzed mean trust scores, correct answer rates and answer frequencies and reported global p-values, assessing any difference and pairwise p-values, assessing country-specific differences, using rank-based and ANOVA tests.

Results: Across all countries, CHWs perceived COVID-19 as a relatively controllable disease of little worry and considered their risk of contracting the virus lower than or average as compared to other diseases. In Rwanda and Haiti, CHWs showed strong knowledge of COVID-19 and the COVID-19 vaccine (correct answer rate Rwanda: 87.5%; Haiti: 81.3%), while CHWs knew considerably less in Malawi (correct answer rate: 12.9%). The vast majority of CHWs believed COVID-19 presents a serious threat to the public (Haiti: n=168, 96.0%; Malawi: n=159, 91.0%; Rwanda: n=173, 99.0%) and were confident that their country would win the battle against the COVID-19 virus (Haiti: n=149, 85.0%; Malawi: n=133, 76.0%; Rwanda: n=171, 98.0%).

Conclusions: The knowledge of COVID-19 and the COVID-19 vaccine among CHWs, along with their attitudes and perceptions of the virus, varies across countries and is likely influenced by cultural and political factors. Given the CHWs' roles to disseminate knowledge among communities in Haiti, Malawi, and Rwanda, targeted CHW education and communication training could improve community responsiveness in the future.

Keywords: COVID-19 vaccines, health risks, community health workers, public health, global health, misinformation.

1. Introduction

COVID-19 was one of the deadliest pandemics of the 21st century, with an estimated death toll ranging from 5 to 17 million people[1]. The COVID-19 mortality rate has varied across time, areas, and among countries due to socioeconomic and political disparities[2], with low- and middle-income countries (LMICs) having a higher mortality rate and shorter length of time from infection to death compared to high-income countries during the second and third waves[3]. Further, rural communities experienced a higher COVID-19 mortality rate compared to urban communities because of longstanding healthcare disparities that contributed to delays in accessing healthcare[4].

Vaccines for COVID-19 have proven to be one of the best health strategies to stop the spread of the virus and reduce mortality[5]. However, LMICs have not achieved the full benefits of COVID-19 vaccines. One issue is in-country access to vaccines, with more than 10 billion COVID-19 vaccines largely distributed in high-income countries[6,7]. Specific socioeconomic and political conditions in low-income countries further contribute to disparities in both vaccine administration and acceptance[8]. A second issue is an individual's willingness to be vaccinated, which requires an awareness of COVID-19 risk and the benefits of the vaccines.

Community health workers (CHWs), who are often individuals elected by their communities to serve as a link between the homes and health facilities, are an important part of the health sectors in many LMICs[9–11]. While CHWs cannot increase vaccine availability on a national level, these individuals are an important and trusted source of health-related information who could help educate community members on COVID-19 risks and the vaccine[12,13].

Partners In Health (PIH) is a non-profit organization that works closely with governments in 11 countries, including Haiti, Malawi, and Rwanda, to provide quality healthcare and accompaniment with a preferential option for the poorest communities[14]. The organization champions care delivery in low-income countries using a community based approach and the accompaniment model that engage community health workers in the provision of medicines, in social support, in education, and in the linkage of care between communities and health facilities[15,16]. When the COVID-19 pandemic devastated the world, PIH used its past experiences in combating infectious disease outbreaks and responding to disasters to launch a comprehensive effort to support COVID-19 response across country sites around the world[17]. The Global Coronavirus Response plan by Partners In Health addressed several key areas, including testing, provision of care, support for local government responses, mobilization of community health workers, and research development and capacity building[17].

The study focused on Haiti, Malawi, and Rwanda for several key reasons. An invitation to participate in leveraging CHWs to combat misinformation was extended to all sites in PIH's cross-site COVID-19 research network, which includes Haiti, Malawi and Rwanda. The three countries self-selected to participate due to their established CHW programs, interest in scientific research, and capacity to engage in the study. Their diverse geographic locations, spanning different continents, offered valuable insights into how local contexts, cultures, and experiences shape the response to the COVID-19 pandemic. Finally, at the inception of the study, country partners had identified both significant vaccine hesitancy and high levels of trust in CHWs, rendering Haiti, Malawi and Rwanda ideal candidate countries to explore the role of CHWs in addressing vaccine-related challenges[18–20].

In this paper, we describe the COVID-19 knowledge, attitude, and vaccination perceptions among CHWs in the rural areas of three different LMICs – Haiti, Malawi, and Rwanda. This study informs overall community awareness and activities related to COVID-19, using CHWs as a litmus for their communities, as well as potential areas to target for future CHW interventions. By exploring across

three different countries, we gain a better understanding of the variability in COVID-19 knowledge, attitude, and vaccination perceptions that can support future CHW-driven initiatives and promote successful cross-site research collaboration.

2. Methods

STUDY SETTING: This is a cross-sectional study of CHWs in the rural areas of Haiti, Malawi, and Rwanda that assessed the knowledge, perception and attitude towards COVID-19 and its vaccine. CHWs were selected from the catchment areas of PIH, namely Zanmi Lasante in Haiti, Abwenzi Pa Za Umoyo in Malawi, and Inshuti Mu Buzima in Rwanda. In all three countries, these PIH organizations support health care delivery in underserved rural areas. Health systems in these areas rely on CHWs to connect communities to health facilities. In the Central Plateau and Lower Artibonite regions of Haiti, the CHW program, supported by PIH, operates in alignment with Haiti's national CHW framework. CHWs can either focus on specific diseases or provide general health care support. Overall, PIH supports approximately 2,500 Haitian CHWs in total, serving a population of roughly 3.3 million people[21]. In Neno district, the PIH-supported area in Malawi, PIH implements a household model for CHW care, where a CHW provides support to all members of a household irrespective of their health status. The PIH community health department in Malawi has trained 629 CHWs to serve over 19,000 households, with the goal of ensuring faster access to health care, higher retention, and treatment adherence, as well as greater prevention and economic development[22,23]. In the Kirehe and Southern Kayonza districts of Rwanda, the CHWs supported by PIH are integrated into the national system, which was established in 2007[24]. Each CHW has designated responsibilities, focusing either on the treatment of childhood diseases, malnutrition, providing care during pregnancy, and facilitating delivery at health care centers[20]. In these two districts, PIH supports over 1,200 CHWs, serving approximately 48,000 households[22].

