ORIGINAL ARTICLE

Glycaemic control status among type 2 diabetic patients and the role of their diabetes coping behaviours: a clinic-based study in Tripoli, Libya

Sana Taher Ashur[1], Shamsul Azhar Shah[1], Soad Bosseri[2], Tong Seng Fah[3] and Khadijah Shamsuddin[1]*

[1]Department of Community Health, Universiti Kebangsaan Malaysia Medical Centre, Kuala Lumpur, Malaysia; [2]National Centre for Diabetes and Endocrinology, Tripoli, Libya; [3]Department of Family Medicine, Universiti Kebangsaan Malaysia Medical Centre, Kuala Lumpur, Malaysia

Background: Achieving good glycaemic control is important in diabetes management. However, poor glycaemic control is widely reported. This article assessed the prevalence of uncontrolled and poor glycaemic control among Libyans with type 2 diabetes and examined the relative contribution of diabetes coping behaviours to their glycaemic control status.

Methods: A cross-sectional study was undertaken in 2013 in a large diabetes centre in Tripoli. The study included 523 respondents. Diabetes coping behaviours were measured using the revised version of the Summary of Diabetes Self-Care Activities measure (SDSCA) and the eight-item Morisky Medication Adherence Scale (MMAS-8©), while glycaemic control status was based on the HbA1c level.

Results: Mean HbA1c was 8.9 ($\pm$2.1), and of the 523 patients, only 114 (21.8%) attained the glycaemic control target of HbAc1 of less than 7.0%. Females (OR = 1.74, 95% CI = 1.03–2.91), patients on insulin and oral hypoglycaemic agents (OR = 1.92, 95% CI = 1.05–3.54), patients on insulin (OR = 3.14, 95% CI = 1.66–6.03), and low-medication adherents (OR = 2.25, 95% CI = 1.36–3.73) were more likely to have uncontrolled and poor glycaemic control, while exercise contributed to glycaemic control status as a protective factor (OR = 0.85, 95% CI = 0.77–0.94).

Conclusion: The findings from this study showed the considerable burden of uncontrolled and poor glycaemic control in one of the largest diabetes care settings in Libya. Medication adherence as well as exercise promotion programs would help in reducing the magnitude of poor glycaemic control.

Keywords: *diabetes mellitus*; *glycaemic control*; *HbA1c*; *medication adherence*; *self-care activities*; *diet care*; *exercise*; *foot care*; *blood glucose testing*; *Libya*

*Correspondence to: Khadijah Shamsuddin, Department of Community Health, