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COVID-19 vaccine confidence and its effect on vaccine uptake among people with hypertension or diabetes mellitus in Kilimanjaro region, Tanzania

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ABSTRACT

COVID-19 vaccination effectively reduces disease severity, hospitalization, and mortality, particularly among individuals with chronic conditions who bear a disproportionate burden of disease complications. Vaccine confidence – belief in its safety, effectiveness, and importance – boosts uptake. However, limited data on vaccine confidence in this population hinders the development of targeted interventions. This study examined COVID-19 vaccine confidence and its impact on uptake among individuals with hypertension or diabetes mellitus in the Kilimanjaro region, Tanzania. A community-based cross-sectional study was conducted in March 2023 among 646 randomly selected adults aged ≥18 years with hypertension or diabetes mellitus in three districts of Kilimanjaro region, northern Tanzania. An interviewer-administered electronic questionnaire assessed confidence and uptake of COVID-19 vaccines in addition to related knowledge and demographic characteristics. Data analysis was done for 646 individuals who consented to participate. Multivariable logistic regression models determined the factors associated with COVID-19 vaccine confidence and its effect on vaccine uptake. The proportion of COVID-19 vaccine confidence among all 646 participants was 70% and was highest for perceived vaccine importance (80%), followed by perceived vaccine effectiveness (77%) and perceived vaccine safety (74%). Good knowledge of COVID-19 vaccines and living in the Mwanga municipal council (MC), a semi-urban district, was independently associated with confidence in the vaccines' importance, safety, effectiveness, and overall COVID-19 vaccine confidence. Confidence in COVID-19 vaccines increased the odds of vaccine uptake. Targeted interventions to boost vaccine confidence are therefore essential to enhance vaccine uptake in this high-risk population.

Introduction

COVID-19 was a public health emergency of international concern that has caused over 700 million cases and over 6 million deaths globally.[1] People with chronic illnesses are particularly at increased risk of complications from the disease including severe illness, hospitalization, and death.[2] For this reason, they were prioritized to receive COVID-19 vaccines. In Tanzania, COVID-19 vaccines were first prioritized among people with chronic illnesses apart from the elderly and healthcare workers, before expanding the eligibility to all adult population aged ≥18 years.[3] COVID-19 vaccines prevent severe illness and death from COVID-19 disease.[4] Vaccine hesitancy, however, has been a major setback in COVID-19 vaccination acceptance and uptake both in the general population and among people with chronic conditions.[5,6]

The World Health Organization (WHO) defines vaccine hesitancy as "delay in acceptance or refusal of vaccines despite availability of vaccination services."[7] Vaccine confidence is one

of the key drivers of vaccine hesitancy apart from convenience (availability, affordability, and accessibility) and complacency (perceived necessity of vaccines).[8] The WHO has also defined vaccine confidence as "trust in the effectiveness and safety of vaccines; the system that delivers them, including the reliability and competence of the health services and health professionals and the motivations of policy-makers who decide on the needed vaccines."[8] Vaccine confidence through the Vaccine Confidence Project (VCP) has been mapped globally across populations using a Vaccine Confidence Index (VCI) before the COVID-19 pandemic.[9] The index examines an individual's perception of vaccine safety, effectiveness, importance, and religious compatibility to assess vaccine confidence.[10]

Low confidence in COVID-19 vaccine safety, importance, and effectiveness is among the top reasons for COVID-19 vaccine hesitancy and low uptake not only in the general population,[5,11–14] but also among people with chronic

illnesses.[6,15,16] A previous study on COVID-10 vaccine uptake among people with underlying chronic medical conditions in the districts of Columbia found that while some had high confidence in vaccine importance due to their underlying medical condition, others had concerns that the vaccines may aggravate their underlying medical condition.[17]

Furthermore, available evidence shows that low COVID-19 vaccine confidence from concerns of vaccine safety,[5,14,18,19] less confidence in vaccine importance to protect others and themselves,[6,18,19] and low trust in the vaccine development and approval,[11,19] were strongly associated with low vaccine acceptance among adults in the general population[5,11,20] and healthcare workers.[18,21] Conversely, high confidence in vaccines' importance to protect oneself,[6,12] and high confidence in vaccine safety and effectiveness[14] were strongly associated with high vaccine acceptance and uptake among adults in the general population[12,20] and people with underlying chronic medical conditions.[6]

