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Factors Associated with Health-related Quality of Life after Hospitalization for COVID-19 in Diabetic and Non-diabetic Patients: A Cross-sectional Study

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Abstract

Background: Diabetes is a non-communicable disease with fatal complications. Diabetic patients are highly susceptible to COVID-19 side effects and persistent post-discharge symptoms that impact health-related quality of life (HRQoL).

Objectives: This study aimed to assess HRQoL and examine factors affecting diabetic and non-diabetic COVID-19 patients after hospitalization.

Methods: In a cross-sectional study, 220 diabetic and non-diabetic COVID-19 patients were randomly selected after hospitalization in Sirjan, Iran, from January 2020 to October 2021. The European Quality of Life 5 Dimensions 5 Level Version (EQ-5D-5L) questionnaire was used to measure HRQoL as a dependent variable and its dimensions (including mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) as independent variables. In addition, a checklist was used to identify determinants of HRQoL, including age, gender, education, family income, household ownership, occupation, number of family members, and access to health services, that might affect the HRQoL participants.

Results: The mean HRQoL score in COVID-19 diabetics (0.766±0.110) was significantly lower than that in their non-diabetic counterparts (0.859±0.077). The EQ-5D-5L scores in the diabetic group were significantly higher in younger participants, men, employed subjects, patients with higher educational levels, higher income, higher health status, supplemental insurance, access to health services, and fewer family members. According to the results of the Betamix model, education and diabetes were significant independent predictors of HRQoL scores.

Conclusion: Diabetic COVID-19 cases experienced a significant decrease in HRQoL after hospitalization. This drop might have been due to more side effects of COVID-19 in diabetic patients and lower utilization of health services during this period. It is suggested that the health sector changes the management of diabetics during the COVID-19 epidemic by taking measures such as using telemedicine, providing home services, or prescribing medications for a longer period.

Keywords: COVID-19 infection, Diabetics, Health-related quality of life, Hospitalization

1. Background

Coronavirus disease 2019 (COVID-19) was reported as a new and unknown disease in Wuhan, China, in December 2019 (1). This disease, caused by the severe acute respiratory syndrome coronavirus 2, was declared a pandemic by the World Health Organization due to its rapid worldwide spread and threat to global health (2). This emerging disease, with its astounding daily infection rate, has been associated with high mortality and morbidity as well as significant costs to healthcare systems and populations (3). Furthermore, it has a dramatic impact on the physical and mental health of people in the community (4).

In addition to the acute manifestations of COVID-19 and its complications, there is a phenomenon called “long COVID-19” that can occur not only in the elderly and people with underlying diseases but also in others (5, 6). Thus, these patients and their families often experience long-term physical, cognitive, and mental health disorders referred to as post-intensive care syndrome (7). Evidence suggests that 11-24% of COVID-19 patients may continue to suffer from long-term complications 3 months after the onset. Considering this, COVID-19 may lead to poorer health-related quality of life (HRQoL) in patients who struggle with its short- and long-term consequences (8-10).

The elderly and those with underlying diseases, such as diabetes, obesity, and cardiovascular disease, have been shown to be at higher risk for severe forms of the disease (11) and a much faster disease progresses in the elderly than in younger people (5). As a result, health policymakers have taken several steps to curb its spread by focusing on the most vulnerable people in the community (6). Diabetics are highly susceptible to the side effects of COVID-19 (7). Diabetes is a non-communicable disease with fatal complications, such as limb amputation, blindness, chronic kidney failure, and heart disease (12), which results from an imbalance between the need for insulin and its supply (12). This disease has significant effects on physical, psychological, and

social functioning. Although existing medical treatments alleviate the symptoms of the disease, they lead to the disruption of normal lifestyle (13). In addition, diabetes will be the seventh leading cause of death worldwide by 2030, and more than 80% of deaths will occur in low- and middle-income countries (14). According to the 2019 International Diabetes Federation report, the prevalence of diabetes in the Eastern Mediterranean and North Africa was 24.2% (15). Based on a systematic review in Iran, the prevalence of type 2 diabetes was estimated to be 24% between 1996 and 2004, with a 0.4% annual increase in prevalence in individuals older than 20 years (14). In 2017, approximately 5 million adults in Iran were living with diabetes, and it is estimated that 9.2 million Iranians will have diabetes by 2030 (15).

The COVID-19 pandemic has been added to the earlier diabetes pandemic to include a large and significantly vulnerable group of people with both COVID-19 and diabetes (7). The chronic complications of diabetes and the side effects of COVID-19 affect the physical and mental health of patients and ultimately lead to a reduction in their quality of life (8). Therefore, one of the main goals in the medical care of this type of patients is to improve their quality of life (6).

HRQoL is one of the main health outcomes used for some purposes, such as measuring the impact of health care services (16). Therefore, health assessment includes not only the assessment of the extent and severity of disease but also good status and good quality of life (17). The importance of measuring the quality of life in patients with COVID-19 is increasing because of the post-acute COVID-19 syndrome (3, 18).

