LIFE WITH DIABETES IN THE COVID-19 ERA

**Višnja Madić*[1], Aleksandra Petrović[1], Dragana Jugović[2],
Bojana Maksimović[1], Perica Vasiljević[1]**

[1]Department of Biology and Ecology, Faculty of Science and Mathematics,
University of Niš, Serbia

[2]Laboratory for Immunology and Genetics, Center for Medical and Clinical biochemistry,
University Clinical Center Niš, Serbia

Abstract. The outbreak of the COVID-19 pandemic has changed the lives of billions of people, especially those with chronic diseases such as diabetes. The aim of this study was to evaluate the impact of the pandemic on the physical and mental health of diabetics living in the Balkans. The study was conducted as an online survey in April 2023. 129 people participated in the survey. 76 of them were diagnosed with type 1 and 53 with type 2 diabetes. 6.97% of all respondents had a close family member who died from the consequences of SARS-CoV-2 infection, and as many as 77.78% of these decedents suffered from diabetes and/or cardiovascular disease. The majority of the respondents were also infected with SARS-CoV-2. Most of them were diagnosed with diabetes before infection, and SARS-CoV-2-induced diabetes was mainly type 2. Although they regularly took prescribed pharmacotherapy and nutritional supplements, blood glucose was elevated in half of them, while D-dimer levels were elevated mainly in type 2 diabetics. Also, hospitalization during the acute phase was more frequent in type 2 diabetic patients. Most diabetics suffered from sleep disorders ($p < 0.01$), and type 2 diabetics also suffered from nightmares ($p < 0.05$). Consequently, the use of anxiolytics and antidepressants was more frequent in type 2 diabetic patients. Recovery was significantly faster in type 1 diabetics, due to less comorbidities such as hypertension, cardiovascular and liver diseases, which were more common in type 2 patients.

Key words: COVID-19; diabetes; secondary diabetic complications; pharmacotherapy; supplements.

Introduction

With almost 770 million confirmed cases and nearly 7 million directly caused deaths (WHO, 2023), the outbreak of the COVID-19 pandemic has changed the lives of billions of people globally, especially those ones with chronic diseases such as diabetes mellitus, mainly because of the bidirectional relationship between SARS-CoV-2 infection and diabetes (Lima-Martínez et al., 2021).

Namely, like many other viruses, such as cytomegalovirus, Epstein–Barr virus, varicella-zoster, enterovirus, rubeola, Coxsackie B, etc. (Jaeckel et al., 2002), COVID-19 can act as a diabetogenic agent. To wit, through binding to the ACE2 receptors of the pancreatic islet cells it can cause the dysfunction of the β cells, acute hyperglycemia and, finally, diabetes (Liu et al., 2020).

On the other hand, people who previously had diabetes, due to the already decreased immunity, elevated levels of oxidative stress and inflammation (Iacobellis, 2020), as well as risks of ketoacidosis (Vorgučin et al., 2022) had a much higher chance for hospital admission, severe pneumonia, and death than non-diabetics (Yang et al., 2020).

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*Autor za korespondenciju: Višnja Madić, e-mail: visnja.madic@pmf.edu.rs

Additionally, media pressure, anxiety, depression, and less physical activity caused by lockdowns (Vujčić et al., 2021), together with comorbidities such as cardiovascular diseases and hypertension (Zhou et al. 2020; Vosko et al., 2023) contributed to the elevated level of severe outcomes of the SARS-CoV-2 infection.

The aim of this study was to evaluate the impact of the COVID-19 pandemic on the physical and mental health of diabetics living in the Balkans.

Material and methods

This was a cross-sectional survey conducted online with the help of Diabetes Association of Serbia, Diabetes Association of Belgrade, Serbia, Diabetes Association of Niš, Serbia, and Diabetics without borders, Balkans, during April 2023. The research was performed by surveying a total of 129 respondents. The questionnaire was a combination of open and closed question response formats. Questions were divided into four domains related to demographic data (such as gender, age group, place of residence), dietary habits (adherence to the diet prescribed by a physician), dietary supplements usage (a type of supplements and phytotherapy remedies used), pharmacotherapy usage, and medical history (type of diabetes diagnosed, presence of comorbidities, previous infection with SARS-CoV-2). The research was performed by surveying a total of 129 respondents. The data were statistically analyzed and processed using chi-square test of independence in GraphPad Prism 5 (GraphPad Software, La Jolla California USA). Statistical significance was accepted if p was less than 0.05.

