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# Psychosocial comorbidities of diabetes during the COVID-19 pandemic in Iran

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## Abstract:

**BACKGROUND:** The psychosocial impacts of the COVID-19 pandemic are mainly focused on the general population, while pandemics do not impact the mental health of the entire population uniformly, especially vulnerable populations with underlying health conditions. This study aimed to investigate diabetes psychosocial comorbidities among Iranians with type 1 diabetes (T1D) during the COVID-19 pandemic.

**MATERIALS AND METHODS:** This was a cross-sectional study of 212 adults with T1D in different cities in Iran. Study participants completed an online survey in April–June 2020. The survey collected self-reported data on diabetes psychosocial comorbidities (i.e. diabetes burnout, diabetes distress, and depressive symptoms). Demographic and COVID-19 data before and during the pandemic were also collected. Responses were analyzed using ordinary least squares and logistic regression methods.

**RESULTS:** Around 17.5% reported being tested for COVID-19 virus, 8% were diagnosed positive, 10.8% were hospitalized, and 92.9% followed precaution recommendations during the pandemic. Participants had high levels of diabetes distress (57.1%), depressive symptoms (60.8%), and diabetes burnout (mean score = 3.1 out of 5). During the pandemic, trouble paying for the very basic needs was a consistent factor increasing the risk of diabetes distress, diabetes burnout, and depressive symptoms. Lack of access to diabetes care was only associated with diabetes burnout, while diabetes hospitalization/emergency department (ED) visit was associated with diabetes distress. Existing diabetes disparities before the pandemic were also associated with higher scores of diabetes psychosocial comorbidities [accessing diabetes supplies and medications ( $P < 0.0001$ ) and places for physical exercise ( $P < 0.0333$ )].

**CONCLUSION:** The negative impact of the COVID-19-related changes on individuals with diabetes, as one of the most vulnerable populations, must be recognized alongside the physical, financial, and societal impact on all those affected. Psychological interventions should be implemented urgently in Iran, especially for those with such characteristics.

## Keywords:

Burnout, COVID-19, depression, diabetes mellitus, Iran

## Introduction

The rapid spread of COVID-19 presents critical challenges to health care systems across the world in preventing and managing COVID-19 cases,<sup>[1,2]</sup> and in supporting mental health and psychosocial well-being for different populations.<sup>[3,4]</sup> Disruptions to daily life, lack of social connections due to precautionary measures (i.e. the

use of isolation/quarantine) and adverse socioeconomic consequences have adversely impacted the mental health in the affected individuals and general population.<sup>[5-7]</sup> Previous studies showed evidence for a high prevalence of fear of infection and death, stress, anxiety, and depression among individuals impacted during the COVID-19 pandemic. The adverse psychological impact of persistent stress can be expected to exacerbate the strain on the current health

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care<sup>[8]</sup> system. An understanding of the psychosocial impact of the COVID-19 pandemic is essential to formulate appropriate interventions to improve the mental health of the population.<sup>[9-11]</sup>

Ongoing efforts to understand the psychosocial impacts of the COVID-19 pandemic are mainly focused on the general population, and they show moderate to high levels of psychosocial distress during the pandemic.<sup>[7,12,13]</sup> However, pandemics do not impact the mental health of the entire population uniformly, but they disproportionately affect the most vulnerable populations, such as those with underlying health conditions.<sup>[14]</sup> Evidence suggests that individuals with diabetes are more likely to experience worse clinical outcomes and higher rates of complications associated with COVID-19.<sup>[15]</sup>

Iran reported its first COVID-19 cases (two fatalities) on February 19, 2020 in Qom city. It has since become one of the most heavily impacted countries in the Middle East with the disease spreading to all of its 31 provinces by March 5, 2020,<sup>[16]</sup> and 461000 confirmed cases and 26380 deaths being reported by October 2.<sup>[17]</sup> Although the Iranian government adopted several mitigation measures such as canceling public events, closing public places, and banning festivals and celebrations to combat the COVID-19 pandemic both before and after the entry of the virus into the country, these measures were relaxed in April when the number of deaths declined.<sup>[16]</sup> However, the number of new confirmed cases and deaths increased sharply in the country following the gradual lifting of restrictions.