STUDY DESIGN AND DATA COLLECTION: This study, conducted from June 2023 to October 2023, included 525 eligible CHWs (175 CHWs per country). Participants were eligible for the survey if they were over 18 years old and actively working in the country's target catchment area (Haiti: 289 eligible CHWs, Malawi: 1232 eligible CHWs, Rwanda: 3499 eligible CHWs). In each country, 205 eligible CHWs (175 + 30 backup) were randomly sampled from the group of eligible CHWs, and the first 175 CHWs who agreed to participate were recruited.

The CHW survey was conducted in the local language – Haitian Creole in Haiti, Chichewa in Malawi and Kinyarwanda in Rwanda. The survey was administered by trained enumerators, who directly entered the data into REDCap using tablets. The CHW survey lasted 30 to 90 minutes and comprised of questions about COVID-19 infection and vaccine history, reasons for or against the intention to vaccinate, knowledge of the COVID-19 virus and vaccine, as well as the perceived danger of a COVID-19 infection and overall attitude towards the pandemic. The survey also collected personal demographic information from each CHW.

DATA ANALYSIS: The data were exported from REDCap, cleaned, and analyzed using STATA v15.1.Figures were generated in R v4.3.2. We summarized categorical variables by percentages and counts or medians and interquartile range (IQR), and continuous variables by means and standard deviations. Using the method of Wang et al.[25], we visualized the perceptions of CHWs about COVID-19 about risk, worry, severity and control in a boxplot, stratified by country, with each country team being able to modify their priority disease comparison list. On each plot, we display the median responses for other reference diseases assessed in the survey, namely (1) infectious diseases: cholera, tuberculosis, HIV/AIDS, malaria, typhoid (Haiti only), Ebola (Rwanda only); (2) non-communicable diseases: diabetes, cardiovascular diseases, asthma, malnutrition, hypertension (Rwanda and Haiti only); (3) mental health diseases:

anxiety, depression, suicidal ideation (Haiti only). We tested for a global difference in answer distribution for COVID-19 responses with a Kruskal-Wallis test and pairwise differences between countries with a Mann-Whitney U-test.

We quantified the COVID-19 related knowledge among CHWs based on the success rate, indicating the proportion of correct affirmations or rejections of 10 statements surrounding COVID-19 and the COVID-19 vaccine. Such knowledge assessment was used in previous research[26,27]. The statements referred to common COVID-19 related misconceptions and stigma. The success rates were compared across countries in a bar plot. We tested for pairwise country-wise differences in knowledge in a Chi-squared test.

We captured attitudes towards COVID-19 using a 3-level agreement Likert scale – (1) (Strongly) Disagree, (2) Neutral, (3) (Strongly) Agree – to 10 statements surrounding worry about health, beliefs in effectiveness of public health measures, development and controllability of the pandemic, as well as trust in governmental public health management[27]. Pairwise country-wise differences were visualized in a Likert plot and tested for by an unpooled t-test based on the mean attitude towards COVID-19 across statements.

Depending on their vaccination status, the CHWs were prompted to indicate the reasons for or against receiving a COVID-19 vaccination. All CHWs were asked about their intention and reasons to receive vaccine boosters. The answers were attributed to a predefined category (multiple answers possible) or indicated in an "Other" category, following standard procedure[19,28]. The answer frequencies were analyzed in a bar plot.

ETHICS: The study received ethical approval from the Harvard Internal Review Board (IRB# 11-1339), the Malawi National Committee on Research in the Social Sciences and Humanities (IRB# 11/22/694), the Haiti Zanmi Lasante Institutional Review Board (IRB# 11082022), and the Rwanda National Research Ethics Committee (IRB# 00001497). All CHWs provided informed consent prior to study participation. Participants received a baseline compensation of $5 to $10, as well as additional country- and time-specific compensation and reimbursement for travel.

3. Results

DEMOGRAPHIC CHARACTERISTICS: This study included 525 CHWs, divided equally across countries (Table 1). Nearly two-thirds were female in Malawi (n=117, 66.9%) and Rwanda (n=115, 65.7%), but only one-third were female in Haiti (n=66, 37.7%). The mean age was 44.7 years (standard deviation (s.d.) ± 10.2 years). The majority of CHWs (n=457, 90.7%) had at least one child who was ≤18 years old. The median number of children ≤18 years old across countries was 2 (IQR: 1-3); for those children ≤18 years old, the mean age was 8.5 years (s.d.±6.8 years).

