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Prognostic impact of diabetes mellitus on hospitalized COVID-19 patients: A large-scale retrospective cohort study from Türkiye

Türkiye'den büyük ölçekli retrospektif kohort çalışması: Hastaneye yatan COVID-19 hastalarında diyabetes mellitusun prognostik etkisi

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ABSTRACT

BACKGROUND

This study examines the prognostic role of diabetes mellitus (DM) in predicting COVID-19 severity and fatal outcomes among hospitalized patients in Türkiye. By evaluating a large cohort, we aim to delineate the relationship between DM and intensive care unit (ICU) utilization and to validate our findings against Turkish national data.

METHODS

This retrospective study analyzed 906 patients hospitalized with confirmed COVID-19 in 2020 and 2021. Patients were categorized into diabetic and non-diabetic groups. Baseline characteristics, clinical outcomes (ICU admission rates, oxygen requirements, length of stay, and in-hospital mortality), and laboratory parameters were compared between the two groups using bivariate statistical tests. Multivariate binary logistic regression was performed to obtain age-, sex-, and hypertension-adjusted odds ratios for the primary clinical outcomes.

RESULTS

Diabetic patients experienced significantly more severe illness compared to non-diabetics, with markedly higher rates of ICU admission (odds ratio: 1.474, 95% confidence interval: 1.038–2.094; p = 0.030) and oxygen supplementation needs (p = 0.003). Length of stay was significantly longer in the diabetic group (p = 0.013). While the mortality rate was clinically higher for diabetic patients (16.9% vs. 15.9%), the difference was not statistically significant. Advanced age (≥65 years), male sex, and hypertension were identified as primary predictors of severity.

CONCLUSION

Our findings confirm that DM is a primary driver of COVID-19 severity and resource utilization in Türkiye, consistent with the national TurCoviDia study. The increased need for ICU care and respiratory support underscores the necessity of early clinical intervention and rigorous glycemic management to improve prognostic outcomes.

KEYWORDS

COVID-19, diabetes mellitus, intensive care unit, Turkish population

ÖZ

AMAÇ

Bu çalışma, hastanede yatan hastalarda COVID-19 hastalığının şiddeti ve mortalite sonuçlarının öngörülmesinde diyabetes mellitusun (DM) prognostik rolünü incelemeyi amaçlamaktadır. Geniş bir hasta kohortunun değerlendirilmesiyle, DM ile yoğun bakım ünitesine (YBÜ) yatış arasındaki ilişkinin ortaya konulması ve elde edilen bulguların Türkiye ulusal verileriyle karşılaştırılarak doğrulanması hedeflenmiştir.

GEREÇ YÖNTEM

Bu retrospektif çalışmada, 2020–2021 yılları arasında doğrulanmış COVID-19 tanısı ile hastaneye yatırılan toplam 906 hasta analiz edilmiştir. Hastalar, diyabet tanısı olan ve olmayan bireyler olarak iki gruba ayrılmıştır. DM'nin YBÜ yatış oranları, oksijen gereksinimi, hastanede kalış süresi ve hastane içi mortalite üzerindeki etkilerini değerlendirmek amacıyla yaş ve cinsiyet açısından eşleştirilmiş analizler yapılmıştır.

BULGULAR

Diyabetli hastaların, diyabeti olmayan hastalara kıyasla anlamlı düzeyde daha şiddetli hastalık seyri gösterdiği saptanmıştır. Diyabetli grupta YBÜ'ye yatış oranlarının (OR = 1,474; %95 GA: 1,038–2,094; p = 0,030) ve oksijen desteği gereksiniminin (p = 0,003) anlamlı derecede daha yüksek olduğu belirlenmiştir. Ayrıca, hastanede kalış süresi diyabetli hastalarda anlamlı olarak daha uzun bulunmuştur (p = 0,013). Diyabetli hastalarda mortalite oranı klinik olarak daha yüksek gözlenmiş (%16,9'a karşı %15,9) olmakla birlikte, bu fark istatistiksel açıdan anlamlı değildi. İleri yaş (≥65 yıl), erkek cinsiyet ve hipertansiyon, hastalık şiddetinin başlıca belirleyicileri olarak tanımlanmıştır.

SONUÇ

Elde edilen bulgular, ulusal "TurCoviDia" çalışmasıyla uyumlu olarak, diyabetin Türkiye'de COVID-19 hastalığının şiddeti ve sağlık kaynaklarının kullanımı üzerinde belirleyici bir faktör olduğunu göstermektedir. Yoğun bakım ve solunum desteğine duyulan artmış gereksinim, prognozun iyileştirilmesi açısından erken klinik müdahalenin ve etkin glisemik kontrolün önemini vurgulamaktadır.

