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Analysis of post-COVID syndrome and preventive strategies in diabetes mellitus

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Аналіз постковідного синдрому та профілактичних стратегій при цукровому діабеті

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Introduction

Diabetes mellitus is a disease with a significant socio-economic impact. Its incidence and prevalence are increasing in Slovakia, as in many other countries. It is a lifelong condition associated with substantial mortality and morbidity. Due to acute and chronic complications, patients not only face increased risks of illness and death, but also a significantly reduced quality of life. A person suffering from a serious illness often becomes unable to fulfill social roles, which may lead to diminished self-esteem and a disrupted self-concept. Feelings of hopelessness and helplessness may become a part of life for those affected. Role changes, stress, financial problems, loneliness, and changes in social habits are burdens the patient must cope with. To manage these, external support is needed – from physicians, social workers, nurses, and most importantly, family members [1]. The Slovak Republic ranks among the countries with a high prevalence of diabetes mellitus (DM). According to data published by the National Health Information Centre (NCZI), the number of patients with type 2 diabetes (DM2) rose from 303,365 to 325,084. Per 100,000 inhabitants, 5,590.2 were diagnosed with DM2 in 2009, compared to 5,981.1 in 2021. In addition, a large proportion of the population remains undiagnosed. A pilot project focused on DM2 screening revealed that up to 16% of patients are undiagnosed [2]. The current diabetes situation is also linked to the impact of post-COVID syndrome. The COVID-19 pandemic has affected the overall health of the population, including an increased rate of complications among people with DM. COVID-19 symptoms may not always be severe and can resolve quickly, but some patients experience long-term effects, referred to as post-COVID syndrome or long COVID. This occurs in people with both severe and mild initial symptoms. According to the National Health Portal, post-COVID syndrome is a multisystem disorder characterized by symptoms persisting for at least 8 to 12 weeks after the initial infection. These can also include permanent consequences, as the virus may cause lasting damage to the lungs, heart, kidneys, liver, or brain. Some theories suggest that viral fragments may remain dormant in the body and reactivate later, as seen with the Herpes simplex virus. Early detection and appropriate treatment of post-COVID syndrome are essential. Treatment includes symptomatic therapy, rehabilitation, breathing exercises, and spa treatment. In terms of prevention and management of post-COVID syndrome complications – especially in individuals with pre-existing metabolic diseases such as diabetes mellitus – micronutrients with immunomodulatory properties play a key role. These include vitamins D, C, A, E, and the B-complex group. Deficiencies in these vitamins are common among diabetics and may contribute to weakened immunity, increased oxidative stress, and prolonged recovery. Vitamin D regulates gene expression in the immune system, and its active form supports the production of antimicrobial peptides such as cathelicidin LL-37, which has antiviral effects, including activity against coronaviruses [3]. Additionally, it reduces inflammatory processes and the risk of cytokine storms [4]. Low vitamin D levels have repeatedly been associated with poorer COVID-19 outcomes, which is why the WHO recommends its supplementation for at-risk groups. Vitamin C, a potent antioxidant, is involved in regulating phagocytosis and apoptosis of immune cells, and its levels are quickly depleted during infection. In patients with severe COVID-19, intravenous vitamin C supplementation has been linked to improved clinical outcomes and shorter hospital stays [5]. Special attention should also be paid to B vitamins – particularly thiamine, pyridoxine, and cobalamin – which contribute to metabolism, neurological protection, and proper immune system function [6]. Vitamin A aids in the regeneration

