Assessment of diabetes self-management among diabetic patients attending Jeddah Care Center for Diabetes, Saudi Arabia.

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Article Title

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Abstract

Objectives:

To assess the levels and the associated demographic factors with diabetic self-management (DSM) among diabetic patients in Saudi Arabia. The impact of implementing DSM practices on glycemic control was additionally investigated.

Results:

The responses of 349 patients were analyzed (51.0% males and 37.2% obese). The median (IQR) raw DSMS score was 187 (165-205). Higher DSMS scores were reported for young adults (aged 20-29 years), insulin users, employed patients, as well as those with normal body mass index values and normal HbA1c results compared to their counterparts. Low HbA1c values were linearly associated with high scores of the healthy eating (β = -0.014, p=0.018) and physical activity subscales (β = 90-0.009, p=0.042).

Keywords: Self-management; diabetes; glycemic control; Saudi Arabia

Introduction

Diabetes is a chronic condition that has detrimental consequences on the well-being of affected patients, their families, societies, and healthcare settings(1). Estimates indicate that the global prevalence of diabetes was 9.3% in 2019, and the figure is projected to reach as high as 10.2% by 2030(2). In Saudi Arabia, data related to diabetes is relatively scarce, and few nation-wide epidemiological studies have been conducted. Based on available evidence, the prevalence of T2DM has linearly increased from 18.2% in 2005 to 31.6% in 2011(3, 4), and the country-based prevalence is on the rise. As with other countries, diabetes in Saudi Arabia is linked to the growing burden of obesity(5).

In general, premature mortality attributable to diabetes is associated with the incidence of preventable diabetes-related complications. These include macrovascular and microvascular complications(6). The development of such complications could be delayed or prevented via improving glycemic control and adhering to tailored managemental plans. Therefore, multidisciplinary approach including self-management has been cited as a strong determinant of improved health outcomes, better glycemic control and reduced healthcare costs(7-9). As such, diabetes self-management (DSM), defined as the actual performance of self-care activities, plays an integral role in the success of diabetes control and alleviating the impact of disease-related complications.

However, DSM is a complex, multifaceted process, in which the patient would be responsible for caring for his condition via distinct skills, confidence, knowledge, and commitment. Each patient has a unique lifestyle, and self-management practices might differ according to demographic and psychosocial variables(10). The present study aimed to assess the level of DSM practice of patients with diabetes in Saudi Arabia. Additionally, we explored the differences in DSM levels across demographic groups of patients and the impact of DSM practices on glycemic control.

Main text

Methods

A paper based-survey cross-sectional study was carried out during the period between June 2019-2020 at Jeddah Care Center for Diabetes, King Abdul-Aziz Hospital (KAH). Diabetic patients with T1DM and T2DM, who had been receiving treatment for at least 6 months before participation were eligible. Males and females aged between 20 and 79 years were included. Excluded population: Gestational DM, those with major complications that might have hindered their self-management activities, and those with cognitive impairment or psychiatric illnesses.

The sample size was calculated using the OpenEpi online calculator(11). Considering a 95% confidence interval (CI) the required sample size is 384. 450 diabetic patients were targeted, A convenience sample of 349 patients agreed to participate in the study, and a written consent was taken.

A semi-structured validated questionnaire developed by Sousa et al(12), consisted of three major domains: 1) demographic characteristics, 2) diabetes-related data and 3) the Diabetes Self-Management Scale (DSMS), which measures the level of DSM. The DSMS comprises of Likert-type 60-item distributed across seven components, including dietary control, physical activity, monitoring blood glucose, taking medication, foot care, problem-solving, and risk reduction. The reliability of the overall DSMS scale was graded as "excellent" (**Table S1**). The responses to each item were graded as follow: 1=never, 2=rarely, 3=sometimes, and 4=frequently. Therefore, the total score for each participant ranged between 60 and 240, where high scores have indicated high DSM levels. DSMS's Arabic version has been tested and validated on an Arab population(13).

