



# The relationship between self-care activities, social support, and glycemic control in primary healthcare patients with type 2 diabetes

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## Abstract

**Objective** Egyptian studies in assessing the relationship between diabetes self-care, social support, and glycemic control in primary healthcare (PHC) are limited. Therefore, this study aimed to assess this relationship, and to evaluate the associated factors of diabetes self-care, social support, and glycemic control in Egyptian PHC patients with type 2 diabetes (T2DM).

**Methods** A cross-sectional study was conducted on 320 T2DM patients at four PHC settings in Port Said city, affiliated with the General Authority of Healthcare. A semi-structured questionnaire was used to collect data, including demographic characteristics, socioeconomic status scale, disease profile, the Arabic versions of the Summary of Diabetes Self-Care Activities, and the received social support scales. Data were collected from January 2020 to June 2020.

**Results** Diabetes self-care activities, and self-monitoring of blood glucose had a very weak negative correlations with glycated hemoglobin (HbA1c) levels ( $\rho = -0.125$ ,  $p = 0.025$ ,  $\rho = -0.112$ ,  $p = 0.044$ , respectively). Receiving social support on following a meal correlated positively and very weakly with HbA1c levels ( $\rho = 0.145$ ,  $p = 0.010$ ). Hardly positive correlation was found between receiving emotional support on feelings about diabetes, and following a specific diet ( $\rho = 0.169$ ,  $p = 0.002$ ). Diabetes self-care activities were positively associated with higher education levels, and elevated BMI. Received social support was negatively associated with having coronary artery disease, and marital status e.g. divorced and widow. Increased age, and female gender were the predictors of good glycemic control.

**Conclusion** Diabetes self-care activities were linked with reduced HbA1c levels. Further studies are needed to evaluate the buffering effect of social support on glycemic outcomes in PHC patients with T2DM.

**Keywords** COVID-19 · Diabetes self-care activities · Glycemic control · Primary healthcare · Social support · Type 2 diabetes mellitus

## Introduction

Diabetes is a major health problem worldwide with a comparative prevalence of 9.8%. The Middle East and North Africa region has the highest age-adjusted comparative prevalence of diabetes (18.1%). In Egypt, the comparative prevalence of diabetes was estimated to be 20.9% of the

population aged 20–79 years in 2021. T2DM is the commonest type of diabetes (90%), and has an economic burden on patients, their families, health systems and counties. It can lead to premature mortality, and decreased quality of life as a result of its short- and long-term complications [1].

Individuals with T2DM need to perform lifelong self-care to prevent or delay diabetes-related complications, and to improve their quality of life. Self-care means actions or activities taken by individuals to care for themselves within their environmental conditions. Diabetes self-care involves a series of behaviors that encompass diet, exercise, medication taking (insulin or oral hypoglycemic agents), self-monitoring of blood glucose, and foot care [2].

An older Egyptian study concluded that diabetes self-care activities such as diet and glucose monitoring were suboptimal in rural adult patients with diabetes. Physical activity

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and foot care were not evaluated in that study [3]. Previous studies found diabetes self-care activities associated positively with well-being, better quality of life, and good glycaemic control [4–7]. Diabetes self-care activities could be positively influenced by social support through improving diabetes self-efficacy and decreasing diabetes distress [8].

Diabetes-related social support refers to the provided resources by family, friends, neighbors, work colleagues, peers, healthcare providers, and organizations aiming to encourage and facilitate coping behaviors and to help patients to manage their diabetes. Four categories of diabetes-related social support have been demonstrated: instrumental (tangible), emotional, informational, and appraisal. Instrumental or tangible social support includes the provision of tangible aid, financial assistance, goods, and services for diabetes care. Emotional support describes the provision of love, empathy, trust, appreciation, and caring. Informational support encompasses the provision of advice, information, guidance, and suggestions to address the health problems in diabetic patients. Appraisal support is providing of constructive feedback, and affirmation [9–15].

Social support can play an important role in the management of patients with T2DM. It has a positive effect on glycaemic control, which is mediated by self-efficacy and adherence to proper diet, lifestyle, and medications [16]. Family support was positively associated with glycaemic control in previous studies [11]. Chlebowy et al. found an insignificant association between social support and glycaemic control [17]. Mondesir et al. demonstrated that social support had no association with glycaemic control in males, while had a positive association with good glycaemic control in females [18]. Fortmann et al. displayed increased functional social support was positively associated with poorer glycaemic control [19].

In the light of the burden of T2DM in the world and in Egypt, the essential roles of diabetes self-care activities and social support in improving glycaemic control among patients with T2DM, and there are limited related studies in Egypt's PHC settings, this study was conducted to investigate the relationship between diabetes self-care activities, social support, and glycaemic control as well as to evaluate the frequencies, and associated factors of diabetes self-care activities, social support, and glycaemic control among patients with T2DM in PHC settings in Port Said city, Egypt.