Table 1: Demographics among community health workers in Rwanda, Malawi and Haiti

	Rwanda		Malawi		Haiti		Total	
	n	%	n	%	n	%	n	%
Number of community health workers involved in survey	175	33.33	175	33.33	175	33.33	525	100
Sex								
Female	115	65.70	117	66.90	66	37.70	298	56.80
Children								
Have children	174	99.40	170	97.10	164	93.70	508	96.80

	Rwanda		Malawi		Haiti		Total	
	n	%	n	%	n	%	n	%
Yes, and at least one child is <=18 years	160	92.50	153	91.10	144	88.30	457	90.70
Yes, but all children are >18 years	13	7.40	15	8.60	19	10.90	47	9.00
	Rwanda		Malawi		Haiti		Total	
	mean / median	STD / IQR	mean / median	STD / IQR	mean / median	STD / IQR	mean / median	STD / IQR
Age (years), mean (STD)	42.9	9.9	42.5	10.5	48.7	9	44.7	10.2
Children								
Number of children <=18 years, median (IQR)	2	(1.0-3.0)	2	(2.0-3.0)	2	(1.0-3.0)	2	(1.0-3.0)
Age of child if <18 years old (in years), mean (STD)	7.9	7.2	8.7	6.5	8.8	6.6	8.5	6.8

PERCEPTIONS OF HEALTH RISK-WORRY-SEVERITY-CONTROL OF COVID-19: The perception of COVID-19 controllability among CHWs' varied significantly across countries ($p<0.001$) (*Figure 1A*). The highest belief in COVID-19 controllability was registered in Rwanda (median=5 indicating, "Strongly agree", IQR: 3-5; Malawi: median= 4 indicating "Agree", IQR: 3-5; Haiti: median=4 indicating "Agree", IQR: 3-5). The median controllability value for COVID-19 aligned with the median across all reference diseases (noted by the red stars in *Figure 1A*), indicating similar perceptions of controllability for COVID-19 and the reference diseases.

Perceived risk of a COVID-19 infection varied significantly by country ($p<0.001$) (Rwanda: median=1 indicating "Much lower than average", IQR: 1-2; Malawi: median=3 indicating "Average", IQR: 2-4; Haiti: median=2 indicating "Lower than average", IQR: 1-5) (*Figure 1B*). In Rwanda, CHWs perceived the median risk of contracting a reference disease as "Lower than average" for COVID-19. In Malawi and Haiti, the median risk perception for the reference diseases aligned with the perception of COVID-19 risk.

The perception of the severity of a COVID-19 infection differed significantly between Rwanda and Malawi versus Haiti ($p<0.01$) (Rwanda / Malawi: median=5 indicating "Strongly Agree", IQR: 4-5; Haiti: median=4 indicating "Agree", IQR: 4-5) (*Figure 1C*). In Malawi, CHWs considered COVID-19 a more serious disease than the reference diseases (median=4 indicating "Agree", IQR: 4-5) (*Figure 1C*). The perception of severity for COVID-19 and the reference diseases aligned for Rwanda and Haiti.

The CHWs worried little about contracting COVID-19 (for all countries: median=1 indicating "Not at all", Rwanda: IQR: 1, Haiti / Malawi: IQR: 1-2) (*Figure 1D*). The perceptions of worry varied significantly across countries ($p<0.05$ for Haiti and Malawi, $p<0.001$ otherwise). Participants did not worry more or less about contracting COVID-19 than the reference diseases.

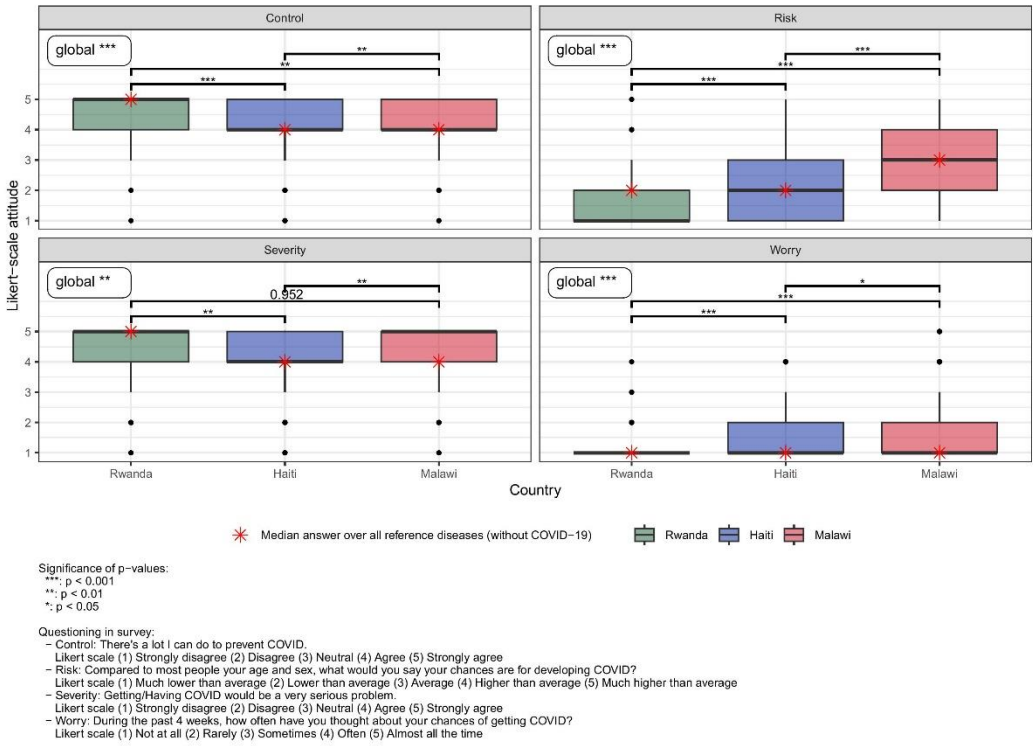

Figure 1: Danger perception towards COVID-19; questioning surrounding perception of risk, worry, severity and control among community health workers in Rwanda, Malawi and Haiti