2. Objectives

Considering that few studies have investigated the impact of the COVID-19 disease and its long-term complications on HRQoL after hospitalization, as well as the greater susceptibility of diabetic patients to COVID-19 disease, this study aimed to evaluate the HRQoL of diabetic and non-diabetic patients with COVID-19 after hospital discharge and to identify the factors affecting HRQoL. We used the European Quality of Life 5 Dimensions (EQ-5D) instrument, which is widely used to assess HRQoL and well-being in different populations (5). The results of this study may help policymakers and health managers to develop and implement appropriate interventions to improve the quality of life of these patients under epidemic conditions, including the COVID-19 epidemic.

3. Methods

3.1. Study design and setting

This cross-sectional study aimed to examine health system factors and patient factors associated with quality of life in diabetic and non-diabetic patients with COVID-19 after hospital discharge. It should be noted that at least 2 weeks was needed to pass since hospital discharge. This study was conducted from January 2020 to October 2021 in two hospitals in Sirjan (a city in the southwest of Kerman province, Iran).

3.2. Sampling method

In the first phase, two hospitals in this city were selected and participants were chosen by simple random sampling method from diabetic and non-diabetic COVID-19 patients. According to the mean and standard deviation of the HRQoL score of the European Quality of Life 5 Dimensions 5 Level Version (EQ-5D-5L) questionnaire in similar studies (19, 20), the mean of the two groups of diabetics and non-diabetics was 0.83 and 0.89, respectively, and the standard deviation for both groups was 0.13. The sample size was set at 220 using the formula below with a 0.05 type I error, 95% confidence interval, 0.9 power, and non-response rate of 10%. Of these, 110 questionnaires were completed by each group of diabetic patients and non-diabetic patients.

$$n = \frac{(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta})^2 2\sigma^2}{d^2} = \frac{10.51 \times 0.0338}{0.0036} \approx 99$$

3.3. Data collection

3.3.1.Method of conducting the study

Data collection was done through telephone interviews. In this regard, after obtaining the code of ethics from the health centers, the researchers collected the contact information of COVID-19 patients admitted and discharged from January 2020 to October 2021 in the hospitals under study. The inclusion criteria for the COVID-19 diabetic patients were having type 2 diabetes, being aged 25 years and older, lacking concomitant diseases (e.g., hypertension, renal diseases, and cardiac disease), and being infected with COVID-19 for at most the previous six months. On the other hand, patients with COVID-19 who were unwilling to participate in the study and those who were in the COVID-19 recovery phase at the time of the study were excluded from the study. It should be noted that at least two weeks should have elapsed since hospital discharge.

3.3.2. Measurement tools

The visual analog scale (VAS) and the EQ-5D-5L questionnaire were used to assess the HRQoL of diabetic and non-diabetic COVID-19 patients after hospital discharge. EQ-5D-5L is the most common instrument used to assess HRQoL. It contains few questions; and therefore, it can be completed by people of all ages and in difficult situations. EQ-5D-5L includes the five dimensions of mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each of these dimensions is rated on a 5-point Likert

scale to define possible health states (1=extreme problems, 2=severe problems, 3=moderate problems, 4=slight problems, and 5=no problems); accordingly, a higher score indicates a higher HRQoL. After calculating each person's HRQoL score, these scores were standardized in the range of 0 to 1. To this aim, the HRQoL score of each person was subtracted from the minimum HRQoL score and divided by the result of subtracting the maximum from the minimum HRQoL score. We also used a vertical calibrated line (0-100) from VAS to indicate the overall health status of the participant, with 0 representing the worst conceivable health status and 100 representing the best conceivable health status (21). A checklist was also created to identify the determinants of HRQoL in diabetic and non-diabetic COVID-19 patients. The checklist included questions about demographic and socioeconomic information, including age, gender, education, family income, housing situation, occupation, and the number of family members that might affect the quality of life of these patients. It should be noted that in the diabetic group, access to health care services, such as treatment and management of diabetes, was also studied. For health care to be accessible, it must be affordable and convenient. In this respect, questions were asked about access to needed medications and health care in terms of availability and affordability. The content validity of the developed checklist was confirmed by the experts.

3.4. Ethical considerations

Before the interviews, participants were informed about the study and its objectives, and their verbal consent was obtained. In addition, they were assured that their information would be kept confidential. The present study was approved by the Ethics Committee of the Sirjan School of Medical Sciences (IR.SIRUMS.REC.1400.012).

3.5. Statistical analysis

All analyses were performed using SPSS22 and Stata16 for Windows. Because the data did not show a normal distribution according to the Kolmogorov-Smirnov test, the Mann-Whitney U test and the Kruskal-Wallis test were used. P values of < 0.05 were considered statistically significant. Considering that the HRQoL scores ranged from 0 to 1, the multiple beta regression model was used to examine the combined effect of the variables. Only the independent variables that showed a significant association with HRQoL in bivariate (P≤0.05) were included in the multiple beta regression model.