## Materials and methods

### Design, setting and sampling

This cross-sectional study was carried out in four PHC settings affiliated with the General Authority of Healthcare at Port Said city from January 2020 to June 2020. The sample size was calculated by using this formula:  $N = ([Z_{\alpha} + Z_{\beta}] / 1/2$

$\log[(1+r)/(1-r)]^2 + 3 = 284$  participants [20]. Calculation was based on correlation coefficient ( $r = 0.367$ ) between glycaemic control and social support [21], type I error rate ( $\alpha = Z_{\alpha}$ ) was 0.05, and type II error rate ( $\beta = Z_{\beta}$ ) was 0.20. It also was enough to determine the frequencies, and predictors of diabetes self-care activities, social support, and glycaemic control. We added 15% for non-response. Convenience sampling was used on 328 middle age and elderly patients (who aged 40 years or more), this patient population age is of interest as T2DM is typically diagnosed after 40 years of age, average life expectancy in Egypt is older than 70 years and T2DM patients carry most of the burden at this age range. We also included who were diagnosed with T2DM for at least 1 year. We excluded five patients with gestational diabetes, amputation of both feet, end-stage chronic kidney disease, severe hearing impairments/vision loss, and severe depression or dementia that could interfere with communication or comprehending questions. We also excluded patients with missed data ( $N = 3$ ). So, 320 participants were actually included in this study.

### Study measures and scales

The study questionnaire consists of demographic data (e.g. age, gender, marital status, education, and occupation), a scale for measuring family socioeconomic status (SES) for health research in Egypt, disease profile [22], the Arabic versions of the Summary of Diabetes Self-Care Activities instrument (SDSCA-Ar) [23–25], and the Arabic version of the perceived social support scales [26].

The SES scale includes educational and cultural, occupational, family, family possessions, economic, home sanitation, and health care domains. Cronbach's alpha for the scale was 0.66.191 [22]. Disease profile consists of smoking status, duration of diabetes (Years), family history of diabetes, current diabetes medications, diabetes-related complications, comorbidities, anthropometric measurement (e.g. weight, height, and Body mass index [BMI]), and the recent glycated HbA1c values, which were not older than 3 months. Glycaemic control considered good if HbA1C levels were less than 7% in adult patients, or less than 7.5% in older adult patients [27].

The original Summary of Diabetes Self-Care Activities (SDSCA) instrument has been developed since 1994, is a 12-item scale, and assessed five aspects of diabetes regimen including general diet, specific diet, exercise, medication taking, and blood glucose testing [23]. Toobert et al. has revised the SDSCA scale and include a core set of 11 items along with the expanded list of 14 additional questions that can be of use in research or practice. This revised scale consists of 5 subscales: diet, exercise, blood sugar testing, foot care, and smoking [24]. The SDSCA-Ar is a 12-item scale, measures the level of diabetes-related self-care, and consists

of general diet, specific diet, exercise, blood sugar testing, foot care, and medications subscales. The SDSCA-Ar scale has sound psychometric properties. For each subscale, a mean score was calculated. The higher scores indicate more frequent performance of the self-care activity [25]. Item 3 (Eating five or more servings of fruits, and vegetables) was illustrated by pictures to avoid confusion related to this issue in our Egyptian society.

The original social support scale is 27-item scale and is derived from the Diabetes Care Profile. It consists of 4 subscales: the desired social support, the received social support received, the global social support, and the most source of caring for patient's diabetes. Of interest in this study is the received social support, which is consist of 6 items. and is arranged in a five-point Likert scale with options of "strongly disagree," to "strongly agree.". It evaluated the patients' perceptions of the revived help and support from family and friends on following of food meal, medication taking, foot care, practicing exercise, glucose testing, and attentions to patients' feelings towards diabetes [26]. Three experts in family medicine revised and ensured the validity of the content of this extracted scale to evaluate the diabetic patients' perceptions towards the received social support on diabetes self-care activities and feelings towards diabetes.

The co-first author translated this scale from the original version (English) to the Arabic language, hence known as forward translation. Then another bilingual translator (lecturer in English department at the Faculty of Arts, Port Said University) translated the translated version blindly to the original language, hence known as backward translation. Afterwards, both produced translations were compared for equivalence in meaning. The process was repeated by other bilingual translators (senior investigator and the principal investigator), until there were no detected discrepancies between the original work and the translated version. Internal consistency of the Arabic version of the received social support was evaluated on 30 patients during pilot testing and Cronbach's alpha was 0.682. Each response for Likert items were scored on a scale of 1 (strongly disagree) to 5 (strongly agree). The overall score of the instrument is 30 and the lowest is 5. For each individual, the mean score of responses were summed. The higher mean score indicates more received social support.