Data was collected by the researchers in the center; for each participant, HbA1c level that had been measured in the past 3 months were obtained from the medical records. Body weight and height were measured according to standard procedure, missing values of body weight and height were due to participants rejection. Different Body Mass Index (BMI) categories were defined according to the World Health Organization's criteria(14). Adequate glycemic control was classified as good (HbA1c$\leq$ 7%) or poor (HbA1c> 7%)(15, 16).

Numerical variables were presented as means and standard deviations, whereas categorical variables were expressed as frequencies and percentages. Missing-data analysis was carried out for the variables with missing values, including height and body weight, indicating that these data were missing completely at random. Accordingly, the linear interpolation method was used to impute the missing data. The reliability of the questionnaire was assessed using Cronbach's alpha values. Non-

parametric tests were used based on the results of tests of normality on the scores of the DSMS scale and subscales (Kolmogorov-Smirnov and Shapiro-Wilk tests [P-value <0.0001 for the DSMS scale and all subscales]). Quantitative scores were expressed as medians and interquartile ranges (IQRs). The scores of different demographic groups were compared using the Mann–Whitney U-test and Kruskal–Wallis H test, where applicable. The impact of DSM practice on glycemic control was assessed by analyzing the effects of DSMS scores (for the main scale and subscales) as predictor variables on HbA1c quantitative values (dependent variable) in a linear regression model. Statistical analysis was performed using the IBM SPSS version 26.0.

Results

349 patients agreed to participate in the study, response rate (77.5%). Missing data were imputed in 50 (14.3%) patients for height and 47 (13.5%) for body weight, and the BMI was calculated for patients with imputed data. Approximately half of the respondents were males (51.0%) and unemployed (53.3%). Majority of patients were married (71.6%) and overweight or obese (38.4% and 37.2%, respectively) **Table 1**.

Majority of patients had been diagnosed with T2DM (73.1%), and less than half of them had the disease for 6-10 years (40.4%). In general, 50 complications had occurred in 40 patients (11.5%), **Table 1**. Abnormal vision was the most frequently reported complication (34.0%), followed by hypoglycemic attacks (16.0%) and retinal hemorrhage (14.0%) (**Figure S1**). The mean value of HbA1C was 8.08% ± 1.69, and 47.9% of patients had poor glycemic control (**Table 1**).

Considering the analysis of two categorical variables, employed diabetic patients scored higher than unemployed patients regarding their self-management practices (median [IQR] values were 80.00 [71.25-86.67] versus 74.58 [66.25-83.33], respectively, P= 0.003, **Table 2**). For variables with more than two categories, the results of the Kruskal-Wallis H test revealed significant differences in the total DSMS scores across subgroups of age (P< 0.0001), treatment type (P< 0.0001), BMI (P= 0.001), and marital status (P= 0.026). Pairwise comparisons were carried out to further investigate the sources of differences (**Table S2**). Using a Bonferroni correction for multiple tests, the findings indicated consistently higher median (IQR) scores of diabetes self-management among single patients compared to widowed patients (P= 0.024), patients with normal BMI values than obese patients (P= 0.001), and patients receiving insulin only than those who had received oral and insulin therapies and exclusive oral therapies (P = 0.001 for both comparisons). Besides, patients aged 20-29 years had higher scores than all other age groups (P≤ 0.001 for all comparisons). Regarding the analysis of DSMS subscales, patients' age and type of treatment accounted for significant differences in six subscales (out of seven), whereas BMI was associated with significant differences in three subscales (**Table S3**). As demonstrated in **Table 3**, the median (IQR) DSMS score was significantly higher among patients with a good control of glycaemia (80.8 [69.6-87.3]) than those with poor glycemic control (76.7 [67.5-83.7], P= 0.038). The same applies

for the dietary control subscale (80.0 [72.5-89.27] versus 75.0 [68.3-83.3] for good and poor glycemic control, respectively, P= 0.002) and the physical activity subscale (75.0 [54.2-87.5] versus 70.8 [50.0-79.2] for good and poor glycemic control, respectively, P= 0.014). Of note, higher dietary control scores (β= -0.014 [95% CI, -0.025 to -0.002], P=0.018) and higher physical activity scores predicted low HbA1c values (β= -0.009 [95% CI, -0.017 to -0.0001], P=0.042); yet, the overall DSMS score did not explain the variation in HbA1c values.