4. Results

The response rate was 100%. The demographic characteristics of participants are presented in Table 1. There was a significant difference between the two groups in age (P<0.001), education level (P=0.001), employment status (P=0.097), marital status (P=0.008), family size (P=0.026), and time elapsed since the onset of infection with COVID-19 (P=0.001) (Table 1).

There was a statistically significant difference in the mean HRQoL scores between diabetic and non-diabetic COVID-19 patients (P<0.001) (Table 2).

Table 1. Intergroup comparison based on demographic characteristics of patients

Demographic characteristics	Categories	Diabetic COVID-19 patients N (%)	Non-diabetic COVID-19 patients N (%)	n (%)	P-value*
Age group (years)	≤40	5 (4.5)	35 (31.8)	40 (18.2)	<0.001
	41-50	24 (21.8)	53 (48.2)	77 (35.0)	
	51-60	41 (37.3)	16 (14.5)	57 (25.9)	
	>60	40 (36.4)	6 (5.5)	46 (20.9)	
Gender	Male	53 (48.2)	55 (50)	108 (49.1)	0.787
	Female	57 (51.8)	55 (50)	112 (50.9)	
Education	<Diploma	39 (35.5)	22 (20)	61 (27.7)	0.001
	Diploma	46 (41.8)	38 (34.5)	84 (38.2)	
	University degree	25 (22.7)	50 (45.5)	75 (34.1)	
Income (dollars)	<100	60 (54.5)	60 (54.5)	120 (54.5)	0.926
	100-130	36 (32.7)	35 (31.8)	71 (32.3)	
	160-240	10 (9.1)	9 (8.2)	19 (8.6)	
	>240	4 (3.6)	6 (5.5)	10 (4.5)	
Employment status	Employed	100 (90.9)	106 (96.4)	206 (93.6)	0.097
	Unemployed	10 (9.1)	4 (3.6)	14 (6.4)	
Homeownership	Homeowner	59 (53.6)	59 (53.6)	118 (53.6)	0.756
	Tenant	51 (46.4)	51 (46.4)	102 (46.4)	
Marital status	Married	82 (74.5)	63 (57.3)	145 (65.9)	0.008
	Single	28 (25.5)	43 (39.1)	71 (32.3)	
	Divorced or widow	0	4 (3.6)	4 (1.8)	
Family members	≤2	8 (7.3)	21 (19.1)	29 (13.2)	0.026
	3-4	31 (28.2)	37 (33.6)	68 (30.9)	
	5-6	47 (42.7)	34 (30.9)	81 (36.8)	
	>6	24 (21.8)	18 (16.4)	42 (19.1)	
Time passed since the onset of the disease (months)	<3	35 (31.8)	61 (55.5)	96 (43.6)	0.001
	3-6	39 (35.5)	19 (17.3)	58 (26.4)	
	≥7	36 (32.7)	30 (27.3)	66 (30)	

*Chi-square test

Table 2. Comparison of HRQoL scores of diabetic and non-diabetic COVID-19 patients

Variable	Diabetic COVID-19 patients (Mean±SD)	Non-diabetic COVID-19 patients (Mean±SD)	P-value*
HRQoL scores	0.766±0.110	0.859±0.077	<0.001

*Mann-Whitney-U test
HRQoL: Health-related quality of life

Table 3 summarizes the association between the mean HRQoL values (EQ-5D-5L index) and demographic characteristics in both groups of diabetic and non-diabetic COVID-19 patients. Mean EQ-5D-5L values in the diabetic group were significantly higher for younger participants (P=0.001), males (P=0.006), employed subjects (P=0.030), patients with higher educational level (P<0.001), higher income (P<0.001), higher health status (P=0.002), supplemental insurance (P=0.009), access to health services (P<0.001), and fewer family members (P<0.001). On the other hand, EQ-5D-5L scores in the non-diabetic group were significantly higher in patients with higher educational levels (P=0.024) (Table 3).

Betamix regression analysis showed that education (P=0.023), access to health services (P=0.031), and presence of diabetes (P<0.001) were significant independent predictors of HRQoL scores (Table 4).

Table 3. Comparison of HRQoL score (based on EQ-5D-5L index) between two groups of diabetic and non-diabetic COVID-19 patients