of the respiratory epithelium, while vitamin E protects cell membranes from oxidative damage, which is especially important when the respiratory and cardiovascular systems are affected [7]. These findings confirm the need to integrate targeted vitamin supplementation into the comprehensive management of patients with diabetes mellitus, particularly during and after COVID-19, as a means to reduce the risk of severe complications and support immune balance. COVID-19 can lead to more severe symptoms, progression, and complications in patients with diabetes mellitus. These patients often suffer from and are treated for additional chronic conditions such as high blood pressure, heart disease, heart failure, kidney disease, open wounds on the legs, and impaired immunity – all of which further increase their risk. Age is also a major risk factor. Elderly diabetic patients with complications are therefore among the most vulnerable groups. It is therefore crucial to minimize this risk through consistent and proactive preventive measures. Despite more than two years of the new and still poorly understood epidemic, the relationship between DM and COVID-19 is not yet fully known. However, the disease clearly has a devastating impact on people with DM, representing a major medical issue today. Diabetics require hospitalization up to three times more often, and 30–40% experience severe disease and increased mortality. Among hospitalized diabetics, 21–43% require intensive care, with a fatality rate around 25%. Hospital mortality is three times higher in patients with type 1 diabetes (DM1) and twice as high in type 2 diabetes (DM2), even after adjusting for comorbidities, compared to non-diabetics [8]. Given this reality, patients with diabetes mellitus may face significant psychological burdens, sometimes manifesting as fatalism – a belief that illness is inevitable. This mindset can lead to psychological resignation and a weakened motivation to actively participate in treatment and adhere to recommended therapeutic regimens [9]. This phenomenon highlights the need for a comprehensive bio-psycho-social approach to diabetic care – one that addresses not only physical health, but also the mental and spiritual needs of patients.

Object, materials and research methods

Data collection was carried out using a special sociological survey method. Respondents were selected for the study intentionally based on a shared characteristic – being diagnosed with diabetes mellitus – as well as the additional criterion of having recovered from COVID-19. A total of 181 diabetic patients who had been hospitalized at the National Institute of Endocrinology and Diabetology in Slovakia participated in the study. Of these, 80 were men (44%) and 101 were women (56%).

The data collected from the questionnaires were processed using Microsoft Excel, where individual questions were evaluated through frequency and contingency tables. To test the research hypotheses, we used statistical tests appropriate to the nature of the variables and the type of data. Hypotheses were tested at a significance level of $\alpha = 0.05$. For Hypotheses 1 and 2, the Mann–Whitney U test was applied. This is a non-parametric alternative to the two-sample Student's t-test and is suitable for comparing differences between two independent groups when dealing with ordinal or non-parametric data. For Hypothesis 3, we used the Kruskal–Wallis H test, which is an extension of the Mann–Whitney test for more than two independent groups. This test is used to determine differences in the distribution of ordinal variables among multiple groups. In Hypothesis 4, to assess the relationship between categorical variables (duration of diabetes mellitus and occurrence of post-COVID syndrome), the Pearson's Chi-square test of independence was used. This test allows us to verify whether there is a statistically significant association between two nominal variables by comparing observed and expected frequencies in a contingency table.

Research results

In the current period, there is a growing emphasis on preventive health strategies, which also include nutritional interventions such as vitamin and mineral supplementation. This trend is particularly evident among individuals with chronic diseases such as diabetes mellitus, which increases vulnerability to infections, including COVID-19. The collected data make it possible to assess the extent to which respondents engage in individual preventive measures in the form of micronutrient intake.

Table 1

Use of vitamins and minerals by respondents during the observed period

	n	%
yes	161	88,95
no	20	11,05
Total	181	100

Table 1 shows that the majority of respondents (n = 161; 88.95%) reported using vitamins and minerals during the observed period, while 11.05% (n = 20) did not. The results indicate a strong interest in preventive micronutrient supplementation, particularly in relation to protecting health during and after COVID-19 infection, with comorbidities such as diabetes mellitus also playing an important role. The high proportion of respondents reporting micronutrient use is also significant from a public health perspective, as it confirms a growing individual interest in supportive preventive strategies based on nutritional interventions.