Results

The research included 129 people, 104 females and 25 males, of which 70.54% were living in Serbia, 16.28% in Bosnia and Herzegovina, 7.75% in Croatia, 0.78% in Montenegro, while 4.65% of them were people born in the Balkans and leaving abroad. 55.91% of respondents were diagnosed with type 1 and 44.09% with type 2 diabetes. The mean age of participants with type 1 diabetes was 37.72±9.94, and with type 2 diabetes 53.09±11.13 years.

The primary therapy for treating type 1 diabetics was insulin (100%), while only 2.63% of them were treated with metformin and dapagliflozin as well. Type 2 diabetics were mostly treated with metformin (77.35%), insulin (35.84%), dapagliflozin (22.64%), and sulfonylureas (3.77%) (Graph. 1 (a)). Vitamins and minerals were more commonly used by type 1 than by type 2 diabetics as supplementary therapies (50 and 19.73% of DM1 and 37.73 and 9.43% of DM2 respondents, respectively), while the use of herbal remedies was only slightly more frequent within type 2 diabetics (28.3% of DM2 and 23.68% of DM1 respondents, respectively) (Graph. 1 (b)).
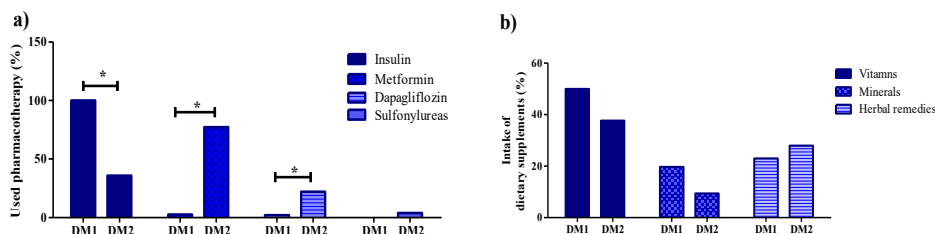
DM1: respondents with type 1 diabetes; DM2: respondents with type 2 diabetes; *$p < 0.05$
Graph. 1. Pharmacotherapy (a) and dietary supplements (b) usage within respondents
***Grafik 1.** Upotreba farmakoterapije (a) i dijetetskih suplemenata (b) među ispitanicima*

Although the majority of both type 1 and type to diabetics had the dietary plan recommended by their physician (75% and 69.81% of DM1 and DM2 patients, respectively) (Graph. 2 (a)), adherence to the dietary plan was more common within type 1 diabetics, while even 43.24% of type 2 diabetics did not follow dietary recommendations (Graph. 2 (b)).
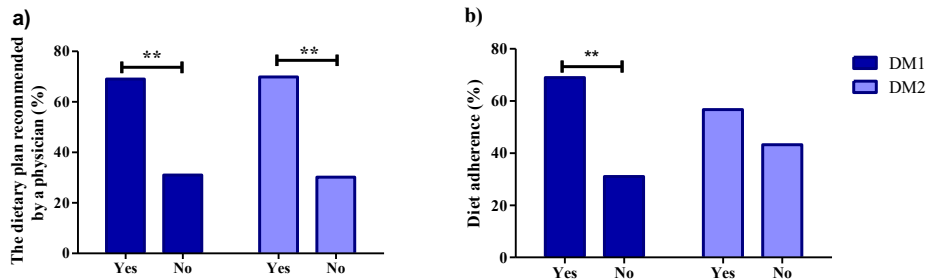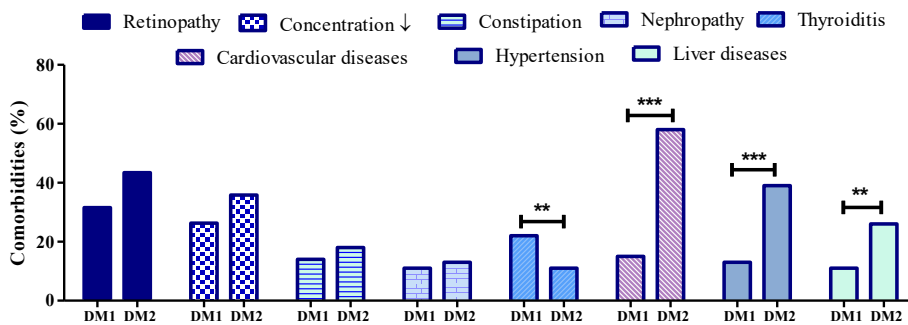