The first case of COVID-19 in Tanzania was confirmed at Kilimanjaro International Airport in Kilimanjaro region on the 13th of March 2020, 2 months after the WHO declared it as a Public Health Emergency of International Concern (PHEIC).[22] This resulted in a panic that was exacerbated by the spread of misinformation not only in the region but also throughout the country. COVID-19 vaccines were first introduced in Tanzania in July 2021 and were prioritized for people with chronic conditions like hypertension and diabetes mellitus due to their increased risk of morbidity and mortality from COVID-19. Currently, more than 13 billion COVID-19 vaccine doses have been administered globally, and more than 39 million doses in Tanzania.[23] Despite vaccination strategies such as mass education campaigns and community engagement, COVID-19 vaccination coverage remains low in Tanzania (51%) perhaps due to initial government denial of the vaccines hence causing vaccine hesitancy.[24,25]

To date, evidence is scarce on drivers of COVID-19 vaccine confidence among people with chronic illnesses including people with hypertension or diabetes mellitus. This study therefore assessed factors associated with COVID-19 vaccine confidence among people with hypertension or diabetes mellitus in the Kilimanjaro region of Tanzania. It also quantified the effect of COVID-19 confidence on COVID-19 vaccine uptake in this population.

Methodology

Study design, setting, and population

We conducted a community-based cross-sectional study in March 2023 in three districts; Moshi Municipal Council (MC), Moshi District Council (DC), and Mwanga Municipal Council (MC) of Kilimanjaro region, northern Tanzania. We included adults aged ≥18 years who had either hypertension or diabetes mellitus. Participant's diabetes and/or hypertensive status was self-reported and further validated using their clinic cards and current use of diabetes or anti-hypertensive medications. Kilimanjaro region was purposefully selected because it was the first region to have reported an imported COVID-19 case early in the pandemic, hence massively impacted.[22] The

three districts were randomly selected with consideration of urban and rural representation. Wards were further randomly selected from each district taking into consideration their population weight. Participating villages/streets were then randomly selected from each ward. Hamlets were then randomly selected from each village. A list of households with people who met the inclusion criteria was provided by a community health worker from each hamlet. The sample size was estimated using a single proportion formula $N=[(Z_{\alpha/2})^2 \times p(1-p)]/\varepsilon^2$ where the proportion of COVID-19 vaccine hesitancy among people with diabetes was 26% from a previous study.[26] Taking a standard normal value of 1.96 corresponding to a 95% confidence level, a standard error of 3.5%, and assuming a nonresponse rate of 10%, we obtained a minimum sample size of 663 individuals.

Variables

Confidence in COVID-19 vaccine safety, effectiveness, importance, and overall COVID-19 vaccine confidence were the primary dependent variables. We adopted the Vaccine Confidence Index (VCI) that was developed in 2015 by the Vaccine Confidence Project. It uses standardized methodology to map individual's perception on vaccine importance, safety, effectiveness, and compatibility with people's beliefs; all of which entails vaccine confidence.[9] Participants were asked to rate their responses to three questions regarding their perception of COVID-19 vaccine importance, safety, and effectiveness. Responses to the three questions 'COVID-19 vaccines are important,' 'COVID-19 vaccines are safe,' and 'COVID-19 vaccines are effective' were coded in a Likert scale from 'Strongly agree,' 'Agree,' 'I don't know,' 'Disagree,' and 'Strongly disagree.' A response of 'Strongly agree' and 'Agree' to either of the questions was regarded as having confidence in either and no confidence if otherwise. The confidence variables in COVID-19 vaccine importance, safety, and effectiveness were further used to derive the overall COVID-19 vaccine confidence. Participants were considered to have overall COVID-19 vaccine confidence if they had confidence in COVID-19 vaccine importance, safety, and effectiveness (all three components) and no overall COVID-19 vaccine confidence if otherwise. COVID-19 uptake (secondary dependent variable) was examined based on its association with confidence in vaccine safety, effectiveness, importance, and overall COVID-19 vaccine confidence. Details on how COVID-19 vaccine uptake was derived have been published elsewhere[20] and this was further validated using records from vaccination cards.

