

COVID-19 infection mortality risk in Iranian patients with type 2 diabetes, hypertension and obesity

Mahdi Shadnough,¹ Soghra Rabizadeh,² Alireza Esteghamati,² Manouchehr Nakhjavani,² Nasrin Baiat Paridari,³ Mostafa Khoshabi,⁴ Armin Rajab² and Fatemeh Ghaemi⁵

¹Department of Clinical Nutrition, Faculty of Nutrition and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Islamic Republic of Iran ²Endocrinology and Metabolism Research Center, Vali-Asr Hospital, Tehran University of Medical Sciences, Tehran, Islamic Republic of Iran.

³Non-Communicable Disease Treatment Group, Ministry of Health and Medical Education, Tehran, Islamic Republic of Iran. ⁴Department of Geospatial Information Systems, Center of Excellence in GIS, K.N. Toosi University of Technology, Tehran, Islamic Republic of Iran. ⁵ Department of Transplantation and Disease Management, Ministry of Health and Medical Education, Tehran, Islamic Republic of Iran (Correspondence to: F. Ghaemi: Ghaemifa77@gmail.com).

Abstract

Background: Diabetes mellitus and hypertension are highly prevalent among patients with severe COVID-19.

Aims: To study the mortality risk of COVID-19 infection in patients with type 2 diabetes and additive effect of hypertension and obesity in the Iranian population.

Methods: This was a cross-sectional survey of the national COVID-19 registry from the Iranian Ministry of Health. The medical status of 22 002 patients with COVID-19 between 1 March and 30 April 2020 was analysed.

Results: Patients with type 2 diabetes had a higher risk of mortality with an odds ratio (OR) of 1.67 [95% confidence interval (CI): 1.53–1.82, $P < 0.001$]. The risk of mortality was also high in patients with diabetes and hypertension, with an odds ratio of 1.76 (95% CI: 1.56–1.99, $P < 0.001$). The odds ratio of the risk of mortality in patients with diabetes, hypertension and obesity was 1.87 (95% CI: 1.35–2.58, $P < 0.001$).

Conclusion: Type 2 diabetes, hypertension and obesity each predict mortality in Iranian patients with COVID-19, and when they are present together, patients have a greater risk of mortality.

Keywords: COVID-19, diabetes mellitus, hypertension, obesity, mortality, Iran

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Introduction

COVID-19 is a rapidly spreading global pandemic. At the time of writing, there had been > 157 million cases and > 3 274 000 deaths from COVID-19 reported worldwide (1). The Islamic Republic of Iran is known as the hotspot of COVID-19 in the Middle East (2), with around 2 640 000 cases and > 74 000 deaths recorded (1). Diabetes mellitus (DM) is associated with higher mortality risk in hospitalized patients with COVID-19 (3), which was observed in previous coronavirus epidemics, including the Middle East respiratory syndrome (4), and severe acute respiratory syndrome (5). Patients with diabetes have an increased risk of infection. Also, severe COVID-19 might worsen diabetes through direct effects on β -cell function, and could be a precipitating factor for acceleration of acute complications of diabetes (6). Patients with type 2 diabetes mellitus usually suffer from other comorbidities such as obesity and hypertension, which can accentuate the poor prognosis and mortality risk of COVID-19 (7, 8). Furthermore, among patients with severe COVID-19, type 2 DM (T2DM) and hypertension are more prevalent (9).

Although the number of publications about COVID-19 has progressively increased in the Middle East and North Africa (MENA), there is a need for accurate data on the

epidemiology of COVID-19 from all MENA countries (10). In this study, we studied the mortality risk in COVID-19 patients in the Islamic Republic of Iran with comorbid T2DM and the additive effects of hypertension and obesity.

Methods

This was a cross-sectional survey from 1 March to 30 April 2020 of the national COVID-19 registry from the Iranian Ministry of Health, including 22 002 patients with COVID-19 from 58 medical universities located across 31 provinces. The following clinical information was recorded daily from all medical centres: demographics, symptoms, signs, and physical examination on admission, medical and medication history, anthropometrics, laboratory test results (including complete blood count and inflammatory markers), imaging findings, therapeutic interventions, and disease outcomes. Suspicion of diagnosis of COVID-19 was based on clinical signs and symptoms as well as computed tomography, and definite diagnosis was based on a positive reverse transcription polymerase chain reaction (RT-PCR) nasopharyngeal swab test (11).

T2DM was defined according to positive medical history, consumption of antidiabetic medication, or glycated haemoglobin $\geq 6.5\%$ and fasting blood

glucose ≥ 126 mg/dL. Hypertension was defined based on medical history of patients or use of antihypertensive medication. Obesity was defined as body mass index (BMI) ≥ 30 kg/m².