The analysis presented in Table 2 follows up on the previous finding that the majority of respondents (88.95%) reported taking vitamins or minerals. This question allowed for multiple selections, which is why the total number of recorded responses (n = 577) exceeds the number of respondents (n = 181). For this reason, it is methodologically inappropriate to present the data as percentages; instead, the items are ordered by absolute frequency. The most frequently reported supplements

Table 2

Use of vitamins and minerals

	n	Rank
Vitamin C	152	1.
Vitamin D	127	2.
Zinc	93	3.
Vitamin B1 (thiamine)	40	4.
Vitamin B6 (pyridoxine)	35	5.
Vitamin B12 (cobalamin)	32	6.
Vitamin A	30	7.
Vitamin E	28	8.
None	20	9.
Selenium	15	10.
Other	5	11.
Total	577	

were vitamin C (n = 152), vitamin D (n = 127), and zinc (n = 93), due to their proven immunomodulatory and antioxidant effects, which are particularly relevant in the context of viral infections. Among the B vitamins, the most frequently mentioned was thiamine (vitamin B1; n = 40), followed by pyridoxine (vitamin B6; n = 35) and cobalamin (vitamin B12; n = 32), all of which play important roles in metabolic processes, neurological protection, and immune function regulation. Vitamins A (n = 30) and E (n = 28) were also reported, especially in relation to epithelial regeneration and antioxidant tissue protection. Although selenium (n = 15) has a significant biological role as a cofactor of antioxidant enzymes, it was mentioned less frequently. The "Other" category (n = 5) included less common responses such as colostrum, magnesium, calcium, unspecified B vitamins, magnesium (repeated by respondents), or fruit, which were spontaneously listed as part of their supplemental nutrition. Twenty respondents (n = 20) reported that they did not take any vitamins or minerals during the observed period. The order of items in the table reflects the most commonly reported forms of supplementation in the context of prevention and management of COVID-19 consequences, with special emphasis on individuals with chronic metabolic diseases, particularly diabetes mellitus.

Table 3

Intensity of post-COVID symptoms

	Mean	Rank
Joint/muscle pain	2,2	1
General fatigue	2,1	2
Shortness of breath	1,9	3
Headache	1,4	4
Persistent cough	1,3	5
Dizziness	1,1	6
Chest pressure/pain	1,1	7
Changes in smell/taste	1,0	8
Sleep disturbances	0,9	9
Hair loss	0,6	10
Anxiety, depression	0,4	11
Diarrhea/nausea	0,4	12
Skin problems	0,4	13
Stomach pain	0,3	14

Table 3 presents the presence of post-COVID symptoms among respondents. A total of 62 respondents (51%) reported having or having had post-COVID symptoms, while 59 respondents (49%) reported no post-COVID symptoms. The most commonly reported symptoms were joint/muscle pain, general fatigue, and shortness of breath. The average response for these symptoms was close to 2, indicating a moderate intensity of post-COVID symptoms. Headache, persistent cough, dizziness, chest pressure/pain, changes in smell/taste, sleep disturbances, and hair loss had an average response close to 1, which corresponds to a mild intensity of post-COVID symptoms. Symptoms such as anxiety, depression, diarrhea/nausea, skin problems, and stomach pain were assigned no intensity, as their average response was 0, meaning that respondents did not experience these post-COVID symptoms.

Hypothesis testing

Hypothesis 1: The frequency of post-COVID syndrome occurrence differs between men and women.

Table 4

Relationship between gender and the occurrence of post-COVID syndrome

		Ranks			
	Gender	N	Mean	Mean Rank	Sum of Ranks
post-COVID syndrome occurrence	Men	80	,80	85,93	6874,00
	Women	101	,91	95,02	9597,00
	Total	181			

Test Statistics[a]	
	post-COVID syndrome occurrence
Mann-Whitney U	3634,000
Wilcoxon W	6874,000
Z	-1,265
Asymp. Sig. (2-tailed)	,206
a. Grouping Variable: Gender	

In the results table, we can see that the 80 men experienced post-COVID syndrome on average 0.80 times. In the group of 101 women, the average was slightly higher – 0.91 times. This relationship is also reflected in the mean rank values: the value for the male group is lower than for the female group. However, this difference is relatively small. The calculated p-value of 0.206 confirms that the difference is not statistically significant and is more likely the result of random variation rather than the gender factor. Since the p-value is higher than the significance level of 0.05, the null hypothesis cannot be rejected and must be accepted. We conclude that Hypothesis 1 was not confirmed. The occurrence of post-COVID syndrome is comparable between men and women.