### Statistical analysis

Data management and analyses were conducted using the Statistical Package for the Social Sciences (SPSS), version 24.0 (IBM Corporation, NY, USA). Categorical variables were summarized as frequencies and percentages, while continuous variables were outlined as means, and standard deviations (SD) or median, and interquartile range (IQR) [if they were not normally distributed]. Shapiro–Wilk test

evaluated the data normality of these variables. Spearman's correlation evaluated the relationship between diabetes self-care activities (the total SDSCA-Ar score), received social support score, and glycemic control (HbA1c values). Spearman Correlations were interpreted as very weak or hardly (0.00–0.19), weak (0.20–0.39), moderate (0.40–0.59), strong (0.60–0.79) and very strong (0.80–1.0) [28]. Linear regression was used to determine the predictors of diabetes self-care activities and received social support. Binary logistic regression assessed the predictors of good glycemic control. All *p* values below 0.05 were considered statistically significant.

### Research ethics

The ethical approval for the present study was obtained from the Research Ethics Committee of Faculty of Medicine, Suez Canal University, Ismailia, Egypt (Ref No. 4025/2019, dated 13-11-2019). Informed consent was obtained from all participants.

## Results

### Demographic and clinical characteristics of the participants

Our study included a sample of 320 PHC patients with T2DM. The mean age of the participants was  $59.96 \pm 7.15$  years (48–73 years), and 29.1% of them were older adults ( $\geq 65$  years). Slightly less than two-thirds (62.2%) of the participants were female. The majority (78.8%) of the sample were married. Near half (48.4%) of the participants were housewife or non-working. Only 16.9% of the participants graduated from universities (Table 1). Near three-fourths (74.1%) of the participants were non-smokers, 13.4% of them were smokers, and 40 patients were ex-smokers (12.5%).

More than three-fourths (78.7%) of the participants had suffered from diabetes for 10 years or more, and 52.8% of them had a family history of diabetes. The most reported diabetes-related complications were neuropathy (85.9%), and retinopathy (40.3%). The mean BMI in our sample was  $36.97 \pm 5.78$  (6.9–11.08), and 89.1% of them were obese. Only 5% of the participants achieved glycemic targets (Table 1).

### Level of diabetes self-care activities and received social support

Diabetes self-care activities had a mean score of  $27.65 \pm 5.96$  (Score index using actual score divided by possible maximum score was 35.06%). The lowest attained scores on the

**Table 1** Participants' demographic and clinical characteristics ( $N = 320$ )

Characteristics	Frequency (%)
<b>Age</b>	59.96 ± 7.15 (48–73)
(years), mean ± SD (range)	
< 65 years	227 (70.9%)
≥ 65 years	93 (29.1%)
<b>Gender</b>	
Male	121 (37.8%)
Female	199 (62.2%)
<b>Marital status</b>	
Married	252 (78.8%)
Divorced	31 (9.7%)
Widow	37 (11.6%)
<b>Education level</b>	
Illiterate	20 (6.3%)
Read and write	57 (17.8%)
Primary school	33 (10.3%)
Secondary school	15 (4.7%)
High school	74 (23.1%)
Intermediate education	67 (20.9%)
University	54 (16.9%)
<b>Occupation</b>	
Housewife/Non-working	155 (48.4%)
Unskilled manual worker	23 (7.2%)
Skilled manual worker	22 (6.9%)
Trades/business	52 (16.2%)
Semi-professional	31 (9.7%)
Professional	37 (11.6%)
<b>Socioeconomic status</b>	
Very low or low	124 (38.8%)
Middle	156 (48.8%)
High	40 (12.5%)
<b>Duration of diabetes</b> , mean ± SD (range)	17.46 ± 7.44 (5–30)
≤ 10 years	68 (21.3%)
> 10 years	252 (78.7%)
<b>Family history of diabetes</b>	169 (52.8%)
<b>Antidiabetic medications</b>	
Oral hypoglycemic agents	168 (52.5%)
Insulin-containing regimens	152 (47.5%)
<b>Diabetes-related complications</b>	
Retinopathy	129 (40.3%)
Nephropathy	19 (5.9%)
Neuropathy	275 (85.9%)
Coronary artery disease	15 (4.7%)
Foot problems	2 (0.6%)
<b>Co-morbidities</b>	
Hypertension	271 (84.7%)
Dyslipidemia	21 (6.6%)
<b>BMI</b> , mean ± SD (range)	36.97 ± 5.78 (25.2–58.7)
Overweight	35 (10.9%)
Obesity	285 (89.1%)
<b>HbA1c</b> %, mean ± SD (range)	9.09 ± 1.18 (6.9–11.08)
<b>Glycemic control</b>	
Good	16 (5%)
Poor	304 (95%)

