

# Health-Related Quality of Life and Associated Factors Among Covid-19 Survivors. Experience from Ethiopian Treatment Centers

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**Background:** The pandemic of the novel coronavirus (Covid-19), which is extremely stressful and has an adverse effect on people's health-related quality of life (HRQoL), poses a serious threat to global public health. As a result, this study evaluated the health-related quality of life and associated factors among Covid-19 patients who were discharged from Ethiopian treatment centers.

**Methods:** We conducted a multi-center, cross-sectional study among 493 Covid-19 survivors who had been discharged from treatment centers between 1st January 2020, and 20th October 2021. We collected respondents' data using validated Amharic version EuroQol 5-dimensional-5 levels (EQ-5D-5L) questionnaire along with medical records of the patients. Differences in HRQOL scores between patient subgroups were tested by Mann–Whitney U or Kruskal–Wallis test, and the multivariable betaMix regression was used to investigate factors associated with HRQOL scores.

**Results:** The EQ-5D and VAS median score for Covid-19 survivors was 0.940 (IQR: 0.783–0.966) and 87 (IQR: 70–91) respectively. Overall, married individuals, old-aged, individuals who had low educational status, high monthly income, comorbidities, admitted to the Intensive care Unit, received intranasal oxygen care, and prolonged hospitalization had lower utility scores and EQ-VAS scores compared to their counterparts. In multivariate betaMix regression, respondents' health status at admission, old age, chronic obstructive pulmonary disease, asthma, and hospital length of stay were significantly associated with the lower EQ-5D-Index value and EQ-VAS score.

**Conclusion:** We found that Covid-19 infection had a persisting impact on the physical and psychosocial health of Covid-19 survivors. Age, having asthma and chronic obstructive pulmonary disease, having a worsening health state upon admission, and a prolonged hospital length of stay were significantly associated with the lower EQ-5D and EQ-VAS score. Therefore, the cost-effective psychological treatment such as cognitive behaviour therapy should be encouraged after hospitalization to improve the post-Covid-19 depression and fatigue.

**Keywords:** quality of life, Covid-19, Ethiopia

## Introduction

Human coronaviruses are enclosed viruses with single-stranded RNA genomes that were first discovered in the 1960s. They can cause mild to severe/critical upper respiratory tract diseases in susceptible people.<sup>1</sup> Covid-19 is a global pandemic caused by the novel coronavirus and it was first reported in China.<sup>2</sup> It causes a wide range of clinical manifestations, ranging from mild to severe disease, with a sore throat; dry cough, muscle pain, and high-grade fever were commonly reported signs and symptoms.<sup>3,4</sup> Among the Covid-19 patients, 40% had abnormal findings on the chest X-ray, 92% had a fever, 53% had a cough, 20% had dysosmia, 10% had dysgeusia, and 39.9% had fatigue.<sup>5,6</sup> The World Health Organization (WHO) announced the Covid-19 outbreak as a public health emergency of worldwide concern after the virus produced a significant burden of

morbidity and mortality in China and other nations.<sup>7</sup> After the WHO declared the disease as a public health threat, 281,808,270 confirmed cases and 5,411,759 deaths were reported to WHO until December 29, 2021. Out of this, Ethiopia reported 405,745 confirmed cases of Covid-19 with 6911 deaths to WHO.<sup>8</sup> With the pandemic evolving more swiftly to more than 180 countries across all regions, concerns arose that these numbers would even get worse and reach out of control.<sup>9</sup> Thus, countries imposed measures such as closing their borders, repatriating, banning mass gatherings and religious celebrations, suspending air travel, obligatory quarantine of suspected individuals, social distancing and hand hygiene as well as lockdown of schools and Universities.<sup>10–12</sup> However, the government policies and social exclusion had a considerable impact on the psychological discomfort and physical activities of people, which varies with risk factors, disease severity, and epidemiology.<sup>13–16</sup> For instance, social distancing, and lockdowns to control the rapid spread of the Covid-19 pandemic have decreased physical activity levels, increased sedentary behaviour, irregular sleeping pattern, and loss of cardiorespiratory fitness.<sup>17–20</sup> Moreover, previous studies found that individuals who survived Covid-19 infection had also a deteriorated HRQoL, particularly in terms of their physical and psychological well-being, which resulted from prolonged hospitalization.<sup>21–23</sup> In hospitalized individuals, the mobility, self-care, and usual activity dimensions all showed improvement, but the pain and depression/anxiety domain impairment persisted for another six months.<sup>24</sup> For instance, a systematic review of Covid-19 revealed that the proportion of depressive symptoms after 12 weeks following severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection ranges from 11% to 28%.<sup>25,26</sup> Several factors such as age, gender, employment status, comorbidities, health status, and socioeconomic factors have been reported to influence HRQoL in Covid-19 infected individuals.<sup>27–29</sup>

Health-related Quality of life is a multi-dimensional concept that assesses the effects of disease and chronic illnesses on the physical, mental, and social dimensions of health. It is an important tool for medical personnel to understand the patient's perceptions of their health, the quality of the services they received, and their perception of their illness.<sup>30–33</sup> Various tools such as Short form-36(SF-36), COV19-QoL, WHOQOL-BREF, and EQ-5D were used to assess how diseases affected the HRQoL.<sup>34–36</sup> The EQ-5D tool was created by the EuroQol group as a straightforward and preference-based tool to characterize and quantify HRQoL based on the patient's opinion of their health. For many years, EQ-5D-3 levels (EQ-5D-3L) were used to evaluate patients' HRQoL. However, the EQ-5D-5L was recently designed to evaluate HRQoL due to reduced ceiling effects and good sensitivity.<sup>37,38</sup> The five dimensions of health are described in both EQ-5D versions, however, the levels for each dimension vary. Each dimension is measured using three levels in the EQ-5D-3L and five levels in the EQ-5D-5L.<sup>39,40</sup> Evaluation of HRQoL across various domains helps to identify the range of factors that affect patients' well-being.<sup>41</sup> It is also important to understand the mostly impaired HRQoL domains after the Covid-19 hospitalization. Besides, evaluation of the HRQoL of patients who survived Covid-19 infection is crucial for developing a variety of health strategies to improve the post-Covid-19 HRQoL. To the best of our knowledge, no research has yet been conducted that generated utility scores for Covid-19 survivors in Ethiopia using EQ-5D-5L. The Ethiopian population tariff has not been used to investigate the Covid-19 effects on HRQoL. As a result, this study evaluated HRQoL and associated factors among Covid-19 survivors who were discharged from Ethiopian treatment facilities.

## Method and Material

### Study Setting, Design, and Population

We conducted a multicenter, cross-sectional study among 493 Covid-19 survivors who had been discharged from three treatment centers in Ethiopia. We conducted this study at Dilla University hospital, Asella Referral and Teaching hospital (ARTH), and Bokoji primary hospital treatment center. The latter (i.e ARTH and Bokoji primary hospital) were found in Oromia Region whereas the former exists in South Nation, Nationalities Peoples Region. These treatment centers provide Covid-19 services under the treatment and admission protocol of the Federal Ministry of Health of Ethiopia. All patients discharged from these treatment centers between 1st January 2020 and 20th October 2021 were eligible and patients under 18 years old, who had no contact address and were deceased on arrival or during follow-up were excluded.

## Sample Size and Sampling Technique

To determine the sample size for a study, we used a single population proportion method and the following assumptions: a 95% confidence level of  $Z_{\alpha/2} = 1.96$ , 5% margin of error, design effect of 1.5, the proportion of problem reported in anxiety/depression dimension of EQ-5D index ( $p=69\%$ )<sup>42</sup> and non-response rate of 10%. Then, we obtained the final sample size calculation of 542. We used multi-stage sampling to recruit the study participants. We purposively selected two zones based on the availability of data and the convenience of the geographical location of the treatment centers. Then, we selected the available treatment centers in these zones using simple random sampling and allocated a sample proportionally to each treatment center based on the number of patients discharged during the study period. Then, based on the medical records of Covid-19 patients, 493 patients were interviewed using systematic random sampling.

## Study Variable and Operational Definition

Health-related Quality of Life, the study's dependent variable, is defined as an individual's feelings of their well-beingness in terms of satisfaction with significant areas of life. In addition, the independent variables in this study were socio-demographic factors like age, sex, marital status, education level, place of residence, income, and employment status, as well as clinical traits like health status at admission, comorbidities, intravenous oxygen use, and length of hospital stay. We defined patients' health status at admission according to the updated WHO and the Ethiopian Covid-19 national diagnosis and treatment protocol.<sup>43,44</sup> Asymptomatic infections were defined as an absence of clinical signs and symptoms with a positive test for SARS-CoV-2 using a virologic test, whereas mild Covid-19 cases were defined as mild signs and symptoms of Covid-19 without shortness of breath, dyspnea, or abnormal chest imaging. Moderate cases were defined as the presence of clinical signs of pneumonia (fever, cough, dyspnoea, and fast breathing) but without symptoms of severe pneumonia, including  $SpO_2 \geq 94\%$  in a room at sea level. Severe disease was defined as the presence of at least one of the following conditions: respiratory distress, a respiratory rate  $\geq 30$  beats/min, or lung infiltrates  $>50\%$ ; oxygen saturation in resting-state  $\leq 94\%$ ; or an arterial partial pressure of oxygen to fraction of inspired oxygen ( $PaO_2/FiO_2$ )  $\leq 300$  mmHg. Critically ill was defined as individuals who have respiratory failure, septic shock, and/or multiple organ dysfunction.

## Data Collection Procedure and Quality Management

We completed the EQ-5D-5L questionnaire, along with socio-demographic characteristics for patients discharged from treatment centers using telephone interviews. Clinical data such as comorbidities, status at admission, site of care, length of hospitalization, and type of supportive care received were extracted from the medical records of patients using a data abstraction form. We provided two days of training and two health experts collected data from individuals discharged from each treatment center. The principal investigator supervised and cross-checked data for completeness on daily basis.

## Health-Related Quality of Life

We collected the HRQoL information of the study participants using the validated Amharic version of the EQ-5D-5L questionnaire. The EQ-5D contains five domains: Mobility, Self-Care, Usual Activities, Pain/Discomfort, and Anxiety/Depression. For each domains, there were five levels to describe the severity, namely, have no problems, have slight problems, have moderate problem, have severe problems, and have extreme problems, which could describe 3125 possible health combinations. The predicted values for the EQ-5D-5L ranged from  $-0.718$ (worst possible health) to 1(best possible health).<sup>45</sup> EQ-5D also contains the descriptive system known as EQ Visual analogue scale [EQ-VAS]), which asks the respondents to rate their health status from the best health state(score of 100) to the worst health state (score of 0). We converted the HRQoL measured by EQ-5D to a single utility score using value set for the Ethiopian population.<sup>45</sup>

## Data Analysis

Data were imported into STATA version 16 from MS Excel 2010 for analysis. We computed descriptive statistics as appropriate depending on the nature of the data. Interquartile range (IQR) and median were used to summarize continuous variables, while frequencies and percentages were computed for categorical variables. The Shapiro–Wilk test, multi-collinearity, and heteroscedasticity assumption were statistically assessed on the HRQoL utility scores (index values) and

EQ-VAS scores. We found data is not normally distributed using the Shapiro–Wilk test and the Kruskal–Wallis test or Mann–Whitney *U*-test was used to ascertain the variations in EQ-5D index score and EQ-VAS score by patient characteristics. The health utility data is typically skewed, multimodal, truncated, and frequently has a significant number of observations at the top, making the employment of fundamental models like ordinary least squares and Tobit theoretically problematic for the analysis of such data. However, betaMix regression models offer a flexible way of modeling skewed, multimodal, and truncated distribution of EQ-5D data.<sup>46</sup> Therefore, we used the multivariable betaMix regression analysis model to identify the determinants of the HRQoL score and VAS score, and a *p*-value of  $< 0.05$  was considered statistically significant.

## Ethical Approval and Consent to Participate

We conducted this study in accordance with the Declaration of Helsinki. We secured the Ethical approval from the Institutional Review Board of Dilla University College of Health Sciences and Medicine. Verbal informed consent to participate was approved by the ethical committee since the period was in the 2nd Covid-19 wave and impossible for written consent. We also obtained permission from the administration of the treatment center to access the patient medical records. Participants have informed of the purpose of the study and the right to decline to participate in the interview. Moreover, no personal identifier was used, and all data gathered was kept private and only used for the study.