ANAHTAR KELİMELER

COVID-19, diyabetes mellitus, Türk popülasyonu, yoğun bakım ünitesi

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The emergence of unidentified pneumonia clusters in Wuhan, China, in late 2019 marked the discovery of a novel enveloped RNA betacoronavirus (1). Formally designated as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), this pathogen triggered the global coronavirus disease 2019 (COVID-19) crisis (2). While its clinical manifestations vary, the virus primarily affects the pulmonary system, frequently leading to interstitial pneumonia and progressing to acute respiratory distress syndrome (ARDS) in severe cases (3). Individuals with preexisting chronic conditions are disproportionately vulnerable to adverse outcomes and increased mortality following infection (4). High-risk comorbidities frequently cited in the clinical literature include cardiovascular diseases, chronic obstructive pulmonary disease, cerebrovascular disorders, chronic kidney disease, malignancies, and obesity (5,6). Furthermore, large-scale observational data and meta-analyses have consistently identified advanced age and male sex as independent predictors of heightened disease severity and poorer survival rates (7). Current evidence also suggests that diabetes mellitus significantly exacerbates the clinical course of COVID-19, leading to a marked rise in mortality. Hospital-based studies indicate that patients with diabetes often face prolonged hospitalization and require intensive care unit (ICU) admission at substantially higher rates than their non-diabetic counterparts (8).

The growing prevalence of diabetes remains a formidable public health challenge, driving global morbidity and mortality. According to 2021 projections by the International Diabetes Federation, approximately 10.5% of the adult population (ages 20–79) is affected, representing a global burden of 537 million individuals (9). Beyond the direct viral threat of COVID-19, pandemic-related lockdowns severely hindered access to routine clinical follow-up and maintenance therapies. These disruptions compromised glycemic management, resulting in a measurable decline in disease control during the post-pandemic era.

This study retrospectively evaluates the clinical characteristics and laboratory profiles of patients hospitalized during the initial phases of the pandemic (2020–2021). Our objective is to delineate the differences in disease progression and outcomes between diabetic and non-diabetic cohorts, contributing large-scale data from Türkiye to the broader international literature.

Materials and Methods

Between March 1, 2020, and March 1, 2021, 906 adult patients hospitalized with COVID-19 in the Dokuz Eylül University Faculty of Medicine were enrolled in this research. The investigators utilized the institution's digital information infrastructure to extract the necessary data for this retrospective cohort study, encompassing clinical history, physical examination findings, comorbidities, pharmacological treatments, and body mass index (BMI). Patients were divided into two main groups based on the presence or absence of diabetes mellitus. Patients were identified as having diabetes mellitus based on a documented preexisting medical history of diabetes, active treatment with oral antidiabetic agents or insulin therapy prior to admission, or a new-onset diagnosis during hospitalization defined in accordance with the guidelines of the Society of Endocrinology and Metabolism of Türkiye (i.e., meeting at least one of the following criteria: fasting plasma glucose of ≥126 mg/dL, HbA1c level of ≥6.5%, or random plasma glucose level of ≥200 mg/dL in the presence of typical diabetes symptoms) (10). Inpatient laboratory parameters and therapeutic interventions were systematically documented. Post-discharge follow-up was conducted via telephone interviews with patients who were accessible to assess persistent post-COVID symptoms. The study protocol was approved by the Non-Interventional Research Ethics Committee of Dokuz Eylül University (decision number 2021/12-21, April 2021).

Statistical analysis

All statistical procedures were performed on data from a primary cohort of 906 individuals, who were further stratified into diabetic (n = 272) and non-diabetic (n = 634) subgroups for comparative evaluation. Categorical data were expressed as absolute frequencies and corresponding valid percentages "" to account for missing values, with inter-group differences evaluated using the Pearson chi-square test or Fisher exact test as appropriate. The normality of continuous variables was systematically assessed prior to analysis using both graphical methods (histograms and Q–Q plots) and the

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Kolmogorov–Smirnov test, which is appropriate for large sample sizes. Continuous variables were summarized as medians with interquartile ranges (IQRs: 25th–75th percentiles) due to non-normal distributions. Between-group comparisons for continuous clinical and laboratory parameters measured during hospitalization were performed using the Mann–Whitney U test. Missing data were handled using complete-case analysis; specifically, BMI data were only available for 156 patients (17.2%) and no statistical imputation was performed to avoid bias. In addition, clinical outcomes were compared across key strata (sex, obesity status, and age group) using chi-square tests. The independent association of diabetes with the three primary clinical endpoints of ICU admission, mortality, and the need for supplemental oxygen was assessed using multivariate binary logistic regression models. For each outcome, a separate model was fitted, with diabetes status as the primary exposure and prespecified covariates (age group [≥65 years vs. <65 years], sex [male vs. female], and hypertension [yes vs. no]). Results are reported as adjusted odds ratios (aORs) with 95% confidence intervals (CIs) and exact two-sided p-values, with statistical significance defined as $p < 0.05$. Model calibration and performance were evaluated using the Hosmer–Lemeshow goodness-of-fit test, visual inspection of calibration plots, –2 log-likelihood, and Nagelkerke R2 values. All analyses were conducted using IBM SPSS Statistics 30.0 (IBM Corp., Armonk, NY, USA).