Data were analysed using SPSS for Windows version 24 (Chicago, IL, USA). Logistic regression analysis was performed to show the adjusted effect of T2DM, hypertension and obesity on the mortality risk of COVID-19. Hence, sex, age, BMI, smoking, and comorbidities were included in the model.

The study was performed in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Results

There were 22 002 patients with suspicious diagnoses of COVID-19, and 17 476 (79.4%) had definite diagnoses with positive RT-PCR nasopharyngeal swab test results. The mean age was 51.8 (21.1) years and 41.7% were female (Table 1). Among patients with positive RT-PCR tests, 7713 (44.1%) had T2DM: 3016 (39.1%) female and 4697 (60.9%) male (Table 2), and 6060 (34.7%) had a history of hypertension (Table 1). Among patients with T2DM, 4167 (54%) had a history of hypertension and 5370 (69.6%) were overweight or obese (Table 2).

Logistic regression analysis showed that patients with T2DM, hypertension or obesity had a significantly higher risk of mortality (Table 3). The risk of mortality was significantly higher in patients with T2DM and hypertension, or T2DM, hypertension and obesity than in patients with any of the conditions alone.

Discussion

The current study shows that Iranian patients with COVID-19 with diabetes or hypertension or both comorbid conditions had a significantly increased risk of mortality. When obesity was added the mortality risk increased. Our results agree with a previous study in the MENA region by Alguwaihes et al. which showed that patients with DM had a significantly higher mortality rate than patients without DM (20.5% vs 12.3%) (12).

Due to the high prevalence of diabetes worldwide, these patients represent a large percentage of the

Table 1 Prevalence of T2DM, hypertension and high BMI among 17 476 patients diagnosed with COVID-19

Characteristics	
Sex	
Female	7281 (41.7%)
Male	10 195 (58.3%)
Age, mean (SD)	51.8 (21.1) years
hypertension	6060 (34.7%)
T2DM	7713 (44.1%)
Obesity (BMI > 30 kg/m²)	1226 (5.6%)
Overweight (25 < BMI < 30 kg/m²)	6816 (39.0%)
Smoking	1933 (8.78%)

Results presented as number (percentage), unless otherwise stated. BMI = body mass index; SD = standard deviation; T2DM = type 2 diabetes mellitus.

Table 2 Characteristics of 7713 patients with type 2 diabetes and COVID-19

Characteristics	
Sex	
Female	3016 (39.1%)
Male	4697 (60.9%)
Age, mean (SD)	62.81 (12.98) years
Hypertension	4167 (54.0%)
Obesity (BMI > 30 kg/m²)	442 (5.7%)
Overweight (25 < BMI < 30 kg/m²)	4928 (63.9%)
Smoking	718 (9.3%)

Results presented as number (percentage), unless otherwise stated. BMI = body mass index; SD = standard deviation.

COVID-19 population. Mantovani et al. in a meta-analysis of 83 studies involving 78 874 patients hospitalized with COVID-19 in 2020 showed that the pooled prevalence of diabetes was 14.34%. Hospitalized patients with diabetes had a 2-fold higher risk of having severe COVID-19 and a 3-fold increased risk of mortality (13). In our study, 35% of all patients with COVID-19 had T2DM. DM and hypertension are 2 of the more prevalent comorbidities among patients with COVID-19 (14). Unfortunately, patients with DM, specifically T2DM, suffer from other comorbidities and the additive effect of those diseases results in severe COVID-19. Khan et al. showed that patients with 2 or more comorbidities such as T2DM and hypertension have a 2.5 times greater risk of worse outcome than patients with 1 or no comorbidities (15).

Prevalence of hypertension was high in the general population. Current knowledge about hypertension and COVID-19 is from observational studies that have shown an association between hypertension and critical illness

Table 3 Results of logistic regression analysis for prediction of mortality in patients with COVID-19

	B	SE	P	OR	95% CI
T2DM	0.513	0.044	< 0.001	1.67	1.53–1.82
HTN	0.345	0.044	< 0.001	1.41	1.29–1.54
Obesity	0.254	0.080	0.001	1.29	1.10–1.51
T2DM+HTN	0.565	0.063	< 0.001	1.76	1.56–1.99
T2DM+HTN+obesity	0.627	0.165	< 0.001	1.87	1.35–2.58

CI = confidence interval; HTN = hypertension; OR = odds ratio; SE = standard error; T2DM = type 2 diabetes mellitus.

in COVID-19 but causality has not been established (16, 17). There is evidence that obesity can increase the severity of COVID-19, and when it coexists with other comorbidities such as diabetes, prognosis is even poorer (18). Moreover, there is a current global pandemic of obesity, which could make COVID-19 more severe (19).

