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ORIGINAL RESEARCH

Knowledge and Proportion of COVID-19 Vaccination and Associated Factors Among Cancer Patients Attending Public Hospitals of Addis Ababa, Ethiopia, 2021: A Multicenter Study

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Background: Cancer patients are classified as being at high risk of contracting COVID-19 infection, hospitalization, and death and were recommended to have early access to the limited COVID-19 vaccine. However, there are limited studies on the knowledge and acceptance of the COVID-19 vaccine among cancer patients. Therefore, this study aimed at assessing the awareness, readiness, and associated factors among cancer patients.

Methods: Institution-based cross-sectional study was conducted on 422 cancer patients from May to August, 2021. A structured interviewer-administered questionnaire was used to collect primary data. A systematic random sampling technique was used to select study participants. Descriptive statistics and binary logistic regression followed by multivariable analysis were performed to investigate the independent association of factors with the outcome variable. Finally, statistical significance was declared at P <0.05 using AOR and 95% CI.

Results: From the 422 cancer patients who participated, 77 (18.2%) had a history of COVID-19 infection, and 224 (55%) believe that the cancer disease will not make them more vulnerable to be infected by COVID-19. Accordingly, younger age (18–30 years) (AOR = 2.73: 95% CI: 0.18, 4.51), female (AOR = 6.4: 95% CI: 0.7, 13.8), having information about COVID-19 vaccine (AOR = 6.9: 95% CI: 3.1, 15.2), COVID-19 infection history (AOR = 6.0: 95% CI: 2.5, 11.8), duration since cancer diagnosis (≥10 years) (AOR= 6.2: 95% CI: 2.6, 14.7), and belief about the likelihood of dying of COVID-19 infection (AOR = 3.05: 95% CI: 1.03, 4.05) were the independent predictors of the likelihood of receiving COVID-19 vaccine among cancer patients.

Conclusion: This study has found significant cancer patients with poor knowledge about the vaccine, and the percentage of both the first and second round of COVID-19 vaccination was small. Therefore, information communication with cancer patients and oncologists about the COVID-19 vaccine may help to decrease vaccine hesitancy.

Keywords: COVID-19, vaccine, willingness, cancer, Ethiopia

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Introduction

In Ethiopia, since the first COVID-19 positive case was identified on March 13, 2020, the number of new cases has been rapidly increasing, and now the country is one of the five countries with the highest COVID-19 burden in Africa.[1] Since the pandemic was identified, the Ethiopian government and Ministry of Health have

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been working hard to disseminate information about COVID-19 prevention measures and have achieved remarkable results through a decrease in new cases and deaths.[2] However, in the past two months, the number of new cases and deaths has started to increase (weekly increase in the number of new cases by up to 130% in July and 61% in August from the weekly new cases of June).[3,4] COVID-19 infection is a serious public health emergency,[5] and the morbidity and mortality are particularly high in exposed populations with inadequate health service facilities.[6]

Many international studies have explored the variability in the susceptibility of individuals to COVID-19 infection and disease outcome, and several socio-demographic, economic, patient-related, and chronic comorbidities, including cardiovascular disease, diabetes, and cancer, have shown to increase the susceptibility to, severity of, and mortality resulting from the disease.[7–9] Cancer patients, because of their compromised immune system, old age, underlying malignancy burden, and toxicity related to cancer treatments, appear to have an increased risk of contracting the virus, hospitalization, needing treatment at intensive care unit, and death.[9,10] Cancer patients are the major victims of this pandemic, with increased risks of morbidity and mortality from COVID-19 infection.[11,12] Cancer patients of different types with COVID-19 have higher mortality and hospitalization rates than non-cancer individuals; in Spain, 45/1069 Covid-19 morbidity in cancer patients vs 42,450/6,662,000 in total population;[13] in China, case fatality of 2.3 to 8.0% in the general population vs 5.6% in cancer patients;[10] in a cohort study, 21% of cancer patients with COVID-19 died vs 7.8% in non-cancer groups;[14] and the probability of death among cancer diseased patients with COVID-19 was also estimated to be around 25.6%.[15] COVID-19 also negatively affects the screening, diagnosis, follow-up, and treatment schedule of cancer patients as the current oncological treatment and diagnostic guidelines have not been reviewed in light of the current reality.[16,17]