**Table 1** (continued)

*BMI* body mass index; *HbA1c* glycated hemoglobin; *SD* Standard deviation

SDSCA-Ar scale were exercise, blood glucose monitoring, and foot care subscales, respectively. All participants had not practiced physical activity for 30 min within a week, 90.3% of them had not done any specific exercise during the last week, and only 9.7% of those participants had practiced in a specific exercise session every day per last week. About one-fourth (25.6%) of the participants had not tested their blood sugar during a week, while the majority (74.4%) of them tested their blood glucose 1–3 times per the last week. About half (53.1%) of the participants had not checked their feet weekly, 19.1% of our participants checked their feet 1–3 times weekly, and only 5.3% of them had checked their feet every day per week. Near one-third (31.9%) of the participants reported not inspecting their footwear during the last week, however, most of (68.1%) them inspected their footwear 1–3 times per week (Table 2). Medications' subscale was the most reported diabetes self-care activities among our participants. All the participants took their medications and insulin every day during the last week.

The score index of the received social support score was 71.2%. Participants reported receiving support from families and friends on following a meal plan (mean score was  $3.63 \pm 1.13$ ), and medication taking (mean score was  $3.61 \pm 1.10$ ) had the highest attained scores on the received social support scale, whereas social support on foot care had the lowest score (mean score was  $3.49 \pm 1.07$ ), but it still was good (Table 2).

### Correlations between diabetes self-care, received social support, and HbA1c

The total diabetes self-care activities score, and self-monitoring of blood glucose score had a very weak negative correlations with HbA1c values ( $\rho = -0.125$ ,  $p = 0.025$ ,  $\rho = -0.112$ ,  $p = 0.044$ , respectively). Diabetes self-care activities on specific diet, exercise, and foot care correlated negatively, but insignificantly with HbA1c values. Diabetes self-care activities, and HbA1c values were not significantly associated with the total received social support score (Table 3). Hardly positive correlation was observed between received social support on following a meal and HbA1c values ( $\rho = 0.145$ ,  $p = 0.010$ ). The received emotional support about diabetes was positively correlated with following a specific diet ( $\rho = 0.169$ ,  $p = 0.002$ ), Table 4.

**Table 2** Descriptive statistics of the participants' diabetes self-care, and received social support (N= 320)

Variables	Mean (SD)	Median [IQR]	0 time/the last 7 days	1–3 times/the last 7 days	≥ 4 times/the last 7 days
<b>Diabetes self-care activities during the last seven days</b>					
<b>General diet</b>	<b>3.19 (1.57)</b>	<b>3 [2–4.5]</b>			
1.Following a healthful eating plan	2.92 (1.997)	3 [1–5]	49 (15.3%)	135 (42.2%)	136 (42.5%)
2.Following an eating plan over the last month)	3.46 (2.263)	4 [1–5]	40 (12.5%)	119 (37.2%)	161 (50.3%)
<b>Specific diet</b>	<b>3.66 (1.45)</b>	<b>3.5 [2.5–4.5]</b>			
3.Eating five or more servings of fruits and vegetables	3.28 (2.281)	3 [1–5]	47 (14.7%)	128 (40%)	145 (45.3%)
4.Eating high fat foods e.g. red meat and full fat dairy product	2.96 (2.05)	3 [1–4]	38 (11.9%)	174 (54.4%)	108 (33.8%)
<b>Exercise</b>	<b>0.38 (1.05)</b>	<b>0 [0–0]</b>			
5.participating in at least 30 min of physical activity	0.07 (0.26)	0 [0–0]	297 (92.8%)	23 (7.2%)	0 (0%)
6.participating in specific exercise session	0.68 (2.07)	0 [0–0]	289 (90.3%)	31 (9.7%)	0 (0%)
<b>Blood glucose monitoring</b>	<b>1.48 (0.80)</b>	<b>1.5 [1, 2]</b>			
7.testing blood sugar	1.54 (1.15)	2 [0–3]	82 (25.6%)	238 (74.4%)	0 (0%)
8.testing blood sugar, the number of times recommended	1.43 (1.15)	1 [0–2.75]	93 (29.1%)	227 (70.9%)	0 (0%)
<b>Foot care</b>	<b>1.62 (1.71)</b>	<b>0.5 [0–3]</b>			
9.Checking foot	(2.42)	0 [0–4]	170 (53.1%)	61 (19.1%)	89 (27.8%)
10. Inspecting the inside of shoes		1 [0–2]	102 (31.9%)	185 (57.8%)	33 (10.3%)
<b>Diabetes self-care activities</b>	<b>27.65 (5.96)</b>	<b>28 [24–32]</b>			
	Mean (SD)	Median [IQR]	Strongly disagree/ disagree	Neutral	Strongly agree/Agree
<b>Friends and family offer support on</b>					
1.following a meal plan	3.63 (1.13)	4 [3–5]	73 (22.8%)	66 (20.6%)	181 (56.6%)
2.taking medicine	3.61 (1.10)	4 [3–5]	70 (21.9%)	69 (21.6%)	181 (56.6%)
3.taking care of feet	3.49 (1.07)	3 [3–5]	72 (22.5%)	90 (28.1%)	158 (49.4%)
4.getting enough physical activity	(1.11)	4 [3, 4]	72 (22.5%)	68 (21.3%)	180 (56.3%)
5. Testing sugar	(1.11)	4 [3, 4]	77 (24.1%)	73 (22.8%)	170 (53.1%)
6. Handling feelings about diabetes	3.51 (1.13)	3 [2–5]	80 (25%)	80 (25%)	160 (50%)
<b>Received social support</b>	<b>21.36 (2.56)</b>	<b>21 [20–23]</b>			