Our study had some limitations. There was a lack of investigation of clinical laboratory factors such as glycaemic control, which can have a significant impact on mortality risk of COVID-19. In some cases, diagnosis of T2DM and hypertension was based on self-report,

and some patients were newly diagnosed based on measurement of blood glucose and HbA1c. Unfortunately, the exact type of diagnosis was not available, and there was no information in the national registry about patients who were newly diagnosed with diabetes.

In conclusion, the current study shows that diabetes, hypertension and obesity each predicts mortality in patients with COVID-19 in the Iranian population, and when they coexist, patients have a greater mortality risk. Further studies are needed to investigate the effects of comorbidities on other adverse effects of COVID-19.

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Risque de mortalité lié à l'infection par la COVID-19 chez les patients iraniens souffrant de diabète de type 2, d'hypertension et d'obésité

Résumé

Contexte: Le diabète sucré et l'hypertension sont très prévalents chez les patients atteints d'une forme grave de COVID-19.

Objectifs: Étudier le risque de mortalité lié à l'infection par la COVID-19 chez les patients atteints de diabète de type 2 et l'effet additif de l'hypertension et de l'obésité dans la population iranienne.

Méthodes: Il s'agissait d'une enquête transversale du registre national de la COVID-19 du ministère iranien de la Santé et de l'Éducation médicale. L'état de santé de 22 002 patients atteints de COVID-19 entre le 1^{er} mars et le 30 avril 2020 a été analysé.

Résultats: Les patients atteints de diabète de type 2 présentaient un risque de mortalité plus élevé avec un odds ratio (OR) de 1,67 [intervalle de confiance (IC) à 95 % : 1,53-1,82, $p < 0,001$]. Le risque de mortalité était également plus élevé chez les patients diabétiques et hypertendus, avec un OR de 1,76 (IC à 95 % : 1,56-1,99, $p < 0,001$). L'odds ratio du risque de mortalité chez les patients diabétiques, hypertendus et obèses était de 1,87 (IC à 95 % : 1,35-2,58, $p < 0,001$).

Conclusion: Le diabète de type 2, l'hypertension et l'obésité permettent respectivement de prédire la mortalité chez les patients iraniens atteints de COVID-19, et lorsqu'ils sont présents ensemble, les patients ont un risque de mortalité plus élevé.

خطر الوفاة الناجمة عن الإصابة بكوفيد-19 لدى المرضى الإيرانيين المصابين بالنمط 2 من السكري وارتفاع ضغط الدم والسمنة

مهدي شدنوش، صغرا ربيع زاده، علي رضا إستغاماتي، منوشهر ناخجواني، نسرین بیات باریداری، مصطفی خشای، آرمن رجب، فاطمة غامي

الخلاصة

الخلفية: ينتشر داء السكري وارتفاع ضغط الدم انتشارًا كبيرًا بين المرضى المصابين بحالة وخيمة من كوفيد-19.

الأهداف: هدفت هذه الدراسة إلى دراسة خطر الوفاة الناجمة عن الإصابة بكوفيد-19 لدى المرضى المصابين بالنمط 2 من السكري، والتأثير الإضافي لارتفاع ضغط الدم والسمنة لدى السكان الإيرانيين.

طرق البحث: أُجري مسح مقطعي للسجل الوطني الخاص بمرض كوفيد-19 في وزارة الصحة الإيرانية. وجرى تحليل الحالة الطبية لعدد 22002 من المرضى المصابين بكوفيد-19 في الفترة بين 1 مارس / آذار و30 أبريل / نيسان 2020.

النتائج: كان المرضى المصابون بالنمط 2 من السكري أكثر عرضة للوفاة بنسبة أرجحية 1.67 [فاصل ثقة 95%: 1.53-1.82، القيمة الاحتمالية > 0.001]. وكان خطر الوفاة أيضًا أعلى لدى مرضى السكري وارتفاع ضغط الدم، بنسبة أرجحية 1.76 (فاصل ثقة 95%: 1.56-1.99،

القيمة الاحتمالية > 0.001). وبلغت نسبة أرجحية خطر الوفاة لدى مرضى السكري وارتفاع ضغط الدم والسمنة 1.87 (فاصل ثقة 0.95-2.58، القيمة الاحتمالية > 0.001).

الاستنتاجات: يُنبئ كلٌّ من النمط 2 من داء السكري وارتفاع ضغط الدم والسمنة بالوفيات لدى المرضى الإيرانيين المصابين بكوفيد-19، وعندما تترافق تلك الأمراض معاً، يزداد خطر وفاة المرضى.

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