Results

The study comprised a cohort of 906 hospitalized individuals with COVID-19, with a marginal male predominance (54%). The median age was 65.8 years, with a wide IQR of 19–102 years. Clinical history assessment revealed hypertension as the primary comorbidity, affecting 53.8% of the population, followed by diabetes mellitus (30%, n = 272). Among the subset of patients with documented BMI data (n = 156), obesity was present in 43.6%. While the origin of infection remained unidentified for 66.2% of the participants, familial contact (19.5%) and community transmission (11.6%) were the leading known sources. Laboratory confirmation via polymerase chain reaction (PCR) was achieved in 91.6% of the cases. Comprehensive demographic and clinical data are presented in Table 1. The therapeutic approaches utilized during hospitalization are illustrated in Figure 1. It was noted that patients typically received a combination of pharmacological agents.

Among the 272 diabetic patients, type 2 diabetes mellitus (T2DM) was predominant (n = 271), with only a single case of type 1 diabetes mellitus (T1DM) included in this study. Notably, 4.4% (n = 12) of these individuals were first diagnosed with diabetes upon hospital admission for COVID-19. Metabolic complications were observed in a segment of the cohort, with 33 cases of ketosis and one case of diabetic ketoacidosis (DKA). Pre-admission insulin use was reported by 42.1% of diabetic patients, and this rate increased to 48.1% during their hospital stays. Further details regarding this subgroup are provided in Table 2.

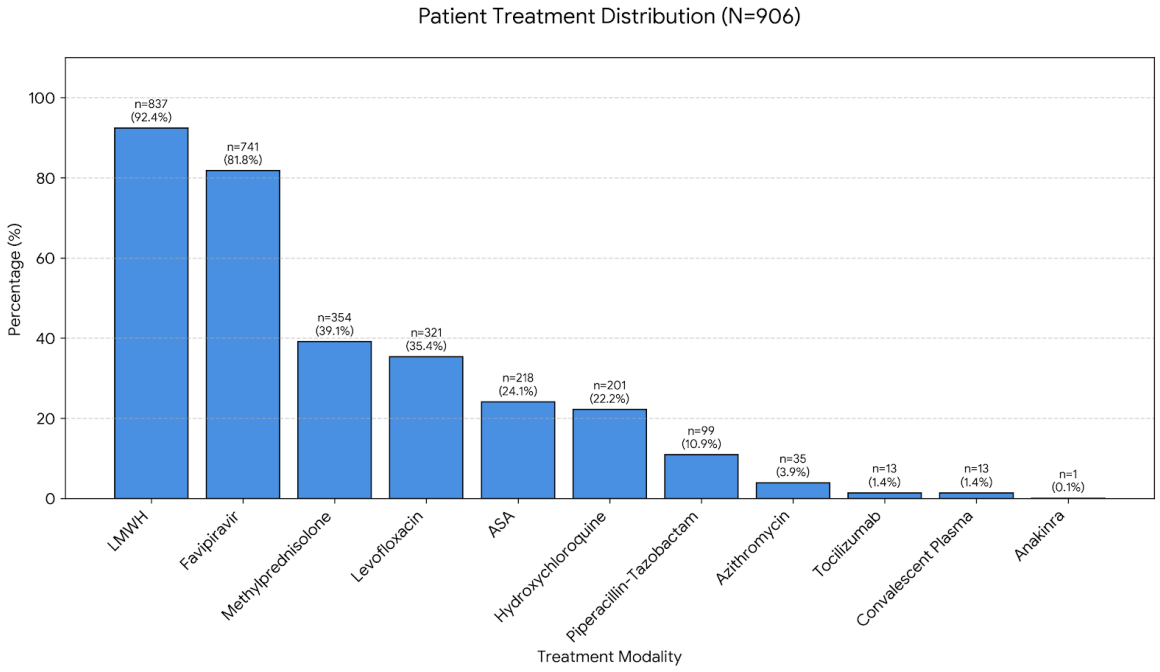
A significant age disparity was observed between the cohorts, with individuals in the diabetic group being notably older than those in the non-diabetic group ($p < 0.001$), although BMI levels did not differ significantly between the groups. Similarly, no marked differences were found in PCR positivity or radiological lung involvement scores. However, the diabetic group exhibited substantially higher needs for oxygen supplementation and corticosteroid therapy ($p = 0.003$ and $p = 0.004$, respectively). Moreover, the diabetic patients had longer hospital stays and higher rates of ICU admission ($p = 0.013$ and $p = 0.010$, respectively). While the mortality rate was numerically higher in the diabetic cohort, the difference did not reach statistical significance. Interestingly, the post-infection incidence of vascular issues, such as new-onset hypertension and coronary artery disease, was markedly elevated among diabetic patients ($p < 0.001$ and $p < 0.001$, respectively), as summarized in Table 3. Among patients re-evaluated after discharge, persistent symptoms such as dyspnea, fatigue, myalgia, and cough were most frequent, with no significant variance observed between the diabetic and non-diabetic groups ($p = 0.612$). Laboratory analysis (Table 4) indicated that markers of organ dysfunction and disease severity, specifically including troponin, procalcitonin, creatinine, and alanine aminotransferase (ALT), were significantly higher in the diabetic group ($p = 0.018$, $p \leq 0.001$, $p < 0.001$, and $p = 0.011$, respectively).