Vaccines are one of the most reliable and cost-effective tools used to prevent and reduce the risk of developing severe illness from an infectious disease like COVID-19.[18,19] Currently, there are more than 50 different COVID-19 vaccine types developed to curb the spread of the infection.[20] To reduce the continued impact of COVID-19 and to achieve maximum effectiveness, high uptake of COVID-19 vaccines in a short duration is needed. However, due to little knowledge about the disease and the vaccine, and limited supply of the vaccines, vaccinating large populations within a short period is almost impossible. Consequently, WHO recommended prioritizing a roadmap through the National Deployment and Vaccination Plan (NDVP) whereby frontline health care workers and individuals with underlying conditions or high-risk groups like cancer patients are recommended to be given priority.[18,21] Though patients with cancer disease are classified as high risk and recommended to have early access even to the limited COVID-19 vaccine supply, there is a lack of data about the safety and efficacy of the vaccine in cancer patients and cancer patients were excluded from most COVID-19 and vaccine clinical trials.[22,23] At this time of uncertainty, increased misconceptions and apprehensions about vaccine safety and efficacy, negative attitudes towards vaccination, and fear of unforeseen side effects may result in vaccine hesitancy leading to undermining efforts to reduce the impact of COVID-19 and these misbeliefs are thought to be pronounced in cancer patients.[24,25] The main factors that determine an individual's intent to take the COVID-19 vaccine include perceived severity of the illness, perceived susceptibility to the disease, perceived benefits that the person is likely to obtain as a result of the vaccine, perceived barriers, and information and knowledge about the disease and the vaccine.[26,27]

Therefore, assessing cancer patients' awareness of and readiness to receive the COVID-19 vaccine along with the main factors which could increase the likelihood of receiving the vaccine will help develop and implement effective strategies in promoting the COVID-19 vaccine and decrease the recent alarming increase in COVID-19 new cases among cancer patients. However, there are no prior studies conducted in Ethiopian cancer patients which assess the awareness about the new vaccine, their main concerns which may hinder them to take the vaccine, and factors that may increase the likelihood of receiving the vaccine. Therefore, to fill this gap the current study was aimed to assess the first and second round COVID-19 vaccine coverage and the willingness to take the vaccine and its determinants among cancer patients attending public hospitals of Addis Ababa, Ethiopia.

Materials and Methods

Study Design, Setting, and Period

An institution-based cross-sectional study was conducted from May 2021 to 15 August 2021. The study was

conducted at public hospitals in Addis Ababa, Ethiopia. Addis Ababa city health administration has a total of 5 public hospitals, namely, Tikur Anbessa Specialized Hospital, Zewditu Memorial Hospital, St. Paul Specialized Hospital, Yekatit 12 specialized hospital and Abet general hospital. There is a separate oncology center at Tikur Anbessa Specialized Hospital providing diagnostic, follow-up and treatment (radiotherapy and chemotherapy) services only for cancer patients and the remaining four hospitals provide diagnostic, patient treatment (surgery and/or chemotherapy) and follow-up care services for patients of different cancer types. Cancer patients of a different type from all over Ethiopia are referred to hospitals of Addis Ababa either for further diagnostic or treatment services as these hospitals have holistic care for cancer patients.

Study Participants, Sampling Method, and Sample Size Determination

This study was conducted during the period in which the Ethiopian government and Ministry of Health had already started administering the first dose of COVID-19 vaccine and the second dose was also started for those populations most at risk of infection with COVID-19 as per the National Deployment and Vaccination Plan (NDVP) developed following the WHO Prioritizing Roadmap. In the first round of vaccination, frontline health care workers, individuals with chronic illnesses including cancer, and a few elderly individuals got the chance to be vaccinated, due to the lesser amount of vaccines, but during the data collection period, any voluntary person was allowed to take both first and second round of the vaccine. Consequently, the study population of the present study were all pathologically confirmed adult (above 18 years) cancer patients of both sexes who visited the pathology or oncology clinics or patients who were admitted for any type of cancer treatment at the selected hospitals.

The sample size for this particular study was determined using the single population proportion formula by taking, P = 50% (proportion of vaccination among cancer diseased patients in Ethiopia), d = 5% (margin of error), Zα/2 = 1.96 (the value of the standard normal curve score corresponding to the confidence interval), and 95% confidence level. After adjusting and adding a 10% non-response rate, the final total sample size was n = 422.

$$n = \frac{(Z\alpha/2)^2 \times p(1-p)}{d^2} = \frac{(1.96)^2 \times (0.5 \times 0.5)}{(0.05)^2}$$

$$n = 384$$

The sample was proportionally allocated to each of the five hospitals found in Addis Ababa, Ethiopia. The participants were selected through a systematic random sampling technique using a patient register chart.