DM1: respondents with type 1 diabetes; DM2: respondents with type 2 diabetes; ** *p*<0.01
Graph. 2. The dietary plan recommended by a physician
***Grafik 2.** Plan ishrane preporučen od strane lekara*

Respondents with type 2 diabetes had a statistically higher incidence of cardiovascular diseases, hypertension, and liver diseases compared to respondents with type 1 diabetes (58.49, 39.62 and 26.41% of DT2, and 15.79, 13.16 and 11.84% of DT1 respondents, respectively), while thyroiditis was more frequents in type 1 diabetics (22.37% of DT1 and 11.32 % of DT2 respondents). Other observed comorbidities, i.e., retinopathy, problems with concentration, neuropathy, and constipation, were of similar frequency in both type 1 and type 2 diabetics (Graph. 3).
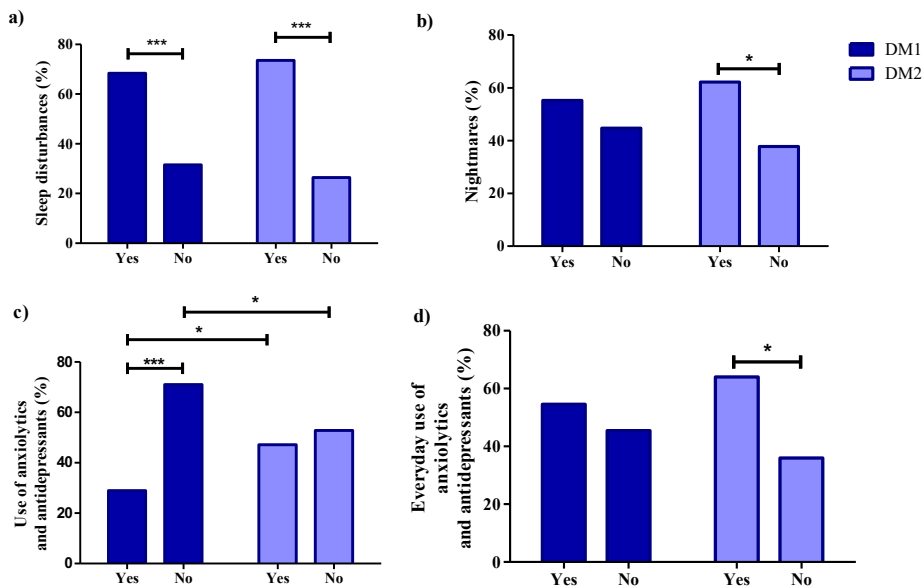

DM1: respondents with type 1 diabetes; DM2: respondents with type 2 diabetes; ** *p* < 0.01, *** *p* < 0.001
Graph. 3. Comorbidities of respondents
***Grafik 3.** Pridružene bolesti ispitanika*