Discussion

Healthy lifestyle practices are an important determinant of management outcomes in diabetes therapy. Promoting effective self-managemental strategies throughout the lifetime of diabetes, where health and therapeutic challenges may arise at distinct timepoints, can be an integral part of the management plan for those who cannot reach the recommended therapeutic goal. In this study, the raw score of the DSMS scale was 187 for the total population, and higher scores were evident in distinct demographic groups, including single and employed participants, young adults (20-29 years), along with those who are receiving insulin therapy, as compared to their counterparts. Furthermore, patients with optimal HbA1c values had higher DSMS scores. Compliance with appropriate dietary practices and physical activity recommendations were significant predictors of good glycemic control.

The reported DSMS score in the current study is higher than the mean score reported in previous cross-sectional study among patients attending primary healthcare centers in Jeddah(17). However, we demonstrated a relatively high level of poor glycemic control (48%) among patients with T1DM and T2DM. Similarly, recent studies carried out in Riyadh and Al Kharj showed that 43.13% and 44.5% of patients had uncontrolled diabetes, respectively(18, 19). Other national studies have shown alarming levels in T2DM, where suboptimal HbA1c values were reported among 74.0% of patients in Jizan(20) and 73.8% in Al-Madinah(21). Such findings underline the need to find urgent solutions to improve glycemic control via effective self-managemental strategies.

The outcomes indicate an association between protective self-management strategies and improved glycemia. More specifically, a negative linear correlation was found between the scores of healthy eating and physical activity and HbA1c levels, indicating an optimal glycemic control in patients with good adherence to these recommendations. Likewise, diet and exercise are primarily branches in lifestyle management as revealed by the recommendations of the American Diabetes Association(22). Adults with DM are encouraged to avoid sedentary behaviors which represent a great challenge in the Saudi context(23). Reduction of weight is another important aspect to improve clinical indicators via nutritional therapy and regular exercise(22).

Young adults expressed higher compliance levels to self-management practices than other age groups. Supporting diabetic young adults is necessary since they are more likely to develop diabetes-related cardiovascular complications than their counterparts without diabetes(24). Their high DSM scores are possibly because of their increased knowledge regarding the importance of maintaining a healthy lifestyle. Knowledge levels might have played significant roles in promoting DSM practices among employed participants, which was corroborated in a recent study conducted in Riyadh city(25). Employment has been also associated with improved insulin use(26, 27), and this have caused a significant interaction to increase DSM scores among insulin users in our study. Finally, it was not surprising that obese patients had lower DSM scores than those with normal BMI values since the formers are more likely to be noncompliant to healthy lifestyle approaches. Importantly, demographic groups with low DSM scores, including unemployed patients, middle-aged and older adults, obese patients, and non-insulin users should be targeted in future health campaigns to promote their knowledge levels and improve their compliance to DSM practices, considering the established cultural and societal barriers.

Based on the findings, self-management in diabetes is a crucial aspect of patient management. A multidisciplinary approach should therefore entail patient-centered empowerment to support behavior change, particularly in terms of diet and physical activity related domains. Understanding patients' needs and priorities are warranted to provide relevant interventions based on autonomy motivation. Ultimately, diabetes self-management education and support would improve patients' clinical outcomes and quality of life and reduce healthcare costs(28, 29).

In conclusion, the levels of DSM were adequate as reported by the diabetic patients in Jeddah. However, based on HbA1c values, approximately half of the patients had poor glycemic control, and they scored lower DSM scores. In addition, distinct demographic groups adhered to adopting adequate DSM practices more frequently than their counterparts, such as young adults, employed participants, and insulin users, possibly due to their increased knowledge.

Limitations:

This study utilized the DSMS, which showed good to excellent reliability indices. However, there are limitations in the study design that need to be addressed in future work. Firstly, the inherent limitations of self-reported responses (response bias) remain apparent in this study. Secondly, the impact of DSM on complications was not clinically investigated, and the outcomes may not reflect those existing in other patient populations. Thirdly, although missing data analysis indicated that the data were missing completely at random, there is still a possibility of ascertainment bias. However, such data is exclusively related to BMI calculations, which might not impact the primary outcomes.

List of Abbreviations

DM: Diabetes Mellitus

HbA1c: Glycated Hemoglobin

T1DM: Type 1 Diabetes Mellitus

T2DM: Type 2 Diabetes Mellitus

DSM: Diabetic Self-Management

DSMS: Diabetic Self-Management Scale

IQR: Interquartile range

BMI: Body Mass Index

KAUH: King Abdul-Aziz University Hospital

KAH: King Abdul-Aziz Hospital

Declarations:

- **Ethics approval and consent to participate**

All eligible participants were informed about the objectives of the study, and the confidentiality of the data were assured to ensure privacy. Patients' data was exclusively utilized for research purposes. The study was carried out following applicable regulations of the King Abdul-Aziz University Hospital (KAUH), and ethical approval was obtained from the institutional review board (125-19). (HA-02-J-008) #No of Registration At National Committee of Bio. & Med. Ethics.

A written consent was taken from each participant after obtaining the ethical approval, which includes the permission to use written consent.

- **Consent for publication**

Not applicable

- **Availability of data and materials**

The data that support the findings of this study are available from Jeddah Care Center for Diabetes, King Abdul-Aziz Hospital. But restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Jeddah Care Center for Diabetes, King Abdul-Aziz Hospital.

- **Competing interests**

The authors declare that they have no competing interests.

- **Funding**

The authors no funding source to be declared.

- **Authors' contributions**

RA and SA designed and directed the study; AH, SI, SHA and MA contributed to data acquisition. SA and RA performed the statistical analysis. SA, RA, AH, SI, SHA and MA contributed to the interpretation of the results. All authors discussed the results and contributed to the final manuscript and provided critical feedback and helped shape the research, analysis and manuscript.

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Table 1: Demographic and clinical characteristics of the responding patients (n=349).

Parameter	Category	Frequency	Percentage
Gender	Male	178	51.00
	Female	171	49.00
Age	20-29	51	14.60
	30-39	49	14.00
	40-49	62	17.80
	50-59	81	23.20
	60-69	74	21.20
	70-79	32	9.20
Marital Status	Single	60	17.20
	Married	250	71.60
	Divorced	14	4.00
	Widow	25	7.20
Educational Level	Illiterate	61	17.50
	Primary	40	11.50
	Preparatory	38	10.90
	Secondary	109	31.20
	University	84	24.10
	Diploma	17	4.90
Occupational Status	Employed	163	46.70
	Unemployed	186	53.30
Income (per month)	≤ 3,000 SAR	145	41.50
	3,000-5,000 SAR	120	34.40
	5,000-10,000 SAR	53	15.20
	≥ 10,000 SAR	31	8.90
height (cm)	Mean ± SD	161.78	10.40
Body Weight (kg)	Mean ± SD	77.03	20.40
BMI	Mean ± SD	29.47	8.00
BMI category	Underweight	7	2.00
	Normal	78	22.30
	Overweight	134	38.40
	Class 1 Obesity	82	23.50
	Class 2 Obesity	22	6.30
	Class 3 Obesity	26	7.40
Type of diabetes	Type 1	94	26.90
	Type 2	255	73.10
Duration of diabetes	≤ 5 years	87	24.90
	6-10 years	141	40.40
	11-20 years	89	25.50
	≥ 21 years	32	9.20

Treatment Type	Oral only	180	51.60
	Oral and insulin	67	19.20
	Insulin only	100	28.70
	No treatment	2	0.60
Complications existence	No	309	88.50
	Yes	40	11.50
HbA1c (%)	Mean ± SD	8.08	1.69
Glycemic control	Good (HbA1c≤7%)	125	35.8
	Poor (HbA1c>7%)	224	64.2

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Table 2: The relationship between DSMS scores and demographic characteristics