Data Collection Procedures

An interviewer-based pretested and structured questionnaire was used to collect primary data on cancer patients' socio-demographic characteristics, their general awareness of and opinion about the COVID-19 vaccine, COVID-19 vaccination history, and possible reasons for lack of willingness to take the COVID-19 vaccine. Furthermore, a structured checklist was employed to abstract secondary data from patients' charts about the type of cancer, duration since cancer diagnosis, active cancer treatment status, and past/current COVID-19 infection experience. The questionnaire was prepared by reviewing many international studies with some modifications in the local context,[15,28–30] but most questions were developed by the researcher by consulting oncologists. The questionnaire was first prepared in English and then translated to Amharic language and the final tool was prepared in English after retranslating the Amharic version for consistency purposes. Pretest was done on 5% of the total sample size and modifications were made accordingly.

The study assessed study participants' Covid-19 infection history (current/past, their/another individual) (10 items), awareness of and opinion about COVID-19 vaccine (9 items), COVID-19 vaccination history (7 items), and possible reasons for the lack of willingness to take the first (10 items) and second (9 items) doses of COVID-19 vaccine. Both primary and secondary data were collected by trained public health and nurse professionals and the investigator facilitated and supervised the data collection process. All the necessary COVID-19 prevention precautions were taken during the data collection process.

Data Analysis Procedures

The collected data were checked for completeness and internal consistency, coded, edited, and entered into epi-data version 4.2. Then, Stata version 14 was used for statistical analysis. Descriptive statistical analysis such as frequencies and proportion, and summary statistics and cross-tabulation were used. Variable candidacy (P <0.25)

for multivariable analysis was determined after running bi-variable analysis using binary logistic regressions and then multivariable logistic regressions were performed to investigate the statistically significant association with the likelihood of receiving the Covid-19 vaccine. Finally, statistical significance was declared at (P <0.05) using AOR and 95% CI.

Data Quality Assurance

Before actual data collection, training and discussion with data collectors and supervisors were undertaken. All data were collected by well-trained public health and nurse professionals who have experience in working at Covid-19 quarantine/ isolation/treatment centers. All collected data was reviewed for completeness and consistency on a daily basis.

Results

Socio-Demographic Characteristics and COVID-19 Infection History of Study Participants

In this study, a total of 422 pathologically confirmed cancer diseased patients of different types were included and all approached participants agreed to participate, thus resulting in a response rate of 100%. The mean age of study participants was 35.7 (SD = ±6.86) years, of whom 45.1% were between 31 and 40 years. One-third of study participants 127 (30.1%) were ten years or above since being diagnosed with cancer and female gynecologic cancers were the most comment type (86, 20.4%). Seventy-seven (18.2%) cancer patients had currently/past COVID-19 infection history. More than half (224, 55%) thought that the cancer disease will not make them more vulnerable to COVID-19 than non-cancer individuals and only 111 (26.3%) of them believe that COVID-19 can cause severe illness and/or hospitalization (Table 1).

Study Participants' General Awareness/ Opinion of COVID-19 Vaccine and COVID-19 Vaccination History

Of the 422 cancer patients who participated, most (401, 95%) know the availability of a vaccine against COVID-19 infection and most (287, 68.1%) cancer patients thought that the current COVID-19 vaccines are not safe for cancer patients. Almost one-fourth (120, 28.5%) of study participants thought that cancer patients should be given priority for the COVID-19 vaccine. Of all participants, 78 (14.5%) have received the first round of the COVID-19 vaccine and 152 (44.2%) are still willing to get the first dose of the vaccine soon (Figure 1). Of those participants who took the first round of the vaccine (n = 78), 24 (30.8%) have received the second round of the COVID-19 vaccine (Figure 2 and Table 2).

Study Participants' Reasons for the Lack of Willingness to Take the First and Second Round of the COVID-19 Vaccine

As shown in Table 3, the study also assessed the main reasons of study participants for not receiving the first round (in those patients who were not vaccinated in the first round) and for the second round (in those participants who have received the first but not the second round) of the COVID-19 vaccine. Concern related to the safety and side effects of the vaccine (287, 84.4%), and hearing rumors that the vaccine may have severe side effects and/or may cause the virus itself in cancer patients (188, 54.6%) were the main reason of respondents for not receiving the first round of COVID-19 vaccine, while believing the first round of the vaccine was sufficient (34, 62.9%) and having no information that the second round was started in Ethiopia (22, 40.7%) were the main reasons for not receiving the second round of the vaccine (Table 3).