IQR interquartile range; SD standard deviation

**Associated factors of diabetes self-care, received social support, and glycemic control**

Linear regression showed that diabetes self-care activities were significantly associated with elevated level of education ( $\beta = 0.251$ , 95% CI 0.211–0.565,  $p < 0.001$ ), and increased BMI ( $\beta = 0.144$ , 95% CI 0.024–0.273,  $p = 0.02$ ). The received social support was negatively associated with divorced, ( $\beta = -0.177$ , 95% CI - 2.488 to 0.566,  $p = 0.002$ ) and widow patients ( $\beta = -0.169$ , 95% CI - 2.311–0.385,  $p = 0.006$ ), as well as with those having coronary artery disease ( $\beta = -0.155$ , 95% CI - 3.563 to 0.194,  $p = 0.029$ ), Table 5. Achieving good glycemic control associated significantly with advanced age (OR = 9.830, 95% CI

2.603–37.116,  $p = 0.001$ ), and female gender (OR = 7.633, 95% CI 1.526–38.181,  $p = 0.013$ ), Table 6.

**Discussion**

To our knowledge, this was the first study to investigate the relationship between diabetes self-care activities, received social support, and glycemic control among patients with T2DM attending urban PHC settings in developing countries such as Egypt. Data collection in this study was conducted during the very early stages of Covid-19 pandemic in 2020 where the first lockdown regulations in Egypt commenced on Mars 19, 2020, “the third month” of data collection. Our study found only five percent of the participants had good

**Table 3** Correlation between diabetes self-care activities, received social support, and HbA1c ( $N=320$ )

Variables	General diet	Specific diet	Exercise	Blood glucose monitoring	Foot care	Diabetes self-care activities	Received social support	HbA1c
General diet	1							
Specific diet	-0.010	1						
Exercise	0.083	0.042	1					
Blood glucose monitoring	-0.060	0.023	-0.026	1				
Foot care	-0.014	-0.023	-0.006	0.033	1			
Diabetes self-care	0.497**	0.483**	0.329**	0.254**	0.514**	1		
Received social support	0.052	0.053	-0.065	0.008	-0.069	-0.016	1	
HbA1c	-0.067	0.000	-0.023	-0.112*	-0.072	-0.125*	0.105	1

*IQR* interquartile range; *SD* standard deviation; *HbA1c* glycated hemoglobin

\*Spearman's Correlation is significant at the 0.05 level (2-tailed)

\*\*Spearman's Correlation is significant at the 0.01 level (2-tailed)

**Table 4** Correlation between participants' perceptions on received social support, diabetes self-care activities, and HbA1c ( $N=320$ )

Variables	Support on following a meal plan	Support on taking medicine	Support on taking care of feet	Support on getting enough physical activity	Support on testing sugar	Support on handling feelings about diabetes
<i>Friends and family offer support on</i>						
<b>1. Following a meal plan</b>	1					
<b>2. Taking medicine</b>	-0.010	1				
<b>3. Taking care of feet</b>	-0.040	0.027	1			
<b>4. Getting enough physical activity</b>	-0.003	-0.023	-0.052	1		
<b>5. Testing sugar</b>	0.029	-0.022	-0.030	-0.048	1	
<b>6. Handling feelings about diabetes</b>	-0.096	0.014	-0.023	0.014	-0.074	1
<b>Received social support</b>	0.379**	0.416**	0.351**	0.383**	0.362**	0.355**
General diet	-0.001	-0.019	0.029	0.026	-0.028	0.094
Specific diet	0.019	-0.011	-0.041	-0.053	0.049	0.169**
Exercise	-0.070	0.034	-0.036	-0.001	-0.058	-0.014
Blood glucose monitoring	0.043	0.044	-0.020	-0.059	0.012	-0.005
Foot care	-0.074	0.041	0.012	-0.109	0.041	-0.044
<b>Diabetes self-care activities</b>	-0.041	0.016	-0.019	-0.085	0.024	0.077
<b>HbA1c</b>	0.145**	0.023	-0.018	0.050	0.044	-0.033

*IQR* interquartile range; *SD* standard deviation; *HbA1c* glycated hemoglobin

\*Spearman's Correlation is significant at the 0.05 level (2-tailed)

\*\*Spearman's Correlation is significant at the 0.01 level (2-tailed)

glycemic control, and suboptimal levels of diabetes self-care activities had been found. Diabetes self-care activities, and self-monitoring of blood glucose correlated negatively and hardly with HbA1c levels. The total received social support score was neither correlated with diabetes self-care activities nor HbA1c levels. Social support from family and friends on following a meal had a positive very weak correlation with increased HbA1c levels. Receiving emotional support for

the participants' feelings about diabetes correlated positively and hardly with following a specific diet.