Hypothesis 2: The use of vitamins and minerals is significantly associated with the occurrence of symptoms

This hypothesis aimed to compare the use of vitamins and minerals between the group of patients without post-COVID syndrome and the group of patients with post-COVID symptoms.

Table 5 analyzes the relationship between vitamin use and the occurrence of post-COVID syndrome using the Mann–Whitney U test. The group without symptoms (N = 148) had a higher mean rank (103.11) than the group with symptoms (N = 33, Mean Rank = 77.62), indicating more frequent vitamin use among individuals without the syndrome. The test statistic (U = 2934.5; Z = -3.938; $p < 0.001$) confirms a statistically significant difference between the groups. Patients without post-COVID symptoms reported more frequent use of vitamins, suggesting a potential preventive or mitigating effect of vitamin supplementation. The results support the hypothesis that regular vitamin intake may contribute to better recovery after COVID-19 and reduce the risk of developing post-COVID complications. However, this conclusion requires further research to confirm a causal relationship.

Hypothesis 3: The occurrence of post-COVID syndrome is significantly associated with the age of respondents

In the results tables, we can observe slight differences in the occurrence of post-COVID syndrome across age groups. In the youngest age category (up to 25 years), the average number of post-COVID cases is 0.80. In the older age group (26 to 45 years), the average increases to 0.93. It is even higher (0.98) in the 46 to 58 age group. Finally, in the oldest age category (over 59 years), the average decreases to 0.76. This trend – a rise up to

Table 5

Relationship between vitamin use and the occurrence of post-COVID syndrome

	Ranks				
	post-COVID syndrome occurrence	**N**	**Mean**	**Mean Rank**	**Sum of Ranks**
Vitamin Use	Yes	33	4.14	77,62	6675,50
	No	148	4.67	103,11	9795,50
	Total	181			

Test Statistics[a]	
	Vitamin Use
Mann-Whitney U	2934,500
Wilcoxon W	6675,500
Z	-3,938
Asymp. Sig. (2-tailed)	<,001
a. Grouping Variable: Presence of post-COVID symptoms	

Table 6

Relationship between respondents' age and the occurrence of post-COVID syndrome

	Ranks			
	age groups	**N**	**Mean**	**Mean Rank**
post-COVID syndrome occurrence	18–25 years	10	,80	79,60
	26–45 years	44	,93	95,77
	46–58 years	47	,98	98,54
	59 years and above	80	,76	85,37
	Total	181		

Test Statistics[a,b]	
	post-COVID syndrome occurrence
Kruskal-Wallis H	3,256
Df	3
Asymp. Sig.	,354
a. Kruskal Wallis Test, b. Grouping Variable: Age	

the third age category followed by a drop in the oldest group – is also reflected in the mean rank values. We found that there are some differences in the occurrence of post-COVID syndrome among patients of different ages. However, the p-value of 0.354 indicates that these differences are not statistically significant. This result may be due to the unequal distribution of respondents across age groups and the high variability of symptoms within the groups.

Hypothesis 4: We assume that the duration of diabetes mellitus has a significant impact on the occurrence of post-COVID syndrome.

The table presents a contingency analysis of the frequency of post-COVID symptom occurrence based on the duration of diabetes mellitus. The highest occurrence of post-COVID syndrome was recorded among patients who had diabetes for more than 11 years (8.84%), while patients with a shorter duration of the disease (up to 10 years) and those diagnosed with diabetes in childhood showed a lower prevalence of these symptoms. This difference may be influenced by younger patient age, better metabolic control, regular follow-up care, and higher adherence to treatment regimens. Statistical analysis using the chi-square test ($\chi^2 = 8.84$; df = 2) demonstrated a statistically significant association between the duration of diabetes and the occurrence of post-COVID syndrome ($p = 0.012$). The findings indicate that long-standing diabetes mellitus is a significant risk factor for the development of persistent post-acute symptoms after recovering from COVID-19. The results support the need for targeted prevention, early intervention, and personalized management for this high-risk group of patients.

Discussion of research results

The COVID-19 pandemic brought numerous complex and urgent challenges for healthcare systems, which were particularly evident in the care of chronically ill patients [10]. Within this group, individuals with diabetes mellitus emerged as a particularly vulnerable subgroup. Among chronic diseases, type 2 diabetes mellitus stands out due to its association with increased susceptibility to SARS-CoV-2 infection. These patients not only face a heightened risk of severe acute COVID-19, but are also more prone to long-term complications associated with post-COVID syndrome. This syndrome is characterized by a wide range of persistent symptoms that can last for months after the acute infection, significantly impairing physical performance, metabolic balance, and the overall quality of life of diabetic patients. Our study included 181 diabetic patients who had recovered from COVID-19 and were hospitalized at the National Institute of Endocrinology and Diabetology in Slovakia. Respondents reported their intake of vitamins and minerals, and we monitored the presence or absence of post-COVID symptoms following infection. In our sample, symptoms such as joint and muscle pain, general fatigue, shortness of breath, headache, cough, dizziness, chest pressure, altered sense of smell and taste, sleep disturbances, and hair loss were reported by a portion of respondents. The analysis revealed a statistically significant difference in vitamin and mineral intake between the symptomatic and asymptomatic groups. Respondents who reported no post-COVID symptoms were more likely to have regularly taken vitamin and mineral supplements. These findings suggest a potential preventive or mitigating effect of supplementation, which may help reduce the risk of persistent post-infectious complications. They support the hypothesis that adequate nutritional support may play an important role in the recovery process after COVID-19. However, further research, particularly longitudinal and controlled studies involving larger sample sizes and clearly defined methodologies – is necessary to validate these associations. Such studies could help identify which specific vitamins or minerals provide the most significant protective effects, as well as clarify the optimal dosage and duration of supplementation to prevent long-term health complications following COVID-19. When comparing symptom prevalence between men and women, no statistically significant differences were observed. Although age groups showed slight variations in symptom occurrence, these differences were also not statistically significant. The fourth hypothesis examined the relationship between the duration of diabetes mellitus and the occurrence of post-COVID syndrome. The results confirmed a statistically significant association, respondents with diabetes lasting more than 11 years showed a substantially higher prevalence of post-COVID symptoms compared to those with a shorter disease duration or those diagnosed from birth. This finding highlights the impact of chronic disease duration on the body's ability

Table 7

Relationship between the duration of diabetes mellitus and the occurrence of post-COVID syndrome

Observed frequencies / post-COVID syndrome occurrence	Duration of diagnosed diabetes mellitus						
	from birth	%	up to 10 years	%	11 years or more	%	Total
yes	3	1,66	14	7,74	16	8,84	33
no	1	0,55	69	38,12	78	43,09	148
Total	4		83		94		181
p-value					**0,0120**		
chi-square test (χ^2)					8,842		
df					2		