Determinant Factors Associated with the Likelihood of Receiving COVID-19 Vaccine Among Cancer Patients of Addis Ababa, Ethiopia, 2021

To determine the factors associated with the likelihood of receiving the COVID-19 vaccine, a bi-variable followed by multivariable logistic regression analysis was performed. For those variables with a p-value of ≤0.25 on bi-variable logistic regression, multivariable logistic regression was performed to determine their independent association with the outcome variable. The bi-variable logistic regression analysis showed that 8 factors, namely, age, sex, educational status, information about the COVID-19 vaccine, previous or current history of COVID-19 infection, duration since cancer diagnosis, know someone who has died of COVID-19 infection, and belief about the likelihood of dying of Covid-19 infection, were crudely associated with the likelihood of receiving COVID-19 vaccine. However, after statistical adjustments in the final

Table 1 Socio-Demographic Characteristics and COVID-19 Related Information of Cancer Patients in Addis Ababa, Ethiopia, 2021 (N = 422)

Questions	Response	Frequency	%
Sex	Male	181	42.8
	Female	241	57.2
Age (years)	18–30	93	22.1
	31–40	191	45.1
	41–50	69	16.4
	> 50	69	16.4
Residence	Rural	229	54.3
	Urban	193	45.7
Marital status	Single	148	35.1
	Married	224	53.1
	Widowed	50	11.8
Religion	Orthodox	202	47.9
	Muslim	162	38.5
	Protestant	40	9.6
	Others	8	2.0
Educational status	No formal school	78	18.5
	Primary school	107	25.4
	Secondary school	91	21.6
	College or university attended	146	34.6
Occupational status	Government employee	80	22.4
	Private	83	23.2
	Farmer	92	25.7
	Other	102	28.6
Duration since diagnosed with cancer (in years)	<5	101	23.9
	5–10	194	46
	>10	127	30.1
Type of cancer (CA)	Breast CA	79	18.7
	Female gynecologic CA	86	20.4
	Gastrointestinal, colonic, and rectal CA	78	18.6
	Cardiothoracic CA	62	14.6
	Esophageal CA	15	3.5
	Head and neck CA	31	7.4
	Pancreatic CA	9	2.2
	Blood CA	33	7.9
	Lymphomas	21	4.9
	Skin CA	8	1.8
Currently on active cancer treatment/ hospitalized	Yes	282	66.8
	No	140	33.2
Did you get infected (currently/past) by COVID-19?	Yes	77	18.2
	No	345	81.8
Do you know any cancer patient ever infected by COVID-19?	Yes	46	10.9
	No	376	89.1
Do you know someone (non-cancer) ever infected by COVID-19?	Yes	178	42.2
	No	244	57.8
Do you know any cancer patients who ever died of COVID-19?	Yes	18	4.3
	No	404	95.7
Do you know someone (non-cancer) who died of COVID-19?	Yes	85	20.2
	No	337	79.8
Do you think you can be infected by COVID-19?	Yes	341	80.8
	No	81	19.2
Do you think cancer makes you more vulnerable to COVID-19 than a non-cancer individual?	Yes	198	45
	No	224	55
Do you think cancer makes you more prone to severe illness/ hospitalization if infected by COVID-19?	Yes	111	26.3
	No	311	73.7
Do you think you are likely to die if infected by COVID-19?	Yes	99	23.5
	No	323	76.5
Do you follow Covid-19 prevention methods (hand washing, face mask…)?	Yes	399	94.5
	No	23	5.5

Notes: CA; cancer; Female gynecologic CA includes cervical, endometrial, and ovarian cancers.

model, educational status and knowing someone who has died of COVID-19 infection were not independent predictors of the outcome variable (Table 4).