Diabetes is a major public health issue in Iran, with a prevalence of 11.4%,<sup>[18]</sup> and it is projected to increase by 13.1% by 2030.<sup>[19]</sup> According to a country-wide survey conducted in 2017, only 13.2% of Iranians with diabetes achieve target glycemic control.<sup>[20]</sup> Diabetes is a leading cause of mortality, accounting for 17.3–17.8% of all Iranian deaths.<sup>[21]</sup> It also imposes a substantial economic burden on the society.<sup>[22]</sup> The high diabetes morbidity and mortality rates and associated costs suggest that diabetes initiatives and management programs in Iran are inefficient. Furthermore, high medication costs, lack of access to diabetes care, shortage of diabetes facilities, and a weak referral system are known barriers to quality diabetes care in the country.<sup>[20,23]</sup> The COVID-19 pandemic can exacerbate the existing health disparities in Iran, thereby influencing the diabetes population particularly those with T1D due to a lack of access to insulin and diabetes supplies during the pandemic. Therefore, evidence-based-driven psychosocial supports for individuals with diabetes are necessary to ensure a continuum of mental health during normal circumstances and public health emergencies. The objective of this study

was to examine diabetes psychosocial comorbidities of Iranian adults with T1D during the pandemic.

## Material and Methods

### Study design and setting

A cross-sectional study design was used to investigate diabetes psychosocial comorbidities among adults with T1D in Iran during the COVID-19 pandemic (April–June 2020).

### Study participants and sampling

Eligibility criteria for inclusion in the study included (1) age  $\geq 18$  years, (2) being diagnosed with T1D for  $\geq 1$  year, (3) ability to read and write in Farsi, and (4) consenting that one's life had been affected by the COVID-19 pandemic. Of the 732 individuals who were initially screened, 343 were ineligible and 177 declined to complete the survey, leaving a final sample of 212 eligible participants from different cities across the country. Each participant received a small compensation (150000 Rial—Iranian currencies) for completing the survey.

### Data collection tool and technique

A link to online questions screening potential participants for eligibility for inclusion in the study, the study survey, and an informed consent form was shared in various Iranian diabetes support groups on social media (i.e. Instagram). The survey was developed using a Porsline web-based tool. Following study measures were used.

Diabetes psychosocial comorbidities: we translated valid and reliable measures of diabetes distress, diabetes burnout, and depressive symptoms following the translation/back-translation procedure.<sup>[24]</sup> Diabetes distress, the negative emotional burden of living with diabetes, was assessed using the type 1 diabetes distress scale (T1-DDS).<sup>[25]</sup> This is a 28-item self-report instrument highlighting seven reliable diabetes-specific subscales of distress including powerlessness, management distress, hypoglycemia distress, negative social perceptions, eating distress, physician distress, and friends/family distress. A six-point Likert scale (1 = Not a problem to 6 = A very serious problem) was used to rate each item, after which the T1-DDS scale was obtained by averaging the scores of the questions in each domain and overall.<sup>[25]</sup>

Depressive symptoms were assessed using the Patient Health Questionnaire-8 (PHQ-8), which comprises eight items that assess depressive symptoms using a four-point Likert scale (0 = Not at all to 3 = Nearly every day). We used published clinical cutoff points of  $> 10$  for moderate/severe depressive symptoms.<sup>[26]</sup>

We used published clinical cutoff points of higher than 3 for T1-DDS and higher than 10 for PHQ-8, respectively,<sup>[25,26]</sup> to define various categories. This resulted in two levels for T1-DDS (i.e. moderate distress with score >2 and <3 and high distress with score  $\geq$ 3) and 3 levels for PHQ-8 (i.e., No or mild with score <10, Moderately severe with score >10 and <20 and severe with score  $\geq$ 20). However, moderately severe and severe levels for depressive symptoms (PHQ-8 scores  $\geq$ 10) were combined due to an inadequate number of participants at the severe level.

Diabetes burnout is a state in which someone with diabetes grows tired of managing their condition and/or is frustrated with losing control over diabetes, and then purposefully ignores diabetes for a period of time<sup>[27]</sup> that was assessed using the diabetes burnout scale (DBS). This is a newly developed 12-item scale comprising three subscales, that is, exhaustion (4 items), detachment (5 items), and loss of control (3 items). DBS assesses diabetes burnout in the past 1 month using a five-point Likert scale (1 = Strongly disagree to 5 = Strongly agree).<sup>[28]</sup> We obtained a total score for DBS by averaging the 12 questions that comprise the scale.