## Result

### Socio-Demographic Characteristics of Respondents and EQ-5D Index and EQ-5D-VAS Scores

A total of 493 individuals were interviewed making the response rate around 91%. Of the 493 respondents included in the studies, more than two-fifths (42.6%) were in the age group between 31–45 years, and the majority (64.9%) were male. Furthermore, about two-thirds (64.5%) of the participants were from urban, 70.8% were married, and 45.8% had primary education. Nearly half (47.9%) of the participants had a monthly income between 1000 and 2000 ETB (Ethiopian birr). We found the median EQ-5D index value for all respondents was 0.940 (IQR: 0.783, 0.966), and the median EQ-VAS was 87 (IQR: 70, 91). The median HRQoL score was lower in individuals aged  $> 59$  years old ( $p = 0.001$ ); those who were married ( $p = 0.001$ ) and had informal education ( $p = 0.001$ ). In addition, the median HRQoL score was lower in individuals who were farmers ( $p = 0.001$ ), and who had high monthly income ( $p = 0.001$ ). The EQ-VAS score also obtained similar results as that of the EQ-5D index score (Table 1).

### Clinical Characteristics of Respondents and EQ-5D Index and EQ-5D-VAS Scores

Nearly a third (30.6%) of the 493 Covid-19 patients interviewed had chronic conditions, and nearly a fourth (25.2%) had diabetes. When they were admitted to treatment facilities, nearly three-fourths (74%) of the participants were clinically classified as moderate, severe, or critical. With a median length of stay (LOS) of 15 days, more than half (52.1%) of participants stayed at the treatment facility for at least 15 days (IQR: 13–19). Intranasal oxygen supplementation was given to about three-fourths of the respondents (74%) and mechanical ventilation supportive treatment was used by 20% of participants who were admitted to the intensive care unit (ICU). We found that patients with chronic illnesses such as hypertension, chronic Cardiac disease, Chronic obstructive Pulmonary Disease (COPD), Asthma, Diabetic Mellitus, Chronic Kidney Disease (CKD), malignance, and HIV/AIDS had significantly lower median EQ-5D scores compared to their counterpart. In addition, individuals with severe/critical and moderate health status at admission, admitted to both ward and ICU or ICU only, received intranasal oxygen supplementation, and stayed 15 days and above in the hospital had lower median EQ-5D score ( $p < 0.001$ ). Similarly, VAS scores also obtained similar findings as that of the EQ-5D index score (Table 2).

### Distribution of the EQ-5D-5L Dimensions

The distributions of HRQoL problems that participants reported for each EQ-5D index dimension were shown in Figure 1. The proportion of individuals who reported problems with mobility, self-care, routine activities, pain/discomfort, and anxiety/depression aspects was 40.4%, 40.6%, 49.1%, and 54.6%, respectively.

**Table 1** Difference in EQ-5D and EQ-VAS Score by Sociodemographic Characteristics of Respondents Discharged from Covid-19 Treatment Centers in Ethiopia, 2020–2021

Category	N(%)	EQ-5D-5L Index		VAS Score	
		Median (IQR)	P-value	Median (IQR)	P-value
<b>Total</b>	493 (100)	0.940 (0.783, 0.966)		87 (70, 91)	
<b>Sex</b>			0.294		0.227
Male	320 (64.9)	0.935 (0.754,0.966)		87 (72, 92)	
Female	173 (35.1)	0.940 (0.815, 0.966)		86 (70, 90)	
<b>Resident</b>			0.818		0.612
Urban	318 (64.5)	0.940 (0.815, 0.966)		87 (70, 92)	
Rural	175 (35.5)	0.904 (0.752, 0.966)		85 (72, 90)	
<b>Age (in years)</b>			0.001		0.001
18–30	128 (26.0)	0.966 (0.963, 0.967)		92 (90, 95)	
31–45	210 (42.6)	0.966 (0.904, 0.967)		90 (85, 92)	
46–59	104 (21.1)	0.815 (0.752, 0.904)		75 (70, 87)	
≥ 60	51 (10.3)	0.752 (0.678, 0.860)		70 (65,76)	
<b>Marital status</b>			0.001		0.001
Married	349 (70.8)	0.904 (0.752,0.966)		80 (70, 90)	
Others	144 (29.2)	0.966 (0.904, 0.967)		91 (85,95)	
<b>Educational status</b>			0.001		0.001
Non-formal	153 (31.0)	0.815 (0.752, 0.966)		75 (70,90)	
Primary (1–8)	226 (45.8)	0.966 (0.815,0.967)		89 (73, 92)	
Secondary and above	114 (23.1)	0.966 (0.815,0.967)		89 (70,91)	
<b>Occupational status</b>			0.001		0.001
Farmer	79 (16.0)	0.815 (0.752, 0.966)		75 (70, 90)	
Merchant	118 (23.9)	0.904 (0.752,0.966)		80.5 (70,90)	
Government employee	45 (9.1)	0.904 (0.694,0.966)		85 (69,90)	
Others	251 (50.9)	0.966 (0.815, 0.966)		90 (74, 94)	
<b>Monthly income (in ETB)</b>			0.001		0.001
<1000	140 (28.4)	0.953 (0.815, 0.966)		89.5 (74, 92)	
1000–2000	236 (47.9)	0.904 (0.756, 0.966)		85 (70, 90)	
2001–4000	102 (20.7)	0.917 (0.752,0.966)		86.5 (70,92)	
Above 4000	15 (3.0)	0.815 (0.693,0.882)		75 (70,85)	

