Community Research

A cross-sectional study on the telemedicine usage and glycemic status of diabetic patients during the COVID-19 pandemic

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ABSTRACT

BACKGROUND The coronavirus disease 2019 (COVID-19) pandemic disrupts self-management in diabetic patients in Indonesia. This study aimed to determine the telemedicine usage and factors contributing to glycemic control in type 2 diabetes mellitus (T2DM) patients during the pandemic.

METHODS A cross-sectional study was conducted in T2DM patients aged 25–54 years. The questionnaire included general characteristics, diabetes conditions, consultation factors, and self-care management. Glycemic status was evaluated using glycated hemoglobin (HbA1c) levels, which was categorized into poor (HbA1c≥7%) and good glycemic control (HbA1c<7%). Data were analyzed using chi-square and binary logistic regression.

RESULTS Of 264 patients, only 19.2% used telemedicine and 60.2% had poor glycemic control during the pandemic. Overweight or obesity (odds ratio [OR] = 5.740 [95% confidence interval [CI] = 2.554–12.899]; $p<0.001$), insulin injection (OR = 3.083 [95% CI = 1.238–7.677]; $p = 0.016$), and frequent fried food consumption (OR = 5.204 [95% CI = 1.631–16.606]; $p = 0.005$) were the factors contributing to poor glycemic control. The risk is lower if exercised regularly (OR = 0.036 [95% CI = 0.007–0.195]; $p<0.001$) and consulted with a doctor using telemedicine (OR = 0.193 [95% CI = 0.044–0.846]; $p = 0.029$) or in-person visits (OR = 0.065 [95% CI = 0.016–0.260]; $p<0.001$).

CONCLUSIONS Glycemic control was not optimal during the COVID-19 pandemic. Therefore, keeping a healthy lifestyle and staying connected with a doctor are important to ensure optimal blood glucose control and reduce the risk of diabetes-related complications.

KEYWORDS COVID-19, diabetes mellitus, glycemic control, Indonesia, telemedicine

As Indonesia reported its first coronavirus disease 2019 (COVID-19) case, the large-scale social restrictions were urgently implemented on April 10, 2020 to curb the spread of COVID-19. The regulation involves mobility restrictions, especially for people with comorbidity such as diabetes that was reported as the highest underlying cause of COVID-19 mortality in Indonesia.[1] Furthermore, these extended restrictions disrupt self-management and affect glycemic control in diabetic patients.

The COVID-19 pandemic has been severely disrupted the self-management in diabetic patients.[2–7] Although hospitals are open, telemedicine is the suggested healthcare service during the pandemic. Kshanti et al[3] found that many diabetic patients in Indonesia experienced difficulties managing their

condition (e.g., attending diabetes consultation, accessing diabetes medication, controlling diet, checking blood glucose, and performing regular exercise). However, a proactive self-care of glycemic control is required to prevent diabetes-related complications and infection risks. It includes regular eating (at least 2–3 times a day), 30-min of daily exercise, medication adherence, and routine blood glucose testing.[8,9] During the pandemic, telemedicine is the suggested medical care service unless for an emergency. The recommendation is given to protect people from COVID-19 transmission.[10]

Numerous international studies have evaluated glycemic control among diabetic patients during the COVID-19 pandemic.[4,11–13] However, there are limited studies assessed in Indonesia. Thus, this study aimed to identify the telemedicine usage and factors contributing to glycemic control in type 2 diabetes mellitus (T2DM) patients during the COVID-19 pandemic in Jakarta, Indonesia.

METHODS

This was a cross-sectional study conducted from March 1–31, 2021. A total of 264 participants were included using convenience sampling with criteria: aged 25–54 years old, had T2DM at least 3 months, lived in Jakarta, checked for glycated hemoglobin (HbA1c), and was not infected with COVID-19. Pregnant women, history of medical hospitalization, and psychiatric disorders were excluded. This study was approved by the Health Research Ethics Committee, Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta, Indonesia (No.052/PE/KE/FKK-UMJ/II/2021).

An invitation link was given to the potential participants who met inclusion criteria via WhatsApp (WhatsApp Inc., USA). After obtaining informed consent, a self-constructed questionnaire consisted of 53 questions about general characteristics, diabetes conditions, self-care management, and HbA1c level was given in Indonesian. The questionnaire passed the validity and reliability tests with an index of item-objective congruence of 0.8 and a Cronbach's alpha score of 0.7, respectively. The variables included age, gender, education level, employment status, income level, marital status, body mass index (BMI), diabetes duration, medication type, comorbidity, smoking status, telemedicine experience, meal plan, frequent food consumed, medication compliance, regular exercise, self-monitoring blood glucose, and doctor consultation. HbA1c level was self-reported by the participants from their latest laboratory results between June 2020 and March 2021. Telemedicine was defined as mobile health applications (m-Health) or other platforms (e.g., WhatsApp) usage to consult with a doctor during the COVID-19 pandemic. Income before and after the pandemic was asked. BMI was calculated using the data given by the subjects in the questionnaire and was classified using the World Health Organization criteria.[14] Subjects were asked about their comorbidity by choosing hyperlipidemia, hypertension, thyroid problems, chronic lung problems, chronic kidney disease, coronary artery disease, or others. Subjects were also asked whether they followed a meal plan, and those without a meal plan were classified as never following a meal plan. Frequently consumed meals, during the pandemic were asked whether it was fried, grilled, steamed, baked, or boiled foods. Medication adherence was assessed based on whether the subjects followed diabetes medication and how many times the patients forgot to take medicine within 12 months.

Data were analyzed using SPSS software version 22.0 (IBM Corp., USA) (licensed by Chulalongkorn University, Thailand). Frequencies (n) and percentages (%) were presented for categorical variables, and continuous variables were computed using the mean, median, and standard deviation. For analysis purposes,

Table 1. Telemedicine usage during the coronavirus disease 2019 (COVID-19) pandemic

Characteristics	n (%) (N = 52)
Telemedicine platform	
Health apps	24 (46)
Non-health apps (e.g., WhatsApp)	28 (54)
Communication type	
Text	32 (61)
Phone call	2 (4)
Video call	18 (35)
Frequency of consultation	
<6 times	38 (73)
≥6 times	14 (27)
Duration of consultation	
<10 min	16 (31)
10–15 min	10 (19)
≥15 min	26 (50)

Table 2. Association of all variables and glycemic status

Characteristics	Glycemic status (N = 264)		Bivariate analysis	Multivariate analysis	
	Good, n (%) (N = 105)	Poor, n (%) (N = 159)	*p*	OR (95% CI)	*p*
Age (<50 years)	54 (41.9)	75 (58.1)	0.498	-	-
Sex (female)	42 (29.8)	99 (70.2)	**<0.001***	1.553 (0.698–3.457)	0.281
Education level			0.083		
Below senior high school	48 (34.8)	90 (65.2)		1.00	-
Bachelor's degree or higher	57 (45.2)	69 (54.8)		0.198 (0.078–0.503)	**0.001**
Employment status (employed)	67 (40.6)	98 (59.4)	0.721	-	-
Income level			**0.043***		
No change	90 (42.9)	120 (57.1)		1.00	-
Decreased	15 (27.8)	39 (72.2)		2.583 (0.987–6.762)	0.053
Marital status (married)	95 (40.6)	139 (59.4)	0.444	-	-
BMI			**<0.001***		
Underweight or normal	57 (58.8)	40 (41.2)		1.00	
Overweight or obese	48 (28.7)	119 (71.3)		5.740 (2.554–12.899)	**<0.001**
Diabetes duration			0.750		
<5 years	43 (41.0)	62 (59.0)		-	-
≥5 years	62 (23.5)	97 (76.5)		-	-
Medication type			**<0.001***		
Oral medicine	85 (46.4)	98 (53.6)		1.00	-
Others (insulin or combination)	20 (24.7)	61 (75.3)		3.083 (1.238–7.677)	**0.016**
Comorbidity	14 (41.2)	20 (58.8)	0.858	-	-
Smoking	9 (24.3)	28 (75.7)	**0.038***	2.513 (0.723–8.740)	**0.001**
Used telemedicine			**0.009***		
Never	77 (36.0)	137 (64.0)		1.00	-
Ever	28 (56.0)	22 (44.0)		0.372 (0.139–0.995)	**0.049**
Followed a meal plan			**0.003***		
Never	51 (39.5)	78 (60.5)		1.00	-
Sometimes	30 (30.9)	67 (69.1)		1.660 (0.669–41.18)	0.275
Always	24 (63.2)	14 (36.8)		0.568 (0.189–1.710)	0.314
Consumed fried foods	25 (56.8)	19 (43.2)	**0.011***	5.204 (1.631–16.606)	**0.005**
Poor medication compliance	13 (52.0)	12 (48.0)	0.189	2.696 (0.660–11.008)	0.167
Exercise			**<0.001***		
≤30 min/day	76 (32.6)	157 (67.4)		1.00	-
>30 min/day	29 (93.5)	2 (6.5)		0.036 (0.007–0.195)	**<0.001**
Exercised ≥2 times/week	87 (45.8)	103 (54.2)	**0.001***	0.568 (0.240–1.344)	0.198
Had SMBG	43 (38.4)	69 (61.6)	0.694	-	-
Consultation during COVID-19			**<0.001***		
Never	4 (6.2)	60 (93.8)		1.00	-
Telemedicine	28 (53.8)	24 (46.2)		0.193 (0.044–0.846)	**0.029**
In-person visit only	73 (49.3)	75 (50.7)		0.065 (0.016–0.260)	**<0.001**

BMI=body mass index; CI=confidence interval; COVID-19=coronavirus disease 2019; OR=odds ratio; SMBG=self-monitoring blood glucose
*Chi-square

the median was used as a cut-off point because all continuous data were not normally distributed. Chi-square was used to identify the association between the categorical variables. Binary logistic regression was used to identify factors contributing to glycemic status during the COVID-19 pandemic. Multivariate analysis included all variables with $p<0.25$ that was related to poor glycemic status in bivariate analysis. A two-sided α less than 0.05 was considered statistically significant (95% confidence interval).