The independent variables included COVID-19 vaccine knowledge and participant demographic characteristics including; age in years and categories (<50, 50–59, 60–69, 70 and above), sex (male and female), district of residence (Moshi MC, Moshi DC, Mwanga MC), bank account ownership, marital status, level of education, and health insurance ownership. Bank account ownership was used as a proxy for socioeconomic status. Details on how COVID-19 vaccine knowledge was derived have been published elsewhere.[20] Participants were also asked about their history of COVID-19 infection.

Data management and analysis

Data management and analysis were done using STATA version 18. Categorical variables were summarized using absolute numbers and percentages, while measures of central tendencies and their respective measures of dispersion summarized continuous variables. Independent variables were cross-tabulated against COVID-19 importance, safety, effectiveness, and overall COVID-19 vaccine confidence and vaccine uptake and the Chi-squared test was used to assess their association for which a p-value of less than 0.05 was considered statistically significant. Multivariable logistic regression was used to estimate odds ratios and their 95% confidence intervals (CI) using a manual stepwise regression approach (at an alpha level of 0.1) for the factors associated with COVID-19 importance, safety, effectiveness, and overall COVID-19 vaccine confidence and their effect on COVID-19 vaccine uptake. Age and sex were specified a priori as confounders for the effect of perceived confidence in COVID-19 vaccines and the effect on COVID-19 vaccine uptake. For this analysis, none of the potential confounders apart from COVID-19 vaccine knowledge produced at least a 10% change in the odds ratio, and therefore all models were adjusted for age, sex, and COVID-19 vaccine knowledge.

Results

Participant characteristics

Data were analyzed for 646 participants. More than three-quarters of all participants (78.3%) were females and about a third (30.2%) were aged >70 years with the median (interquartile range, IQR) being 62 (54, 72) years. About three-quarters, (73.2%) attained primary education level. Fewer than half of the participants (42.6%) had good knowledge of COVID-19 vaccines and just over half (52.2%) had taken the COVID-19 vaccines (Table 1). About two-thirds (62%) of participants had taken the Johnson & Johnson vaccine, followed by Sinopharm (16.1%) and a lower proportion of participants had taken Pfizer, Moderna, AstraZeneca, Sinovac (data not shown in the table).

COVID-19 vaccine confidence

Seventy percent of the participants had overall COVID-19 vaccine confidence, i.e., combined perceived confidence in COVID-19 vaccines' safety, effectiveness, and importance. Of the 646 individuals, 80% had confidence in vaccine importance, 77% had confidence in vaccine effectiveness, and 74% had confidence in vaccine safety (Figure 1).

Table 2 summarizes the association between participants' characteristics and the overall COVID-19 vaccine confidence using Chi-square test. There was a significant difference in the proportion of participants who had overall COVID-19 vaccine confidence across categories of COVID-19 vaccine knowledge, COVID-19 risk perception, marital status, education, district, and owning a bank account. A higher proportion of participants who had overall COVID-19 vaccine confidence had good COVID-19 knowledge (90.6%) vs to those with poor knowledge (55.3%), perceived themselves as at risk of getting

Table 1. Background characteristics of individuals with diabetes mellitus and hypertension in Kilimanjaro region, Tanzania (*N* = 646).

Variables	Frequency	Percent
Age (years)		
Median (IQR)	62 (54-72)	
<50	100	15.5
50-59	181	28.0
60-69	170	26.3
70+	195	30.2
Sex		
Male	140	21.7
Female	506	78.3
Education		
None	81	12.5
Primary education	473	73.2
Secondary or above	92	14.2
District		
Moshi MC	217	33.6
Moshi DC	174	26.9
Mwanga MC	255	39.5
Marital status[1]		
In union	364	56.4
Not in union	282	43.7
Religion		
Muslim	317	49.1
Christian	320	49.5
Others	9	1.4
Health insurance		
No	435	67.3
Yes	211	32.7
Bank account		
No	537	83.1
Yes	109	16.9
Ever being infected with COVID-19		
No	612	94.7
Yes	34	5.3
COVID-19 risk perception		
Not at risk	394	61.0
At risk	252	39.0
COVID-19 vaccine knowledge[2]		
Poor knowledge	371	57.4
Good knowledge	275	42.6
COVID-19 vaccine uptake[2]		
No	307	47.5
Yes	339	52.5

[1]In union meant married/cohabiting and not in union included being single/separated/divorced/widow/widower.
[2]Details on how COVID-19 vaccine knowledge and uptake were measured have been published elsewhere.[20]

COVID-19 (74.6%) vs to their counterparts (67.5%), were in union, i.e., married or cohabiting (74.2%) than those who were not in union (separated, divorced, widows and widowers) (65.3%), had attained secondary education and above (82.6%) than those in primary education (71.7%) and no education (48.2%) and owned a bank account (82.6%) than those who do not (67.8%) (Table 2). The distribution of participants' characteristics across other components of confidence, i.e., perceived importance, safety, and effectiveness are given in the Supplementary file.