Demographic data: We collected data on participant's gender, age, race, education level, marital status, employment status, income level, and residence rural-urban designation.

COVID-19 and diabetes-specific data: Respondents answered yes/no questions that assessed the following: whether they had been tested for, diagnosed, and hospitalized with COVID-19; if they followed precaution recommendations related to the COVID-19 pandemic such as wearing masks and social distancing; whether they experienced difficulties paying for basic necessities, accessing diabetes care, supplies and medications, healthy food, and safe places for physical exercise; whether they had been hospitalized or visited the ED due to diabetes; and whether they were worried about losing their jobs, health insurance, or housing both before and during the pandemic.

### Ethical consideration

The research study (No: 5403) was funded by the Shahrekord University of Medical Sciences in Iran. It was approved by Ethics in Research Committee of Shahrekord University of medical sciences (ethical code: IR SKUMS REC #1399.051). This open online survey was voluntary. Eligible participants who were interested had access to the link which directs them to the consent form and survey.

### Data analysis

Summary statistics including percentages for categorical variables and median or mean, minimum, and maximum,

interquartile range for continuous variables were used to describe the characteristics of study participants. The McNemar test was used to assess whether various COVID-19-related challenges differed before versus during the pandemic.

Univariable and multivariable associations of each explanatory variable with measures of diabetes psychosocial comorbidities both before and during the pandemic were investigated using either logistic (for T1-DDS and PHQ-8) or ordinary least squares (for DBS) regression models. Multivariable models were built using the stepwise selection method, specifying a 5% significance level. The No/mild and Moderate levels were used as reference categories for PHQ-8 and T1-DDS, respectively. Significant regression coefficients were reported as odds ratios (OR) or estimates together with their associated *P* values and confidence intervals. All statistical analyses were performed in SAS version 9.4 (SAS Institute Inc., Cary, NC).

## Results

### Descriptive results

Overall, our study sample ( $n = 212$ ) was predominantly female (75.5%), single (67.5%), and Fars (60.1%). Most (56.2%) participants had above high school education level, less than a fifth (17.5%) of respondents had a full-time job, and about a third (31.6%) had no income. Most (90.6%) of the respondents lived in urban locales [Table 1]. Since it was an online survey, participants were from different cities in Iran.

The median age for participants was 29 years (interquartile range = 11.0 years), and 50% of them had lived with T1D for at least 11 years (interquartile range = 7.0 years). The median DBS score was 3.01 out of 5 (interquartile range = 1.33). Based on the clinical cut points for the PHQ-8 and T1-DDS, 60.85% of the participants would be classified as having moderately severe (scores = 10–19) to severe (scores  $\geq$ 20) depressive diabetes symptoms, while 49.92% of participants would be classified as having moderate diabetes distress (score = 2.0–2.9) with the rest (57.08%) having high (scores  $\geq$ 3) diabetes distress.

Table 2 shows the results obtained when responses to specific questions related to COVID-19 were compared before versus during the pandemic. A significant ( $P < 0.0001$ ) percent of respondents reported decreased access to diabetes care during the pandemic (37.74%) compared to before the pandemic (9.43%), a 28.31% decrease in access. A significantly ( $P = 0.0026$ ) larger percent of respondents also reported more difficulties accessing diabetes supplies and medication during the pandemic compared

**Table 1: Sociodemographic characteristics of Iranian individuals with T1D**

Sociodemographic characteristics	Frequency	Percentage
Gender		
Male	48	24.5
Female	148	75.5
Race		
Fars	129	60.8
Tork	35	16.5
Lor	6	2.8
Baloch	5	2.4
Other	37	17.5
Marital status		
Married	69	32.6
Single	143	67.4
Education level		
High school	73	43.9
Associate degree	14	6.6
Bachelor degree	65	30.7
Graduate degree	40	18.9
Residential area		
Rural	20	9.4
Urban	192	90.6
Employment status		
Full time	44	20.8
Part time	15	7.1
Unemployed	26	12.3
Self employed	23	10.8
Home-maker	29	13.7
Student	59	27.8
Military	1	0.5
Others	15	7.1
Income (Iranian currency)		
No income	67	31.6
<500k	40	18.9
501k-1m	20	9.4
1.1m-2m	23	10.8
2.1m-3m	25	11.8
3.1m-4m	19	9.0
>4m	18	8.5

