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Effect of Physical Activity Change on Glycemic Control and Complication Rates in <65 Years Patients During the Covid-19 Pandemic Restrictions

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Abstract

The study aimed to determine the effect of physical activity during social distancing/isolation in patients aged <65 years with diabetes on changes in glucose, glycated hemoglobin, diet, and the frequency of complications.

Materials and methods: A retrospective analytical cross-sectional study using a special online survey questionnaire was selected for the research design. A total of 276 physicians participated in the study.

Results and discussion: The results revealed a statistically significant difference between physical activity and other factors. Many patients did not exercise or test for glycemia and glycated hemoglobin; therefore, high glycaemic levels and the frequency of complications in terms of kidneys and lower limbs in this category were statistically significantly higher. In patients who were regularly physically active to one degree or another, these parameters were closer to the target numbers.

Conclusion: The results confirm that physical activity in patients with diabetes positively affects diabetes compensation and reduces complications compared to inactive individuals. High inactivity is likely related to social isolation and distancing during Covid-19.

Keywords: Diabetes, Social isolation/distancing, COVID-19, Glycemia, Physical activity, Complications.

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1. Introduction

1.1 The COVID-19 pandemic, declared by the WHO on March 11, 2020, has significantly impacted the mental and physical health of the world's population (World Health Organization 2020). To prevent the spread of the virus, all countries-imposed restrictions on social distancing, isolation, hygiene, travel, gatherings, and essential services have moved online. The virus has been characterized by wave-like outbreaks due to its rapid spread. After China, Italy was the hardest hit in early 2020. The Georgian government implemented all measures recommended by the WHO from the beginning. The first wave was recorded in Georgia in fall 2020. Adjara was the hardest hit in terms of viral spread. Several diseases have been identified that are associated with a higher risk of death, with diabetes mellitus coming second (NCDC 5th Revision). Diabetes requires ongoing care with multifactorial risk-reduction strategies. According to the American Diabetes Association (ADA), patients with diabetes require support to change their behavioral forts Colberg et al. (2016).

1.2 Regular physical activity has been shown to improve mental health, quality of life, and overall well-being, as well as prevent and treat no communicable diseases (NCDs) like heart disease, stroke, diabetes, and breast and colon cancer (World Health Organization 2018b). During the COVID-19 pandemic, some services have been closed, and most have moved online, significantly reducing physical activity. Studies have mainly been conducted on elderly patients, with little research on the socially and physically active population aged <65.

1.3 According to the IDF, diabetes is now among the top 10 causes of global deaths and a leading cause of stroke, cardiovascular and kidney diseases, blindness, oral diseases, and lower-limb amputation. This places a heavy burden on individuals, families, and economies, particularly in low- and middle-income countries where 79% of people with diabetes live. In the context of the COVID-19 pandemic, people living with diabetes and other non-communicable diseases are at an increased risk of severe disease and death due to disruptions in essential healthcare and the virus itself ". (International Diabetes Federation 2023)

1.4 The study aimed to determine the impact of physical activity changes on glycemic control and complication rates in patients aged <65 with diabetes mellitus (COVID-19 Pandemic Restrictions.

Ethical Compliance: All procedures performed in studies involving human participants were by 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. The Ethics Committee of University No. 451 approved the protocol.

2. Method

A retrospective analytical cross-sectional study using a unique survey questionnaire was selected as the research design. Prepare surveys guided by existing European scales and questionnaire systems adapted to the specific study issue. The questionnaire was transferred to an online

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format using Microsoft Excel. For validity, we used Cronbach's alpha coefficient, which was 0.84, and according to George and Mallery (2003), it was >0.7 valid and acceptable.

Questionnaire survey for physicians, family physicians, and endocrinologists. In Adjara, there were 38 endocrinologists and 159 active family physicians.

During the pandemic, 37 physicians of various specialties were trained to provide medical services in COVID-19 hotels, while 42 physicians were employed in insurance companies; the total number of respondents selected for the survey was 276.

Statistical data analysis was performed using SPSS version 27. Descriptive statistics are presented as mean absolute numbers and percentages. We used $\chi 2$ to analyze such differences in categorical variables and test whether the variables were related. For all statistical significance, p-value <.05 was used as a 95% confidence interval (CI) cut-off point.

Socio-demographic characteristics of the study participants

A total of 276 physicians participated in the study, of=236(85.2%) female and n=41(14.8%) male. 265 agreed to complete the survey questionnaire, while 13 physicians refused. Most of them, 57.0%, work in Batumi/Insurance Company and Family Centers. 17% in the highlands of Ajara, 14.8% in Kobuleti/Chakvi, and 11.2% in Khelvachauri rejoin. 58.8% participants were family doctors, 11.9 % endocrinologists. Most of them, n=147 (53.1%), worked during the pandemic. (Table. 1