Demographic characteristics	Categories	HRQoL score (based on EQ-5D-5L index) Mean±SD			
		Diabetic COVID-19 patients	P-value*	Non-Diabetic COVID-19 patients	P-value*
Age group (years)	≤40	0.844±0.054	0.001	0.855±0.077	0.619
	41-50	0.803±0.088		0.862±0.079	
	51-60	0.793±0.090		0.866±0.066	
	>60	0.745±0.087		0.823±0.086	
Gender	Male	0.784±0.110	0.027	0.873±0.068	0.056
	Female	0.749±0.107		0.843±0.082	
Education	<Diploma	0.686±0.0.067	<0.001	0.825±0.072	0.024
	Diploma	0.806±0.075		0.852±0.084	
	University degree	0.814±0.075		0.877±0.067	
Income (dollars)	<100	0.726±0.111	<0.001	0.843±0.082	0.199
	100-130	0.800±0.093		0.873±0.07	
	160-240	0.854±0.065		0.887±0.052	
	>240	0.835±0.047		0.886±0.054	
Employment status	Employed	0.773±0.106	0.044	0.858±0.077	0.916
	Unemployed	0.693±0.121		0.855±0.073	
Homeownership	Homeowner	0.767±0.128	0.522	0.861±0.075	0.710
	Tenant	0.762±0.089		0.855±0.078	
Marital status	Married	0.756±0.116	0.160	0.861±0.078	0.183
	Single	0.794±0.086		0.860±0.076	
	Divorced or widow	-		0.801±0.04	
Family members	≤2	0.753±0.117	<0.001	0.865±0.061	0.561
	3-4	0.777±0.098		0.855±0.082	
	5-6	0.809±0.084		0.867±0.080	
	>6	0.671±0.113		0.841±0.075	
Time passed since the onset of the disease (months)	<3	0.784±0.091	0.340	0.846±0.081	0.115
	3-6	0.766±0.113		0.860±0.085	
	≥7	0.742±0.120		0.883±0.055	
Health status (Based on VAS score)	<50	0.770±0.085	0.002	0.856±0.081	0.277
	50-70	0.813±0.095		0.847±0.077	
	>70	-		0.869±0.075	
Supplementary insurance	Yes	0.810±0.100	0.009		
	No	0.741±0.108			
Access to health services	Yes	0.797±0.097	<0.001		
	No	0.678±0.101			
Reason for not referring	Tendency to self-medicate	0.756±0.115	0.772		
	Ignoring the disease or feeling better	0.773±0.076			
	Lack of geographical access	0.740±0.127			
	Lack of financial ability	0.776±0.111			
	Uncertainty about treatment in health centers	0.775±0.136			
	Fear of COVID-19 infection	0.756±0.115			
	Other	0.773±0.076			

*Kruskal-Wallis test
HRQoL: Health-related quality of life; VAS: Visual analog scale

Table 4. Betamix regression analysis for determining the combined effect of variables on HRQoL

	B*	Std. Error**	P-value	95.0% Confidence Interval for B	
(Constant)	0.91	0.318	<0.001	0.291	1.537
EXP_DIS	-0.081	0.012	<0.001	-.105	-.057
Gender					
Female	-	-	-	-	-
Male	-0.10	0.170	0.342	-0.297	0.103
Education					
Under Diploma	-	-	-	-	-
Diploma	0.28	0.124	0.023	0.039	0.524
University degree	0.21	0.166	0.214	-0.119	0.532
Income (dollars)					
<100	-	-	-	-	-
100-130	0.04	0.132	0.764	-0.218	0.297
160-240	0.28	0.199	0.160	-0.110	0.669
>240	0.10	0.261	0.694	-0.409	0.615
Employment status					
Unemployed	-	-	-	-	-
Employed	0.15	0.170	0.378	-0.183	0.484
Family members					
<2	0.20	0.204	0.337	-0.218	0.297
3-4	-0.01	0.145	0.949	-0.292	0.274
5-6	0.19	0.135	0.150	-0.070	0.459
>6	-	-	-	-	-
Supplementary insurance					
Yes	-	-	-	-	-
No	0.09	0.113	0.414	-0.129	0.313
Access to health services					
Yes	-	-	-	-	-
No	0.26	0.121	0.031	0.024	0.497
Health status (based on VAS scale)					
≤50	-	-	-	-	-
>50	0.001	0.138	0.997	-0.270	0.271
Age groups					
<40	-	-	-	-	-
40-50	-0.28	0.228	0.221	-0.726	0.168
50-60	-0.20	0.233	0.380	-0.662	0.252
>60	-0.45	0.244	0.068	-0.923	0.033

*Betamix regression coefficient of variables; **Standard error of coefficient
HRQoL: Health-related quality of lifeTable 5. EQ-5L-5D dimensions frequency in diabetic and non-diabetic patients
*Chi-square test

Table 5 tabulates the frequency of HRQoL dimensions in diabetic and non-diabetic patients. The dimensions were scored on a 5-point Likert scale; however, because the frequency of some items was zero, they were combined so that two conditions of the presence and absence of a problem were considered for each dimension. This table shows slight to severe problems for diabetics in some dimensions, among which usual activities (61.8%) and anxiety/depression (31.8%) dimensions had the highest frequency (Table 5).