to before the pandemic (58.02 vs. 67.45%). Before the pandemic, 10.85% of participants did not have access to healthy food. This increased to 48.11% during the pandemic. Surprisingly, a larger percent of respondents had access to safe places for physical exercise during the pandemic (81.6%) compared to before the pandemic (75.94%); however, it was not statistically significant. The number of participants who worried about job, housing, and insurance losses did not change substantially during the pandemic. This notwithstanding, the percent of respondents reporting increased difficulty paying for basic necessities increased from 59.43% before the pandemic to 65.09% during the pandemic. A majority (92.9%) of participants followed recommended measures (i.e., wearing mask and social distancing) for preventing COVID-19. Close to a

fifth (17.5%) of participants were tested for COVID-19 virus, 8% tested positive and 10.8% were hospitalized due to the virus [Table 2].

### Associations of sociodemographic and COVID-19-related challenges with diabetes distress

Several questions related to worries and challenges during the pandemic, except for questions on adherence to the COVID-19 preventive measures and access to safe places for physical exercise, were independently associated with high diabetes distress. Age, gender, and marital status were not significantly associated with diabetes distress. Living in a rural residential area increased the odds of higher levels of diabetes distress by 7.77 times ( $P = 0.006$ ) compared to living in the urban area. The odds of high diabetes distress for individuals with a high school degree were 2.3 times significantly ( $P = 0.02$ ) higher compared to the odds for individuals with a graduate degree.

When all potential predictors of diabetes distress were assessed together in a multivariable model, only difficulty accessing diabetes supplies and medications and insurance loss worries were associated with high diabetes distress before the pandemic; the odds of high diabetes distress for individuals with difficulty accessing diabetes supplies and medications and insurance loss worries were 4.29 and 7.17 times, respectively, compared to those for individuals without these issues. During the pandemic, high diabetes distress was only associated with difficulties in paying (OR = 4.25,  $P = 0.0012$ ) and diabetes-related hospitalization/ED visit (OR = 5.46,  $P = 0.0029$ ) [Table 3].

### Associations of demographic and COVID-19-related challenges with diabetes burnout

All diabetes-specific COVID-19-related challenges but access to healthy food and safe places for physical exercise were independently significantly associated with high diabetes burnout scores before the pandemic. Similar to diabetes distress, none of the sociodemographic factors assessed were associated with diabetes burnout before the pandemic. All diabetes-specific COVID-19-related challenges assessed were significantly (coefficient = 0.35–0.70;  $P = 0.0154 - <0.0001$ ) associated with high diabetes burnout during the pandemic. Among the sociodemographic factors, only rural residence increased DBS score significantly (coefficient = 0.41,  $P = 0.0325$ ) [Table 4].

When sociodemographic factors and diabetes-specific COVID-19-related difficulties were modeled together, difficulties paying for basic necessities, accessing diabetes care, diabetes medications and supplies and safe places for physical exercise, and health insurance



**Table 2: Comparison of responses to COVID-19-related challenges before the pandemic versus during the pandemic**

Challenge	Percent (prior)	Percent (during)	P*
Difficulty accessing diabetes care (n)			
Yes	9.43	37.74	<0.0001
No	90.57	62.28	
Difficulty accessing diabetes supplies or medication (n)			
Yes	58.02	67.45	0.0026
No	41.98	32.55	
Difficulty accessing healthy food (n)			
Yes	10.85	48.11	<0.0001
No	89.15	51.48	
Difficulty accessing safe place for physical activity (n)			
Yes	24.06	18.40	0.1088
No	75.94	81.60	
Difficulty paying for basic necessities (n)			
Yes	59.43	65.09	0.0186
No	40.57	34.91	
Worry about job loss (n)			
Yes	38.74	35.77	0.0736
No	61.26	64.23	
Worry about loss of housing (n)			
Yes	23.93	23.93	0.6547
No	76.07	76.07	
Worry about loss of insurance (n)			
Yes	34.15	33.15	0.1088
No	65.88	66.85	
Adhered to CDC recommendations (n)			
Yes		92.92	
No		7.08	
Tested for COVID-19 (n)			
Yes		17.5	
No		82.5	
Diagnosed with COVID-19 (n)			
Yes		8.0	
No		92.0	
Hospitalized with COVID-19 (n)			
Yes		10.8	
No		89.2	

\*McNemar test

loss worries significantly increased (coefficient = 0.35–0.69,  $P = 0.0393 - <0.000$ ) diabetes burnout before the pandemic. Only difficulties accessing diabetes care (coefficient = 0.35,  $P = 0.0131$ ) and paying for basic necessities (coefficient = 0.60,  $P = 0 - <0.0001$ ) significantly increased diabetes burnout during the pandemic [Table 4].