The majority of both type 1 (68.42%) and type 2 diabetics (73.58%) had sleep disturbances (Graph 4 (a)) and of all of these people, even 55.26% of type 1 and 62.26% of type 2 diabetics had nightmares as well (Graph 4 (b)). Although the occasional usage of anxiolytics and antidepressants was more frequent in type 2 diabetics (47.17 and 28.95% of DM2 and DM1, respectively) (Graph 4 (c)), of all the people who use those pharmaceuticals, even 54.54% of type 1 and 64% of type 2 diabetics used them on the everyday basis (Graph 4 (d))
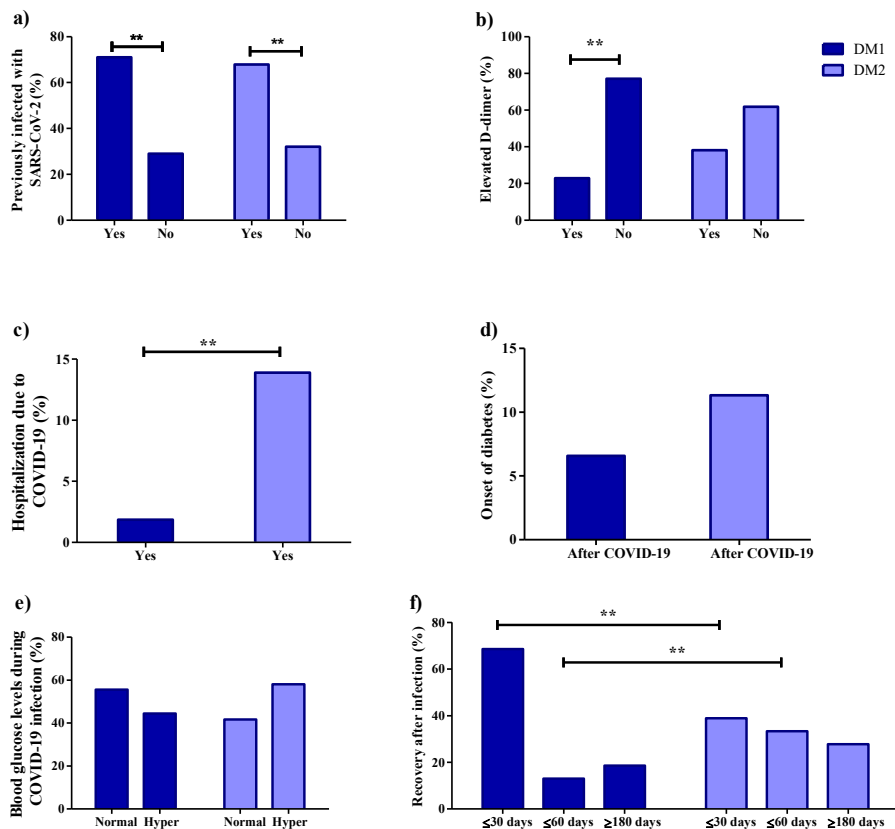
DM1: respondents with type 1 diabetes;
DM2: respondents with type 2 diabetes; * $p < 0.05$, *** $p < 0.001$
Graph. 4. Psychological status of respondents
Grafik 4*. Psihološko stanje ispitanika*

Most of the respondents, i.e., 71.05% of type 1 and 67.92% of type 2 diabetics had been infected with SARS-CoV-2 ($p < 0.01$) (Graph 5 (a)). However, only 6.58% of type 1 and 11.32% of type 2 diabetics developed *diabetes mellitus* as a result of COVID-19 (Graph 5(D)). 22.86% of type 1 and even 38.09% of type 2 diabetes patients had elevated levels of D-dimer (Graph 4. (b)). The blood glucose levels were elevated in 44.44% of respondents with type 1, and 58.33% of those with type 2 diabetes (Graph 5 (e)). Hospitalization due to COVID-19 infection for more frequent in type 2 diabetic patients (13.89% of DM2 and 1.85% of DM1 who were infected) (Graph 5 (c)). Similarly, the recovery was significantly faster in type 1 diabetics ($p < 0.01$). Namely, 68.52% of DM1 fully recovered in less than a month, 12.96% in less than 2 months, while only 38.89% of DM2 patients recovered within 30 days, and 33.33% of them in less than 60 days. However, there were no statistically significant differences in patients who needed more than 3 months to recover (18.52% of DM1 and 27.78% of DM2 respondents) (Graph. 5 (f)). Interestingly, even 6.97% of all respondents had a close family member who died from the consequences of SARS-CoV-2 infection, and as many as 77.78% of these decedents suffered from diabetes and/or cardiovascular disease.

DM1: respondents with type 1 diabetes; DM2: respondents with type 2 diabetes; ** *p* < 0.01
Graph. 5. Effect of COVID-19 on physical health of respondents
Grafik 5. Efekat COVID-19 na fizičko zdravlje ispitanika

Discussion

This study determined the influence of COVID-19 pandemic on the psychological and physical health of diabetics living in the Balkans.