Factors associated with COVID-19 vaccine confidence

In the multivariable analysis, the district of residence and knowledge of COVID-19 vaccines significantly predicted confidence in vaccines' importance, safety, effectiveness, and overall COVID-19 vaccine confidence. Compared to participants living in the Moshi municipality (an urban district in the region), participants living in Mwanga MC (semi-urban
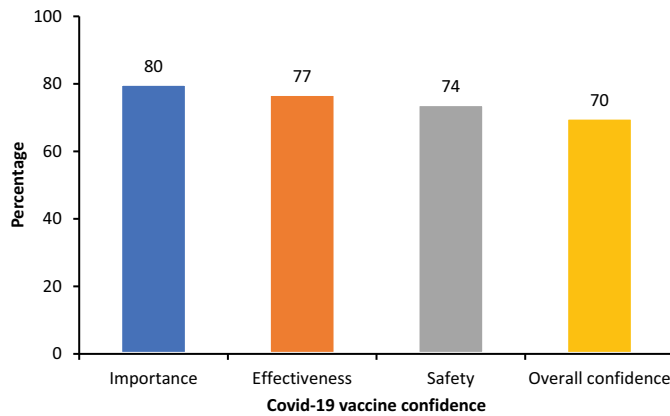
Figure 1. COVID-19 vaccine confidence among individuals with hypertension or diabetes mellitus in Kilimanjaro region, Tanzania.

Table 2. COVID-19 vaccine confidence among by participants' characteristics among individuals with hypertension or diabetes mellitus in Kilimanjaro region, Tanzania (N = 646).

Variable	Participants (n)	Overall COVID-19 vaccine confidence (%)	P value
Age (years)			.004
<50	100	72 (72.0)	
50-59	181	137 (75.7)	
60-69	170	127 (74.7)	
70+	195	118 (60.5)	
Sex			.59
Male	140	101 (72.1)	
Female	506	353 (69.8)	
Education			<.001
None	81	39 (48.2)	
Primary Education	473	339 (71.7)	
Secondary and above	92	76 (82.6)	
District			.03
Moshi MC	217	145 (66.8)	
Moshi DC	174	115 (66.1)	
Mwanga MC	255	194 (76.1)	
Marital status[1]			.01
In union	364	270 (74.2)	
Not in union	282	184 (65.3)	
Have bank account			.002
No	537	364 (67.8)	
Yes	109	90 (82.6)	
Religion			.44
Muslim	317	224 (70.7)	
Christian	320	222 (69.4)	
Others	9	8 (88.9)	
Covid-19 risk perception			.05
Not at risk	394	266 (67.5)	
At risk	252	188 (74.6)	
Ever infected with COVID-19 disease			.23
No	612	427 (69.8)	
Yes	34	27 (79.4)	
COVID-19 vaccine knowledge[2]			<.001
Poor knowledge	371	205 (55.3)	
Good Knowledge	275	249 (90.6)	

[1]In union is being married or cohabiting. Not in union includes being single/ divorced/separated/widow/widower.
[2]Details on how COVID-19 vaccine knowledge was measured have been published elsewhere.[20]

district) had significantly higher odds of having confidence in vaccines' importance (OR 2.13, 95% CI 1.26–3.59), safety (OR 1.67, 95% CI 1.04–2.67), effectiveness (OR 1.94, 95% CI 1.18–3.18) and overall COVID-19 vaccine confidence (OR 2.01, 95% CI 1.27–3.19). Good knowledge of COVID-19

vaccines was strongly associated with higher odds of confidence in vaccines' importance (OR 11.41, 95% CI 5.75–22.65), safety (OR 6.76, 95% CI 4.09–11.16), effectiveness (OR 8.30, 95% CI 4.71–14.63) and overall COVID-19 vaccine confidence (OR 7.23, 95% CI 4.53–11.69). Having a bank account was significantly associated with higher odds of having confidence in vaccines' safety (OR 2.20, 95% CI 1.07–4.51) but no evidence of association with having confidence in vaccines' importance, safety, and overall COVID-19 vaccine confidence (Table 3).