### Associations of sociodemographic and COVID-19-related challenges with depressive symptoms

Lack of access to diabetes supplies and medications, trouble paying for basic necessities, and diabetes-related hospitalizations/ED visits were significantly independently associated with depressive symptoms, increasing the odds of moderate to severe depressive symptoms by 2.33–3.82 times in individuals experiencing these challenges before the

pandemic. Among diabetes-specific COVID-19-related challenges, only worries regarding housing and health insurance losses were independently unassociated with depressive symptoms during the pandemic. Among sociodemographic factors, only education was independently significantly associated with depressive symptoms during the pandemic ( $P = 0.0014$ ), with the odds of moderate to severe depressive symptoms being 4.58 times higher in individuals with high school education levels than in individuals with a graduate degree.

When sociodemographic factors and diabetes-specific COVID-19-related difficulties were modeled together, only difficulties of accessing diabetes supplies and medications (OR = 5.67,  $P < 0.0001$ ) and places for physical exercise (OR = 2.87,  $P < 0.0333$ ) were associated

**Table 3: Univariable and multivariable associations of COVID-19-related diabetes-specific challenges and sociodemographic factors with diabetes distress (T1-DDS) in Iranians with T1D before and during the COVID-19 pandemic**

Challenge/Sociodemographic factor	Before COVID-19			During COVID-19		
	P	OR*	CI 95%	P	OR*	CI 95%
<i>Univariable analysis</i>						
Difficulty accessing diabetes care	0.7814	1.142	0.447-2.924	<0.0001	4.856	2.672-8.824
Difficulty accessing diabetes supplies or medication	<0.0001	3.909	2.194-6.966	<0.0001	3.953	2.154-7.255
Difficulty accessing healthy food	0.0910	2.315	0.874-6.135	<0.0001	5.177	2.866-9.352
Difficulty accessing safe places for physical exercise	0.3488	1.362	0.713-2.747	0.4193	1.333	0.664-2.675
Difficulty paying for basic necessities	<0.0001	5.318	2.932-9.647	<0.0001	4.479	2.451-8.185
Job loss worries	<0.0001	5.737	2.378-13.841	<0.0001	6.500	2.869-14.726
Housing loss worries	<0.0001	8.826	4.002-19.466	<0.0001	4.666	2.319-9.388
Health insurance loss worries	<0.0001	13.393	4.479-40.046	<0.0001	8.743	3.233-23.643
Diabetes-related hospitalizations/ED visits				<0.0001	6.103	2.886-12.909
Gender (ref=female)				0.1885	1.550	0.806-2.985
Age				0.5076	0.988	0.954-1.023
Education (ref=graduate degree)						
High school				0.0283	2.330	1.094-4.960
Associate degree					2.200	0.625-7.742
Bachelor degree					1.260	0.572-2.778
Marital status (ref=married)				0.8550	1.056	0.590-1.888
Residential area (ref=urban)				0.0069	7.777	1.756-34.442
Following recommended COVID-19 precautions				0.0762	3.229	0.884-11.801
Being tested for COVID-19				0.0021	3.956	1.650-9.485
<i>Multivariable analysis</i>						
Difficulty accessing diabetes supplies/medications (ref=no)	0.0006	4.288	1.874-9.813			
Health insurance loss worries (ref=no)	<0.0001	7.165	2.653-19.352			
Difficulty paying for basic necessities (ref=no)				0.0012	4.249	1.771-10.196
Diabetes-related hospitalization/ED visits (ref=no)				0.0029	5.459	1.787-16.674

\*Odds ratio for high diabetes distress

with moderate to severe depressive symptoms before the pandemic. During the pandemic, difficulty paying for basic necessities, being female and having a high school degree were all associated with moderate to severe depressive symptoms; the odds of moderate to severe depressive symptoms were higher by 4.95, 2.79, and 7.73 times, respectively, compared to those for individuals with no difficulty paying for basic necessities, of the male gender, and with a bachelor degree [Table 5].