Table 5. EQ-5L-5D dimensions frequency in diabetic and non-diabetic patients

Dimension			n (%)		Non-diabetic COVID-19 patients n (%)		Diabetic COVID-19 patients n (%)		P-value*
Mobility		No	204 (92.7)		110 (100.0)		94 (85.5)		<0.001
	Yes	Mild	16 (7.3)	14 (6.4)	0 (0.0)	0 (0.0)	16 (14.5)	14 (12.7)	
		Moderate and more		2 (0.9)		0 (0.0)		2 (1.8)	
Self-care		No	180 (81.8)		96 (87.3)		84 (76.4)		0.036
	Yes	Mild	40 (18.2)	39 (17.7)	14 (12.7)	14 (12.7)	26 (23.6)	25 (27.7)	
		Moderate and more		1 (0.5)		0 (0.0)		1 (0.9)	
Unusual activities		No	114 (51.8)		72 (65.5)		42 (38.2)		<0.001
	Yes	Mild	106 (48.2)	104 (47.3)	38 (34.5)	38 (34.5)	68 (61.8)	66 (60.0)	
		Moderate and more		2 (0.9)		0 (0.0)		2 (1.8)	
Pain/discomfort		No	93 (42.3)		76 (69.1)		17 (15.5)		<0.001
	Yes	Mild	127 (57.7)	123 (55.9)	34	33 (30.0)	93 (84.5)	90 (81.8)	
		Moderate and more		4 (1.8)		1 (0.9)		3 (2.7)	
Anxiety/depression		No	175 (79.5)		100 (90.9)		75 (68.2)		<0.001
	Yes	Mild	45 (20.5)	39 (17.8)	10 (9.1)	9 (8.2)	35 (31.8)	30 (27.3)	
		Moderate and more		6 (2.7)		1 (0.9)		5 (4.5)	

5. Discussion

In this study, the HRQoL scores of diabetic and non-diabetic COVID-19 patients after discharge from two hospitals in Sirjan were evaluated using the EQ-5D-5L questionnaire, and the factors affecting HRQoL were investigated. The overall mean scores of HRQoL in diabetic and non-diabetic COVID-19 patients were found to be 0.766 and 0.859, respectively. This means that diabetic and non-diabetic patients who suffered from COVID-19 lost on average 23.4% and 14.1% of the achievable HRQoL score, respectively. In a study conducted by Alina on patients with COVID-19 (n=320) after discharge from hospitals in Iran, this percentage was reported to be 13.7% for patients with COVID-19 and 20.7% for severe cases (22), which was almost in agreement with the results of our study.

Based on the findings of the current study, the mean HRQoL scores of diabetic COVID-19 patients were significantly lower than those of non-diabetic COVID-19 patients. It can be said that due to the severity of complications caused by COVID-19 disease in diabetic patients, the HRQoL of these patients is lower than that of non-diabetic patients. This result was consistent with the findings of several recent studies in which diabetes was known to be a factor that reduced HRQoL in COVID-19 patients (7, 8, 11, 23). Feldman reviewed clinical evidence of worse clinical outcomes of COVID-19 infection in diabetic patients compared to non-diabetic patients, including certain patient groups, such as children, pregnant women, and racial and ethnic minorities. His study drew parallels between COVID-19 and the pathology of diabetes and demonstrated that complications or pathologies in patients with diabetes could exacerbate the course of infection. Finally, this study presented the perspective of long-term effects after COVID-19 for vulnerable populations of diabetic patients (7).

The results of EQ-5D-5L questionnaire showed moderate to severe problems for diabetic patients in some dimensions: mobility in 16 patients (14.5%), self-care in 26 patients (23.6%), anxiety/depression in 35 patients (31.8%), usual activities in 68 patients (61.8%), and pain /discomfort in 93 patients (84.5%). Among these, the dimensions of “usual activities” and “anxiety/depression” were the most frequent. In a study conducted in northern Portugal on 45 patients with severe COVID-19, the dimensions of useful activity (51.1%) and anxiety/depression (37.8%) were the highest prevalent reported problems. It also demonstrated that 42.2% had problems standing for long periods, 40.0% had problems walking for long distances, 31.1% had problems doing homework, and 37.8% had problems with their daily activities (24). In some other studies, the anxiety/depression dimension was the most common of the problems reported (23, 25). Furthermore, in a study by Ping, pain/discomfort (19.0%) and anxiety/depression dimensions (17.6%) had the highest frequency among the reported problems (26).

The results of our study showed a positive association between access to health services and HRQoL in diabetic patients. Moreover, diabetic patients who had supplemental insurance had significantly higher HRQoL, showing the importance of economic access to health care for HRQoL indices in this group of patients. In addition, the patients reported that they had problems with the insulin availability during the study period. It is noteworthy that they refused to receive the health care services they needed because of fear of COVID-19 infection at health centers, demonstrating the impact of anxiety on HRQoL scores in these patients. In their study, Joensen et al. outlined the specific concerns about COVID-19 and general psychosocial health among diabetic patients in the early stages of the COVID-19 pandemic in Denmark and examined the characteristics of diabetic patients with high levels of concerns about the COVID-19 pandemic. The results of this study showed that people with diabetes had particular concerns about COVID-19. More than half of them were concerned that they would be overly affected by COVID-19 because of their diabetes; about one-third of them were identified as a risk group for diabetes and were able to control it if they were infected. The study also showed that being a woman, having type 1 diabetes, having diabetes complications and anxiety, feeling isolated and alone, and having altered diabetes behavior were associated with greater concern about COVID-19 and diabetes (8).