This study demonstrated that good glycemic control was present in five percent of the participants. This surprising finding is considered a serious concern problem and is far lower than that reported in a recent Egyptian study (23%) [29], these marked discrepancies might be attributed to the eligible ages of the participants and the sampling techniques in the two studies were different, in addition to the

**Table 5** Linear regression analysis for predicting diabetes self-care activities, and received social support (*N*=320)

Variables	Diabetes self-care activities		Received social support	
	$\beta$ (95% CI)	<i>P</i>	$\beta$ (95% CI)	<i>P</i>
Age (Years)	- 0.046 (- 0.137 to 0.060)	0.438	0.091 (- 0.011 to 0.076)	0.138
Gender (Female vs. Male)	0.079 (- 0.835 to 2.774)	0.291	- 0.117 (- 1.408 to 0.172)	0.125
Marital status				
Divorced vs. Married	0.074 (- 0.702 to 3.687)	0.182	- 0.177 (- 2.488 to 0.566)	0.002*
Widow vs. Married	- 0.032 (- 2.799 to 1.598)	0.591	- 0.169 (- 2.311 to 0.385)	0.006*
Education level (Reference category = illiterate)	0.251 (0.211–0.565)	<0.001*	0.019 (- 0.065 to 0.090)	0.749
Occupation (Reference category = non-working)	0.144 (-0.008–0.928)	0.054	- 0.080 (- 0.315 to 0.095)	0.291
Duration of diabetes (Years)	- 0.031 (- 0.112 to 0.063)	0.580	- 0.005 (- 0.040 to 0.037)	0.936
Family history of diabetes (Present vs. Absent)	0.007 (- 1.192 to 1.353)	0.901	- 0.049 (- 0.806 to 0.308)	0.380
Antidiabetic medications (Insulin regimen vs. OHAs)	- 0.074 (- 2.189 to 0.431)	0.188	0.035 (- 0.394 to 0.753)	0.539
Retinopathy (Present vs. Absent)	0.088 (- 0.385 to 2.515)	0.149	- 0.047 (- 0.881 to 0.388)	0.446
Nephropathy (Present vs. Absent)	- 0.039 (- 3.748 to 1.782)	0.485	- 0.051 (- 1.762 to 0.659)	0.371
Neuropathy (Present vs. Absent)	0.054 (- 1.428 to 3.281)	0.439	- 0.017 (- 1.155 to 0.907)	0.813
Coronary artery disease (Present vs. Absent)	0.030 (- 3.006 to 4.690)	0.667	- 0.155 (- 3.563 to 0.194)	0.029*
Diabetic foot (Present vs. Absent)	0.053 (- 4.067 to 12.026)	0.331	- 0.002 (- 3.573–3.473)	0.978
BMI (Kg/m <sup>2</sup> )	0.144 (0.024 to 0.273)	0.020*	- 0.045 (- 0.074 to 0.035)	0.474
Glycemic control (Good vs. Poor)	- 0.055 (- 4.528 to 1.515)	0.327	- 0.047 (- 1.874 to 0.773)	0.414

$\beta$  Standardized beta coefficients; *BMI* body mass index; *CI* confidence Interval; *OHAs* oral hypoglycemic agents

All requested variables entered. Dependent variables: diabetes self-care activities score, and received social support score. Values are presented as  $\beta$ - coefficient (95% confidence interval). Note: *P* < 0.05

Model for diabetes self-care activities: [*R*-square=0.141; Model ANOVA: *F*=3.097; *P*<0.001]

Model for diabetes received social support: [*R*-square=0.109; Model ANOVA: *F*=2.312; *P*=0.003]