Effect of COVID-19 vaccine confidence on COVID-19 vaccine uptake

In both crude and adjusted logistic regression models, confidence in vaccines' importance, safety, effectiveness, and overall COVID-19 vaccine confidence was strongly associated with higher odds of COVID-19 vaccine uptake compared to not having COVID-19 vaccine confidence. After adjusting for age, sex, and knowledge of COVID-19 vaccines, having confidence in vaccines' importance (OR 6.35, 95% CI 3.82–10.55, $p < .001$), safety (OR 7.36, 95% CI 4.67–11.61, $p < .001$), effectiveness (OR 7.15, 95% CI 4.42–11.55, $p < .001$) and overall COVID-19 vaccine confidence (OR 6.88, 95% CI 4.46–10.61, $p < .001$) was strongly associated with higher odds of COVID-19 vaccine uptake (Table 4).

Discussion

We investigated factors associated with confidence in COVID-19 vaccines' safety effectiveness, importance, and overall COVID-19 confidence and the effect of confidence on COVID-19 vaccine uptake among people with hypertension or diabetes mellitus in the Kilimanjaro region of Tanzania. This study revealed that overall, the proportion of participants with overall COVID-19 vaccine confidence was 70% and was highest for perceived vaccine importance (80%), followed by perceived vaccine effectiveness (77%) and perceived vaccine safety (74%). High confidence in COVID-19 vaccines in this population (70%) may be due to their high-risk profile. Since people with underlying medical conditions are at an increased risk of complications of COVID-19 including death and hence prioritized to receive the vaccines, they may have been more likely to seek information regarding COVID-19 vaccines from trustful sources like healthcare workers. This therefore may explain the high confidence levels in this group compared to the general population among adult community members in Tanzania.[14]

Nevertheless, we observed low COVID-19 vaccine uptake of just above half of the participants. This is contrary to what we expected because of the high-risk nature of our study population together with the initial prioritization of COVID-19 vaccination among people with underlying chronic conditions. A possible explanation for our observed findings could be due to myths that were spreading about potential safety concerns of COVID-19 vaccines in the initial phases of the COVID-19 vaccine rollout. Additionally, this could have been compounded by the initial government denial of the existence of COVID-19

Table 3. Adjusted odds ratios and 95% confidence intervals for predictors of COVID-19 confidence in effectiveness, safety, importance, and overall confidence among the study population (N = 646).

Variable	Importance	Safety	Effectiveness	Overall
Age				
<50	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
50-59	1.09 (0.53-2.25)	1.21 (0.64-2.30)	1.23 (0.63-2.40)	1.15 (0.62-2.14)
60-69	1.41 (0.68-2.92)	1.57 (0.82-3.02)	1.76 (0.88-3.50)	1.48 (0.80-2.78)
70+	0.78 (0.39-1.57)	0.98 (0.52-1.85)	0.89 (0.46-1.70)	0.97 (0.52-1.80)
Sex				
Male	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Female	1.17 (0.65-2.10)	1.28 (0.75-2.17)	1.26 (0.72-2.18)	1.30 (0.78-2.17)
Education				
None	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Primary education	1.49 (0.83-2.69)	1.45 (0.83-2.54)	2.09 (1.18-3.70)	1.60 (0.92-2.80)
Secondary and above	1.51 (0.58-3.98)	1.88 (0.76-4.64)	2.77 (1.10-6.97)	2.23 (0.93-5.30)
District				
Moshi MC	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Moshi DC	1.30 (0.74-2.28)	1.07 (0.63-1.80)	1.25 (0.72-2.15)	1.16 (0.70-1.93)
Mwanga MC	2.13 (1.26-3.59)	1.67 (1.04-2.67)	1.94 (1.18-3.18)	2.01 (1.27-3.19)
Marital status[1]				
In union	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Not in union	0.87 (0.54-1.38)	0.78 (0.51-1.19)	0.80 (0.51-1.25)	0.80 (0.53-1.21)
Religion				
Muslim	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Christian	0.96 (0.62-1.50)	1.03 (0.69-1.55)	0.99 (0.65-1.52)	1.03 (0.70-1.53)
Others	1.57 (0.17-14.29)	-	1.81 (0.20-16.16)	2.95 (0.33-26.11)
Bank account				
No	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Yes	1.35 (0.63-2.90)	2.20 (1.07-4.51)	1.07 (0.54-2.14)	1.61 (0.84-3.08)
Covid-19 disease risk perception				
Not at risk	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
At risk	1.36 (0.85-2.16)	1.03 (0.68-1.57)	1.41 (0.91-2.19)	1.13 (0.76-1.69)
Ever infected with Covid-19				
No	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Yes	1.42 (0.37-5.41)	1.00 (0.34-2.99)	0.92 (0.30-2.79)	0.83 (0.31-2.22)
Covid-19 vaccine knowledge[2]				
Poor knowledge	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Good knowledge	11.41 (5.75-22.65)	6.76 (4.09-11.16)	8.30 (4.71-14.63)	7.23 (4.53-11.69)