Post hoc testing for diabetics showed that there was a significant positive association between age and HRQoL. The HRQoL of people older than 60 years was lower than that of people younger than 40 and 40-50. In other studies, age was identified as a significant variable (11, 23, 27). Arab-Zozani et al. reported that older patient groups had lower scores of HRQoL. Based on their Betamix regression analysis, age and diabetes had the least effect on HRQoL (23). In our study, no significant association was found between age and HRQoL levels in non-diabetic patients. Based on our results, gender was another variable for which there was a significant association with HRQoL in the diabetic group; accordingly, men had higher HRQoL than women. In the non-diabetic group, HRQoL was higher in men than in women; nevertheless, this association was not statistically significant. However, other studies showed different results. In a study by Kaso, gender was not found to be a predictor of HRQoL (4), whereas in studies by Arab-Zozani, Joensen, and Nguyen, a significant association was found between gender and HRQoL (8, 23, 27). Diabetic patients are exposed to higher levels of stress and social pressures associated with COVID-19; these factors

are reported to have a greater impact on women than on men (8, 23).

Our results indicated that there was a significant difference between education and HRQoL in both the diabetic and non-diabetic groups. In this regard, the HRQoL score of participants with under diploma education was lower than that of those with a diploma or university degree. In addition, a significant association was found between education and HRQoL in the beta regression analysis, which was consistent with the results of other studies (23, 27, 28). Kastien-Hilka et al. stated that this positive association might be due to the fact that a higher level of education allows for a better job and higher income, which in turn affects the HRQoL through better social interactions, better self-care, and fewer psychological, social, and financial problems (28). On the other hand, the role of education in awareness and self-efficacy should not be ignored, which in turn affects the HRQoL. Educated people make more confident decisions, are more active, and have more access to social media. These social databases provide people with greater access to information and allow them to observe and learn about commonly accepted and corrected behavior patterns among their peers.

Previous studies have shown that social and family conditions can influence patients' HRQoL (29-31). In this regard, according to our results, a negative significant association was found between family size and HRQoL in the diabetic group. Patients who lived in families with fewer members had higher HRQoL scores. This was consistent with the results of a study by Arab-Zozani (23). In addition, the results of the present study revealed that employment and income level had a positive significant association with HRQoL in participants with diabetes. Some studies have examined the role of these variables on HRQoL (26). Arab-Zozani reported a significant relationship between HRQoL on the one hand, and employment and income variables on the other (23). Moreover, in a study by Ping, a significant relationship was found between income level and HRQoL scores (26). In this regard, Almeida et al. referred to a decrease in people's income during the COVID-19 pandemic and its negative impacts (32). Measures to control the COVID-19 pandemic have led to fundamental changes in the daily lives of numerous people. For many people, uncertainty about their physical well-being or the security of their income also played an important role during the epidemic (33). Among them, people who were employed by the government were less affected and had job and income security, which in turn affected their quality of life. In addition to employment status, other economic factors, such as income, may also affect well-being and access to health services, and thus the HRQoL. This problem may be more pronounced among people with diabetes because of the high cost of health care. In the non-diabetic group, HRQoL was higher in the employed than in the unemployed; however, this association was not statistically significant. Finally, the findings of our study showed a positive significant relationship between perceived overall health status (VAS) and HRQoL scores among diabetics, which was not consistent with the results of a study by Alinia (22).

5.1. Strengths and limitations

The strengths of this study included adequate sample size, selection of samples from two existing hospitals, attention to the aspect of access to health services, special attention to diabetic patients, and comparison of their quality of life with that of non-diabetic patients However, our study had two major limitations. First, due to the cross-sectional nature of the study, the results could not be generalized to other times and places. Second, because of the prevalence of COVID-19 disease, face-to-face interviews were not possible and interviews were conducted by telephone to prevent possible transmission of the disease to study participants, which might have influenced the participants' responses.

5.2. Suggestions for future studies

It is suggested that longitudinal studies be conducted to examine the long-term complications of COVID-19 in diabetic patients and to assess the HRQoL of these patients with other instruments and in different contexts to compare the results obtained.

6. Conclusion

Diabetic COVID-19 patients experienced a significant decrease in their HRQoL scores after hospital discharge compared to non-diabetic COVID-19 patients. This decline was probably due to more side effects of COVID-19 in diabetic patients as well as lower utilization of health care services because of access problems and greater fear of COVID-19. Therefore, the health care system should adopt strategies to change the patients' interactions with health care providers in clinics and hospitals. These measures can include the use of telemedicine, home delivery services, or prescribing medications for a longer period.

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Footnotes

Conflicts of Interest: There is no conflict of interest.
Author contributions: OA and RS designed this study and determined the methods. OA, MH, MM, MR,

and IN conducted the collection, analysis, and interpretation of the data with assistance from RS and IN for revising the analytical approach. All authors discussed the results and contributed to the final manuscript. OA, RS, and MH drafted the manuscript. All authors contributed to the development and approval of the final manuscript. RS is the guarantor.