to cope with infection and its long-term effects. Vansač and Noga (2021) reported that up to 87% of healthcare personnel regularly or occasionally engaged in supportive conversations with patients. During the COVID-19 pandemic, such interactions were crucial in helping patients overcome isolation and psychological distress. Supportive conversation proved to be a valuable strategy in coping with loneliness and fear [11]. Recent research has also focused on potential protective factors, such as vitamin and mineral supplementation. For instance, a meta-analysis by Martineau et al., based on individual data from 25 randomized clinical trials (n = 10,933), demonstrated that vitamin D supplementation significantly reduces the risk of acute respiratory infections, especially in individuals with low vitamin D levels (<25 nmol/L) and with consistent daily or weekly dosing without high bolus administration [12]. Conversely, a meta-analysis by Xu et al. (2024), which included 11 randomized clinical trials in hospitalized COVID-19 patients, found that vitamin C supplementation did not reduce hospital mortality or ICU stay duration [13]. In a controlled study by Mittal et al., patients with type 2 diabetes and post-COVID syndrome frequently reported fatigue [14]. Older women with type 2 diabetes and sarcopenia face more severe declines in functional capacity, such as excessive fatigue and walking difficulties and tend to recover more slowly from COVID-19 compared to other groups [15]. Additionally, SARS-CoV-2 infection can accelerate the onset of sarcopenia, influenced by factors such as prolonged hospitalization, nutrient deficiencies, and steroid treatment [16]. In a study by Mechi et al., up to 88% of diabetic patients reported experiencing at least one persistent post-COVID symptom [17]. The most commonly reported symptoms included neurocognitive dysfunction, neurological issues, shortness of breath, and cardiovascular complications [18]. Furthermore, COVID-19 may exacerbate microvascular dysfunction in diabetic individuals [19]. These results are consistent with research by Liu et al. (2024), who found significant cognitive impairments in patients with type 2 diabetes following COVID-19, particularly in attention, memory, and executive functioning [20]. In this context, two important clinical questions arise: ***Does diabetes increase the risk of developing post-COVID syndrome? Does long-term post-COVID syndrome increase the risk of developing diabetes?*** It is hypothesized that COVID-19 may trigger newly diagnosed diabetes mellitus weeks to months after acute infection, possibly through direct infection of pancreatic beta cells and immune dysregulation [21].

Studies monitoring diabetic patients after COVID-19 have assessed the infection's impact on exacerbating chronic diabetic complications, such as diabetic nephropathy and neuropathy. The findings suggest that individuals with long-term post-COVID symptoms may experience a faster progression of these conditions, highlighting the need for ongoing monitoring, targeted treatment, and anti-inflammatory strategies for this high-risk population. Based on our findings, the following practical recommendations can be proposed:

− Implement targeted screening for post-COVID symptoms in patients with long-standing diabetes to enable early detection of complications.

− Incorporate nutritional counseling and supplementation into standard post-COVID care for diabetic patients, particularly in cases of documented deficiencies.

− Enhance individualized treatment approaches, taking into account the duration of diabetes, functional status, and psychosocial context.

− Establish specialized post-COVID outpatient clinics for patients with chronic conditions, including diabetes.

− Encourage interdisciplinary collaboration among diabetologists, nutritionists, physiotherapists, and psychologists.

− Promote applied research focused on the effectiveness of nutritional interventions and the long-term health outcomes of post-COVID syndrome in diabetic patients.

In conclusion, the pandemic has presented not only a crisis but also a valuable opportunity to rethink the care of vulnerable populations. A diabetic patient who has recovered from COVID-19 should no longer be viewed as merely chronically ill, but rather as a complex case requiring a holistic, multidisciplinary, and evidence-based approach [22]. Preparing healthcare systems for future challenges requires a fundamental shift toward personalized care situated at the intersection of nutrition, chronic illness, and the long-term consequences of COVID-19.

Prospects for further research

Future research should focus on assessing the readiness of healthcare professionals to implement individualized preventive and therapeutic approaches for chronically ill patients after COVID-19. An important objective is to verify the effectiveness of multidisciplinary strategies in the areas of nutritional support, rehabilitation, and psychosocial care, with the aim of mitigating the long-term consequences of post-COVID syndrome.