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Table 1. Demographic and clinical characteristics of the study population (n = 906).

Characteristics		Frequency (n)	Percentage (%)
Sex	Female	417	46
	Male	489	54
BMI	≥30	68	43.6
	<30	88	56.4
Smoker		56	6.2
DM		272	30
Other Comorbidities			
	HT	487	53.8
	CAD	149	16.4
	CHF	38	4.2
	CRF	63	7
	PAD	3	0.3
	CVD	28	3.1
	HL	122	13.5
	CA	66	7.3
	Hypothyroidism	68	7.5
	Asthma-COPD	123	13.6
PCR positivity		830	91.6

BMI;Body mass index, DM; diabetes mellitus, HT; hypertension, CAD; coronary artery disease, CHF; congestive heart failure, CRF; chronic renal failure, PAD; peripheral arterial disease, CVD; cerebrovascular disease, HL; hyperlipidemia, CA; cancer or malignancy, COPD; chronic obstructive pulmonary disease, PCR; polymerase chain reaction.



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Figure 1. Distribution of therapeutic interventions administered to the study cohort (n = 906). The majority of patients received low-molecular-weight heparin (LMWH; 92.4%, n = 837) and favipiravir (81.8%, n = 741). Other common treatments included methylprednisolone (39.1%), levofloxacin (35.4%), and acetylsalicylic acid (ASA; 24.1%). Advanced biological therapies and specialized treatments such as tocilizumab (1.4%), convalescent plasma (1.4%), and anakinra (0.1%) were administered to a smaller subset of patients.

Table 2. Clinical and demographic profiles of diabetic patients (n = 272).

Characteristics		Frequency	Percentage
Sex	Female	131	48.2
	Male	141	51.8
BMI	≥30	28	51.9
	<30	26	48.1
	Missing data	218	
Diabetes Type	Type 1 DM	1	0.4
	Type 2 DM	271	99.6
Newly diagnosed DM		12	4.6
Ketosis		14	7.8
Ketoacidosis		1	0.6
Treatment	OAD	159	67.4
	Insulin	99	42.1
Treatment at hospital	OAD	53	19.6
	Insulin	133	48.9

BMI; Body mass index, DM; diabetes mellitus, OAD; oral antidiabetic drug.

Table 3. Clinical outcomes of the study population and comparison of diabetic and non-diabetic patients.

	All patients (n = 906)	**Diabetic (n = 272)**	**Non-diabetic (n = 634)**	**p**
Age	65 (52–76)	67 (59–76)	62.5 (50–76)	**<0.001**[i]
BMI	28.7 (25.8–34.0)	31 (26.8–35.1)	27.8 (25.2–33.1)	
BMI of ≥30	68 (43.6)†	28 (51.9)†	40 (39.2)†	0.130*
PCR positivity	830 (91.6)	243 (89.3)	587 (92.7)	0.089*
Radiological score >10	177 (45.7)	55 (43.3)	122 (46.9)	0.503*
Oxygen need	499 (55.2)	170 (62.7)	329 (52)	**0.003***
ICU admission	210 (2.2)	78 (28.7)	132 (20.8)	**0.010***
Death	147 (16.2)	46 (16.9)	101 (15.9)	0.713*
Hospital stay (days)	7 (4–12)	8 (5–12.7)	7 (4–11)	**0.013**[i]
Corticosteroid need	354 (39.2)	125 (46.3)	229 (36.1)	**0.004***
New-onset HT	487 (53.8)	213 (78.3)	274 (43.2)	**<0.001***
Newly diagnosed CAD	149 (16.4)	64 (23.5)	85 (13.4)	**<0.001***
Newly diagnosed CHF	38 (4.2)	13 (4.8)	25 (3.9)	0.565*
Newly diagnosed CVD	28 (3.1)	5 (1.8)	23 (3.6)	0.153*
Post-COVID symptoms	73 (47.7)	24 (44.4)	49 (49.5)	0.612*