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Ethical considerations: In our study, participants were provided with necessary information about the study and its objectives, and verbal consent was obtained from them before the telephone interviews. In addition, participants were assured of the confidentiality of their information. The present study was approved by the Ethics Committee of the Sirjan School of Medical Sciences (IR.SIRUMS.REC.1400.012).

References

1. Choi EP, Hui BP, Wan EY, Kwok JY, Tam TH, Wu C. COVID-19 and health-related quality of life: a community-based online survey in Hong Kong. *Int J Environ Res Public Health*. 2021;**18**(6):3228. doi: 10.3390/ijerph18063228. [PubMed: 33804725].
2. Malik P, Patel C, Pinto C, Jaiswal R, Tirupathi R, Pillai S, et al. Post-acute COVID-19 syndrome (PCS) and health-related quality of life (HRQoL)—A systematic review and meta-analysis. *J Med Virol*. 2021;**94**(1):253-62. doi: 10.1002/jmv.27309. [PubMed: 34463956].
3. Sandmann F, Tessier E, Lacy J, Kall M, Leeuwen EV, Charlett A, et al. Long-term health-related quality of life in non-hospitalised COVID-19 cases with confirmed SARSCoV-2 infection in England: Longitudinal analysis and cross-sectional comparison with controls. *Clin Infect Dis*. 2022;**75**(1):962-73. doi: 10.1093/cid/ciac151. [PubMed: 35245941].
4. Kaso AW, Agero G, Hurisa Z, Kaso T, Ewune HA, Hailu A. Evaluation of health-related quality of life of Covid-19 patients: a hospital-based study in South Central Ethiopia. *Health Qual Life Outcomes*. 2021;**19**(1):1-10. doi: 10.1186/s12955-021-01900-y. [PubMed: 34930294].
5. Amdal CD, Pe M, Falk RS, Piccinin C, Bottomley A, Arraras JI, et al. Health-related quality of life issues, including symptoms, in patients with active COVID-19 or post COVID-19; a systematic literature review. *Qual Life Res*. 2021;**30**(12):3367-81. doi: 10.1007/s11136-021-02908-z. [PubMed: 34146226].
6. Gupta R, Ghosh A, Singh AK, Misra A. Clinical considerations for patients with diabetes in times of COVID-19 epidemic. *Diabetes Metab Syndr*. 2020;**14**(3):211-2. doi: 10.1016/j.dsx.2020.03.002. [PubMed: 32172175].
7. Feldman EL, Savelieff MG, Hayek SS, Pennathur S, Kretzler M, Pop-Busui R. COVID-19 and diabetes: a collision and collusion of two diseases. *Diabetes*. 2020;**69**(12):2549-65. doi: 10.2337/dbi20-0032. [PubMed: 32938731].
8. Joensen LE, Madsen KP, Holm L, Nielsen KA, Rod MH, Petersen AA, et al. Diabetes and COVID-19: psychosocial consequences of the COVID-19 pandemic in people with diabetes in Denmark—what characterizes people with high levels of COVID-19-related worries?. *Diabet Med*. 2020;**37**(7):1146-54. doi: 10.1111/dme.14319. [PubMed: 32392380].
9. Poudel AN, Zhu S, Cooper N, Roderick P, Alwan N, Tarrant C, et al. Impact of Covid-19 on health-related quality of life of patients: A structured review. *PloS One*. 2021;**16**(10):e0259164. doi: 10.1371/journal.pone.0259164. [PubMed: 34710173].
10. Tenforde MW, Kim SS, Lindsell CJ, Rose EB, Shapiro NI, Files DC, et al. Symptom duration and risk factors for delayed return to usual health among outpatients with COVID-19 in a multistate health care systems network—United States, March–June 2020. *MMWR Morb Mortal Wkly Rep*. 2020;**69**(30):993-8. Doi: 10.15585/mmwr.mm6930e1. [PubMed: 32730238].
11. Williamson EJ, Walker AJ, Bhaskaran K, Bacon S, Bates C, Morton CE, et al. Factors associated with COVID-19-related death using Open SAFELY. *Nature*. 2020;**584**(7821):430–6. doi: 10.1038/s41586-020-2521-4. [PubMed: 32640463].
12. McDonald PE, Tilley BC, Havstad SL. Nurses' perceptions: issues that arise in caring for patients with diabetes. *J Adv Nurs*. 1999;**30**(2):425-30. doi: 10.1046/j.1365-2648.1999.01096.x. [PubMed: 10457245].
13. Vares ZM, Baghayi P, Masudi alavi N, Mirbagher ajorpaz N. Evaluation of quality of life and related factors in diabetic patients referred to the center of Kashan Diabetes. *Nurs res*. 2010;**17**(5):14-22.
14. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. *PLoS Med*. 2006;**3**(11):e442. doi: 10.1371/journal.pmed.0030442. [PubMed: 17132052].
15. International Diabetes Federation (IDF). IDF diabetes Atlas; 2019.
16. Sadeghie Ahari S, Arshi S, Iranparvar M, Amani F, Siahpoosh H. The effect of complications of type II diabetes on patients' quality of life. *J Ardabil Univ Med Sci*. 2009;**8**(4):394-402.
17. Lee GK CJ, Bishop M. The effects of psychosocial factors on quality of life among individuals with chronic pain. *Rehabil Couns Bull*. 2008;**51**(3):177-89. doi: 10.1177/0034355207311318.
18. Briggs A, Vassall A. Count the cost of disability caused by COVID-19. *Nature*. 2021;**593**(7860):502-5. doi: 10.1038/d41586-021-01392-2. [PubMed: 34040204].
19. Abedini MR, Bijari B, Miri Z, Emampour FS, Abbasi A. The quality of life of the patients with diabetes type 2 using EQ-5D-5 L in Birjand. *Health Qual Life Outcomes*. 2020;**18**(1):18. doi: 10.1186/s12955-020-1277-8. [PubMed: 32000785].
20. Dudzińska M, Zwolak A, Tarach JS. Quality of life in patients with type 2 diabetes in Poland-comparison with the general population using the EQ-5D questionnaire. *Adv Clin Exp Med*. 2015;**24**(1):139-46. doi: 10.17219/acem/38137. [PubMed: 25923098].
21. Oemar M, Janssen B. EQ-5D-5 L user guide-basic information on how to use the EQ-5D-5 L instrument. Rotterdam: EuroQol Group; 2013.
22. Alinia C, Yaghmaei S, Abdullah FZ, Ahmadi A, Samadi N, Pourteimour S, et al. The health-related quality of life in Iranian patients with COVID-19. *BMC Infect Dis*. 2021;**21**(1):459. doi: 10.1186/s12879-021-06170-z. [PubMed: 34016041].
23. Arab-Zozani M, Hashemi F, Safari H, Yousefi M, Ameri H. Health-related quality of life and its associated factors in COVID-19 patients. *Osong Public Health Res Perspect*. 2020;**11**(5):296-302. doi: 10.24171/j.phrp.2020.11.5.05. [PubMed: 33117634].
24. Fernandes J, Fontes L, Coimbra I, Paiva J A. Health-related quality of life in survivors of severe COVID-19 of a university hospital in northern Portugal. *Acta Med Port*. 2021;**34**(9):601-607. doi: 10.20344/amp.16277. [PubMed: 34708687].
25. Alimehr M, Malayen S, Vafa FS, Tahmasebi MJ, Nikbina M, Doostifar K. The impact of coronavirus disease (COVID-19) on quality of life in diabetic patients. *Clin Diabetol*. 2021;**10**(3):237-42.
26. Ping WW, Zheng JZ, Niu XH, Guo CZ, Zhang JF, Yang H, et al. Evaluation of health-related quality of life using EQ-5D in China during the COVID-19 pandemic. *PLoS One*. 2020;**15**(6):e0234850. doi: 10.1371/journal.pone.0234850. [PubMed: 32555642].
27. Nguyen HC, Nguyen MH, Do BN, Tran CQ, Nguyen TT, Pham KM, et al. People with suspected COVID-19 symptoms were more likely depressed and had lower health-related quality of life: the potential benefit of health literacy. *J Clin Med*. 2020;**9**(4):965. doi: 10.3390/jcm9040965. [PubMed: 32244415].
28. Kastien-Hilka T, Rosenkranz B, Sinanovic E, Bennett B, Schwenkglenks S. Health -related quality of life in South

African patients with pulmonary tuberculosis. *PLoS One*. 2017;**12**(4):e0174605. doi: 10.1371/journal.pone.0174605. [PubMed: 28426759].
29. Yalachkov Y, Soydaş D, Bergmann J, Frisch S, Behrens M, Foerch C, et al. Determinants of quality of life in relapsing-remitting and progressive multiple sclerosis. *Mult Scler Relat Disord*. 2019;**30:**33–7. doi: 10.1016/j.msard.2019.01.049. [PubMed: 30735970].
30. Malkova N, Riabukhina O, Babenko L, Ionova T, Kishtovich A. Health-related quality of life in patients with multiple sclerosis. *Zh Nevrol Psikhiatr Im S S Korsakova*. 2005;**105**(12):31–7. [PubMed: 16447564].
31. Heiskanen S, Meriläinen P, Pietilä AM. Health-related quality of life–testing the reliability of the MSQOL-54 instrument among MS patients. *Scand J Caring Sci*. 2007;**21**(2):199–206. doi: 10.1111/j.1471-6712.2007. 00456.x. [PubMed: 17559438].
32. Almeida V, Barrios S, Christl M, De Poli S, Tumino A, van der Wielen W. The impact of COVID-19 on households' income in the EU. *J Econ Inequal*. 2021;**19**(3):413-31. doi: 10.1007/s10888-021-09485-8. [PubMed: 34093098].
33. Eicher S, Pryss R, Baumeister H, Hövener C, Knoll N, Cohrdes C. Quality of life during the COVID-19 pandemic–Results of the CORONA HEALTH App study. *J Health Monit*. 2021;**6**(6):2-21. doi: 10.25646/8867. [PubMed: 35585992].