RESULTS

Of 264 patients, only 19.7% initiatively used telemedicine during the COVID-19 pandemic (Table 1). General characteristics, diabetes conditions, and self-care management on glycemic status are provided in Table 2. Of 159 patients, 60.2% had poor glycemic status (HbA1c≥7%). Patients with obesity, having insulin injections, and who consumed fried foods frequently had a higher risk of poor glycemic control. Patients doing consultation via telemedicine or in-person visit and having regular exercise had better glycemic control (Table 2).

DISCUSSION

T2DM patients in Jakarta, Indonesia, were likely to have a poor glycemic control (HbA1c≥7%) during the COVID-19 pandemic. This trend was also found in the pre-pandemic era that only one-third of T2DM patients achieved good glycemic control.[15] However, this condition worsened during the pandemic due to difficulties in managing health care.[3] Our result was also similar to other studies in India,[4,5] China,[6] Korea,[16] and a country that did not implement lockdown such as Japan.[7] Contrarily, glycemic control in T2DM patients was improved in Greece and Italy.[17,18] These heterogeneous results might be caused by different socioeconomic status, duration of lockdown, baseline glycemic control, and health access during the COVID-19 pandemic.

Telemedicine uses technology to provide medical consultation at a distance via interactive chats, voice calls, and video calls.[19] Evidence has shown that telemedicine can improve self-management care,[20] disease monitoring,[21] and clinical outcome.[22] However, only less than 20% of patients used telemedicine due to unfamiliarity with the service[23] and in-person visit preference. Virtual care is also not accessible for the National Health Insurance holders,[3] which only covers the in-person visits. In addition, telemedicine usage has been hindered due to data privacy, diagnostic accuracy, legal protection concern, and reimbursement issue.[24] Telemedicine usage was expected to increase during the COVID-19 pandemic, but our findings showed otherwise. Doctor consultation is still suggested for controlling diabetes either through in-person visits or telemedicine. In addition, telemedicine could be an effective service for diabetes education if properly organized in a primary health center or private clinic. Further studies are needed to identify the effectiveness of telemedicine *versus* in-person visits using a case-control study.

This study found that females had poorer glycemic control. The possible causes include biological factors[25] (e.g., metabolic process, regulation of glucose homeostasis, and treatment response) and psychological stress.[26] Yan et al[26] reported that higher psychological stress in females amid the pandemic might be partially due to the workload impact and homecare burden. In terms of sociodemographic factors, income level was significantly associated with HbA1c levels. This study assumed that the decreased income during the pandemic might limit T2DM patients' ability to afford the medication, recommended diet, blood glucose monitoring supplies, and diabetes care access.

In line with this study, previous studies also found overweight or obesity with poor glycemic control as the contributing factor of T2DM.[27,28] Following a meal plan, which is defined as adherence to a healthy eating plan to control blood glucose level, was also associated with glycemic control. Furthermore, this study found that many participants consumed fried foods while staying at home. This might affect their glycemic status because fried foods are high in fat and calories. Interestingly, the large-scale social restrictions was not an obstacle for the participants to exercise at home, although the frequency and duration may vary. Physical activity could help T2DM patients improving their glycemic status and enhance metabolic health and immune defense, which are beneficial in the current situation.[29,30] In contrast, Ruiz-Roso et al[31] found that a reduction of physical activity during the pandemic was due to increased sitting time. Additionally, the result found oral medicine as

the most medication used by T2DM patients. Evidence has supported the effectiveness of monotherapy and in combination with other therapeutic agents for lowering HbA1c levels.[32] Our findings highlighted the importance of maintaining a healthy BMI by following a meal plan (e.g., eating regularly with healthy foods), doing regular exercise (at least 2 times per week), and having medication adherence during and after the pandemic. Smoking cessation therapy should also be considered to decrease the risk of diabetes-related complications.

This study had several limitations. First, data on general characteristics, diabetes conditions, self-care management, and HbA1c level were self-reported, which may be subjected to information and recall bias. Second, this study recruited the subjects conveniently. All participants were T2DM patients who visited a healthcare facility within 1-year either for a doctor consultation, blood glucose check, or taking medication, which may lead to selection bias. Third, the glycemic status cannot reflect the actual condition because the data were collected using Google Form (Google LLC., USA). Furthermore, this study cannot determine the impact of the large-scale social restrictions on glycemic control since this study did not have cohort data before the pandemic. Further studies covering other areas in Indonesia are needed to identify glycemic control among diabetic patients during the COVID-19 pandemic. Moreover, future research assessing the effectiveness of telemedicine *versus* in-person visits in diabetes care during and after the pandemic is suggested.

In conclusion, BMI, medication type, food consumption, and consultation factors including telemedicine usage were the contributing factors to glycemic status. The findings suggested that compliance with a healthy lifestyle and routine follow-up appointments with a doctor (in-person visits or using telemedicine) must be considered to achieve good glycemic status (HbA1c<7%) during and after the COVID-19 pandemic.

Conflict of Interest

Pradana Soewondo is the editorial board member but was not involved in the review or decision process of the article.

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