[1]In union is being married or cohabiting. Not in union includes being single/divorced/separated/widow/widower.
[2]Details on how COVID-19 vaccine knowledge was measured have been published elsewhere.[20]

Table 4. Effect of COVID-19 vaccine confidence on vaccine uptake among individuals with hypertension and diabetes mellitus in Kilimanjaro region, Tanzania (N = 646).

Variable	[1]COR (95% CI)	P value	[2]AOR(95% CI)	P value
Importance		<0.001		<.001
No	1.00 (ref)		1.00 (ref)	
Yes	7.25 (4.46-11.76)		6.35 (3.82-10.55)	
Safety		<0.001		<.001
No	1.00 (ref)		1.00 (ref)	
Yes	8.00 (5.20-12.33)		7.36 (4.67-11.61)	
Effectiveness		<0.001		<.001
No	1.00 (ref)		1.00 (ref)	
Yes	7.83 (4.97-12.33)		7.15 (4.42-11.55)	
Overall confidence		<0.001		<.001
No	1.00 (ref)		1.00 (ref)	
Yes	7.64 (5.11-11.42)		6.88 (4.46-10.61)	

OR, Odds Ratio. [1]Crude odds ratio. [2]Adjusted odds ratio. The odds ratio was derived from the logistic regression model and in the multivariable analyses were adjusted for age, sex, and COVID-19 vaccine knowledge.

disease before the COVID-19 vaccine rollout in Tanzania, leading to low confidence in the vaccines and therefore explaining this low uptake.[25] A qualitative study among general community members in Tanzania further revealed that conflicting information from the government leaders who discouraged people from getting vaccinated and encouraged traditional medicine instead was reported as one of the barriers to COVID-19 vaccine uptake among unvaccinated participants.[27] These may have stemmed

lasting concerns on the safety of the vaccines resulting in hesitancy that can lead to low vaccine uptake.

We also explored factors associated with COVID-19 vaccine confidence. The study found that good knowledge of COVID-19 vaccines was strongly associated with having confidence in vaccines' safety, effectiveness, importance, and overall COVID-19 vaccine confidence. Sources of information that people trust influence what they know about vaccines and this subsequently affects their knowledge and hence confidence in vaccines.[28] Social media has been a major means of spreading rumors, misinformation, and disinformation about COVID-19 vaccines. Having social media as the trusted source of information has been associated with COVID-19 vaccine confidence as opposed to having healthcare bodies and government sources as the source of information.[28] These findings are consistent with the results we obtained from our previous study among general community members in Tanzania.[20] This suggests that having the right information regarding vaccines can influence one's knowledge and perception of vaccines and therefore confidence. For this, education campaigns have been one of the key interventions to address public confidence in COVID-19 vaccines and therefore increase uptake in Tanzania.[29] Targeted interventions to educate people with chronic illnesses are highly needed to increase vaccine confidence in this population.

Those living in Mwanga MC had higher odds of confidence in the vaccines' safety, importance, effectiveness, and overall COVID-19 vaccines than those living in Moshi MC. Door-to-door campaigns that were intensively conducted in Mwanga MC by community health workers may have explained the higher odds of vaccine confidence in these areas than in Moshi MC. Additionally, Moshi MC is located in an urban area while Mwanga MC is in a semi-urban area. Since people living in urban areas have relatively more access to sources of information like social media where rumors and myths about the vaccines spread which influence confidence in the vaccines, this may have explained the higher confidence we observed in this semi-urban district as compared to the urban district.