KNOWLEDGE ABOUT COVID-19 AND COVID-19 VACCINE AMONG COMMUNITY HEALTH WORKERS: In Rwanda and Haiti, CHWs were very knowledgeable, while they were less so in Malawi (COVID-19 knowledge: Malawi-Haiti / Malawi-Rwanda p<0.001; Rwanda-Haiti: p= 0.429; COVID-19 vaccine knowledge: Rwanda-Malawi / Rwanda-Haiti / Malawi-Haiti: p<0.001). In Rwanda and Haiti, CHWs showed more knowledge on the effectiveness of preventive measures (facemasks, avoid crowded places, immediate isolation of contact person) than CHWs in Malawi (facemasks: Haiti: n=151, 86.3%; Malawi: n= 1, 0.6%; Rwanda: n=168, 96.0%) (avoid crowded places: Haiti: n=163, 93.1%; Malawi: n= 5, 2.9%; Rwanda: n=157, 89.7%) (immediate isolation of contact person: Haiti: n=156, 89.1%; Malawi: n=9, 5.1%; Rwanda: n=164, 93.7%) (*Figure 2A*). Popular COVID-19 myths seemed widely disseminated in Malawi; 42 (24.0%) CHWs believed that a virus transmission cannot happen without a fever; only 64 (36.4%) CHWs correctly rejected the statement that contracting the COVID-19 disease was safer than receiving the vaccine; 3 (1.7%) CHWs correctly rejected the belief that the COVID-19 vaccine can cause infertility; and only 10 (5.7%) correctly rejected that a vaccination can lead to an infection with COVID-19 (*Figure 2A, 2B*).

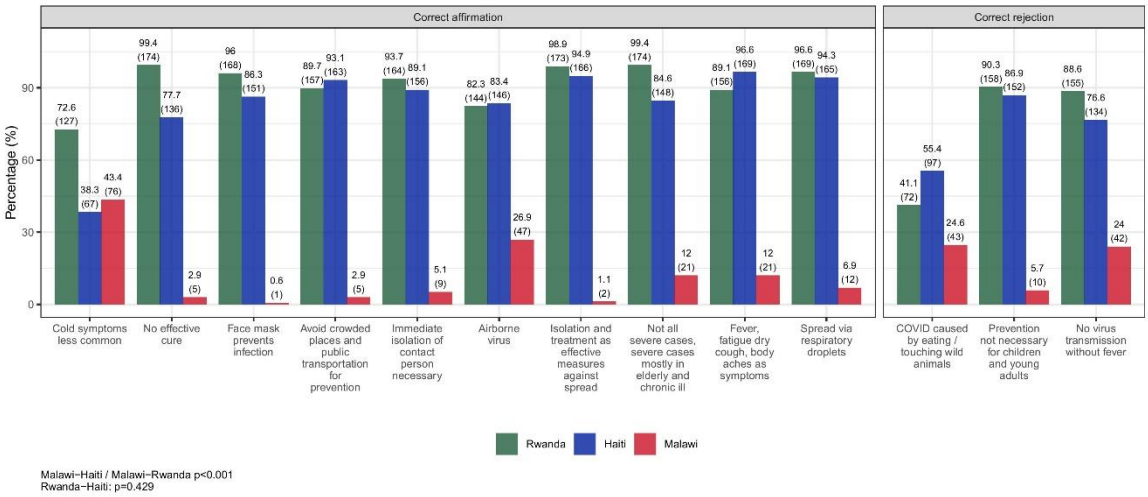

Figure 2A: Correct answer rate for statements surrounding COVID-19 virus among community health workers in Rwanda, Malawi and Haiti; absolute numbers in brackets

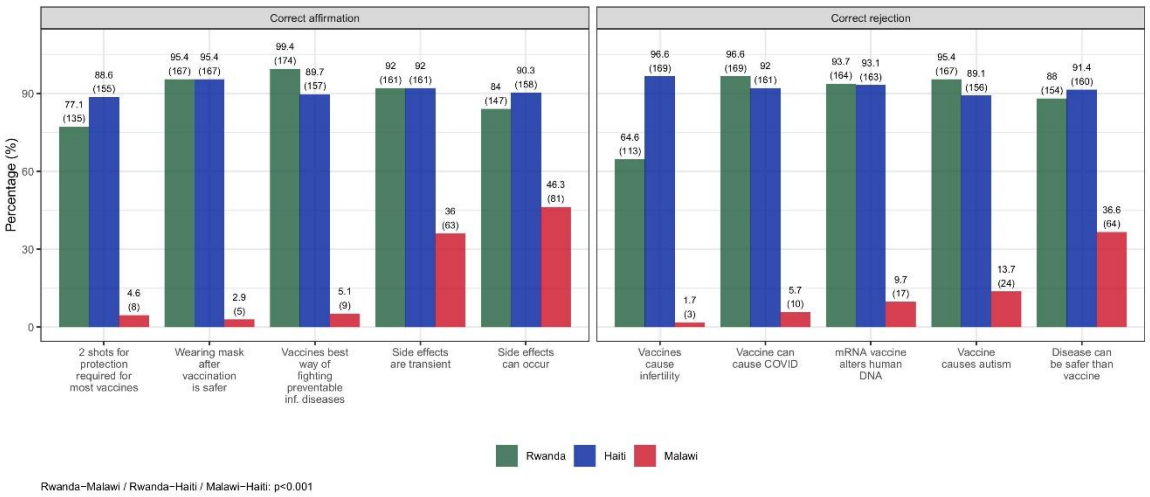

Figure 2B: Correct answer rate for statements surrounding COVID-19 vaccine among community health workers in Rwanda, Malawi and Haiti; absolute numbers in brackets

ATTITUDES ABOUT COVID-19 AMONG COMMUNITY HEALTH WORKERS IN HAITI, MALAWI, AND RWANDA: The mean attitude across countries differed significantly across countries (Rwanda-Malawi: p<0.001; Rwanda-Haiti: p<0.001; Malawi-Haiti: p=0.0013). Most CHWs acknowledged the threat COVID-19 posed to the public (Haiti: n=168, 96.0%; Malawi: n=159, 90.9%; Rwanda: n=173, 98.9%) and agreed on the efficacy of social distancing to control COVID−19 (Haiti: n=162, 93.6%; Malawi: n=170, 97.7%, Rwanda: n=160, 94.7%) (*Figure 3*). Participants were confident in the abilities of their country to overcome the COVID−19 virus (Haiti: n=149, 85.1%; Malawi: n=133, 76.4%; Rwanda: n=171, 97.7%).

Figure 3: Attitude of community health workers towards the COVID-19 pandemic and its management in Rwanda, Malawi and Haiti; absolute numbers in brackets

In Haiti and Malawi, CHWs expressed little concern for their health as well as for the health of their families and friends (personal health: Haiti: n=141, 81.0%; Malawi: n=89, 50.9%; Rwanda: n=31, 17.7%); (friends and family members' health: Haiti: n=123, 70.3%; Malawi: n=72, 41.1%; Rwanda: n=28, 16.0%). Haitian CHWs expressed fear and doubt about their physicians and healthcare system (unafraid of visiting doctor: n=53, 31.7%; no belief in the healthcare system's ability to control the virus: n=33, 19.4%), yet did not believe the outbreak to worsen (n=140, 80.5%). Rwandan and Malawian CHWs were more pessimistic in terms of the future development of the pandemic

("Strongly agree"/"Agree" outbreak will not get worse: Malawi: n=40, 23.0%; Rwanda: n=7, 4.9%).

HISTORY OF COVID-19 VACCINATIONS AMONG COMMUNITY HEALTH WORKERS: Most CHWs could not recall a previous infection with COVID-19 (Haiti: n=167, 95.4 %; Malawi: n=166, 94.9%; Rwanda: n=172, 98.3%) (*Table 2*). Many CHWs in Haiti and Rwanda confirmed having received the COVID-19 vaccine (Haiti: n= 170, 97.1%; Rwanda: n=175, 100%); however, 58 (33.1%) Malawian CHWs did not receive a COVID-19 vaccine. Rwanda had the highest vaccination rate with two doses of the COVID-19 vaccine (n=134, 76.6%) and the highest COVID-19 booster rate (n=133, 99.3%). Booster was unavailable in Haiti. Most CHWs across countries would agree to be vaccinated if an approved third and fourth dose of vaccine to prevent COVID-19 was available today at no cost (Haiti: n=163, 93.7%; Malawi: n= 155, 88.6%; Rwanda: n=174, 99.4%).

Table 2: Vaccine history and vaccination intention among community health workers in Rwanda, Malawi and Haiti

	Rwanda		Malawi		Haiti		Total	
	n	%	n	%	n	%	n	%
Previous COVID-19 infection								
To your knowledge, do you have or have you had COVID-19?	N = 175		N = 175		N = 175		N = 525	
No	172	98.3	166	94.9	167	95.4	505	96.2
Yes	3	1.7	5	2.9	8	4.6	16	3
Not sure/It depends	0	0	4	2.3	0	0	4	0.8
COVID-19 vaccination history								
Have you received a COVID-19 vaccine?								
No	0	0	58	33.1	5	2.9	63	12
Yes	175	100	117	66.9	170	97.1	462	88
How many doses of COVID-19 vaccine have you received?	N = 175		N = 117		N = 170		N = 462	
One dose	25	14.3	40	34.2	91	53.5	156	33.8
Two doses	134	76.6	77	65.8	79	46.5	290	62.8
Don't know	16	9.1	0	0	0	0	16	3.5
Have you received a booster dose?	N = 134		N = 77		N = 79		N = 290	
No	1	0.7	41	53.2	79	100	121	41.7
Yes	133	99.3	36	46.8	0	0	169	58.3
Intention to vaccinate								
If an approved third and fourth dose of vaccine to prevent COVID-19 was available to you today at no cost, would you agree to be vaccinated?	N = 175		N = 175		N = 174		N = 524	
No	0	0	15	8.6	8	4.6	23	4.4
Yes	174	99.4	155	88.6	163	93.7	492	93.9
No sure/it depends	1	0.6	5	2.9	3	1.7	9	1.7

REASONS AGAINST PAST VACCINATION AND FOR OR AGAINST THE INTENTION TO VACCINATE: In Haiti, CHWs lacked trust, resulting in refusing vaccination in the past (lack of trust in international donors/foreign governments: n=1, 20%; in local government: n=1, 20%; in vaccine manufacturers: n=1, 20%). In Malawi, CHWs expressed safety concerns as the main reason for refusing vaccination in the past (harmfulness of vaccine: n=15, 25.9%; unsafe vaccine/side effects:

n=11, 19.0%; lack of trust in vaccine manufactures: n=4, 6.9%; concern about vaccine types: n=5, 8.6%) (*Figure 4A*). All CHWs in Rwanda were vaccinated.

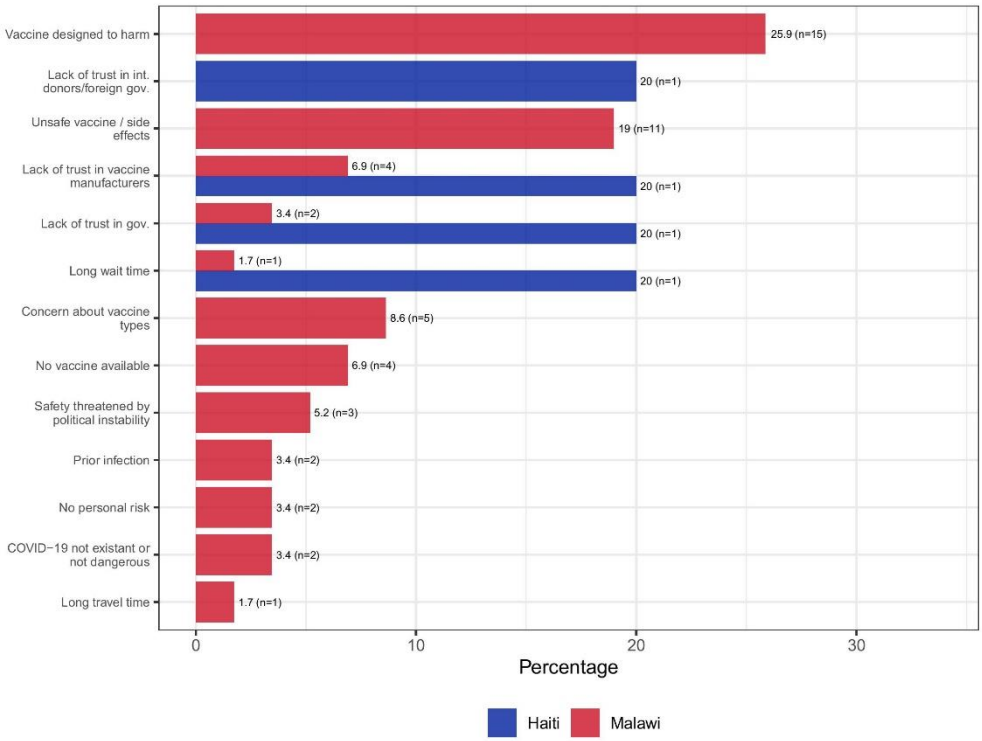

Figure 4A: Reasons against vaccination among community health workers in Haiti (n=5) and Malawi (n=58); no community health workers in Rwanda reported being unvaccinated; absolute numbers in brackets

Reasons for expressing no intention to get vaccinated in Haiti included vaccine availability (n=2, 18.2%), unsafe vaccine (n=1, 9.1%), and the belief that COVID-19 did not exist or did not constitute a danger for community members (n=1, 9.1%) (*Figure 4B*). In Malawi, safety concerns were the primary reason to refuse additional vaccination (unsafe vaccine: n=5, 25.0%; concerns about vaccine types: n=2, 10.0%; vaccine designed to harm: n=2, 10.0%). In Rwanda, one CHW considered themselves not at risk for COVID-19.

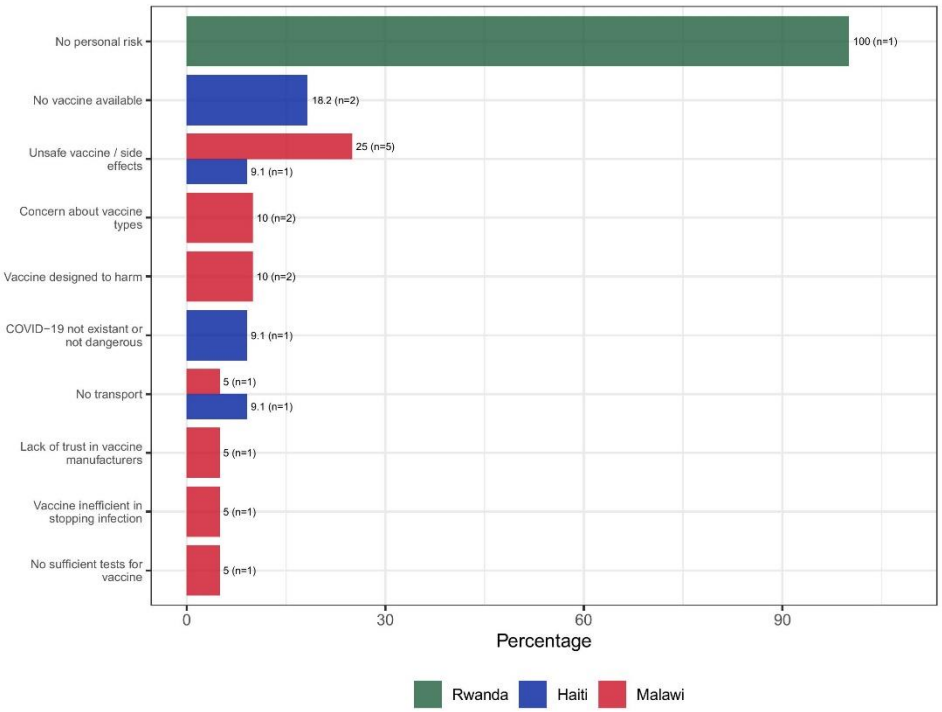

Figure 4B: Reasons against intention to vaccinate among community health workers in Rwanda (n=1), Haiti (n=11) and Malawi (n=20); absolute numbers in brackets

Personal health, the health of family, and their communities were the main reason for expressing intentions to vaccinate across countries (personal health: Haiti: n=153, 93.9%, Malawi: n=140, 90.3%, Rwanda: n=159, 91.4%; family health: Haiti: n=72, 44.2%, Malawi: n=39, 25.2%, Rwanda: n=83, 47.7%; community health: Haiti: n=52, 31.9%, Malawi: n=24, 15.5%, Rwanda: n=63, 36.2%). Another reason included CHWs desire to stop the COVID-19 pandemic (Haiti: n=30, 18.4%, Malawi: n=38, 24.5%, Rwanda: n=120, 69.0%). In Rwanda, recommendations by the government and the Ministry of Health as well as travel requirements incentivized vaccination (recommendation: Rwanda: n=71, 40.8%; Haiti: n=11, 6.8%; Malawi: n=2, 1.3%; travel: Rwanda: n=58, 33.3%; Haiti: n=3, 1.8%, Malawi: n=2, 1.3%). Recommendations by a health care worker strongly motivated Haitian and Malawian CHWs (Haiti: n=18, 11.0%, Malawi: n=19, 12.3%; Rwanda: n=11, 6.3%).