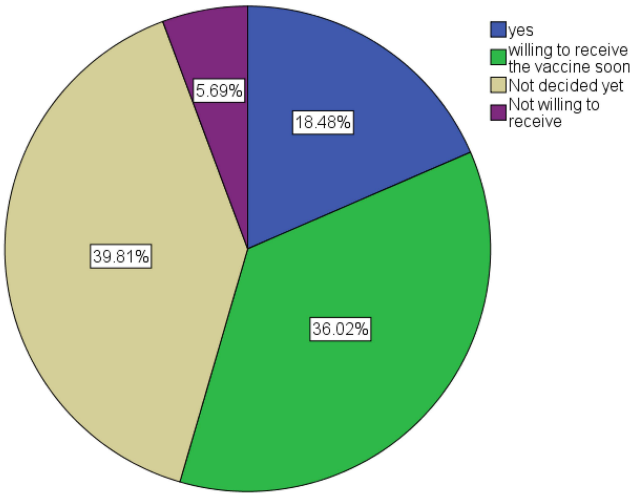

Figure 1 Experiences and willingness to receive the first dose of the COVID-19 vaccine among cancer patients in Addis Ababa, Ethiopia, 2021 (N = 422).

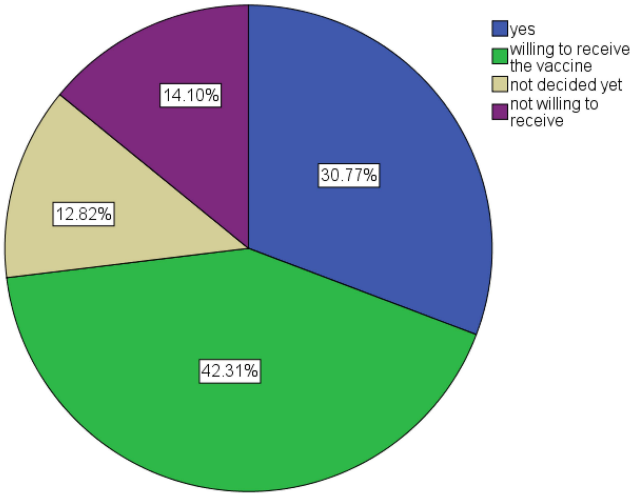

Figure 2 Experiences and willingness to receive the second dose of the COVID-19 vaccine among cancer patients in Addis Ababa, Ethiopia, 2021 (N = 78).

Cancer patients of younger age (18–30 years) were 2.73 (AOR = 2.73: 95% CI: 0.18, 4.51) times more likely to get vaccinated than older age groups. Female cancer patients were 6.4 (AOR = 6.4: 95% CI: 0.7, 13.8) times more likely to take the vaccine than male patients. The likelihood of receiving the COVID-19 vaccine was 6.9 (AOR = 6.9: 95% CI: 3.1, 15.2) times higher in those cancer patients who have information about the vaccine than in those who do not have it. Cancer patients who experienced either previous or current COVID-19 infection were 6.0 (AOR = 6.0: 95% CI: 2.5, 11.8) more likely to get the vaccine than when compared to those patients who had no Covid-19 infection experience. Cancer patients who were with cancer for more than ten years were 6.2 (AOR = 6.2: 95% CI: 2.6, 14.7) times more likely to receive the COVID-19 vaccine than those patients with a shorter duration with cancer. Finally, cancer patients who believe in the likelihood of dying of COVID-19 infection had 3.05 (AOR = 3.05: 95% CI: 1.03, 4.05) times higher odds of the likelihood of receiving COVID-19 vaccine than those patients who do not believe (Table 4).

Discussion

In this study, the knowledge of cancer diseased patients related to the COVID-19 vaccine and percentage of these patients who got the first and second dose of the vaccine, the reasons why they are not willing to receive the vaccine, and determinant factors associated with the likelihood of receiving the vaccine among cancer patients attending public hospitals of Addis Ababa are reported. Age, sex, information about COVID-19 vaccine, previous or current history of COVID-19 infection, duration since cancer diagnosis, and belief about the likelihood of dying of COVID-19 infection were found to be significant predictors.