**Table 2** Clinical Characteristics of Covid-19 Patients Discharged from Treatment Centers in Ethiopia, 2020–2021

Category	N (%)	EQ-5D-5L Index		VAS Score	
		Median (IQR)	P-value	Median (IQR)	P-value
<b>Status at admission</b>					
Mild	128 (26.0)	0.966 (0.960,0.967)	0.001	94 (90.5, 95)	0.001
Moderate	176 (35.7)	0.940 (0.815,0.966)		87 (75,90)	
Severe/Critical	189 (38.3)	0.752 (0.678, 0.815)		70 (65, 75)	
<b>Comorbidity</b>			0.001		0.001
Yes	151 (30.6)	0.752 (0.678, 0.815)		70 (65, 75)	
No	342 (69.4)	0.966 (0.872, 0.966)		90 (80, 94)	
<b>Hypertension</b>			0.001		0.001
Yes	37 (7.5)	0.752 (0.693,0.815)		70 (65, 74)	
No	456 (92.5)	0.940 (0.815, 0.966)		87 (72, 91)	

(Continued)

Table 2 (Continued).

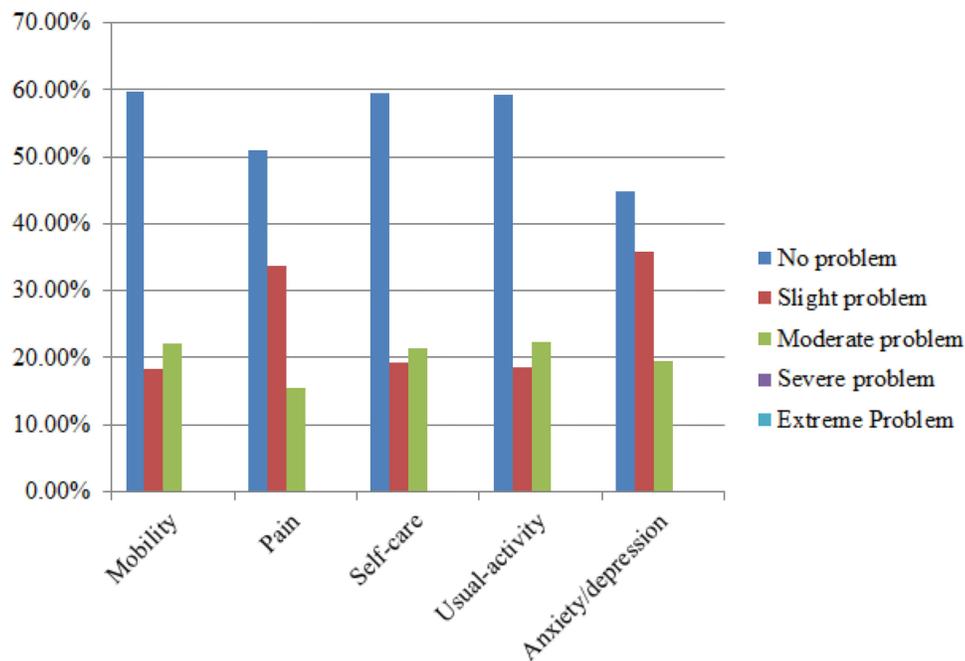
Category	N (%)	EQ-5D-5L Index		VAS Score	
		Median (IQR)	P-value	Median (IQR)	P-value
<b>Chronic Cardiac disease</b>					
Yes	22 (4.5)	0.940 (0.815, 0.966)	0.001	67 (65,72)	0.001
No	471 (95.5)	0.723 (0.678,0.904)		88 (72, 92)	
<b>COPD</b>					
Yes	37 (7.5)	0.940 (0.815, 0.966)	0.001	67 (65, 72)	0.001
No	456 (92.5)	0.693 (0.678, 0.815)		87 (72, 92)	
<b>Diabetic Mellitus</b>					
Yes	64 (13.0)	0.752 (0.678, 0.815)	0.001	70 (65, 74)	0.001
No	429 (87.0)	0.940 (0.815, 0.966)		88 (73, 92)	
<b>Asthma</b>					
Yes	39 (7.9)	0.940 (0.815, 0.966)	0.001	88 (72, 92)	0.001
No	454 (92.1)	0.752 (0.678, 0.815)		69 (65, 74)	
<b>Malignance</b>					
Yes	18 (3.7)	0.746 (0.678, 0.815)	0.001	67 (65, 71)	0.001
No	475 (96.3)	0.940 (0.815, 0.966)		87 (71, 91)	
<b>HIV/AIDS</b>					
Yes	19 (3.9)	0.815 (0.693,0.815)	0.001	73 (65, 75)	0.001
No	474 (96.1)	0.940 (0.815, 0.966)		87 (70, 91)	
<b>CKD</b>					
Yes	18 (3.7)	0.752 (0.693, 0.815)	0.001	71 (70, 75)	0.001
No	475 (96.3)	0.940 (0.815, 0.966)		87 (70, 91)	
<b>Intranasal oxygen use</b>					
Yes	365 (74.0)	0.815 (0.752, 0.966)	0.001	75 (70, 89)	0.001
No	128 (26.0)	0.966 (0.965, 0.967)		94 (91, 95)	
<b>Place of care</b>					
Ward	458 (92.9)	0.940 (0.815,0.966)	0.001	88 (72,91)	0.001
ICU	13 (2.6)	0.678 (0.677,0.752)		68 (65,70)	
Both	22 (4.5)	0.693 (0.678,0.815)		67.5 (65,71)	
<b>Intubated</b>					
Yes	7 (20.0)	0.678 (0.677,0.694)	0.153	65 (65,70)	0.500
No	28 (80.0)	0.693 (0.678,0.785)		70 (65,71.5)	
<b>Length of stay (in days)</b>					
Less than 15 days	236 (47.9)	0.966 (0.904,0.967)	0.001	90 (86,95)	0.001
15 and above days	257 (52.1)	0.815 (0.693, 0.940)		73 (68, 88)	

## Multivariable BetaMix Regression Model for EQ- 5D Index and EQ- 5D VAS Scores

We used multivariable betaMix regression analysis to assess the relationship between socio-demographic and clinical characteristics to predict the determinants of EQ- 5D Index and EQ- 5D VAS scores. We found that older age, being in worsening condition during admission, having COPD, asthma, and prolonged hospitalization had significant negative effects on both the EQ-5D-5L index and EQ-5D-VAS score ( $p < 0.05$ ). In addition, individuals who had malignancy had lower EQ-5D-VAS scores compared to those who were without malignancy ( $p < 0.029$ ) (Table 3).

