Prevalence of COVID-19 Infection in Type 2 Diabetes Patients and Their Anxiety Levels

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ABSTRACT

Purpose: This study was conducted to identify the prevalence of COVID-19 infection and anxiety levels in type 2 diabetes patients.

Materials and methods: A total of 201 diabetes patients who presented to the internal medicine and endocrinology and metabolic diseases outpatient clinics of a university hospital between 19 October and 19 December 2020 were included in this descriptive and cross-sectional study. The data were collected using a Patient Identification Form and the Coronavirus Anxiety Scale. Chi-squared test and Fisher's exact test were used to compare the patients' COVID-19 infection status and anxiety levels based on some variables.

Results: It was determined 37.8% of the participants had COVID-19 infection before. Among the participants who had COVID-19 infection, 51.3% stated that the COVID-19 infection aggravated their diabetes symptoms, and 13.2% said they received intensive care support due to the infection. Besides, it was found that 17.9% of the participants had high levels of anxiety. The participants who had COVID-19 before had a lower percentage of having any diabetes-related complication than those who never had COVID-19 before ($p<0.05$). Moreover, the rates of those who had COVID-19 before, those who thought of having adequate information about COVID-19 infection, and those who participated in the use of masks against the risk of COVID-19 infection were lower among the participants who had high levels of COVID-19 anxiety ($p<0.05$).

Conclusions: It was discerned that the diabetes patients had a higher frequency of having experienced COVID-19 infection, and nearly one-fifth of them had high levels of COVID-19-related anxiety. In this respect, following up diabetes patients at home during the COVID-19 pandemic and offering telehealth services to diabetes patients who are unable to visit healthcare facilities due to the pandemic is recommended.

Keywords: COVID-19, anxiety, diabetes, frequency

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INTRODUCTION

Diabetes is a chronic metabolic disease characterized by blood glucose level fluctuations caused by absolute or relative insulin deficiency [1]. Moreover, diabetes has become a significant public health problem observed more frequently with each passing day and had unfavorable effects on mortality and morbidity rates, quality of life, and the health system [2]. As a pandemic and chronic disease that is not infectious but quite prevalent, diabetes affects nearly 9.3% of the world's population aged 20-79 years according to the 2019 data [3]. As diabetes gives rise to pathophysiological changes in the metabolism, it increases susceptibility to infectious diseases [4,5].

The novel coronavirus disease 2019 (COVID-19) is an infectious disease that has affected all countries in the world in the last few years. COVID-19 that was first reported in the Wuhan city of China in December 2019 and then declared a pandemic by the World Health Organization in March 2020 has led to considerable morbidity and mortality rates since its outbreak [6]. In comparison to influenza, COVID-19 has a higher infection rate and a higher risk of death. Even if most COVID-19 patients are expected to have a favorable outcome, patients who have underlying health conditions can have a poor prognosis [7]. Type 2 diabetes was identified as the chronic disease accompanying COVID-19 infection most frequently and affecting its prognosis and mortality [8].

Along with the pandemic, reduced physical activity, increase in stress, and setbacks experienced in the use of healthcare services led to the aggravation of glycemic control in diabetes patients and made diabetes patients more susceptible to COVID-19 infection [9,10]. How diabetes contributes to the development of COVID-19 in the physiopathological sense and affects its severity is uncertain. However, in the relevant literature, it is asserted that diabetes will increase the risk and severity of infection along with the effects of hyperglycemia on systemic inflammatory responses and immune system dysfunction [5,6,11-13]. Moreover, in the relevant literature, it is put forward that in diabetes patients, advanced age, proinflammatory and hypercoagulable states, hyperglycemia, and underlying comorbidities (e.g., hypertension, cardiovascular disease, chronic kidney disease, obesity) contribute to the risk of infection [14].

As diabetes has a high prevalence, it is important to understand the particular aspects of COVID-19 infection in diabetes patients [15]. In patients who simultaneously have diabetes and COVID-19 infection, the combined effects of these two pandemics and the large number of patients affected by both pandemics have paved the way for poor prognosis [5]. Having diabetes aggravates the prognosis of COVID-19 infection [13,16]. In numerous studies, it has been stated that COVID-19 infection is more severe in diabetes patients, and it increases the mortality rates of this patient population [17-20]. Besides, in the relevant literature, it is emphasized that COVID-19 infection would make glycemic control even more difficult [6]. Hussain et al. [12] put forward that increased chronic inflammation and pancreatic injury along with COVID-19 were indicative of the relationship between the prognoses of diabetes and COVID-19.