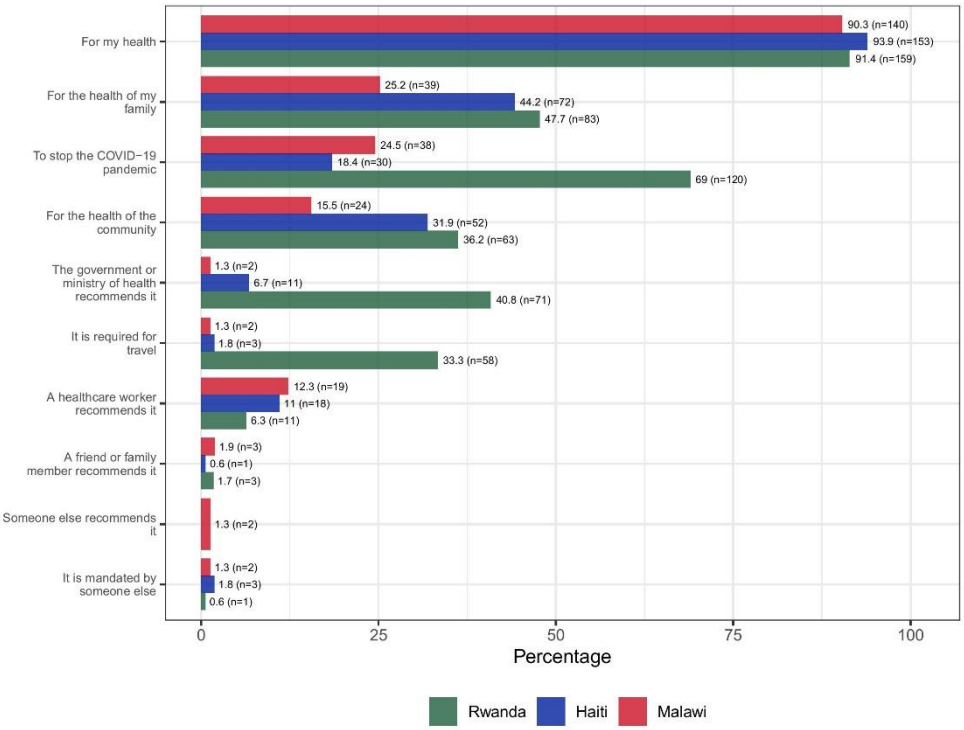

Figure 4C: Reasons for intention to vaccinate among community health workers in Rwanda (n=174), Malawi (n=155) and Haiti (n=163); absolute numbers in brackets

Discussion

The study investigated differences in CHW's risk perception, knowledge, and attitude towards COVID-19 and COVID-19 vaccination efforts across three LMICs: Rwanda, Malawi, and Haiti. Overall, CHWs considered COVID-19 a serious public health threat and expressed their support for adherence to public health interventions; yet, they did not perceive the virus as an immediate threat to their personal health. They voiced doubt about the intensity and effectiveness of national pandemic responses. Knowledge around COVID-19 as well as vaccination rates depended on national settings.

Rwandan CHWs exhibited a strong sense of control over COVID-19, with little worry about contracting the disease. Early in the pandemic, the Rwandan government (including the Rwandan Ministry of Health, the Biomedical Center, and the Surveillance Response Division) implemented a comprehensive Coronavirus National Preparedness and Response Plan, whose key aims were to contain the spread of the virus and combat misinformation[29]. It implemented innovative strategies using drones, robots, and social media for the rapid dissemination of public health information, COVID-19 response supplies, and transparent risk communication, fostering trust in its communities[30]. Most Rwandans received at least two doses of the COVID-19 vaccine, contributing to the high confidence in their country's healthcare system[31].

In Haiti and Malawi, weaker health infrastructure and misinformation may have negatively affected the risk perceptions of COVID-19[32–34]. Participants in Malawi considered COVID-19 a more uncontrollable, severe disease and expressed a pessimistic outlook on future pandemic developments. Yet, many CHWs in Malawi considered the response to the pandemic overblown and perceived the risk of a personal COVID-19 infection as low. Their perceptions might have been negatively affected by the limited training opportunities for CHWs in remote regions, the focus on theoretical training without practice modules, and by the non-availability of equipment for knowledge application[35].

Overall, the lack of knowledge about COVID-19 in Malawi also likely contributed to the perception of virus as being of little concern, compared to CHWs in Haiti and Rwanda who demonstrated accurate knowledge about COVID-19 and the vaccine. To date, there have been no studies comparing the knowledge about COVID-19 and the COVID-19 vaccine among CHWs in Haiti, Malawi, and Rwanda. Previous research has shown that knowledge of COVID-19 and its vaccine differs across countries[36,37]. Our findings align with those of a community-based survey on Knowledge, Attitudes, and Practices (KAP) related to COVID-19 among adults in Malawi, which revealed limited knowledge of the virus[38]. A qualitative study involving Bangladesh, India, Kenya, Malawi, and Nigeria indicated inadequate training opportunities and lack of necessary equipment were the main causes of the CHWs' lack of knowledge[35]. In Malawi, particularly in the Neno district, low knowledge levels about COVID-19 and vaccines might be attributed to remote location and context, gaps in the levels of education, opportunities for ongoing dialogue during the design and implementation of the community sensitization activities, and limited access to information[39,40]. Conversely, CHWs from Haiti demonstrated a strong awareness of the infectious nature of the virus and expressed concerns about contracting COVID-19.

The differences in knowledge might have contributed to differences in CHWs' attitude towards COVID-19. Our results revealed that a majority of CHWs in Haiti displayed apprehension towards seeking medical assistance. Amid the COVID-19 pandemic, numerous Haitians refrained from seeking healthcare services[41]. Additionally, adverse political conditions and large-scale lockdowns significantly hampered the overall accessibility of the healthcare system. Haitian CHWs harbored some skepticism regarding the healthcare system's capability to manage the virus. This lack of trust in the healthcare system and COVID-19-related information was compounded by the fact that Haiti faced tremendous challenges in stopping the pandemic due to inadequate biosecurity, testing infrastructure, and resources, along with the spread of misinformation and stigma surrounding COVID-19[41]. In addition, adverse political conditions, violence, and large-scale lockdowns significantly hampered the overall accessibility of the healthcare system[42]. The COVID-19 pandemic concurred with extreme political instability and gang violence in Haiti, calling for any results to be set into perspective.