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BMI; Body mass index, PCR; polymerase chain reaction, ICU; intensive care unit, HT; hypertension, CAD; coronary artery disease, CHF; congestive heart failure, CVD; cerebrovascular disease, IQR; interquartile range (25th–75th percentiles).

Categorical variables are presented as n (%) or n (valid %)† to account for missing data; continuous variables are reported as median (IQR: 25th–75th percentiles). Valid percentages were calculated based on available data.

[i]; p-values were derived from the Mann–Whitney U test for continuous variables. *; The chi-square test was used for categorical variables.

Table 4. Laboratory parameters of diabetic versus non-diabetic patients during hospital stays.

	Diabetic (n=272)	Non-diabetic (n=634)	p*
FPG (mg/dL)	158 (124–238)	113 (100–131)	**<0.001**
HbA1c (%)	8.0 (7–10)	5.6 (5.1–6.2)	**<0.001**
CRE (mg/dL)	0.9 (0.7–1.2)	0.8 (0.6–1.0)	**<0.001**
LDH (U/L)	300 (237–421)	218 (218–392)	0.082
WBC (×10³/μL)	6.5 (5–8.8)	6.3 (4.7–8.8)	0.236
LYM (×10³/μL)	1.1 (0.7–1.5)	1.1 (0.7–1.5)	0.485
Procalcitonin (ng/mL)	0.1 (0.05–0.23)	0.07 (0.04–0.14)	**<0.001**
CRP (mg/L)	53.6 (9.8–122.1)	43.9 (9.2–106.7)	0.273
Ferritin (ng/mL)	185.8 (85–424.3)	195.7 (79–430)	0.834
D-Dimer (μg/mL)	1.0 (0.5–3.0)	0.9 (0.5–2.8)	0.115
TROP (ng/L)	7.5 (5.6–19)	5.6 (5.6–13.3)	**0.018**
AST (U/L)	33.5 (22–53)	31 (23–47)	0.366
ALT (U/L)	30 (20–45)	27 (17–42)	**0.011**

FPG; Fasting plasma glucose, HbA1c; glycated hemoglobin, CRE; creatinine, LDH; lactate dehydrogenase, WBC; white blood cell count, LYM; lymphocyte count, CRP; C-reactive protein, TROP; troponin, AST; aspartate aminotransferase, ALT; alanine aminotransferase. Data are presented as median (IQR: 25th–75th percentiles).

*; p-values were derived from the Mann–Whitney U test for continuous variables.

Stratified analysis demonstrated that male sex and advanced age (≥65 years) were meaningful predictors of adverse outcomes. Specifically, male sex was associated with significantly higher oxygen requirements ($p < 0.001$), longer ICU stays ($p < 0.001$), and increased mortality ($p = 0.002$). Similarly, advanced age was a strong predictor of all three outcomes ($p < 0.001$ for all). Notably, male patients also required more frequent corticosteroid interventions ($p < 0.001$). Conversely, BMI did not significantly influence these clinical outcomes. Hypertension was associated with a greater need for ICU monitoring and oxygen compared to normotensive individuals ($p = 0.038$ and $p < 0.001$, respectively). Detailed comparative analyses of these clinical requirements are presented in Table 5.

The independent prognostic value of diabetes status regarding clinically significant outcomes was quantified through the implementation of three multivariate logistic regression models addressing ICU admission, mortality, and oxygen requirements (Table 6) while adjusting for age group, sex, and hypertension. In these analyses, diabetes was independently associated with increased odds of ICU admission (OR: 1.474, 95% CI: 1.038–2.094; $p = 0.030$) and it also

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had a borderline association with oxygen requirements (OR: 1.372, 95% CI: 0.997–1.889; p = 0.052). No independent association between diabetes and mortality was found after adjusting for age, sex, and hypertension (p = 0.953). In these models, male sex and age of ≥65 years remained the strongest independent predictors of ICU admission and oxygen requirements (p < 0.001), while hypertension was not significantly associated with any outcome after adjustment (p > 0.05 for all). Model calibration was acceptable across all three models based on non-significant Hosmer–Lemeshow tests (p = 0.686, p = 0.774, and p = 0.336), although the explanatory power remained modest (Nagelkerke R2 = 0.080–0.126), indicating that the inclusion of additional clinical severity indicators could further improve model performance.