Table. 1 Socio-demographic characteristics of the study participants

Gender	Female	236	85,2%
	Male	41	14,8%
Primary employment, please, indicate	Batumi/Insurance Company and Family Center.	158	57,0%
	Highland Ajara	47	17,0%
	Kobuleti/Chakvi	41	14,8%
	Khelvachauri	31	11,2%
How many jobs do you hold?	2 and more	91	32,9%
	one	184	66,4%
	No	2	,7%
Specialty	Family doctor	163	58,8%
	Endrocrinologist	33	11,9%
	Other	81	29,2%
Did you continue to work during isolation?	Yes	267	96,4%
	No	10	3,6%
Where did you work during the pandemic?	Regular workplace/online clinic	147	53,1%
	Only with infected patients	26	9,4%
	Not working	4	1,4%
	Quarantine area/COVID hotel	55	19,9%
	All of them	45	16,2%

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One chapter of the study examined the influence of lifestyle on the quality of glycemic control during isolation and the frequency of complications.
These are the factors discussed in this study (Table. 2)3

Table.2 Questionnaire-survey

Factors		Frequency	%
How often did patients check their blood sugar levels?	Once a week	86	37.72%
	They didn't check it	71	31.14%
	Once a day	38	16.67%
	Several times a day	33	14.47%
Blood sugar level fluctuation while in isolation	Fluctuated within 140 mg - 250 mg	120	53.1%
	Systematically, over 250 mg	52	23.01%
	I did not ask	30	13.27%
	Mainly, it was in the norm, within 90mg-120mg%	19	8.41%
	Periodically, it was low, less than 100mg	5	2.21%
Glycated hemoglobin level of the patients	Did not check	82	39.81%
	07.авг	64	31.07%
	06.июл	28	13.59%
	9 and over	18	8.74%
	08.сен	14	6.8%
The dietary regimen of diabetic patients while in quarantine	Violated every day	75	33.33%
	Did not follow a diet	61	27.11%
	Did not follow, once a week	51	22.67%
	Followed the diet strictly	24	10.67%

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	Violated once a month	14	6.22%
Physical activities of the patients during the COVID-19 pandemic	Lying or sitting all-day	79	35.11%
	Walking two or three times a week	54	24%
	Keeping exercise at home	53	23.56%
	Going outside, walking or running frequently, sometimes dancing	23	10.22%
	Doing housework	14	6.22%
	I did not ask	2	0.89%
Did patients experience the progression of diabetes-related late complications and/or require hospitalization for cardiovascular issues?	Arterial hypertension - crisis	88	39.82%
	Acute myocardial infarction	42	19%
	No	33	14.93%
	Angina attack	32	14.48%
	Heart failure	26	11.76%
Did patients experience the progression of diabetes-related late complications and/or require hospitalization for kidney issues?	No	122	56.22%
	Transfer to dialysis	36	16.59%
	Macroalbuminuria	27	12.44%
	Reduced creatinine clearance	17	7.83%
	Microalbuminuria	15	6.91%
Did patients experience the	Increased pain	77	34.84%
	No	58	26.24%

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progression of diabetes-related late complications and/or require hospitalization for the pathology of lower extremities?	Night cramps	42	19%
	Phlegmon	30	13.57%
	Amputation	14	6.33%

3. Results

According to physicians, 31.4% of patients did not check their blood glucose levels, 37.72% checked it once a week, and only 14.47% it several times a day.

23.01% of patients have high > 250mg% blood glucose levels, and 53.1% have Fluctuated within 140 mg - 250 mg.

39.81% Of the patients did not check glycated hemoglobin levels; 31.07% was- 7-8%, 9 and over, 8.74%; from 8-9% was 6.8%, and only13.59% had Hb1c 6-7 %.

According to the doctors, patients' dietary regimen said that 33.33% violated every day, 27.11% did not follow a diet, and only 10.67% followed the diet strictly.

Most patients were 35.11% lying or sitting all day, walking two or three times a week 24%, 23.56% Kept exercising at home, 10.22% went outside, walking or running frequently, sometimes dancing, and 6.22% did housework.

Progression of diabetes-related late complications and/or requiring hospitalization for cardiovascular issues was celebrated in 39.82% of arterial hypertension - -crises, 19% of acute myocardial infarction in 14.48% of angina attacks, and 11.76% of heart failure.

Progression of diabetes-related late complications and/or requiring hospitalization for kidney issues was celebrated in16.59% needed to transfer to dialysis, macroalbuminuria revealed a 12.44% Reduced creatinine clearance in 7.83% and Microalbuminuria-6.91% accordingly.

Patients experience the progression of diabetes-related late complications and/or require hospitalization for the pathology of lower extremities; increased pain revealed in 34.84%, night cramps in 19%, Phlegmon-13.57%, and Amputation- 6.33%.

We then used Crosstabs and compared the physical activities of the patients during the COVID-19 pandemic with other factors. (Table 3)

Table.3 Crosstabs

		Physical activities of the patients during the COVID-19 pandemic												
		Keeping exercise at home		Walking two or three		Going outside, walking		Doing housework		Lying or sitting all day		I did not ask		
		n	%	n	%	n	%	n	%	n	%	n	%	
How often did patients check their blood glucose levels?	Once a day	16	7.14 %	9	4.02 %	3	1.34 %	3	1.34 %	6	2.68 %	0	0%	$\chi^2(15) = 52.27$, $p = <.001$, Cramér's V = 0.28
	Several times a day	15	6.7%	7	3.13 %	5	2.23 %	0	0%	5	2.23 %	0	0%	
	Once a week	18	8.04 %	24	10.71 %	12	5.36 %	3	1.34 %	28	12.5 %	1	0.45 %	
	They didn't check it	4	1.79 %	14	6.25 %	3	1.34 %	8	3.57 %	39	17.41 %	1	0.45 %	
Blood sugar level fluctuation while in isolation	Fluctuated within 140 mg - 250 mg	39	17.49 %	34	15.25 %	15	6.73 %	5	2.24 %	26	11.66 %	1	0.45 %	$\chi^2(20) = 67.5$, $p = <.001$, Cramér's V = 0.28
	I did not ask	1	0.45 %	4	1.79 %	1	0.45 %	7	3.14 %	13	5.83 %	1	0.45 %	
	Mainly, it was in the norm, within 90mg-120mg%	7	3.14 %	3	1.35 %	3	1.35 %	1	0.45 %	5	2.24 %	0	0%	
	Systematically, over 250 mg	5	2.24 %	12	5.38 %	2	0.9 %	1	0.45 %	32	14.35 %	0	0%	
	Periodically, it was low, less than 100mg	0	0%	1	0.45 %	2	0.9 %	0	0%	2	0.9%	0	0%	
Glycated	6%-7%	1	6.83	4	1.95	6	2.93	1	0.49	3	1.46	0	0%	$\chi^2(2$

hemoglobin level of the patients	8%-9%	1	0.49	7	3.41	1	0.49	0	0%	5	2.44	0	0%	0) = 62.5, p = <.001, Cramér's V =
	7%-8%	1	8.78	1	9.27	9	4.39	1	0.49	1	8.29	0	0%	
	9 and over	2	0.98	5	2.44	1	0.49	0	0%	1	4.88	0	0%	
	Did not check	8	3.9%	1 3	6.34 %	5	2.44 %	1 2	5.85 %	4 1	20%	2	0.98 %	
The dietary regimen of diabetic patients while in quarantine	Did not follow	1	6.7%	1	4.91	5	2.23	5	2.23	2	10.27	1	0.45	$\chi^2(20)$ = 76.48, p = <.001, Cramér's V = 0.29
	Violated every day	1 3	5.8%	1 2	5.36 %	2	0.89 %	2	0.89 %	4 6	20.54 %	0	0%	
	Did not follow, once a week	8	3.57 %	2 0	8.93 %	7	3.13 %	6	2.68 %	1 0	4.46 %	0	0%	
	Followed the diet strictly	1 3	5.8%	5	2.23 %	5	2.23 %	0	0%	0	0%	1	0.45 %	
	Violated once a month	3	1.34 %	6	2.68 %	4	1.79 %	1	0.45 %	0	0%	0	0%	
Did patients experience the progression of diabetes-related late complications and/or require hospitalization for cardiovascular issues?	Arterial hypertension - crisis	2 6	11.82 %	1 9	8.64 %	7	3.18 %	6	2.73 %	2 9	13.18 %	1	0.45 %	$\chi^2(20)$ = 27.52, p = .121, Cramér's V = 0.18
	No	1	4.55	1	4.55	1	0.45	3	1.36	8	3.64	0	0%	
	Angina attack	9	4.09 %	8	3.64 %	4	1.82 %	1	0.45 %	9	4.09 %	1	0.45 %	
	Heart failure	2	0.91 %	3	1.36 %	5	2.27 %	2	0.91 %	1 4	6.36 %	0	0%	
	Acute myocardial infarction	3	1.36 %	1 4	6.36 %	6	2.73 %	2	0.91 %	1 7	7.73 %	0	0%	

Did patients experience the progression of diabetes-related late complications and/or require hospitalization for kidney issues?	No	33	15.28 %	24	11.11 %	12	5.56 %	11	5.09 %	40	18.52 %	1	0.46 %	$\chi^2(20) = 35.09$, $p = .02$, Cramér's V = 0.2
	Transfer to dialysis	3	1.39 %	13	6.02 %	3	1.39 %	1	0.46 %	16	7.41 %	0	0%	
	Macroalbuminuria	2	0.93 %	10	4.63 %	2	0.93 %	1	0.46 %	12	5.56 %	0	0%	
	Reduced creatinine clearance	4	1.85 %	5	2.31 %	5	2.31 %	1	0.46 %	2	0.93 %	0	0%	
	Microalbuminuria	6	2.78 %	2	0.93 %	1	0.46 %	0	0%	5	2.31 %	1	0.46 %	
Did patients experience the progression of diabetes-related late complications and/or require hospitalization for the pathology of lower extremities ?	No	22	10%	9	4.09 %	9	4.09 %	5	2.27 %	13	5.91 %	0	0%	$\chi^2 = 42.29$ $p = .003$, Cramér's V = 0.22
	Night cramps	9	4.09 %	10	4.55 %	3	1.36 %	2	0.91 %	18	8.18 %	0	0%	
	Increased pain	18	8.18 %	21	9.55 %	9	4.09 %	7	3.18 %	19	8.64 %	2	0.91 %	
	Amputation	1	0.45 %	2	0.91 %	0	0%	0	0%	11	5%	0	0%	
	Phlegmon	2	0.91	1	4.55	2	0.91	0	0%	1	7.27	0	0%	

Fiscally active patients who kept exercising at home checked blood glucose levels several times per day in 6.7% and once daily in 7.14 %. Of patients who were Lying or sitting all patients, 17.41% did not check their blood glucose levels. Other patients checked their blood glucose once a week; 10.71% walked two or three times a week, and 5.36% went outside, walking or running frequently, sometimes dancing. There was a statistically significant relationship $\chi^2 = 52.27$, $p = <.001$ (Figure 1).

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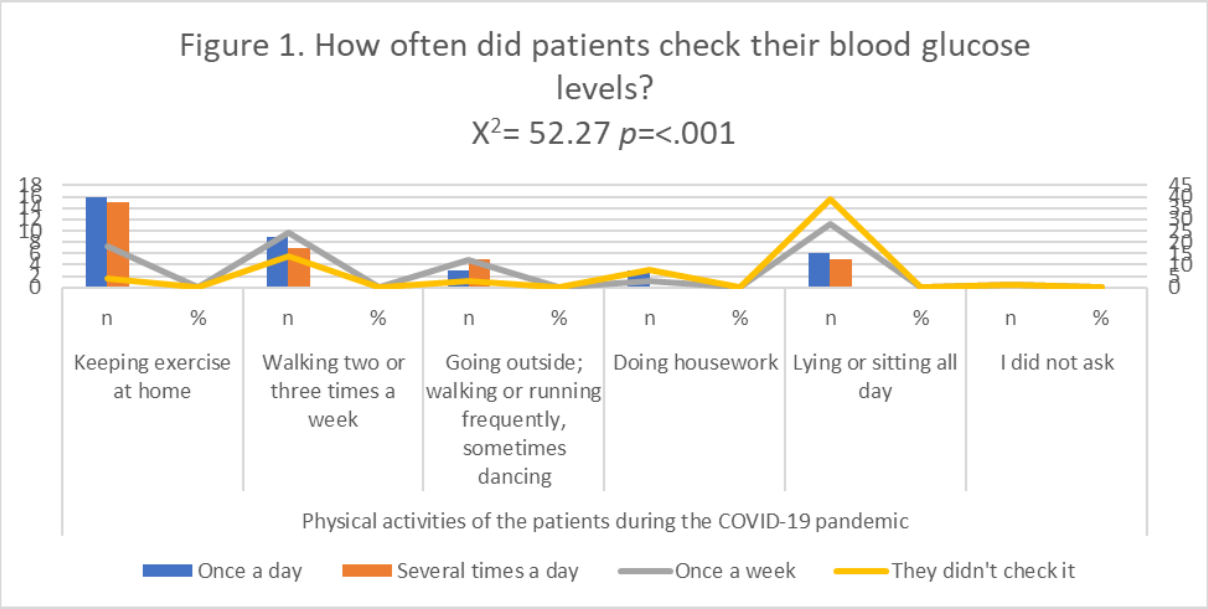
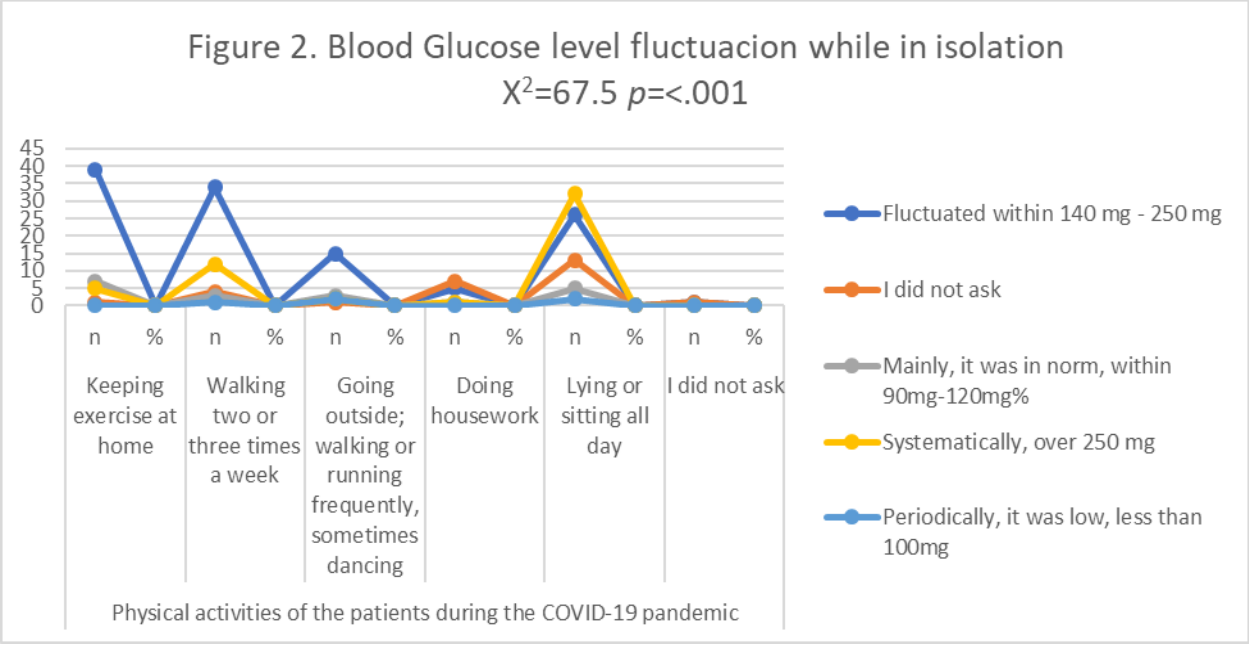


There was an exciting relationship between blood sugar level fluctuation and patients' isolation and physical activities during the COVID-19 pandemic. Patients who Kept exercise at home had 17.49% Fluctuated within 140 mg - 250 mg and 15.25% Walking two or three times a week, Lying or sitting all day11.66%; Systematically, over 250 mg14.35% Lying or sitting all or sitting all day and Walking two or three times a week 5.38% There was a statistically significant relationship χ^2= 67.5, p = <.001, Cramer's V = 0.28 (Figure 2.



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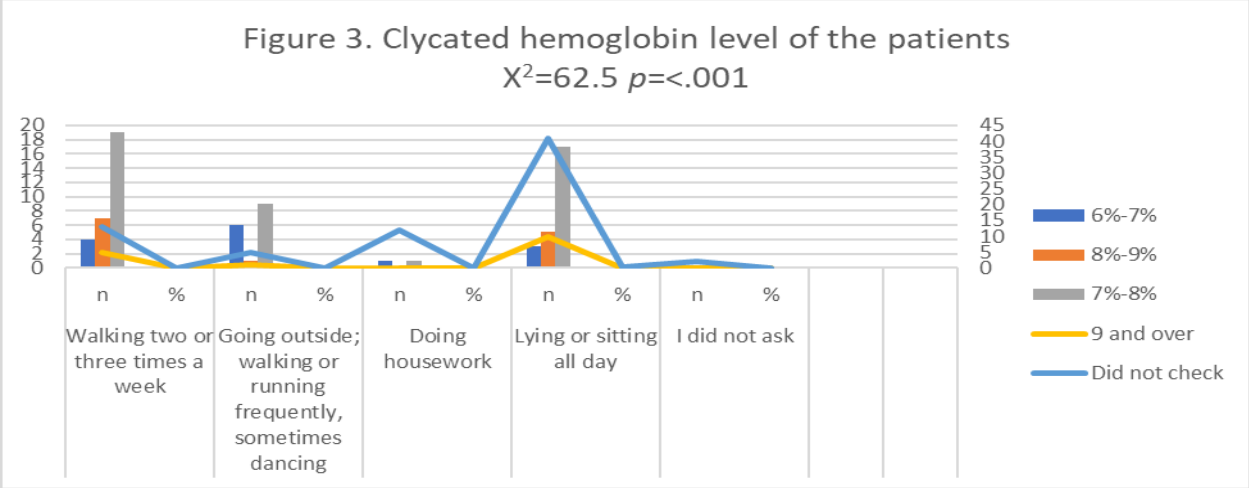
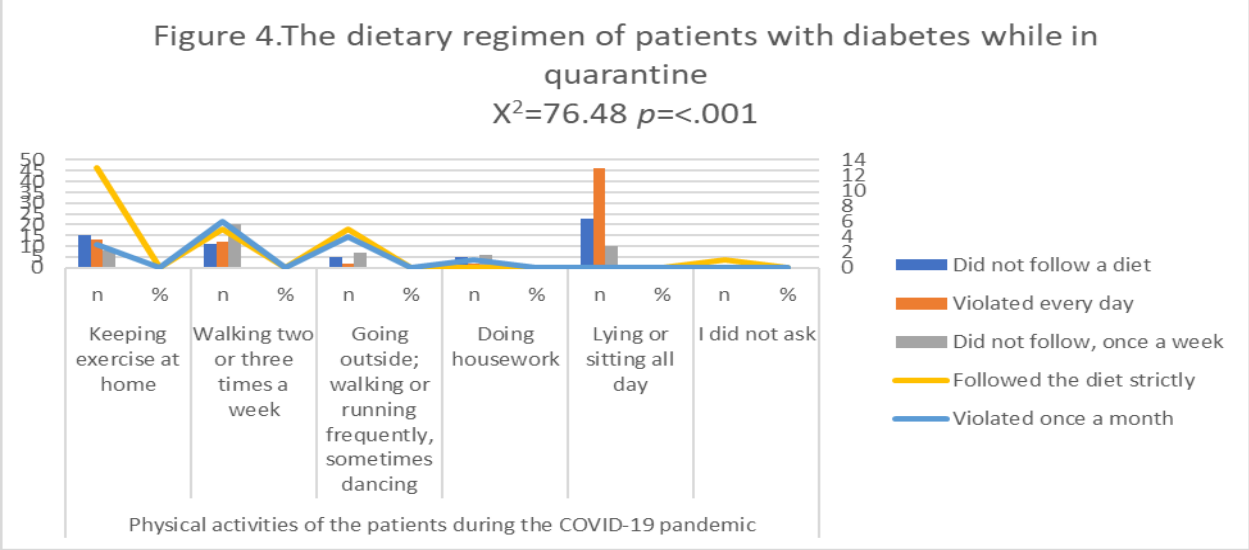
Glycated hemoglobin was not determined in 20% of patients who did not engage in physical activity, and in the same group, in 9% or more, the highest figure was 4.88%. Untested glycated hemoglobin was relatively high - 6.34%) in patients who walk two to three times a week and 5.85% in patients who did housework. Relatively reasonable rates were observed for 6-7% of patients exercising at home, 7-8%, 8.78%, and 9.27% among patients exercising at home and walking thrice a week. There was a statistically significant relationship (χ^2 = 62.5, p <.001, Cramer's V = 0.28 (Figure 3.)



The dietary regimen was violated daily; 20.54% of patients were lying or sitting all day, and 10.27% did not follow a diet. Followed The diet strictly 5.8% Keeping exercise at home. 8.93% of those who walked two or three times a week did not follow the diet once a week. There was a statistically significant relationship (χ^2 = 76.48, p <.001, Cramer's V = 0.29 (Figure 4.)



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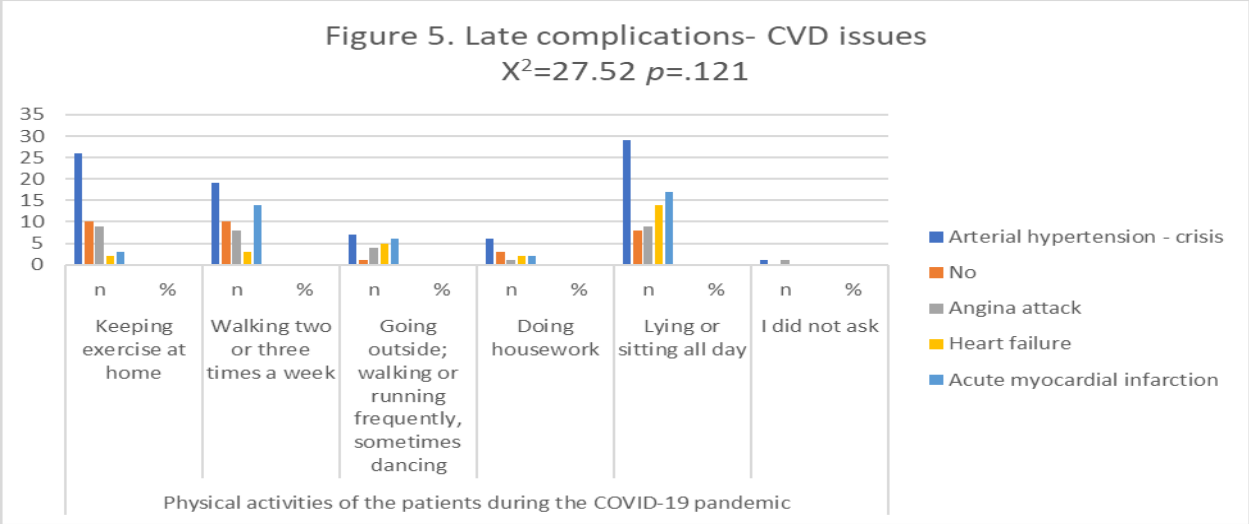
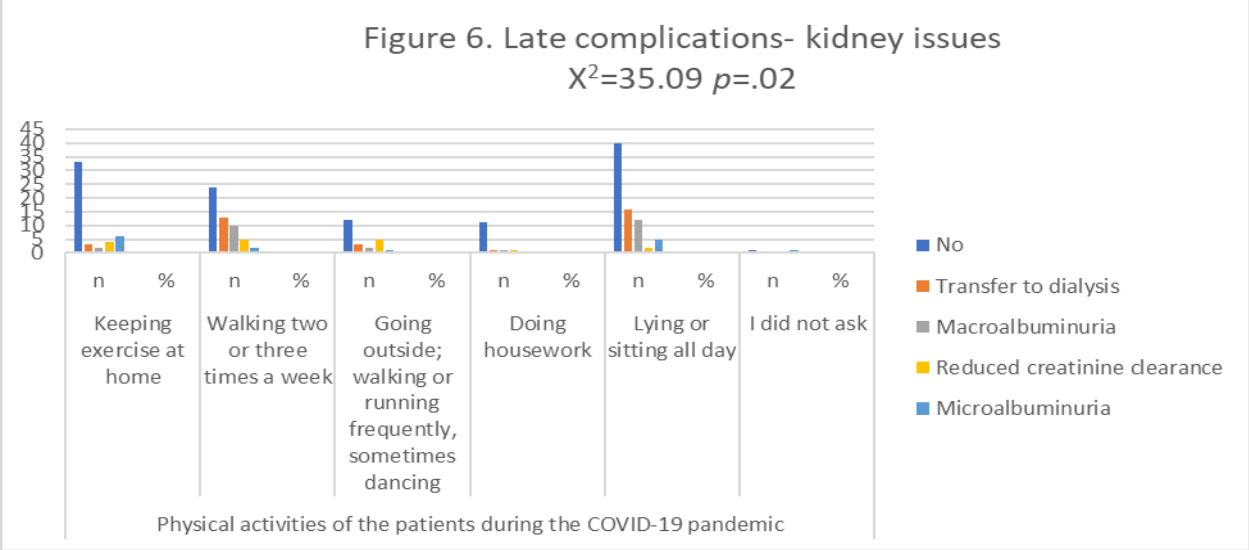
Among the late CVD complications of diabetes mellitus, the arterial hypertensive crisis occurred more often. It accounted for 13.18% of physically inactive patients, 11.82% of those engaged in home exercises, and 8.64% of patients who walked three or two times a week. Myocardial infarction occurred more often in physically inactive patients and amounted to 7.73%). This relationship was not statistically significant ($\chi^2 = 27.52$, $p = 0.121$; Cramer's V = 0.18 (Figure 5.)



In kidney pathology, macroalbuminuria was observed in 5.56% of cases in physically sedentary patients, 7.41% required transfer to dialysis, and in patients walking two to three times a week, high rates of transfer to dialysis also amounted to 6.02%, the decrease in creatinine clearance was greater in 2.31% of patients engaged in housework. A statistically significant relationship ($\chi^2 = 35.09$, $p = 0.02$, Cramer's V = 0.2. (Figure. 6)



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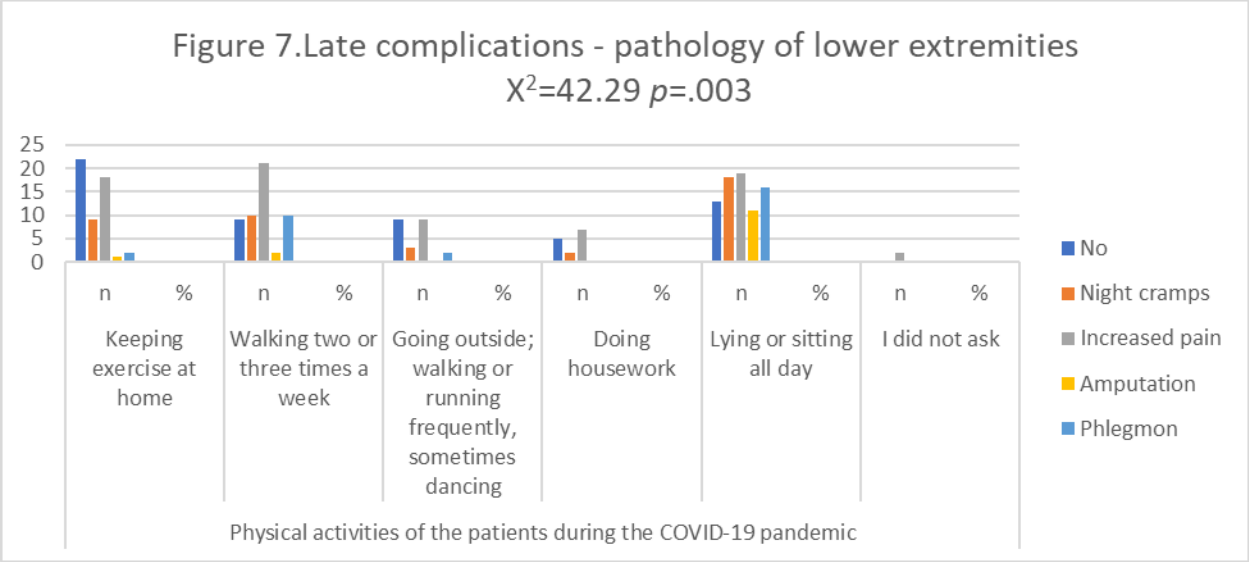
pathology of lower extremities in patients who lying or sitting an all-day amputation was developed in 5%, phlegmon - in 7.27%, and nocturnal cramps in 8.18% compared to other physically active patients. 10% of patients who kept exercising at home had no complications. Only 8.18% had increased pain. Of those walking two or three times a week, 9.55% had increased pain and more developed phlegmon - 4.55%, than other more active patients. There was a statistically significant relationship ($\chi^2 = 42.29$, p = .003, Cramer's V = 0.22 (Figure7.)



4. Discussion

Our study and analysis of the information obtained from the doctor's survey showed that 17.41% of physically inactive patients did not control their glucose levels, 20.54% lay or sat all day, and 10.27% did not follow a diet. Glycated hemoglobin was not determined in 20% of patients who did not engage in physical activity, and in the same group, in 9% or more, the highest figure was 4.88%. Untested glycated hemoglobin is relatively high - 6.34% in patients walking two to three times a week, as well as 5.85% in patients doing housework. The frequency of arterial hypertensive crises is high even in physically active patients, but the incidence of myocardial infarction is statistically significantly higher in physically sedentary patients. Conversion to dialysis and macroalbuminuria were significantly higher in physically inactive patients. In sedentary patients, the incidence of lower-limb amputations and the development of cellulitis are also high. In active patients, the incidence of complications is much lower (Cannata et al., 2020), the control mechanism is preserved, the level of glucose fluctuations is low, and the glycated hemoglobin level is relatively standard. This finding is consistent with the results of studies conducted in other countries. Shawahna et al. (2021) and Eshete et al. (2023)

During the Covid-19 pandemic, diabetes was one of the leading causes of death in infected patients. Therefore, its proper treatment and prevention of complications are very important. In 2022, the ADA and EASD updated the treatment of hyperglycemia in diabetes. Along with the