Conclusions

In clinical practice, post-COVID-19 syndrome presents a challenge not only in terms of diagnosis but also in the treatment and rehabilitation of patients. Persistent symptoms can substantially diminish quality of life for affected individuals and cause long-term health and psychosocial consequences. Due to the diversity of clinical manifestations and the lack of clearly defined therapeutic approaches, a multidisciplinary approach to patient management is essential to optimize health outcomes and reduce the burden of complications. There is a complex interaction of risk factors associated with diabetes mellitus (DM) and increased coronavirus-related mortality. Several biological pathways contribute to this

elevated risk among patients with DM, which may also be involved in various mechanisms of drug interactions in this population. The potential risks include advanced age, cardiovascular disease, obesity, diabetes, hypertension, chronic pulmonary and renal diseases, coagulation disorders, malignancies, and immunosuppressive therapy. Clinical manifestations may include systemic inflammation, myocardial damage (e.g., myocardial infarction, myocarditis), arrhythmias, cardiomyopathy, heart failure, thromboembolic events, and adverse effects from treatments such as immunosuppression or cardiotoxicity.

Given these risks, particularly in patients with chronic diseases it is crucial to rigorously follow hygiene measures. In this context, findings regarding the high environmental stability of SARS-CoV-2, especially on plastic and skin surfaces, underscore the importance of preventive measures in the care of chronically ill patients, including those with diabetes [23]. Summarizing the analysis of post-COVID-19 syndrome, it can be concluded that managing this condition requires a comprehensive and individualized approach, considering the variability of symptoms and their potential long-term impact on patients' health. Patients with diabetes mellitus represent an especially vulnerable group, as they may experience more severe post-COVID-19 symptoms and face greater challenges during recovery. The combination of comorbidities, such as cardiovascular and metabolic disorders, increases the risk of complications and adversely influences the recovery trajectory. Therefore, to effectively address the consequences of the pandemic, the focus must be not only on the virus itself but, more importantly, on the patient as a whole.

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Purpose. The aim of this paper is to analyze the factors contributing to the occurrence of post-COVID syndrome in patients with diabetes mellitus and to highlight the importance of preventive strategies, including nutritional support, in managing the long-term consequences following COVID-19.

Material and methods. The study included 181 patients with diabetes mellitus who had recovered from COVID-19 and were hospitalized in Slovakia. Data were collected using an anonymous questionnaire. Statistical analysis was performed using SPSS software, employing the chi-square test and the non-parametric Mann–Whitney and Kruskal–Wallis tests.

Results. The results showed that the occurrence of post-COVID syndrome was associated with the duration of diabetes – patients with a longer disease duration more frequently reported post-COVID symptoms. The most common symptoms were fatigue, joint and muscle pain, shortness of breath, and sleep disturbances. A significant difference was also found in the use of vitamins and minerals – patients without symptoms more often reported regular supplementation (e.g., vitamins C, D, zinc, B-complex), suggesting a potential protective effect. Neither gender nor age showed a statistically significant impact on the occurrence of symptoms. Although slight differences were observed between age groups, the p-value confirmed they were not significant. This result may be related to the uneven distribution of respondents across age categories and the variability of symptoms.

Conclusions. Post-COVID syndrome in diabetic patients represents a clinically serious issue that requires an individualized and multidisciplinary approach, including targeted prevention and nutritional support.

Key words: long COVID, metabolic comorbidity, micronutrient supplementation, immune system support, chronic disease management, nutritional interventions.

Мета: аналіз чинників виникнення постковідного синдрому у пацієнтів із цукровим діабетом та акцент на важливості профілактичних стратегій, зокрема нутриціальної підтримки, у подоланні довготривалих наслідків після перенесеного COVID-19. Цукровий діабет як хронічне метаболічне захворювання підвищує вразливість пацієнтів до вірусних інфекцій та може ускладнювати перебіг і наслідки COVID-19. Ідентифікація особливостей постковідного синдрому в цієї групи ризику є важливою з погляду профілактики та лікування.