**Table 6** Logistic regression analysis for predicting glycemic control (*N*=320)

Variables	<i>B</i>	<i>SE</i>	Wald	<i>P</i> value	OR	95% CI for OR	
						Lower	Upper
Age (Years)	2.285	0.678	11.366	0.001*	9.830	2.603	37.116
Gender (Female vs. Male)	2.032	0.821	6.123	0.013*	7.633	1.526	38.181
Marital status							
Divorced vs. Married	- 0.481	0.737	0.426	0.514	0.618	0.146	2.620
Widow vs. Married	0.588	1.118	0.277	0.599	1.801	0.201	16.116
Socioeconomic status (Total score)	0.001	0.022	0.004	0.947	1.001	0.959	1.046
Duration of diabetes (Years)	0.004	0.035	0.013	0.910	1.004	0.937	1.076
Family history of diabetes (Present vs. Absent)	- 1.098	0.615	3.189	0.074	0.334	0.100	1.113
Antidiabetic medications (Insulin regimen vs. OHAs)	0.123	0.586	0.044	0.834	1.130	0.358	3.565
Retinopathy (Present vs. Absent)	0.108	1.204	0.008	0.929	1.114	0.105	11.787
Nephropathy (Present vs. Absent)	- 0.755	0.786	0.923	0.337	0.470	0.101	2.192
Self-blood glucose monitoring (Mean score)	0.461	0.357	1.667	0.197	1.585	0.788	3.191
Constant	- 5.188	1.874	7.666	0.006	0.006		

*B* beta; *CI* confidence Interval; *OHAs* oral hypoglycemic agents; *OR* odds ratio; *SE* standard error

Binary logistic regression model 1: omnibus tests  $\chi^2$  (*df*)=26.098 (11), *P*=0.006; Hosmer and Lemeshow  $\chi^2$  (*df*)=2.487 (8), *P*=0.962; Cox & Snell *R* Square=0.078; Negelkerke *R* Square=0.239; Overall correct classification=94.7%

\*Statistically significant *P* value (<0.05)

impact of Covid-19 lockdown, as the most of our sample were recruited during this period. Covid-19 lockdown had a positive influence on worsening of glycemic control in those patients with T2DM through Covid-19-induced psychological distress, and changes in lifestyle, which might affect diabetes management such as increase in sugary food and snack consumption, physical inactivity, more screen time and weight gain [30]. Tao et al. demonstrated that 25.54% of the patients with T2DM had good glycemic control during COVID-19 pandemic [31], which is higher than our finding, the reasons may be related to differences in sociodemographic factors of the participants, the used methodology of the studies, and health care systems.

In the present study, increasing age was significantly associated with good glycemic control, which was similar to the reported findings in previous PHC studies [32–35]. This may be the result of older patients concerned about worsening of their illness, so become more diligent. They may receive more social support on diabetes management from their family [33]. Tao et al. reported that rising age was associated with poor glycemic control [31]. However, Saudi et al. found age was not significantly associated with glycemic control [29]. We found females had a significant good glycemic control than males, which is in line with finding of Omani study [32], this could be attributed to female have more access to PHC for seeking care more than males and also have more levels of self-care. A Saudi study revealed that females had poor glycemic control than males [36]. However, other studies did not find associations between glycemic control and gender [29, 33–35, 37].

We found that the HbA1c levels had an inverse very weak relationship with the diabetes self-care activities total scores, which was nearby what was found in a Chinese study ( $\rho = -0.24$ ) [5]. A Malaysian study demonstrated a negative moderate correlation between HbA1c and diabetes self-care activities in older patients with T2DM [38]. We did not find an association between good glycemic control, and diabetes self-care activities. This finding may be related to the relatively few frequencies of the participants with good glycemic control, in addition to the low level of diabetes self-care activities. Al Johani et al. and Alodhayani et al. also did not demonstrate associations between good glycemic control and diabetes self-care in patients with T2DM [39, 40]. However, Bukhsh et al. and Hurst et al. revealed that good glycemic control was significantly associated with diabetes self-care activities in those with T2DM [6, 41].

In the current study, an inverse relationship was observed between HbA1c and self-monitoring of blood glucose. Good glycemic control was found to be more in those participants having higher levels of self-monitoring of blood glucose compared to those with lower levels of self-monitoring of blood glucose, but without a significant association. Al-Khawaldeh et al. also found an insignificant association between

good glycemic control and self-monitoring of blood glucose monitoring [42]. Al Johani revealed that good glycemic control had a positive association with self-monitoring of blood glucose [39].

Adopting chronic care model especially in Egypt's PHC settings can optimize the provided diabetic care for Egyptian patients. Self-management support is one of the six cores of this model. Providing service of diabetes self-management education for all diabetic patients is needed, this service can facilitate the knowledge, skills, and ability necessary for diabetes self-care [27]. Family physician can play a facilitating role in diabetes self-management [43]. During the comprehensive assessment of diabetic patients, family physician should obtain a history about diabetes education sessions and assess diabetes self-management skills and barriers [44]. Moreover, family physician should assess and gradually encourage diabetic patients' readiness for lifestyle change, build confidence, develop individualized plans with clear goals, address obstacles, and help maintain goals [45].