The COVID-19 pandemic has been a health issue of great concern since its start in 2020 and causes high morbidity and mortality, especially in the higher-risk population groups like the one in this study, patients with cancer.[31] Because of the limited supply of the vaccine and high demand, setting prioritization guidelines is mandatory for the optimum use of the limited vaccine supplies.[32] Many international experimental studies recommended that patients with active cancer are at high risk of SARS-CoV-2 infection and death and should be given priority access to the COVID-19 vaccine.[32–34]

From the study, 18.2% (n = 77) of study participants have been infected with COVID-19, while more than half (55%, n = 224) thought that cancer will not make them more at risk to COVID-19 infection than non-cancer individuals and only 26.3% (n = 111) believe that they are more prone for severe illness/hospitalization if infected by COVID-19. The prevalence of COVID-19 among cancer patients was higher than a study conducted in Norway[35] but lower than from studies in Italy and New York.[10] A study in the chain also revealed that cancer patients have a two-fold risk of contracting COVID-19 when compared to the general population.[36]

In relation to the general awareness and opinions of our study participants about the COVID-19 vaccine, surprisingly about 5% (n = 21) of participants do not even know there are vaccines against COVID-19 infection, only one-third (31.9%, n= 135) thought that COVID-19 vaccine is safe in

Table 2 Knowledge of and Willingness to Receive the First and Second Dose of COVID-19 Vaccine Among Cancer Patients in Addis Ababa, Ethiopia, 2021 (N = 422)

Questions	Response	Frequency	Percentage
Do you think vaccines are important to prevent COVID-19?	Yes No	399 23	94.5 5.5
Do you know currently there are vaccines against COVID-19?	Yes No	401 21	95 5
Do you think that COVID-19 vaccines are effective?	Yes No	244 178	57.8 42.2
Do you think that the COVID-19 vaccine has side effects/risks?	Yes No	312 110	73.9 26.1
Do you think the benefits of the vaccine outweigh the side effects/ risks?	Yes No	254 168	60.2 39.8
Do you think the COVID-19 vaccine is safe in patients with cancer disease?	Yes No	135 287	31.9 68.1
Do you think cancer patients should be given priority for the vaccine?	Yes No	120 302	28.5 71.5
Do you think the government did not give enough attention to cancer patients for the vaccine?	Yes No	129 293	30.5 69.5
Do you know currently COVID-19 vaccine is started in Ethiopia?	Yes No	379 43	89.8 10.2
Did you get the first round of the COVID-19 vaccine?	Yes No	78 344	14.5 81.5
If yes for the above question, why did you take the vaccine (n = 78)?	Had full information Saw others taking the vaccine Family pressure	51 18 9	65.4 23.1 11.5
If no for the above question, are you willing to get the first dose of the vaccine soon (n = 344)?	Yes No Not decided	152 168 24	44.2 48.8 7
Did you take the second round of the COVID-19 vaccine (n = 78)?	Yes No	24 54	30.8 69.2
If no for the above question, are you planning to take the second round of the COVID-19 vaccine(n = 54)?	Yes No Not decided	33 11 10	61.1 20.4 18.5
Is there a family member who took the vaccine?	Yes No	98 324	23.2 76.8
Would you encourage your parents and cancer patients to receive the vaccine?	Yes No	230 192	55.5 45.5

patients with cancer and 28.5% (n = 120) of them suggested that cancer patients should be given priority for the vaccine. This inadequate knowledge about the COVID-19 vaccine could be due to low educational background, poor socio-economic status, poor information delivery system to cancer patients, not including oncologists in vaccination policymaking, and obtaining information from their peer laymen.[37] Our study result also revealed that, though vaccination of

Table 3 Respondents' Reasons for Not Receiving the First and Second Doses of the COVID-19 Vaccine Among Cancer Patients of Addis Ababa, Ethiopia, 2021 (N = 422)

Respondents' reasons for not receiving the first round of the COVID-19 vaccine (n = 344)	**Frequency**	**Percentage**
Had no information about the vaccine	21	6.1
I did not know it was started in Ethiopia	43	12.5
Heard rumors that the vaccine has severe side effects/causes the virus in cancer patients	188	54.6
I am concerned about the safety and side effects	287	84.4
I am concerned that the vaccine will not be effective in cancer patients	287	84.4
I do not think I am exposed to the disease	111	32.3
I do not think I will need the vaccine since I am already infected with the coronavirus	47	13.6
I am totally against the vaccines in general	12	3.4
I believe that other non-vaccine nutrition-related preventive mechanisms are sufficient	59	17.2
Other reasons	17	4.9
Respondents' reasons for not receiving the second dose of COVID-19 vaccine (n = 54, participants who took the first dose but not the second round)		
I think that the first round was sufficient	34	62.9
Had experienced side effects/discomfort of the vaccine in the first dose	19	35.2
I do not have the information that the second round was started	22	40.7
I do not have access to the vaccine	9	16.6
I do not think that I can withstand the vaccine with my current health condition	15	27.8
I think that I am not exposed to the disease	16	29.6
I think that I can easily resist the illness if infected	11	20.4
I think that other non-vaccine preventive mechanisms are sufficient	17	31.5
Other reasons	7	12.9