It is clear that diabetes patients are at high risk in terms of COVID-19 infection and COVID-19-related complications. This situation shows that a more sensitive approach toward diabetes patients should be adopted in the diagnosis, treatment, and follow-up of COVID-19 cases [5,9]. The likelihood that the COVID-19 pandemic gives rise to psychological problems as well as physical health problems [21] affects the glycemic control status of diabetic patients, and thus, their susceptibility to COVID-19 infection. In a previous study, it was determined that 69% of diabetes patients were afraid of dying due to COVID-19, and 68.1% were worried about the possibility of getting infected [22]. Although there are several studies about the COVID-19 pandemic in the relevant literature, there is a limited number of studies about COVID-19-related anxiety in diabetes patients. Moreover, the literature review in this study did not reveal such a study in Turkey. It is considered that this study will be guiding for healthcare professionals in terms of presenting the risk profile for the management of diabetes and contribute to the relevant literature.

MATERIALS AND METHODS

Objective and Design

This is a descriptive and cross-sectional study that was conducted to identify the prevalence of COVID-19 infection and anxiety levels in type 2 diabetes patients.

Population and Sample

The population of the study consisted of patients who presented to the internal medicine and endocrinology and metabolic diseases outpatient clinics of a university hospital between 19 October and 19 December 2020 and had been diagnosed with type 2 diabetes for a minimum of six months.

The minimum required sample size was calculated as 152 by using the sample size calculation formula for a known population [$Ntpq/d^2(N-1)+ t^2pq$] in a confidence interval of 95%, with a standard deviation of 0.05, and a 50% probability of observing anxiety in diabetes patients. In this context, 201 diabetes patients who

met the inclusion criteria determined for the study were included in the sample.

The inclusion criteria were being literate, being 18 years old or older, having no trouble in verbal communication, and consenting to participate in the study.

Data Collection Tools

The data were collected by using a Patient Identification Form and the Coronavirus Anxiety Scale.

Patient Identification Form

This form prepared by the researchers based on their review of the relevant literature included questions addressing each participant's personal data about age, height, weight, sex, marital status, economic status, education level, smoking status, and alcohol consumption status (11 questions) in the first part.

The second part of the form included questions on each participant's diabetes-related data, covering when the participant was diagnosed with diabetes, their diabetes treatment modality, their number meals per day, whether they missed any meal, comorbidities, water consumption volume per day, and status of having any education about diabetes (11 questions).

The third part consisted of questions on whether the participant had COVID-19 before, how their COVID-19 infection affected their diabetes, how long their COVID-19 treatment took, their status of having received intensive care support, status of having adequate information about COVID-19, whether they viewed themselves still at risk in terms of COVID-19 and diabetes, and whether they participated in the use of masks, social distancing rules, and other precautionary practices such as hand-washing (10 questions).

Coronavirus Anxiety Scale (CAS)

This scale was developed firstly by Lee [23] as a brief mental health screener to identify probable cases of dysfunctional anxiety associated with the COVID-19 crisis, and Biçer et al. [21] performed the validity and reliability study for CAS in Turkish. Designed as a five-point Likert-type scale (0: not at all, 1: rare, less than a day or two, 2: several days, 3: more than 7 days, 4: nearly every day over the last 2 weeks), CAS comprises five items and has no sub-scale.

The maximum total score to be obtained from CAS is 20, and a respondent with a total score of 9 or above is considered to have a high level of anxiety. In the validity and reliability study of CAS in Turkish, the Cronbach's alpha coefficient of the scale was reported as 0.83 [21].

In this study, the Cronbach's alpha coefficient of CAS was calculated as 0.96.

Data Collection

The data were collected by the researchers via face-to-face interviews held with the participants in a suitable meeting room. The interviewing researcher verbally informed diabetes patients about the research process. After those who agreed to participate in the study provided verbal and written consent, the researcher administered the survey form to the participants. It took approximately 20 minutes to apply the survey form for each participant. Moreover, the glycemic control information of each participant was obtained from the laboratory result document for the tests that were ordered by the physician when the patient presented to the outpatient clinic.

Data Analysis

The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS) 22.0.

Whether the data were normally distributed was evaluated with the Kolmogorov-Smirnov test, and it was found that the data were not normally distributed.

Chi-squared test and Fisher's exact test were used to compare the COVID-19 infection statuses and anxiety levels of the participants based on some variables. In the analyses, the level of statistical significance was accepted as a p-value below 0.05 ($p<0.05$).

Ethical Aspect of the Study

Before the study was started, ethical approval was obtained from the Ethics Committee of a university (Decision Number: 2020-10/01), and written permission was received from the institution where the research would be conducted. Besides, the diabetes patients were informed about the aim of the study and asked to provide verbal and written consent if they agreed to participate in the study. Moreover, the participants were informed that their data would be used solely within the context of the study, and their confidentiality would be strictly protected.

RESULTS

The participants had a mean age of 49.73±19.37 years, and 57.7% of them were female. Among the participants, 73.1% were married, 34.8% were primary school graduates, 71.1% were not working, 6% lived alone, 71.1% stated that they had medium-level economic status, 7% had no health insurance, 22.9% were current smokers, and 67.8% were overweight or obese.

The mean duration of the diabetes diagnosis of the participants was 10.96±8.83 years. The mean Hba1c level of the participants was 7.97±2.06%, and 71.9% had an HbA1c value of 7%

or above. 38.8% of the participants were using insulin therapy together with an oral antidiabetic agent. 81.6% of the participants stated that they applied their treatment regularly, 40.3% paid attention to their diet, and 21.4% stated that they exercised regularly. 55.7% of the participants reported that they had received information about their disease from a physician or a nurse, 54.2% stated that they had a chronic disease other than diabetes, and 19.4% developed complications due to diabetes. 54.2% of the participants evaluated their general health as moderate.

It was found that 37.8% of the participants had COVID-19 before. Among the participants who had COVID-19 before, 51.3% stated that the COVID-19 infection aggravated their diabetes, and 13.2% said they received intensive care support due to the infection. Nearly half of the participants (41.8%) stated that they did not have adequate information about COVID-19. Besides, 80.6% of the participants perceived themselves at risk in terms of COVID-19 infection, and 76.6% of them thought that being a diabetes patient increased their COVID-19 infection risk. Additionally, it was discerned that the participants participated in the use of masks (88.1%), social distancing rules (83.6%), and personal hygiene (86.6%) as precautions against COVID-19 infection risk (Table 1).

Table 1. Diabetes patients' COVID-19-related characteristics

Characteristics	**n**	**%**
Whether the participant had the COVID-19 infection before		
Yes	76	37.8
No	125	62.2
Whether the COVID-19 infection affected the diabetes disease*		
The COVID-19 infection aggravated diabetes.	39	51.3
The COVID-19 infection did not affect	37	48.7
Whether the participant had intensive care support due to the COVID-19 infection*		
Yes	10	13.2
No	66	86.8
Whether the participant thought of having adequate information about the COVID-19 infection		
Yes	117	58.2
No	84	41.8
Whether the participant viewed himself/herself at risk in terms of the COVID-19 infection		
Yes	168	80.6
No	39	19.4
Whether the participant thought that having diabetes increased the COVID-19 risk		
Yes, the risk increased	154	76.6
No, it created no risk	47	23.4
Whether the participant was attentive to the use of masks against the COVID-19 risk		
Yes	177	88.1
Sometimes	24	11.9
Whether the participant was attentive to social distancing rules against the COVID-19 risk		
Yes	168	83.6
Sometimes	33	15.9
Whether the participant was attentive to personal hygiene in the fight with the COVID-19 risk		
Yes	174	86.6
Sometimes	27	13.4

*The number n has changed

Upon the review of the participants' COVID-19-related anxiety levels, it was found that 17.9% of them had high levels of anxiety (Table 2).

In the comparison of the COVID-19-related characteristics of the participants who had COVID-19 before and those who did not have

COVID-19, a statistically significant difference was found between the two groups in terms of their statuses of having any diabetes-related complication.

In this regard, the participants who had been COVID-19-positive had a lower rate of having diabetes-related complications than those who never had COVID-19 before ($p<0.05$) (Table 3).

Table 2. Distribution of the mean score of the Coronavirus Anxiety Scale of the diabetes patients

Coronavirus Anxiety Scale	Mean±SD	n	%
Total	6.85±3.12		
Low level of anxiety		165	82.1
High level of anxiety		36	17.9

Table 3. The comparison of diabetes-related characteristics of patients who had the COVID-19 infection before and diabetes patients who never had the COVID-19 infection before

	Had the COVID-19 infection (n=76;%37.8)	Not had the COVID-19 infection (n=125;%62.2)	χ^2; p
Age (year)			
<65	59(39.3)	91(60.7)	0.583;0.506
≥65	17(33.3)	34(66.7)	
Gender			
Female	41(35.3)	75(64.7)	0.709; 0.243
Male	35(41.2)	50(58.8)	
Diabetes duration (year)			
<10	39(37.5)	65(62.5)	0.009;0.925
≥10	37(38.1)	60(61.9)	
HbA1c			
<7	24(42.1)	32(57.9)	0.055; 0.815
≥7	64(44.3)	81(55.7)	
Regular application of treatment			
Yes	63(38.4)	101(61.6)	1.248; 0.536
Sometimes	13(37.1)	22(62.9)	
No	0(0.0)	2(100.0)	
Receiving training about the disease from doctor or nurse			
Yes	43(38.4)	69(61.6)	0.036; 0.849
No	33(37.1)	56(62.9)	
Presence of other chronic disease			
Yes	39(35.8)	70(64.2)	0.418; 0.518
No	37(40.2)	55(59.8)	
Presence of complication related to diabetes			
Yes	9(23.1)	30(76.9)	4.467; 0.035*
No	67(41.4)	95(58.6)	

*p<0.05

In the comparison of the COVID-19-related characteristics of the participants who had low levels of COVID-19-related anxiety and those who had high levels, a statistically significant difference was found between the two groups in terms of their statuses of having COVID-19 infection before, thinking of having adequate information about COVID-19 infection, and participating in the use of masks against the risk of COVID-19. In this respect, the participants who had high levels of COVID-19-related anxiety had lower rates of previous COVID-19 infection,

thinking of having adequate information about COVID-19 infection, and participating in the use of masks against the risk of COVID-19 ($p<0.05$) (Table 4).

Tablo 4. The comparison of COVID-19-related characteristics of diabetes patients who had low-level COVID-19-related anxiety and diabetes patients who had high-level COVID-19-related anxiety

	COVID-19-related anxiety level		**χ^2; p**
	Low-level (n=165;%82.1)	**High-level (n=36;%17.9)**	
Whether the participant had the COVID-19 infection before			
Yes	57(75.0)	19(25.0)	4.178; 0.041*
No	108(86.4)	17(13.6)	
Whether the participant thought of having adequate information about the COVID-19 infection			
Yes	90(76.9)	27(23.1)	5.083; 0.024*
No	75(89.3)	9(10.7)	
Whether the participant viewed himself/herself at risk in terms of the COVID-19			
Yes	132(81.5)	30(18.5)	0.155; 0.694
No	32(84.2)	6(15.8)	
Whether the participant thought that having diabetes increased the COVID-19 risk			
Yes, the risk increased	123(79.9)	31(20.1)	2.207; 0.192
No, it created no risk	42(89.4)	5(10.6)	
Whether the participant was attentive to the use of masks against the COVID-19			
Yes	142(80.2)	35(19.8)	3.501; 0.045*
Sometimes	23(95.8)	1(4.2)	
Whether the participant was attentive to social distancing rules against the COVID-19			
Yes	136(81.0)	32(19.0)	0.900; 0.343
Sometimes	29(87.9)	4(12.1)	
Whether the participant was attentive to personal hygiene in the fight with the COVID-19 risk			
Yes	142(81.6)	32(18.4)	0.203; 0.652
Sometimes	23(85.2)	4(14.8)	

*$p<0.05$

DISCUSSION

In the relevant literature, there is evidence that the incidence and severity of COVID-19 increase in diabetes patients compared to the general population [15], and diabetes is a significant risk factor, independent of age, for the severity of COVID-19 [24]. In this study, it was found that more than one-third of the participants had COVID-19 before. A meta-analysis covering 1,527 COVID-19 patients revealed that 9.7% of COVID-19 patients had diabetes [17]. In a study that was conducted with 1,591 critically ill COVID-19 patients in Italy, it was reported that 17% of the COVID-19 patients had diabetes [25]. Similarly, in a retrospective study performed with 393 patients receiving treatment for COVID-19 in New York, it was found that 25.2% of the COVID-19 patients had diabetes [26]. Upon the review of previous studies, it was discerned that diabetes increased the risk of COVID-19 infection, and hence, diabetes patients were at risk in terms of contracting COVID-19.

The high number of people affected by the COVID-19 pandemic along with a highly prevalent chronic disease leads to the aggravation of the prognosis of COVID-19 in patients [27]. At the same time, viral infections exacerbate diabetes by giving rise to fluctuations in blood glucose levels [16]. In this study, half of the participants who had COVID-19 infection before stated that the COVID-19 infection aggravated their diabetes even further, and 13.2% of them received intensive care support due to their COVID-19 infection. In a retrospective study, it was found that diabetes patients experienced COVID-19 infection more severely and had a higher mortality rate than non-diabetes patients, and diabetes was an independent risk factor that had a 2.18-fold effect on the prognosis of COVID-19 [7]. In another retrospective study, type 2 diabetes patients were found to need more medical interventions, they had significantly higher

rates of mortality, and they suffered a larger number of multiple organ injuries due to COVID-19 infection than patients who did not have type 2 diabetes [28]. In a retrospective study that was performed with COVID-19 patients with diabetes and/or hyperglycemia, it was revealed that COVID-19 patients who had uncontrolled hyperglycemia stayed longer at the hospital and had a higher rate of mortality than COVID-19 patients who did not have diabetes [29]. In a study that analyzed the clinical characteristics and outcomes of COVID-19 in patients living with diabetes in Nigeria, it was found that 28.7% of 588 patients diagnosed with COVID-19 and staying at the hospital had diabetes, and these patients exhibited more severe symptoms and had a higher mortality rate than COVID-19 patients who did not have diabetes [30]. Likewise, in a study conducted to assess whether diabetes is a risk factor for the prognosis of COVID-19, it was stated that along with a severe clinical picture in terms of organ injuries, inflammatory factors, or hypercoagulable state, the prognosis of COVID-19 was aggravated, and accordingly, a poor prognosis of COVID-19 was observed in patients who had diabetes in comparison to patients who did not [19]. The finding of this study was consistent with the relevant literature and indicated that COVID-19 infection made the management of diabetes difficult, and the prognosis of COVID-19 infection was aggravated in diabetes patients.

It was reported that variables such as old age, being male, having a non-white ethnic origin, and having a low socioeconomic status had associations with the prognosis of COVID-19 in the general population [14]. In this study, it was discerned that having COVID-19 infection before had no statistically significant relationship with variables such as age, sex, duration of diabetes diagnosis, or glycemic control. However, the participants who had COVID-19 infection before had a lower rate of having any diabetes-related complication than those who never had COVID-19 infection before. In a prospective cohort study, it was found that the risk of hospitalization due to COVID-19 infection was increased by age (OR 1.93 for each 25-year increase) and sex (OR 1.22 for being male) in diabetes patients [31]. In another prospective cohort study conducted on 1,317 diabetes patients, who were hospitalized due to COVID-19 infection and 88.5% of whom had type 2 diabetes, it was reported that age was an independent risk factor for mortality [32]. It is considered that the finding of this study that is mentioned above may have been related to the relatively smaller sample compared to other studies in the relevant literature.

The COVID-19 and diabetes pandemics have presented an unprecedented challenge to the lives of thousands of people across the world [33]. These challenges have also affected the psychological health of numerous patients. In this study, it was found that 17.9% of the participants had high levels of anxiety. Besides, it was discerned that the participants who had high levels of COVID-19-related anxiety had lower rates of having COVID-19 before, thinking of having adequate information about COVID-19 infection, and taking part in the use of masks against the risk of COVID-19. A study that compared diabetes patients to non-diabetic individuals identified no significant difference in COVID-19-related anxiety levels between the two groups. Nevertheless, in the same study, it was found that the diabetes patients adopted a more precautionary approach toward COVID-19 than the non-diabetic individuals [34]. In another study, diabetes patients were found to have COVID-19-related worries, and nearly one-third of them characterized themselves as a risk group due to diabetes and were worried that they would not be able to manage their diabetes if they were infected with COVID-19 [35].

This study had some limitations. The most important limitation was that a probabilistic sampling method was not used in the study, and the participants consisted of patients with type 2 diabetes in only one center. So, the results of this study cannot be generalized. Additionally, this study presents cross-sectional data because it was conducted in a certain time interval. Moreover, the anxiety data of the patient were self-reported. Despite these limitations, our study is one of the pioneering studies examining the prevalence of COVID-19 and the level of anxiety related to COVID-19 in type 2 diabetes patients.

CONCLUSIONS

This study showed that the diabetes patients had a higher prevalence of COVID-19 infection, and nearly one-fifth of them had high levels of COVID-19-related anxiety. Due to the negative effects of hyperglycemia on the immune system, the risk of COVID-19 infection increases in diabetes patients. Thus, healthcare professionals who provide care to diabetes patients should, first of all, undertake practices aimed at ensuring glycemic control in diabetes patients. In this context, providing diabetes patients with education, following them up at home during the pandemic, and extending telehealth services to patients unable to visit healthcare facilities due to the pandemic is recommended. Likewise, informing diabetes patients regularly about their need to comply with vaccination and other preventive measures against COVID-19 infection may be effective in terms of controlling COVID-19 infection rates. Additionally, offering psychosocial support to patients at risk in terms of psychological health problems may contribute to the management of diabetes and the prevention of COVID-19 infections. Moreover, it is

recommended that prospective studies on the same topic be repeated with a larger sample.

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Conflicts of Interest
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