## Discussion

The Covid-19 pandemic is a threat to global public health, causing significant stress and affecting the HRQoL of the survived patients.<sup>41,47</sup> This study used the EQ-5D-5L tool to measure the HRQoL of Covid-19 survivors and the effect of sociodemographic and clinical variables on HRQoL. In our study, the median EQ-5D-5L score for Covid-19 survivors was 0.940. This finding is supported by the finding from Vietnam, 0.95,<sup>17</sup> China, 0.949,<sup>48</sup> and greater than the study



**Figure 1** Distribution of the EQ-5D-5L dimensions among Covid-19 patients discharged from 2020–2021 in Ethiopia.

conducted in Vietnam, 0.66,<sup>49</sup> Hong Kong, 0.897,<sup>50</sup> Norway, 0.82,<sup>51</sup> Iran, 0.6125,<sup>52</sup> and Palestine, 0.65.<sup>53</sup> The observed discrepancy might be due to the difference in tariff value used, method of measurement, study period, study population, and comorbidities. In our study, pain/discomfort (49.1%) and anxiety/depression (54.6%) were the two commonly impaired dimensions of EQ-5D. Our findings are consistent with previous studies, which found a higher burden of psychological distress and fatigue among Covid-19 survivors.<sup>48,52,54,55</sup> This might be due to the fact that Covid-19 survivors have anxiety/depression which is linked to worry about future careers, feelings of job insecurity, loneliness and isolation, concerns about family members, social stigma and discrimination, and workplace discrimination.<sup>56–59</sup> The high prevalence of anxiety/depression and fatigue among Covid-19 survivors highlighted the need for using the cost-effective psychological interventions such as cognitive behaviour therapy [CBT] that have the potential of combating anxiety/depression to improve the post-Covid-19 trauma.<sup>60–62</sup>

We found that the older age Covid-19 survivors had lower scores of HRQoL compared with the younger individuals. This is supported by previous studies that found a decreased EQ-5D score with increasing age of Covid-19 patients.<sup>48,52,53,63</sup> This might be due to psychological stress as a result of news about Covid-19, increased comorbidity, and deterioration of the physical condition of older people.<sup>64,65</sup> The associations between lower HRQoL and prolonged hospitalization, as well as health status at admission in our study, were also consistent with the previous studies.<sup>23,63,66,67</sup> This could be due to respondents who have worsened health status during admission had a long duration of treatment and developing psychological stress due to prolonged social exclusion and confinement in the treatment center.<sup>22–24,66–69</sup> The association between prolonged stay on treatment and the lower HRQoL among individuals who survived Covid-19 infection, highlights the need for implementing post-Covid-19 psychological therapy that has the potential of combating anxiety/depression that persists for six months.<sup>60–62</sup>

The current study revealed a significantly lower HRQoL in individuals with comorbidities such as COPD, Asthma, Diabetic Mellitus, HIV/AIDS, malignance, CKD, and hypertension compared to their counterparts. In addition, the associations between lower HRQoL and comorbidities such as COPD, malignancy, and asthma ( $p < 0.05$ ), were also consistent with previous studies on Covid-19.<sup>23,41,53,55,63,70,71</sup> This could be due to respondents who had underlying diseases might be worried about reinfection after being discharged and avoiding both urgent or emergency and routine medical care that improves their health status.<sup>72</sup> This study has several strengths and added value to the current scientific research. We believe that this is the first study that used the EQ-5D-5L in an Ethiopian setting to determine the utility

**Table 3** Multivariate BetaMix Regression Analysis for Factors Associated with EQ-5D-Index of Covid-19 Survivors Discharged from Treatment Centers in Ethiopia, 2020–2021