Rwandan CHWs optimism towards the pandemic development and an effective governmental response to contain the pandemic aligns with previous studies which revealed a strong belief in virus control and national public health capabilities among citizens[43–46]. The Rwandan government implemented its comprehensive Coronavirus National Preparedness and Response Plan early in the pandemic. It employed innovative strategies for quick dissemination of public health information and transparent risk communication, fostering trust in its communities[30].

In our study, Malawian CHWs questioned the controllability of the virus, yet they did not expect the pandemic to worsen. Many CHWs considered the response to the pandemic overblown, most prominently in Malawi. When COVID-19 arrived in Malawi, public health policies restricted social gatherings[47]. Nevertheless, political rallies were

held, openly violating the public health guidance[47]. This caused severe mistrust in the government and undermined the relevance of the COVID-19 prevention measures[47]. The Malawian High Court overruled the country's lockdown after nationwide protests against lockdown policies[47]. The opposition to movement restrictions in Malawi might have resulted from its direct consequences on livelihoods[48]. As our results showed, a substantial proportion of CHWs in Haiti, Malawi, and Rwanda supported adherence to social distancing measures as an effective intervention to mitigate the spread of COVID-19. At the time of the initial COVID-19 outbreak, stringent restrictions were observed to forestall the virus propagation. These findings align with those originating from a comprehensive review of studies conducted across multiple countries, revealing communities' favorable disposition towards adopting public health directives aimed at containing the COVID-19 virus[36]. Furthermore, an expeditious online cross-sectional survey in China unveiled that a notable majority of respondents voiced concerns regarding crowded locales and readily complied with mandates pertaining to facial covering[44,48]. Adherence to these guidelines exhibited a strong correlation with the practical abstinence from high-risk behaviors conducive to COVID-19 transmission.

Vaccination coverage among CHWs, and the number of vaccine and booster doses, varied according to the availability of COVID-19 vaccines in Rwanda, Malawi and Haiti. The COVID-19 vaccination rate among CHWs in Rwanda are highest compared to Haiti and Malawi. Most Rwandans received at least two doses of COVID-19 vaccine[31]. The vaccination success was attributed to the high confidence of Rwandans in their country's healthcare system[31]. From the beginning of the global vaccination efforts onwards, Rwanda received an ample supply of COVID-19 vaccines. As the pandemic progressed, the government strived to achieve herd immunity by administering several COVID-19 booster doses[31]. These national efforts become apparent in our data. Rwanda had the highest proportion of CHWs who were boosted with additional doses of the COVID-19 vaccine. In Haiti, vaccine supply depended on US donations[50], and many vaccination campaigns failed due to a lack of vaccine supply. Haiti only administered a first and second dose of the vaccine to officials, health care professionals, and people living with comorbidities. No data was available on the percentage of Haitians vaccinated with at least one booster dose of a COVID-19 vaccine[51]. In March 2021, the Malawian government received a shipment of 360,000 doses of AstraZeneca to administer the first dose to healthcare workers, officials, the elderly, and people with comorbidities[52]. Vaccine hesitancy limited the success of the national COVID-19 vaccine campaign[52,53]. Key drivers of vaccine hesitancy in Malawi were mistrust in the safety of the COVID-19 vaccine, complacency due to a lack of knowledge, which became evident in our analysis, and inaccessibility in rural areas[54].

Previous literature additionally emphasized education levels, socio-economic status, exposure to vaccine-related misinformation and trust in public health authorities as pivotal factors influencing vaccine hesitancy[55–59]. When COVID-19 spread, PIH started a global COVID-19 response, and PIH's Strategy for Achieving Equity in COVID-19 Vaccination at all the country sites increased the willingness for vaccination[60]. Healthcare workers, including CHWs, were identified as the most trusted source of vaccine information[61]. Our results, which show that most CHWs in Rwanda, Haiti, and Malawi would be willing to receive additional COVID-19 vaccine doses, provide reasons for optimism.

Several limitations should be considered when interpreting these results. First, the survey relied on self-reported information without requesting any documentation or proof of vaccination to verify given answers. Given that national economic context, public policy, cultural factors and societal dynamics strongly influence knowledge, attitude, risk perceptions and vaccination willingness, our

findings are limited in their comparability and generalizability to other LMICs. In addition, PIH pursued a global COVID-19 response and developed a strategy for achieving equity in COVID-19 vaccination across all country sites. Such coordinated action contributed to an overall willingness for vaccination among PIH staff, including CHWs[60]. This further might restrict generalizability. Lastly, the results of this study were focused on adult CHWs only. Nevertheless, insights from our analyses provide guidance and impetus to leverage CHWs as trusted sources of information and as enforcers of public health interventions.

Conclusion

Risk perception, knowledge of COVID-19 and the COVID-19 vaccine, as well as the attitude towards the pandemic among CHWs, differed across Rwanda, Malawi and Haiti. Overall, CHWs consider COVID-19 a serious disease, yet they do perceive it as a non-immediate health threat. National narratives, public health communication, and training opportunities influence the knowledge of COVID-19 and its vaccine among CHWs. Vaccine availability determined the vaccine history of CHWs. Lack of trust was a frequent reason for vaccine hesitancy. Targeted interventions and transparent, trustworthy communication are essential to ensure that CHWs are well informed, have a cautious attitude toward COVID-19, and possess the skills needed to promote public health compliance within communities.

Conflict of Interest:

The authors have no conflicts of interest to declare.

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