The present study demonstrated that HbA1c levels was not associated with receiving social support from family or friends. An American study also showed that there was no significant relationship between HbA1c levels and social support [17]. However, a systematic review reported that family support was most frequently associated with lower HbA1c levels [46]. A Malaysian study found social support correlated positively and moderately with HbA1c levels [38]. We found that the higher received social support level on following a meal plan was associated with higher HbA1c. Further studies are needed to assess the impact and buffering effect of the received social support on glycemic control in primary care.

Our current study demonstrated that the levels of diabetes self-care activities were suboptimal, which were lower than findings of a Lebanese study [21]. Practicing exercise, self-monitoring of blood glucose, and foot care had the lowest mean scores of diabetes self-care activities in our study, respectively. The reasons for these unacceptable levels of self-care were: negative impact of COVID-19 lockdown on physical activities and diet; some older people with chronic illness such as osteoarthritis may have mobility restriction; inadequate awareness of the participants towards diabetes self-care as a result of the current healthcare system lacked diabetes-management education services; the current healthcare system also do not provide glucometers and strips for patients with T2DM and some patients may have financial constraints about buying these instruments; and culture of adopting healthy lifestyle also needs improvement.

In our study, all participants reported optimal adherence to their OHAs or insulin regimen therapy. Ahmad Sharoni et al. Al Johani et al. and Al-Khawaldeh et al. reported that the highest score of diabetes self-care practices was related to taking medication. These findings reflect that taking



medication was received as easier treatment modality than other diabetes self-care activities [38, 39, 42].

This study found that education level was a significant predictor of diabetes self-care activities. Previous studies also displayed education level as a predictor of self-care [6, 47, 48]. It is reasonable that if the level of education is higher, the level of diabetes self-care behavior is also higher because of higher treatment awareness. We also found that BMI was a significant predictor of self-care. Alodhayani et al. did not find a significant association between BMI and self-care [40]. The explanation of our finding might be the result of the more educated people who can earn more money have higher risk for higher BMI in developing countries e.g. Egypt. Also, those with increased BMI might be more motivated to practice self-care try to manage and reduce the progression of their illness. As those, the relationship between BMI and HbA1c, income, education level, and self-management behaviors need to be considered.

The current study showed that the received social support had a good level, which was congruent with the finding of Sukkarieh et al. [21]. We found that social support had an inverse relationship with diabetes self-care, but this relationship was not significant. However, Ahmad Sharoni et al. showed that increase of social support was significantly associated with decrease of diabetes self-care, which might be a result of a strong bonding between older patients with T2DM and their families, which was resulting in a high level of patients' dependence on their family [38]. Previous studies demonstrated that social support had a positive effect on diabetes self-care activities [8, 21, 49]. In our study, the received social support from families and friends towards handling of patients' feelings about diabetes had a positive effect on following a specific diet. Family physician should ask diabetic patients about their families and friends who are supportive and recommend nurturing relationships with those who promote healthy lifestyles [45].

Divorced and widow participants received significantly a lower social support than married participants, but this unsurprising finding did not significantly influence their diabetes self-care or glycemic control. Participants with coronary artery disease also had an inverse association with social support. Further randomized control trials are needed to establish causal relationships between the risk of developing coronary artery disease and lower levels of social support in PHC patients with T2DM.

### Limitations of the study

Although we did not plan to gather information on dramatic changes of COVID-19 lockdown in the current study protocol, which was approved before the COVID-19 era, other hospital-based studies found that lockdown restrictions

affected physical activity and eating habits, as well as social support in patients with T2DM [50–52]. Our study has some limitations. The cross-sectional nature of our study could not evaluate the causality. Lack of randomization limited our ability to generalize our results. We could not differentiate between the received social support from families and friends. Further studies are needed to assess the effects of desired, global and physicians' social support, and also to evaluate the longitudinal effects of social support on diabetes self-care, and glycemic control. Exclusion of patients who had lost their legs, patients with end-stage renal failure, and patients with vision loss may lead to perceptions about the enrolled subjects were clearly biased towards those with mild illnesses. However, we excluded those patients who lost their both of legs as we assess foot care as one subscale of diabetes self-care activities; caring of patients with end-stage renal failure usually occurs at secondary or tertiary health care and those patients attend PHC setting for getting referral letters; and patients with vision loss may have more communication challenges. Since baseline data on HbA1c and diabetes self-care activities among the participants were not available prior to the COVID-19 era, the impact of the COVID-19 pandemic on these outcomes could not be assessed.

### Conclusion

Glycemic control and diabetes self-care activities were sub-optimal, however social support was optimal. HbA1c levels had an inverse relationship with diabetes self-care activities. Neither HbA1c levels nor diabetes self-care activities were associated with the received social support from families and friends. Glycemic control was significantly associated with rising age and female gender. Higher education level and elevated BMI were associated with the higher levels of diabetes self-care activities. Being divorced or widow and existing of coronary artery disease were negatively associated with received social support.

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## Declarations

**Conflict of interest** The authors declare that they have no conflict of interest.

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