Variables	EQ-5D-Index Score			EQ-5D-VAS Score		
	Coefficient	95% CI	P-value	Coefficient	95% CI	P-value
Age (in a year)	-0.113	-0.168,-0.0059	0.001	-0.0094	-0.0137,-0.0051	0.001
Sex (Ref: female)	0.0661	-0.0616, 0.1938	0.310	0.0595	-0.0399, 0.1589	0.241
Residence (Ref: Rural)	0.0435	-0.1062,0.1932	0.569	0.0283	-0.0866, 0.1432	0.629
Married (Ref: other)	0.0560	-0.0821,0.1941	0.427	0.0275	-0.1364,0.0814	0.621
<b>Educational status</b>						
Primary (1–8) (Ref: non-formal education)	0.0024	-0.1215,0.1263	0.970	0.0046	-0.1013,0.0921	0.926
Secondary and above (Ref: non-formal education)	0.0560	-0.1006,0.2117	0.485	0.0178	-0.1037,0.1393	0.774
<b>Occupational status</b>						
Farmer (Ref: others)	-0.0060	-0.2036,0.1916	0.953	-0.0241	-0.1774,0.1293	0.758
Merchant (Ref: others)	-0.0248	-0.1738,0.1243	0.745	-0.0149	-0.1305,0.1007	0.800
Government employee (Ref: others)	0.0079	-0.2018,0.2174	0.942	-0.0066	-0.1697,0.1564	0.936
<b>Monthly income</b>						
1000–2000 ETB (Ref: less than 1000 ETB)	-0.0101	-0.1357,0.1155	0.875	0.0023	-0.0944,0.0990	0.963
2001–4000 ETB (Ref: less than 1000 ETB)	-0.0189	-0.1701,0.1323	0.807	0.0394	-0.0785,0.1573	0.513
4000 ETB and Above (Ref: less than 1000 ETB)	-0.2853	-0.5734, 0.0028	0.060	-0.1938	-0.4222, 0.0347	0.096
Hypertension (Ref: No)	-0.0618	-0.2406,0.1171	0.498	-0.0397	-0.1822, 0.1029	0.586
Chronic cardiac disease (Ref: No)	-0.1160	-0.3318,0.0998	0.292	-0.0785	-0.2516, 0.0946	0.374
COPD (Ref: No)	-0.2504	-0.4268,-0.0740	0.005	-0.1774	-0.3196,-0.0352	0.014
Asthma (Ref: No)	-0.2357	-0.4116,-0.0598	0.009	-0.1962	-0.3357,-0.0568	0.001
CKD (Ref: No)	-0.1193	-0.3527,0.1140	0.316	-0.1252	-0.3122, 0.0619	0.190
Diabetes mellitus (Ref: No)	-0.1194	-0.2665,0.0277	0.111	-0.1051	-0.2223, 0.0121	0.079
Malignance (Ref: No)	-0.1864	-0.4327,0.0600	0.138	-0.2136	-0.4057,-0.0215	0.029
HIV/AIDS (Ref: No)	-0.1415	-0.3792,0.0961	0.243	-0.1117	-0.2981, 0.0747	0.240
<b>Status at admission</b>						
Moderate (Ref: Mild)	-0.3230	-0.4967,-0.1493	0.001	-0.5855	-0.7196,-0.4513	0.001
Severe (Ref: Mild)	-1.063	-1.2396,-0.8853	0.001	-1.109	-1.249,-0.9691	0.001
Length of stay (in days)	-0.0497	-0.0636,-0.0358	0.001	-0.0339	-0.0450,-0.0228	0.001

value for Covid-19 survivors. It can therefore be used for the economic evaluation analyses of Covid-19 strategies. Additionally, the study was carried out in a multi-center context and can be generalized to a similar setting in Ethiopia. However, our study is not free from limitations. As we collected the HRQoL data from participants' self-reported preferences, the respondents might overestimate or underestimated their real health status. In addition, since there is a significant rate of anxiety and depression reported in non-Covid-19 patients, we cannot indicate whether the reductions in HRQOL in our study are differentially worse than those without Covid-19.

## Conclusion

We found that Covid-19 infection had a persisting impact on the physical and psychosocial health of Covid-19 survivors. Age, having asthma and COPD, having a worsening health state upon admission, and a prolonged hospital length of stay were significantly associated with the lower EQ-5D and EQ-VAS scores. Therefore, cost-effective psychological therapy such as CBT should be encouraged after hospitalization to improve post-Covid-19 depression and fatigue.

## Abbreviations

AIDS, Acquired Immune Deficiency Syndrome; ARTH: Asella Referral and Teaching Hospital, CFR, Case Fatality Rate; CI, Confidence Interval; CKD, Chronic Kidney Disease; COPD, Chronic Pulmonary Disease; EQ-5D-3L, Euro Qol –5-Dimension –3 Level; EQ-5D-5L, Euro Qol –5-Dimension –5 Level; HRQoL, Health-Related Quality of Life; HIV, Human Immune Virus; LMIC, Low and Medium-Income Countries; ICU, Intensive Care Unit; RNA, Ribonucleotide Acid; SD, Standard Deviation; VAS, Visual Analogous Scale; WHO, World Health Organization.

## Data Sharing Statement

The datasets supporting the conclusions of this article were available from the corresponding author upon reasonable request.

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The authors declare that they have no competing interests in this work.

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