frontline health care workers and the population at risk was started in March 2021, only 14.5% (n = 78) have received the first round of COVID-19 vaccine, while 48.8% (n = 168) do not want to get the vaccine at all. Moreover, from those participants who took the first round of the vaccine (78), only one-third 30.8% (n = 24) reported that they have received the second round of COVID-19 vaccine and 20.4% (n=11) disclosed that they are not willing to take it. The vaccination percentage and acceptance of our study participants were lower than studies conducted in France (53.7%);[38] Lebanon, where 55% of cancer patients were ready to be vaccinated and only 14.4% refused the vaccine.[37] In another study, 61.8% and 60.3% willingness to receive COVID-19 vaccine were shown in Korean and Polish cancer patients, respectively.[25,39] Based on a survey conducted in the Ethiopian population, the vaccine acceptance rate was found to be 31.4%,[30] and another study on health care providers found that 63.4% of participants had received the first round of COVID-19 vaccine and 61.6% were willing to receive the second round of COVID-19 vaccine, which was higher than the current study, though the study population was the general population.[29] The main reasons of patients who did not support the first round of vaccination were concern about the safety and side effects of the vaccine (84.4%) followed by hearing rumors that the vaccine may have severe side effects or even cause COVID-19 infection in cancer patients (54.6%), while thoughts that the first round of the vaccine was sufficient (62.9%), and experiencing minor side effects/discomfort during the first dose of the vaccine (35.2%) were the major reasons for refusing the second round of the vaccine. Various factors such as individuals' beliefs about vaccination, physicians' recommendations, socio-demographic and economic factors may affect cancer patients' willingness to get the COVID-19 vaccine.[25,39] All these findings of the study imply that vaccine coverage among cancer patients is low compared to the general population and the Ethiopian government plan (20% population vaccination), therefore an urgent cancer patient-specific awareness creation campaign about the COVID-19 vaccine is needed to increase COVID-19 vaccine acceptance rates of cancer patients.

In the analysis of associated factors which may increase the likelihood of receiving the COVID-19 vaccine, younger age cancer patients (18–30 years) were 2.7 times more likely to get vaccinated than older age groups, and female cancer patients were 6.4 times more likely to

Table 4 Bi-Variable and Multivariable Logistic Regression Analysis of Factors Associated with the Likelihood of Receiving COVID-19 Vaccine Among Cancer Diseased Patients in Addis Ababa, Ethiopia, 2021 (N = 422)

Factors	Participant Likely to Receive COVID-19 Vaccine		95% CI		P-value
	Yes	No	COR (95% CI)	AOR (95% CI)	
1. Age					
18–30	71	22	0.96(0.25,3.40)	2.73(0.18,4.51)	0.001*
31–40	104	87	3.71(1.40,9.82)	1.91(1.01,8.48)	0.56
41–50	38	31	2.77(0.81,12.55)	1.13(0.33,5.91)	0.74
> 50	17	52	1	1	
2. Sex					
Male	63	118	1	1	
Female	167	74	16.1(10.3, 24.8)	6.4 (0.7, 13.8)	0.04*
3. Educational status					
No formal school	31	47	1	1	
Primary school	37	70	1.25(0.65,2.55)	1.14(0.59,2.55)	0.61
Secondary school	69	22	1.32(0.64,3.56)	1.31(0.47,3.44)	0.74
College or university attended	93	53	3.14(1.43,6.34)	3.01(1.48,6.89)	0.42
4. Information about the COVID-19 vaccine					
Yes	221	180	1	6.9 (3.1, 15.2)	0.000*
No	9	12	15.1 (8.1, 23.6)	1	
5. Previous or current history of COVID-19 infection					
Yes	59	18	7.1 (3.7, 10.4)	6.0 (2.5, 11.8)	0.000*
No	171	174	1	1	
6. Duration since cancer diagnosis (in years)					
<5 years	59	42	1	1	
5–10 years	117	77	6.5 (4.7, 10.1)	4.5 (0.4, 1.6)	0.21
>10 years	88	39	3.9 (2.4, 6.4)	6.2 (2.6, 14.7)	0.001*
7. Know someone who died of COVID-19 infection					
Yes	66	19	2.1(0.7, 2.8)	1.2 (0.3, 3.3)	0.771
No	164	173	1	1	
8. Belief about the likelihood of dying of COVID-19 infection					
Yes	61	38	2.29(1.2,3.96)	3.05(1.03,4.05)	0.03*
No	169	154	1	1	