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study of glycemia and glycosyl hemoglobin, blood pressure, and cholesterol control and using guidelines choosing pharmacology medications is essential, but also crucial nonpharmaceutical prevention, such as diet, physical activity, and sleep quality. (Davis et al., 2022). It is crucial to educate diabetes patients and physicians on self-management skills, focusing on access to health care, nutrition, physical activity, and sleep. Which does not require financial costs on the part of the patient, improves the glycemic profile, and reduces the incidence of complications. (Davis et al., 2022)

Conclusion: The results showed that physical activity during isolation during the COVID-19 pandemic positively influenced glycemia and glycosylated hemoglobin levels and reduced complications. A high rate of inactivity was observed, presumably associated with social isolation and distancing, which are the main predictors of decreased activity. As a global pandemic can still threaten the world, there is a need to raise awareness among patients about adequate glucose control, glycated hemoglobin, diet, and physical activity to reduce the risk of complications.

Recommendations:

1. a vital component of diabetes care is metabolic control, which requires monitoring, as control is inadequate when access to medical services is limited.
2. More awareness of patients about the necessity of physical activity is needed
3. It is possible to implement and finance programs that will be aimed at increasing the motivation of patients
4. If there is still a need for isolation/distancing, the home training system should be promoted with videos or other online platforms.

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References

WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. 2020. Available from: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

World Health Organization. Global action plan on physical activity 2018–2030: more active people for a healthier world [Internet]. 2018a. Available from: https://iris.who.int/handle/10665/272722?&locale-attribute=ru

Cannata F, Vadalà G, Russo F, Papalia R, Napoli N, Pozzilli P. Beneficial effects of physical activity in diabetic patients. Journal of Functional Morphology and Kinesiology [Internet]. 2020 Sep 4;5(3):70. Available from: https://doi.org/10.3390/jfmk5030070

Colberg SR, Sigal RJ, Yardley JE, Riddell MC, Dunstan DW, Dempsey PC, et al. Physical Activity/Exercise and Diabetes: A position statement of the American Diabetes

Association. Diabetes Care [Internet]. 2016a Oct 11;39(11):2065–79. Available from: https://doi.org/10.2337/dc16-1728

Davies MJ, Aroda VR, Collins B, Gabbay RA, Green J, Maruthur NM, et al. Management of Hyperglycemia in Type 2 Diabetes, 2022. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). Diabetes Care [Internet]. 2022 Sep 28;45(11):2753–86. Available from: https://doi.org/10.2337/dci22-0034

Eshete A, Mohammed S, Shine S, Eshetie Y, Assefa Y, Tadesse N. Effect of physical activity promotion program on adherence to physical exercise among patients with type II diabetes in North Shoa Zone Amhara region: a quasi-experimental study. BMC Public Health [Internet]. 2023 Apr 19;23(1). Available from: https://doi.org/10.1186/s12889-023-15642-7

Ghram A, Briki W, Mansoor H, Al-Mohannadi AS, Lavie CJ, Chamari K. Home-based exercise can be beneficial for counteracting sedentary behavior and physical inactivity during the COVID-19 pandemic in older adults. Postgraduate Medicine [Internet]. 2020 Dec 30;133(5):469–80. Available from: https://doi.org/10.1080/00325481.2020.1860394

International Diabetes Federation. IDF and NCDA welcome WHA Resolution on reducing the burden of NCDs through strengthening prevention and control of diabetes - International Diabetes Federation [Internet]. International Diabetes Federation. 2023. Available from: https://idf.org/news/idf-and-ncda-welcome-wha-resolution-on-reducing-the-burden-of-ncds-through-strengthening-prevention-and-control-of-diabetes/

Pardhan S, Islam MdS, Sánchez GFL, Upadhyaya T, Sapkota R. Self-isolation negatively impacts self-management of diabetes during the coronavirus (COVID-19) pandemic. Diabetology & Metabolic Syndrome [Internet]. 2021 Oct 29;13(1). Available from: https://doi.org/10.1186/s13098-021-00734-4

Ruissen MM, Regeer H, Landstra CP, Schroijen MA, Jazet IM, Nijhoff MF, et al. Increased stress, weight gain and less exercise in relation to glycemic control in people with type 1 and type 2 diabetes during the COVID-19 pandemic. BMJ Open Diabetes Research & Care [Internet]. 2021 Jan 1;9(1):e002035. Available from: https://doi.org/10.1136/bmjdrc-2020-002035

Shawahna R, Batta A, Asa'ad M, Jomaah M, Abdelhaq I. Exercise as a complementary medicine intervention in type 2 diabetes mellitus: A systematic review with narrative and qualitative synthesis of evidence. Diabetes & Metabolic Syndrome: Clinical Research and Reviews [Internet]. 2021 Jan 1;15(1):273–86. Available from: https://doi.org/10.1016/j.dsx.2021.01.008

Wafa IA, Pratama NR, Sofia NF, Anastasia ES, Konstantin T, Wijaya MA, et al. Impact of COVID-19 Lockdown on the Metabolic Control Parameters in Patients with Diabetes Mellitus: A Systematic Review and Meta-Analysis. Diabetes & Metabolism Journal [Internet]. 2022 Mar 31;46(2):260–72. Available from: https://doi.org/10.4093/dmj.2021.0125