Confidence in vaccines is strongly linked with vaccination decisions including acceptance, uptake, hesitancy, and refusal. Our study found that confidence in COVID-19 vaccine safety, effectiveness, importance, and overall COVID-19 vaccine confidence is strongly associated with higher odds of uptake of COVID-19 vaccines. Safety concerns, fear of side effects, doubts over vaccine effectiveness, and fear of aggravation of underlying medical conditions by vaccines are reasons for unwillingness to vaccinate and non-receipts of COVID-19 vaccines among people with chronic illnesses.[30–32] Nonetheless, confidence in the COVID-19 vaccines' importance, safety, and effectiveness was associated with higher odds of uptake of COVID-19 vaccines among people with chronic illnesses in Ethiopia.[30] Similar findings have been reported among general community members in Tanzania,[20] in an international survey from low- and middle-income countries in Africa and Asia,[12] and a global multi-country survey.[5] Vaccine confidence, apart from convenience and complacency, has been conceptualized by the WHO's Strategic Advisory Group of Experts in Immunization as one of the key drivers for vaccination decisions.[8] Tanzania's COVID-19 vaccination coverage was substantially low after the initial rollout of COVID-19 vaccines from June 2021 perhaps due to the initial refusal of COVID-19 vaccines from the government officials.[25] Raising vaccine confidence was a strategy that Tanzania received from the WHO and its collaborative partners in January 2022 to increase vaccine demand and uptake.[33] This included awareness campaigns to increase awareness of vaccine importance and hence, vaccination which was done door-to-door. This strategy yielded a substantial rise in vaccine coverage from less than 10% in January 2021 to more than 50% in April 2023 in the target population.[33] This therefore implies that strategies to increase vaccine confidence such as education and social behavior change interventions can have a substantial impact on vaccine uptake and therefore coverage. This is particularly critical to mitigate the increased risk of morbidity and mortality from COVID-19 disease that people with underlying medical conditions like hypertension or diabetes mellitus bear.

Value that this study adds

This is the first study to elucidate factors associated with COVID-19 vaccine confidence and the effect it has on COVID-19 vaccine uptake among people with chronic illnesses in Tanzania. Our study also quantified the effect that vaccine confidence had on COVID-19 vaccine uptake. Our findings imply that improving public confidence in COVID-19 vaccines' importance, safety, and effectiveness among people with chronic illnesses can lessen vaccine hesitancy and improve vaccination rates and therefore curb the disproportionate increased risk of morbidity and mortality that this population bears. These findings could also enhance interventions targeted to improve vaccination rates in the current and future pandemics.

Strengths and limitations

The response rate of participants to this study was 97% and hence selection bias due to non-response is unlikely. However, selection bias may have been introduced since data were collected during the working hours of the day and hence more likely to have missed the working group of eligible participants. Furthermore, not all participants' vaccine uptake self-reports were validated using records from vaccination cards leading to possible misclassification of vaccination uptake. Nevertheless, the proportion of those whose vaccination status was not validated by vaccination cards was less than 10% hence the possible misclassification is unlikely to have impacted our estimates. Lastly, our study was conducted among individuals with chronic illnesses, i.e., either hypertension or diabetes, hence our findings cannot be generalized to a wide range of populations.

Conclusions

Seventy percent of the participants had confidence in COVID-19 vaccine safety, importance, effectiveness, and overall COVID-19 vaccine confidence. Having good knowledge of COVID-19 vaccines and living in Mwanga MC increased the odds of COVID-19 vaccine confidence. We also found COVID-19 vaccine confidence was strongly associated with higher odds of vaccine uptake. These findings highlight the need for designing interventions such as education on the safety, effectiveness, and importance of COVID-19 vaccines for people with chronic illnesses. A particular focus should be in urban areas to curb misinformation, increase vaccine confidence, and eventually uptake, without leaving the rural and disadvantaged residents behind.

Notes on contributor

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Data availability statement

Data will be made available upon request.

Statement of ethical approval

This study was approved by the Kilimanjaro Christian Medical University College Ethical Review Board (REC.2609). Informed consent was obtained from all participants before interviewing the participants. Consent was given verbally and was voluntary i.e., participants had the right to withdraw their participation from any time during the interview. All interviews were conducted face-to-face and an interview lasted for an average of 20–30minutes. Privacy and confidentiality was ensured before commencing the interviews.

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