Table 5. Comparison of clinical outcomes by sex, obesity status, and age.

Groups	Mortality, n (%)	O_2 requirement, n (%)	ICU admission, n (%)	CS requirement, n (%)
Male	92 (18.8)	313 (64.0)	140 (28.6)	244 (50.0)
Female	55 (13.2)	186 (44.8)	70 (16.8)	110 (26.4)
p*	**0.022**	**<0.001**	**<0.001**	**<0.001**
Obese	0 (0)	46 (67.6)	9 (13.2)	34 (50.0)
Non-obese	3 (3.4)	50 (56.8)	13 (14.8)	44 (50.0)
p*	-	**0.168**	**0.784**	**0.999**
Age ≥ 65 years	114 (24.9)	299 (65.6)	136 (29.8)	183 (40.1)
Age < 65 years	33 (7.3)	200 (44.6)	74 (16.5)	171 (38.2)
p*	**<0.001**	**<0.001**	**<0.001**	**0.546**
HT: Yes	89 (18.3)	299 (47.8)	126 (20)	199 (41)
HT: No	58 (13.8)	200 (61.5)	84 (25.9)	155 (37)
p*	**0.071**	**<0.001**	**0.038**	**0.215**

ICU; Intensive care unit, CS; corticosteroids, O2: oxygen, HT; hypertension.
*; Categorical variables are expressed as n (%) and were compared using the chi-square test.

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Table 6. Multivariate logistic regression models for ICU admission, mortality, and oxygen requirement.

Predictor	ICU admission OR (95% CI) p	Mortality OR (95% CI) p	Oxygen requirement OR (95% CI) p
Diabetes status (Diabetic vs. Non-diabetic)	1.474 (1.038–2.094), p = 0.030	0.988 (0.654–1.492) p = 0.953	1.372 (0.997–1.889) p = 0.052
Sex (Male vs. Female)	2.167 (1.556–3.018) p < 0.001	1.687 (1.158–2.458) p = 0.006	2.497 (1.886–3.307) p < 0.001
Age group (≥65 vs. <65)	2.225 (1.571–3.151) p < 0.001	4.644 (2.984–7.230) p < 0.001	2.316 (1.720–3.119) p < 0.001
Hypertension (Yes vs. No)	0.993 (0.692–1.424) p = 0.969	0.854 (0.564–1.292) p = 0.454	1.288 (0.944–1.758) p = 0.110
Model fit (Hosmer–Lemeshow)	$\chi^2(7) = 4.785$, p = 0.686	$\chi^2(8) = 4.845$, p = 0.774	$\chi^2(8) = 9.076$, p = 0.336
n (included in analysis)	906	906	904
–2 Log-likelihood	932.126	740.638	1153.682
Nagelkerke R^2	0.080	0.114	0.126

ICU; Intensive care unit, OR; odds ratio, CI; confidence interval. Reference categories are as follows: Non-diabetic, Female (sex), Age <65 (age group), and Hypertension: No.

Discussion

In this study, we investigated factors influencing COVID-19 prognosis by analyzing clinical and laboratory data from 906 hospitalized patients over the course of 1 year (2020–2021). Our primary objective was to clarify the impact of diabetes mellitus on disease course while simultaneously evaluating how factors such as sex, advanced age, obesity, and hypertension contribute to infection severity in cases of COVID-19. Given the substantial sample size and the comprehensive timeframe of our study, the findings provide significant insight into the multifaceted determinants of COVID-19 outcomes in a clinical setting.

Our study demonstrated that diabetic patients experienced more severe illness compared to those without diabetes. Diabetic patients had higher rates of ICU admission, oxygen use, and corticosteroid requirements (p = 0.010, p = 0.003, and p = 0.004, respectively). Consistent with those results, diabetic patients in our cohort also had significantly longer durations of hospital stay compared to non-diabetic patients (p = 0.013). Although the difference did not reach the level of statistical significance, a higher mortality rate was also observed in the diabetic group (16.9% vs. 15.9%, p = 0.713). These findings are largely consistent with the existing literature on the adverse impact of diabetes on COVID-19 outcomes (11).

In addition to the role of metabolic status, our analysis corroborates international findings that identify male sex, advanced age (age ≥65), and elevated blood pressure as primary predictors of poor prognosis in cases of COVID-19 (12,13). Interestingly, however, a divergence from the literature was noted regarding BMI. Although obesity is widely recognized in the literature as an independent predictor of severe COVID-19 outcomes (14), BMI was not significantly associated with ICU admission or mortality in our cohort. However, this lack of association is more likely attributable to data constraints arising from limited statistical power resulting

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from the availability of BMI data for a sub-cohort of only 156 patients (17.2%) rather than a physiological distinction.

In our cohort, the diabetic patient population consisted almost exclusively of individuals with T2DM, with only a single documented case of T1DM. This distribution might reflect behavioral patterns during the early pandemic; T1DM patients may have exercised more stringent social distancing and self-isolation protocols, thereby reducing their infection and hospitalization rates during this specific window of time.

A 2021 meta-analysis further validates our observations, as it reported significantly higher in-hospital mortality among diabetic patients compared to non-diabetics (21.3% vs. 6.1%). Similarly, the incidence of critical complications such as ARDS (31.4% vs. 17.2%) and acute cardiac injury (22.0% vs. 12.8%) was markedly elevated in diabetic cohorts (15). These systemic complications are likely to drive the prolonged hospital stays observed in the literature and in our study population. The literature indicates a significant surge in acute diabetic emergencies, such as DKA and hyperosmolar hyperglycemic syndrome, among COVID-19 patients, even in cases of previously well-controlled diabetes (16). Consistent with these observations, our cohort included 14 (5.1%) cases of diabetic ketosis and one case (0.4%) of DKA. The increased severity of the infection combined with a higher demand for corticosteroid therapy in diabetic patients likely acted as the primary driver for glycemic dysregulation and the subsequent development of these metabolic complications. In an investigation involving 658 individuals hospitalized for COVID-19, ketosis was identified in 42 patients (6.4%); of those patients, 15 were diabetic and 3 eventually progressed to DKA (16).

The molecular basis for the unfavorable outcomes seen among diabetic patients involves a multifactorial inflammatory response. Chronic hyperglycemia fosters a proinflammatory environment that likely amplifies COVID-19-induced cytokine storms. Our laboratory findings support this, as diabetic patients displayed significantly higher levels of organ dysfunction markers, including creatinine, ALT, troponin, and procalcitonin. Furthermore, the interplay between ACE2 receptor dysregulation and an impaired innate immune system may explain the increased reliance on ICU monitoring and therapeutic oxygen in this subgroup (17).

A more recent comprehensive meta-analysis, published in 2025 (18), further underscores the prognostic influence of diabetes as observed in our 906-patient cohort. Our results regarding increased ICU admissions (OR: 1.474) and oxygen needs (OR: 1.372) are consistent with global data showing that T2DM patients have significantly higher odds of severe disease (OR: 1.97) and mechanical ventilation (OR: 2.34).

Moreover, our results align with the findings of the Turkish TurCoviDia study (19). While TurCoviDia reported a 13.6% 30-day mortality rate, the rate of 16.9% observed for our diabetic cohort demonstrates a consistent national trend. Furthermore, upon comparison to age- and sex-matched non-diabetic COVID-19 patients, our study revealed a significantly higher ICU admission rate in the diabetic cohort (OR: 1.474, 95% CI: 1.038–2.094; p = 0.030). These results directly support the findings of the national TurCoviDia study, reinforcing the role of diabetes as a primary driver of adverse clinical trajectories in the Turkish population (19).

While this research offers valuable insight, it also has several limitations. Specifically, the applicability of the findings to diverse clinical environments may be limited by the study's single-center scope and retrospective nature. Another significant limitation was the lack of BMI data for the entire cohort; measurements were available for only 156 of 906 patients, which likely reduced the statistical power to detect a significant association between obesity and disease severity. Furthermore, the study population consisted almost entirely of T2DM patients, limiting the representation of T1DM dynamics.

Conclusion

This study, involving a large cohort of Turkish patients, has confirmed that diabetes remains a critical determinant of COVID-19 severity, specifically driving the need for ICU admission, oxygen therapy, and glucocorticoid therapy. While BMI did not emerge as a predictor in our patient population, the clinical impact of hyperglycemia-induced inflammation and new-onset vascular complications underscores the need for vigilant long-term management of diabetic patients who have recovered from COVID-19.