Матеріали та методи. Збір даних проводився методом спеціального соціологічного дослідження. Критерієм відбору респондентів для опитування стала наявність діагнозу цукрового діабету з обов'язковим додатковим критерієм одужання від COVID-19. У дослідженні взяв участь 181 пацієнт із цукровим діабетом, які були госпіталізовані в Національному інституті ендокринології та діабетології Словаччини. Із них 80 були чоловіки (44%) і 101 жінка (56%). Збір даних здійснювався за допомогою анонімної анкети, що охоплювала соціодемографічні характеристики, тривалість перебігу діабету, наявність постковідних симптомів та прийом вітамінно-мінеральних добавок. Статистичну обробку проводили з використанням програми SPSS. Застосовано критерій χ^2, U-критерій Манна – Уїтні та тест Крускала – Валліса. Перевірка гіпотез проводилася на рівні статистичної значущості $\alpha = 0,05$.

Результати. Більшість респондентів (n = 161; 88,95%) повідомила про вживання вітамінів і мінералів протягом спостережуваного періоду, тоді як 11,05% (n = 20) цього не робили. Результати свідчать про значний інтерес до профілактичного прийому мікронутрієнтів, особливо з метою захисту здоров'я під час та після інфікування COVID-19. Наявність симптомів після COVID відзначили 62 опитані респонденти (51%), тоді як 59 респондентів (49%) повідомили про відсутність симптомів після COVID. Найчастіше повідомлялися такі симптоми: біль у суглобах/м'язах, загальна втома та задишка. Середній показник відповідей щодо цих симптомів був близьким до 2, що вказує на помірну інтенсивність симптомів після COVID. Було опрацьовано робочі гіпотези щодо залежності частоти виникнення постковідного синдрому у досліджуваній групі респондентів від віку та статі; вплив регулярного прийому вітамінно-мінеральних комплексів на прояви симптоматики постковідного синдрому та взаємозв'язок тривалості цукрового діабету і виникнення постковідного синдрому.

Дослідження підтвердило статистично значущий зв'язок між тривалістю цукрового діабету та виникненням постковідного синдрому. Пацієнти з довшою тривалістю хвороби частіше повідомляли про стійкі симптоми, такі як утома, біль у суглобах і м'язах, задишка та порушення сну. Стать і вік не виявили істотного впливу на наявність симптомів, хоча між віковими групами спостерігалися незначні відмінності, які, однак, не були статистично значущими, ймовірно, через нерівномірне представлення. У сфері профілактики виявлено, що пацієнти, які регулярно вживали вітаміни C, D, цинк і B-комплекс, мали нижчий рівень постковідних симптомів. Цей факт указує на потенційний захисний ефект зазначених речовин на імунну систему та запальні процеси в організмі, що має практичне значення для профілактики тривалих ускладнень після COVID-19.

Висновки. Серед хронічних захворювань цукровий діабет II типу виділяється через його зв'язок із підвищеною сприйнятливістю до інфекції SARS-CoV-2. Ці пацієнти не лише стикаються з підвищеним ризиком тяжкого гострого перебігу COVID-19, а й більш схильні до довгострокових ускладнень, пов'язаних із синдромом пост-COVID. Дані ускладнення можуть тривати місяцями після гострої інфекції, значно погіршуючи фізичну працездатність, метаболічний баланс та загальну якість життя пацієнтів із діабетом. Тому постковідний синдром у пацієнтів із цукровим діабетом є серйозною клінічною проблемою. Результати дослідження підкреслюють необхідність індивідуалізованої профілактики та цілеспрямованої нутриціальної підтримки у цієї групи ризику. Регулярне застосування вітамінів і мінералів виглядає як потенційно ефективний захід у подоланні

наслідків постковідного синдрому. Отримані дані можуть стати основою для подальших досліджень і впровадження рекомендацій у клінічну практику.

Ключові слова: тривалий COVID, метаболічна коморбідність, суплементація мікронутрієнтів, підтримка імунної системи, менеджмент хронічних захворювань, нутриційні інтервенції.

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