## Discussion

This study aimed to obtain an understanding of diabetes psychosocial comorbidities during the COVID-19 pandemic among adults with T1D in Iran, so supportive interventions for mental health and diabetes care may be targeted to this vulnerable population. We found high scores of diabetes distress, diabetes burnout, and depressive symptoms during the COVID-19 pandemic. There is ample evidence for negative psychosocial impacts of diabetes including distress, depression, and anxiety in normal daily life (i.e., not related to pandemics).<sup>[29,30]</sup> During the pandemic, the prevalence of psychological problems is expected to increase in affected countries.<sup>[31,32]</sup> This is observed in geographic regions

in the U.S.<sup>[33]</sup> Based on PHQ-8 and T1-DDS scores, our results show that 60.8% of Iranian participants would be classified as having moderately severe or severe depressive symptoms, while 57.1% of participants would be classified as having high distress. These percentages are relatively high compared to those reported for other countries. For example, a cross-sectional survey of 2430 adults with diabetes in Denmark found that 25% of respondents experienced moderate to high diabetes distress at the beginning of the COVID-19 pandemic.<sup>[34]</sup> Data from 215 diabetes centers in 75 countries identified anxiety and stress as the most commonly reported psychological problems faced by 31 and 24% of respondents, respectively, during the COVID-19 outbreak. In that study, only 8% of respondents reported increase depressive symptoms.<sup>[35]</sup>

Our results show significant associations of measures of diabetes psychosocial comorbidities and various COVID-19-related challenges such as difficulties paying for basic necessities and accessing diabetes care during the pandemic. Evidence show that the COVID-19 pandemic may result in two types of psychological harms, including direct (i.e., increased anxiety) and indirect (i.e., pandemic-related job and housing

**Table 4: Univariable and multivariable associations of COVID-19-related diabetes-specific challenges and sociodemographic factors with DBS in Iranians with T1D before and during the COVID-19 pandemic**

Challenge/Sociodemographic factor	Before COVID-19			During COVID-19		
	Estimate	CI 95%	P	Estimate	CI 95%	P
<i>Univariable analysis</i>						
Difficulties to access diabetes care	0.41	0.04;0.78	0.0306	0.53	0.32;0.75	<0.0001
Difficulties accessing diabetes supplies or medication	0.58	0.38;0.79	<0.0001	0.49	0.26;0.72	<0.0001
Difficulties to access healthy food	0.24	-0.11;0.59	0.1746	0.53	0.32;0.73	<0.0001
Difficulties to access safe places to exercise	0.16	-0.10;0.41	0.2289	0.35	0.07;0.63	0.0154
Difficulties to pay for the very basics like food, housing	0.68	0.48;0.88	<0.0001	0.69	0.48;0.90	<0.0001
Job loss worries	0.61	0.34;0.88	<0.0001	0.68	0.39;0.97	<0.0001
Housing loss worries	0.76	0.49;1.02	<0.0001	0.70	0.44;0.96	<0.0001
Health insurance loss worries	0.52	0.27;0.77	<0.0001	0.44	0.21;0.67	0.0003
Diabetes hospitalizations/ED visits				0.49	0.27;0.72	<0.0001
Following recommended COVID-19 precautions				0.52	0.10;0.95	0.0148
Being tested for COVID-19				0.52	0.24;0.80	0.0003
Gender (ref=female)				0.16	-0.10;0.42	0.2213
Age				0.01	-0.01;0.02	0.4790
Education (ref=graduate degree)						
High school				0.12	-0.18;0.41	0.4507
Associate degree				0.21	-0.28;0.70	0.3981
Bachelor degree				-0.17	-0.49;0.15	0.2956
Marital status (ref=married)				0.01	-0.22;0.24	0.9398
Residential area (ref=urban)				0.41	0.04;0.78	0.0325
<i>Multivariable analysis</i>						
Difficulties accessing diabetes care (ref=no)	0.45	0.03;0.88	0.0393	0.35	0.08;0.62	0.0131
Difficulties accessing diabetes supplies/medication (ref=no)	0.47	0.22;0.73	0.0004			
Difficulty accessing safe places for physical exercise	0.35	0.04;0.66	0.0293			
Difficulty paying for basic necessities				0.60	0.32;0.88	<0.0001
Health insurance loss worries	0.69	0.35;1.03	<0.0001			