Notes: *Has a significant association (P <0.05).
Abbreviations: COR, crude odds ratio; AOR, adjusted odds ratio; CI, confidence interval.

take the vaccine than male patients. In contrast to our findings, studies conducted on cancer patients in France, Poland, and Korea found male cancer patients and older age as positive predictors of accepting the COVID-19 vaccine.[15,25,38] However, inconsistent findings were obtained from studies conducted in Ethiopia and UK,[30] but the study subjects were the general population.

The likelihood of receiving the COVID-19 vaccine was 6.9 times higher in those cancer patients who have information about the vaccine than those who do not have such information. A consistent finding was obtained from a study conducted in Ethiopia in the general population.[30] Creating awareness pertinent to a specific group of the population by focusing on their specific

needs has been recognized as the most effective method of increasing vaccination acceptance rate[40] and also knowledge could increase individuals' self-confidence and help them gain experience which may ultimately initiate cancer patients to get the vaccine.

Cancer patients who experienced either previous or current COVID-19 infection were more likely to get the COVID-19 vaccine, as shown by its 6 times higher odds of association with receiving the vaccine when compared to those patients who had no COVID-19 infection experience. Cancer patients who were with cancer for more than ten years were 6.2 times more likely to receive the COVID-19 vaccine than those patients with the shorter duration with cancer. The likely justification could be due to COVID-19 virus infection experienced and chronic cancer patients may fear and realize the consequences of the disease and might see themselves at risk for the disease and believe in the importance of the vaccine.

Finally, the study also revealed that cancer patients who believe in the likelihood of dying of COVID-19 infection had 3 times higher odds of association with the likelihood of receiving COVID-19 vaccine than those patients who do not believe they might die. Psychological antecedents of cancer patients for the disease and vaccination may have been strongly associated with stronger vaccination confidence, collective responsibility, weaker risk perception, and weaker complacency about COVID-19 vaccination.[41]

Limitations of the Study

Despite being the first in type and the robust methodology we employed and the aforementioned findings we reached, the study has the following limitations. Vaccine coverage of other high-risk groups (patients with chronic diseases) was not assessed and comparison was not made, so it is difficult to conclude on the poor vaccine coverage among all high-risk groups. The questionnaire used may not be comprehensive and may fail to grasp all reasons to explain the unwillingness of vaccination in cancer patients. Finally, the study also shares drawbacks of a cross-sectional study design as a causal association between the considered factors and likelihood of vaccine acceptance may be difficult to establish.

Conclusion

In the study area, COVID-19 vaccine coverage among cancer patients was poor. Factors such as younger age, females, cancer patients having information about COVID-19 vaccine, COVID-19 infection experience, longer duration with cancer, and fear about the likelihood of dying if infected by COVID-19 were significantly associated with increased likelihood of receiving COVID-19 vaccine among cancer patients.

Recommendation

The poor acceptance and coverage of the COVID-19 vaccine among cancer patients in the study area can be mitigated through the accountable performance of the Ethiopian government, the Ministry of Health, each of the five hospitals, oncologists, and other stakeholders in charge of optimizing the vaccine coverage. Each of the hospitals, oncologists, and health care providers should make an exhaustive investment of their efforts to increase the knowledge, acceptance, and accessibility of the vaccine as early as possible. Oncologists should be involved in the policymaking of COVID-19 vaccine distribution and the Ministry of Health should supervise to ensure reasonable coverage of cancer patients.

Data Sharing Statement

All data generated and analyzed during this study are included in the manuscript.

Ethics Approval and Consent to Participate

For this study, ethical approval was obtained from the Ethical Review Committee of Debre Tabor University. A formal collaboration letter was provided to all the selected hospitals. Then, verbal consent was obtained from each of the respondents and documented by the data collectors in the participant information sheet. A copy of the documented verbal consent was given to each respondent and confidentiality was maintained by omitting personal identifiers. This study was also conducted following the ethical principles of the Declaration of Helsinki.

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Author Contributions

FT was involved in the initial conceptualization and design of the idea, supervision of the research project, acquisition of data, designing the study, analysis and interpretation of data, write-up of the proposal, and final manuscript write-up and editing. I have agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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