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Conflicts of interest

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Authors' contributions

S.Y. designed the study. G.G.S., M.C.U., B.D.Y., M.Ç., C.T., Ö.A., O.Ö.K., G.Ö.Ş., M.M.B., and N.Ö. collected the patients' data. M.E.A. performed the statistical analyses. The first draft of the manuscript was written by Gökçen Güngör Semiz. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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References

1. Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, et al. Genomic characterization and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. The Lancet 2020;395(10224):565–74.
2. CDC COVID-19 Response Team. Severe outcomes among patients with Coronavirus disease 2019 (COVID-19) - United States, February 12-March 16, 2020. MMWR Morb Mortal Wkly Rep. 2020;69(12):343-346.
3. Landi F, Barillaro C, Bellieni A, Carfi A, D'Angelo M, Fusco D, et al. The new challenge of geriatrics: Saving frail older people from the SARS-COV-2 pandemic infection. J Nutr Health Aging. 2020;24(5):466-470.
4. McMichael TM, Currie DW, Clark S, Pogosjans S, Kay M, Schwartz NG, et al. Epidemiology of COVID-19 in a long-term care facility in King County, Washington. N Engl J Med. 2020;382(21):2005-2011.
5. Centers for Disease Control and Prevention. [updated Oct 14, 2021; Cited 2021 Dec 11]. Available at: https ://www.cdc .gov/ coronavirus/2019- ncov/hcp /clinical-care/ underlying conditions .html
6. Centers for Disease Control and Prevention. [updated Oct 14, 2021; cited 2021 December]. Available at: https ://ww w.cdc .gov/ coronavirus/2019- ncov/science/ science-briefs/ under lying -evidence- table .html
7. Permata AD, Murti B, Tamtomo DG. Hypertension, gender, older age, and their relationships with COVID-19 mortality: Meta-analysis. J Epidemiol Public Health 2021;06(01):98-111.
8. Abdi A, Jalilian M, Sarbarzeh PA, Vlaisavljevic Z. Diabetes and COVID-19: A systematic review on the current evidences. Diabetes Res Clin Pract. 2020 Aug;166:108347.
9. International Diabetes Federation. IDF Diabetes Atlas. 10th ed. Brussels, Belgium: International Diabetes Federation; 2021. Available from: https://idf.org/news-and-resources/resources/idf-diabetes-atlas-2021 [accessed February 15, 2022].
10. Turkish Society of Endocrinology and Metabolism. Diabetes mellitus ve komplikasyonlarının tanı, tedavi ve ˙izlem kılavuzu [Guidelines for the diagnosis, treatment, and follow-up of diabetes mellitus and its complications], 14th ed.; Turkish Society of Endocrinology and Metabolism: Ankara, Turkey, 2020. Available online: http://www.temd.org.tr (accessed on 30 June 2020).
11. Kumar A, Arora A, Sharma P, Anikhindi SA, Bansal N, Singla V, et al. Is diabetes mellitus associated with mortality and severity of COVID-19? A meta-analysis. Diabetes Metab Syndr. 2020 Jul-Aug;14(4):535-545.
12. Khairy Y, Naghibi D, Moosavi A, Sardareh M, Azami-Aghdash S. Prevalence of hypertension and associated risks in hospitalized patients with COVID-19: a meta-analysis of meta-analyses with 1468 studies and 1,281,510 patients. Syst Rev. 2022 Nov 17;11(1):242.
13. Scheen AJ, Marre M, Thivolet C. Prognostic factors in patients with diabetes hospitalized for COVID-19: Findings from the CORONADO study and other recent reports. Diabetes Metab. 2020 Sep;46(4):265-271.
14. Goyal P, Choi JJ, Pinheiro LC, Schenck EJ, Chen R, Jabri A, et al. Clinical characteristics of Covid-19 in New York City. N Engl J Med. 2020 Jun 11;382(24):2372-2374.
15. Kaminska H, Szarpak L, Kosior D, Wieczorek W, Szarpak A, Al-Jeabory M, et al. Impact of diabetes mellitus on in-hospital mortality in adult patients

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with COVID-19: a systematic review and meta-analysis. Acta Diabetol. 2021 Aug;58(8):1101-1110.

16. Li J, Wang X, Chen J, Zuo X, Zhang H, Deng A. COVID-19 infection may cause ketosis and ketoacidosis. Diabetes Obes Metab 2020; 22(10):1935-1941.
17. Albulescu R, Dima SO, Florea IR, Lixandru D, Serban AM, Aspritoiu VM, et al. COVID-19 and diabetes mellitus: Unraveling the hypotheses that worsen the prognosis (Review). Exp Ther Med. 2020 Dec;20(6):194
18. Fatoke B, Hui AL, Saqib M, Vashisth M, Aremu SO, Aremu DO, et al. Type 2 diabetes mellitus as a predictor of severe outcomes in COVID-19 - a systematic review and meta-analyses. BMC Infect Dis. 2025 May 19;25(1):719.
19. Sonmez A, Demirci I, Haymana C, Tasci I, Dagdelen S, Salman S,et al. Clinical characteristics and outcomes of COVID-19 in patients with type 2 diabetes in Turkey: A nationwide study (TurCoviDia). J Diabetes. 2021 Jul;13(7):585-595.