losses and financial insecurity) negative impacts.<sup>[36]</sup> Other studies have also reported specific worries and difficulties related to the COVID-19 pandemic. For instance, a study by Joensen *et al.* (2020)<sup>[34]</sup> showed that 10–24% of adults with diabetes worried about possible lack of diabetes medications, diabetes equipment, diabetes care, healthy food, and reduced quality of health care and insufficient access to health care professionals if needed. A shortage of medical supplies and medications including insulin<sup>[35,37]</sup>, and access to healthy food and exercise have also been reported in other studies.<sup>[38,39]</sup> While other countries implemented telehealth and teleconsultation<sup>[40]</sup> to alleviate these challenges, there is no reimbursement system for such services in Iran, and telehealth is not widely used by healthcare providers and individuals with diabetes. Instead, Iranians with diabetes use informal social groups such as Instagram or Telegram, which are not managed or supported by healthcare teams.

Our results comparing responses to specific questions related to COVID-19 before the pandemic versus during the pandemic suggest that the pandemic may have exacerbated pre-existing health disparities in Iran, thereby negatively impacting diabetes care and psychosocial comorbidities for Iranians with T1D.

Specifically, our study showed significant associations of participant's psychosocial comorbidities with difficulties accessing diabetes supplies or medication, diabetes care, safe places for physical exercise, and insurance loss worries before the pandemic. The causes of diabetes-related health disparities in Iran are multifactorial. For instance, factors related to the physical geography have contributed to inequitable access to healthcare across the country.<sup>[41]</sup> Universal health insurance and universal access model were implemented in Iran to facilitate insurance reimbursements and make access to medical care more affordable to all Iranians.<sup>[22]</sup> However, higher-income groups have higher utilization rates for specialized care, while lower-income groups utilize general physician care at higher rates.

The high percent of participants reporting difficulties paying for basic necessities both before and during the COVID-19 pandemic are indicative of high prices, and high poverty and inflation levels. The sweeping global sanctions imposed on Iran have significantly impacted access to diabetes care, medication, and diabetes supplies by decreasing the importation of insulin and new medications and diabetes technology. The devaluation of Iran's currency and increased inflation have also increased medication costs and contributed to lowering

**Table 5: Univariable and multivariable associations of COVID-19-related diabetes-specific challenges and sociodemographic factors with depressive symptoms (PHQ-8) in Iranians with T1D before and during the COVID-19 pandemic**

Challenge/Sociodemographic factor	Before COVID-19			During COVID-19		
	P	OR*	CI 95%	P	OR*	CI 95%
<i>Univariable analysis</i>						
Difficulties accessing diabetes care	0.6898	1.217	0.464-2.747	0.0008	2.673	1.504-4.751
Difficulties accessing diabetes supplies or medication	<.0001	3.817	2.133-6.830	<.0001	3.520	1.931-6.417
Difficulties accessing healthy food	0.6498	1.233	0.499-3.049	0.0008	2.650	1.501-4.678
Difficulty accessing safe places for physical exercise	0.1044	1.754	0.890-3.460	0.0398	2.089	1.035-4.215
Difficulty paying for basic necessities	<.0001	3.284	1.844-5.849	<.0001	4.485	2.456-8.189
Job loss worries	0.0516	2.062	0.995-4.274	0.1041	1.735	0.893-3.370
Housing loss worries	0.1741	1.674	0.796-3.519	0.1647	1.692	0.806-3.554
Health insurance loss worries	0.0373	2.330	1.113-4.144	0.0226	2.148	1.113-4.144
Following recommended preventive measures for COVID-19				0.3107	1.840	0.566-5.984
Being tested for COVID-19				0.1003	1.932	0.881-4.236
Gender (ref=female)				0.2175	1.511	0.784-2.915
Age				0.0937	0.970	0.936-1.005
Education (ref=Graduate degree)						
High school				0.0014	4.583	2.072-10.138
Associate degree					5.191	1.366-19.725
Bachelor degree					3.792	1.646-8.736
Marital status (ref=married)				0.2322	1.429	0.796-2.558
Residential area (ref=urban)				0.1804	2.053	0.717-5.879
<i>Multivariable analysis</i>						
Difficulties accessing diabetes supplies or medication	<.0001	5.656	2.611-12.253			
Difficulties accessing safe places physical exercise	0.0333	2.865	1.087-7.519			
Difficulty paying for basic necessities				0.0004	4.953	2.035-12.053
Gender (ref=male)				0.0485	2.786	1.007-7.692
Education (ref=Graduate degree)						
High school				0.0082	7.728	2.271-26.297
Associate degree					4.427	0.507-38.640
Bachelor degree					6.084	0.803-20.530