Although the majority of our respondents developed diabetes before the COVID-19, we have noticed that diabetes resulted from this infection was mainly type 2 (Graph. 5 (d)). Interestingly, only 3.77% of the survey respondents with type 2 diabetes are treated with sulfonylureas and 35.84% of them are using insulin injections (Graph. 1 (a)). Having in mind that together with metformin, sulfonylureas are the standard drug for type 2 diabetes in a period where there are still at least some functional pancreatic β cells (Panten et al., 1996), we might conclude that are respondents developed the late-stage type 2 diabetes, or even latent autoimmune diabetes of adults (LADA). These results are similar to the study of Joshi and Pozzilli (2022) who proposed that COVID-19 induced diabetes might be considered as a new form of diabetes where type 2 diabetes is sometimes not even characterized by insulin receptor insensibility, but rather unavailability of insulin caused by β cell damages.

The faster recovery from the infection in type 1 than in type 2 diabetics can be explained by more precautions in terms of dietary habits, more physical activity, younger age, and the presence of fewer comorbidities (Zhou et al. 2020; Vujčić et al., 2021; Vosko et al., 2023).

The sleep deprivation and presence of nightmares that our respondents suffered from (Graph 4 (a, b) can be explained by the blood glucose fluctuations frequent in diabetics, SARS-CoV-2 infection, and most importantly, by elevated anxiety, stress and depression caused by fear of unknown and especially by lockdowns (Huang et al., 2019; Vujčić et al., 2021; Dai at al., 2021). Moreover, having in mind that even 6.97% of all the respondents had a close family member who died from the consequences of SARS-CoV-2 infection, and as many as 77.78% of these decedents suffered from diabetes and/or cardiovascular disease, the high prevalence of people using anxiolytics and antidepressants observed in this study (Graph 4 (c, d)) is not surprising.

However, the fact that 25% of the surveyed people that are diagnosed with type 1, and even 31% of them diagnosed with type 2 diabetes do not have any dietary plan recommended by a physician or dietitian, is surprising. Having in mind that diabetes cannot be treated only with pharmacotherapy but have to be supplemented with proper diet and life-style changes (IDF, 2021), and the fact that the most of our respondents were diagnosed with diabetes before the outbreak of COVID-19, we can notice that the healthcare system has been fractured even before the pandemic.

References

Dai, J., Sang, X., Menhas, R., Xu, X., Khurshid, S., Mahmood, S., ... & Alam, M. N. (2021). The influence of covid-19 pandemic on physical health–psychological health, physical activity, and overall well-being: the mediating role of emotional regulation. Frontiers in Psychology, 12, 667461.

Huang, Y. C., Zuniga, J. A., & Garcia, A. A. (2019). Association between sleep and serious psychological distress in patients with diabetes. Psychology, Health & Medicine, 24(8), 925-935.

Iacobellis, G. (2020). COVID-19 and diabetes: can DPP4 inhibition play a role?. Diabetes research and clinical practice, 162.

International Diabetes Federation. IDF Diabetes Atlas, 10th edn. Brussels, Belgium: International Diabetes Federation, 2021

Jaeckel, E., Manns, M., & Von Herrath, M. (2002). Viruses and diabetes. Annals of the New York Academy of Sciences, 958(1), 7-25.

Joshi, S. C., & Pozzilli, P. (2022). COVID-19 induced Diabetes: A novel presentation. Diabetes Research and Clinical Practice, 110034.

Joshi, S. C., & Pozzilli, P. (2022). COVID-19 induced Diabetes: A novel presentation. Diabetes Research and Clinical Practice, 110034.

Lima-Martínez, M. M., Boada, C. C., Madera-Silva, M. D., Marín, W., & Contreras, M. (2021). COVID-19 and diabetes: A bidirectional relationship. Clínica e Investigación En Arteriosclerosis (English Edition), 33(3), 151-157.

Liu, F., Long, X., Zhang, B., Zhang, W., Chen, X., & Zhang, Z. (2020). ACE2 expression in pancreas may cause pancreatic damage after SARS-CoV-2 infection. Clinical Gastroenterology and Hepatology, 18(9), 2128-2130.