Parameter	Category	DSMS score	
		Median (IQR)	**P**
Gender	Male	78.96 (69.58-85.10)	0.366 [M]
	Female	76.25 (66.67-85.42)	
Age	20-29	86.25 (76.25-91.25)	< 0.0001* [k]
	30-39	76.67 (65.21-87.08)	
	40-49	76.04 (61.98-82.50)	
	50-59	76.67 (64.79-83.33)	
	60-69	75.83 (70.83-84.17)	
	70-79	77.71 (66.35-83.96)	
BMI	Underweight	81.25 (72.92-87.92)	0.001* [k]
	Normal	83.13 (73.23-88.44)	
	Overweight	77.29 (68.13-86.25)	
	Obese	75.21 (65.31-82.08)	
Marital status	Married	77.71 (68.65-83.85)	0.026* [k]
	Single	83.13 (72.92-90.00)	
	Divorced	78.13 (64.38-86.77)	
	Widow	71.25 (65.42-82.50)	
Educational level	Illiterate	74.58 (66.25-83.33)	0.080 [k]
	Primary	72.08 (62.19-83.96)	
	Preparatory	76.04 (65.73-81.46)	
	Secondary	79.58 (71.25-86.04)	
	University	79.58 (68.02-89.48)	
	Diploma	79.58 (72.92-84.79)	
Occupational Status	Employed	80.00 (71.25-86.67)	0.003* [M]
	Unemployed	74.58 (66.25-83.33)	
Monthly salary	≤ 3,000 SAR	78.33 (67.50-85.00)	0.059 [k]
	3,000-5,000 SAR	78.96 (69.69-85.42)	
	5,000-10,000 SAR	78.75 (70.63-86.88)	
	≥ 10,000 SAR	72.50 (55.42-77.08)	
Duration of diabetes	≤ 5 years	76.25 (69.17-86.67)	0.645 [k]
	6-10 years	78.75 (69.58-85.21)	
	11-20 years	78.75 (64.58-84.38)	
	≥ 21 years	74.17 (67.50-84.17)	
Treatment type	Tablets only	77.29 (67.60-83.33)	< 0.0001* [k]
	Tablets and insulin	73.75 (65.42-83.33)	
	Insulin only	83.13 (72.92-90.42)	
	No treatment	72.50 (70.00-75.00)	

*IQR: interquartile range; K: the difference between groups was tested using Kruskal–Wallis H test; M: the difference between groups was tested using Mann–Whitney U Test (two-tailed test); * significant difference at P<0.05*

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Table 3: The relationship between DSMS scores and glycemic control (poor and good levels of HbA1c control) and the impact of self-management scores (as predictor variables) on quantitative HbA1c results.

Parameter	**Glycemic control**			**Univariate LRA**		**Multivariate LRA**	
	Good	**Poor**	**P** [M]	**β (95% CI)**	**P**	**β (95% CI)**	**P**
Dietary Control	80 (72.5-89.17)	75 (68.33-83.33)	0.002 *	-0.017 (-0.028, -0.005)	0.005 *	-0.014 (-0.025, -0.002)	0.018 *
Physical Activity	75 (54.17-87.5)	70.83 (50-79.17)	0.014 *	-0.013 (-0.021, -0.005)	0.001 *	-0.009 (-0.017, 0.0001)	0.042 *
Monitoring Blood Glucose	75 (55-85)	75 (55-80)	0.41	-0.008 (-0.016, 0.001)	0.073	NA	NA
Taking Medication	70.83 (25-100)	75 (38.54-95.83)	0.313	0.004 (-0.002, 0.01)	0.209	NA	NA
Foot Care	85.71 (75-100)	78.57 (72.32-92.86)	0.065	-0.007 (-0.015, 0.001)	0.088	NA	NA
Problem Solving	87.5 (81.25-90.63)	84.38 (75-90.63)	0.058	-0.008 (-0.02, 0.005)	0.23	NA	NA
Risk Reduction	86.54 (75-94.23)	82.69 (69.23-92.31)	0.251	-0.004 (-0.013, 0.005)	0.411	NA	NA
Overall	**80.83 (69.58-87.29)**	**76.67 (67.5-83.65)**	**0.038 ***	**-0.012 (-0.024, 0.001)**	**0.06**	**NA**	**NA**

*M: the difference between groups was tested using Mann–Whitney U Test (two-tailed test); * significant values at P<0.05; LRA: linear regression analysis; NA: not applicable*

Supplementary Files

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