\*Odds ratio for moderate/severe depression

the ability of Iranians to access healthy food and health care.<sup>[42,43]</sup>

Our study shows that sex (female) and education level (high school degree) were the only sociodemographic factors associated with high depressive symptoms (PHQ-8) scores. These findings are similar to those obtained in a study by Joensen *et al.* (2020)<sup>[34]</sup> where women with T1D expressed more anxiety and COVID-19-related worries compared to men. A study of the general population in China also reported greater psychological impacts of the COVID-19 outbreak and higher levels of stress, anxiety, and depression in females with no formal education than in males.<sup>[12]</sup>

Our study provides a more comprehensive picture of psychosocial comorbidities of diabetes during the COVID-19 pandemic in Iran by comparing responses to questions related to the pre-pandemic period to questions related to the pandemic period. Although this study is a cross-sectional study that only provides a snapshot of the impacts of COVID-19. The study does

not inform the progression of changes in psychosocial comorbidities and the role of sociodemographic characteristics and COVID-19-related changes over time. Additionally, the cross-sectional design implies that study findings cannot be used to determine cause and effect. We used DBS, DDS-T1, and PHQ-8 to measure the psychosocial comorbidities of adults with T1D. These were not originally developed to measure psychosocial comorbidities in the context of a pandemic that impacts almost every aspect of an individual's life. This study's participants were selected from social media groups; thus, the sample may not be representative of Iranians living with T1D, leading to selection bias. As a result, the conclusion may not be generalizable to the general population, particularly those with no access to the social media. The study measures were self-reported, and these assessments may not always be aligned with assessments by mental health professionals.

### Limitation and recommendation

Interpretation of the results should be taken with caution since the study has some limitations. Internet access is



very different. This may impact the results. People who have poor psychosocial well-being participate less in diabetes research studies. Therefore, the sample may not be representative of people with different levels of diabetes distress, diabetes burnout, and depressive symptoms. In addition, it must be considered that the study outcome measures and COVID-19-related questions were based on self-reports. Memory recall may have unwanted and systematic errors. TIR was a perception of participants without CGM during the day.

## Conclusion

Our findings similar to other studies across the world suggest that psychosocial well-being has become a significant health challenge in Iran. Similar to other countries, the Iranian health system is struggling to manage the negative impact of the pandemic on physical and psychosocial well-being particularly in vulnerable populations. Many countries including Iran do not have evidence-based driven psychosocial supports for individuals with diabetes to ensure a continuum of mental health during normal circumstances and public health emergencies.

Strengthening psychosocial diabetes care through developing and implementing relevant policies and interventions is an essential part of improving diabetes care in Iran. Access to psychosocial support and existing resources should be promoted, aiming for positive health outcomes in this population. Diabetes care should be adapted to mitigate the psychosocial challenges that individuals with diabetes experience during the pandemic. Continuous monitoring of psychological comorbidities (i.e. diabetes burnout, diabetes distress, and depressive symptoms) should be of routine care during the pandemic. Diabetes policies and strategies during the pandemic should further focus on associated changes related to the pandemic to improve psychosocial well-being and diabetes outcomes and alleviate current inequality among females and low-educated individuals with diabetes. Implementation of telehealth and health applications to support and educate individuals with diabetes may increase the accessibility of the individuals to diabetes care as one of the main pillars in improving diabetes care.

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## Ethics approval

The study was approved by Ethics in Research Committee of Shahrekord University of medical sciences (IR SKUMS REC #1399.051) in Iran.

## Consent to participate

A link to online questions screening potential participants for eligibility for inclusion in the study, the study survey, and an informed consent form was shared in various Iranian diabetes support groups on social media (i.e., Instagram). The survey was developed using a Porsline web-based tool.

## Consent for publication

All authors agree to submit the paper for this journal to be considered for publication.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

There are no conflicts of interest.

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