Panten, U., Schwanstecher, M., & Schwanstecher, C. (1996). Sulfonylurea receptors and mechanism of sulfonylurea action. Experimental and clinical endocrinology & diabetes, 104(01), 1-9.

Vorgučin, I., Savin, M., Stanković, Đ., Miljković, D., Ilić, T., Simić, D., ... & Antić, J. (2022). Incidence of Type 1 Diabetes mellitus and characteristics of diabetic ketoacidosis in children and adolescents during the first two years of the COVID-19 pandemic in Vojvodina. Medicina, 58(8), 1013.

Vosko, I., Zirlik, A., & Bugger, H. (2023). Impact of COVID-19 on Cardiovascular Disease. Viruses, 15(2), 508.

Vujčić, I., Safiye, T., Milikić, B., Popović, E., Dubljanin, D., Dubljanin, E., ... & Čabarkapa, M. (2021). Coronavirus disease 2019 (COVID-19) epidemic and mental health status in the general adult population of Serbia: A cross-sectional study. International journal of environmental research and public health, 18(4), 1957.

Vujčić, I., Safiye, T., Milikić, B., Popović, E., Dubljanin, D., Dubljanin, E., ... & Čabarkapa, M. (2021). Coronavirus disease 2019 (COVID-19) epidemic and mental health status in the general adult population of Serbia: A cross-sectional study. International journal of environmental research and public health, 18(4), 1957.

WHO COVID-19 Dashboard. Geneva: World Health Organization, 2023. Available online: https://covid19.who.int/ [08.08.2023]

Yang, X., Yu, Y., Xu, J., Shu, H., Liu, H., Wu, Y., ... & Shang, Y. (2020). Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. The lancet respiratory medicine, 8(5), 475-481.

Zhou, F., Yu, T., Du, R., Fan, G., Liu, Y., Liu, Z., ... & Cao, B. (2020). Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. The lancet, 395(10229), 1054-1062.

ŽIVOT SA DIJABETESOM U DOBA KOVID-19

Višnja Madić, Aleksandra Petrović, Dragana Jugović, Bojana Maksimović, Perica Vasiljević

Apstrakt. Pandemija COVID-19 promenila je živote milijardi ljudi, posebno onih s hroničnim bolestima poput dijabetesa. Cilj ovog istraživanja bio je procena uticaja pandemije na fizičko i mentalno zdravlje dijabetičara koji žive na Balkanu. Ispitivanje je vršeno anketiranjem putem interneta, u aprilu 2023. godine. U ispitivanju je učestvovalo 129 osoba. Njih 76 imalo je dijagostikovan tip 1, a 53 tip 2 dijabetes. 6,97% svih ispitanika imalo je bliskog člana porodice koji je preminuo od posledica infekcije SARS-CoV-2, a čak 77,78% tih smrtnih slučajeva imalo je dijabetes i/ili kardiovaskularne bolesti. Većina ispitanika takođe je bila zaražena SARS-CoV-2 virusom. Većini ispitanika je dijabetes dijagnostikovan pre infekcije, a dijabetes uzrokovan SARS-CoV-2 uglavnom je bio tipa 2. Iako su redovno uzimali propisanu farmakoterapiju i dodatke prehrani, polovina ispitanika je imala povišen nivo šećera u krvi, dok je nivo D-dimera bio povišen uglavnom kod dijabetičara tipa 2. Takođe, hospitalizacija u akutnoj fazi bila je češća kod dijabetičara tipa 2. Većina dijabetičara patila je od poremećaja spavanja (p < 0,01), a dijabetičari tipa 2 takođe su patili i od noćnih mora (p < 0,05). Shodno tome, upotreba anksiolitika i antidepresiva bila je češća kod ljudi sa tipom 2 dijabetesa. Oporavak je bio znatno brži kod dijabetičara tipa 1, zbog manjeg broja propratnih bolesti poput hipertenzije, kardiovaskularnih bolesti i bolesti jetre, koje su bile češće kod pacijenata sa tip 2 dijabetesom.

Ključne reči: KOVID-19; dijabetes; sekundarne komplikacije dijabetesa; farmakoterapija; suplementi.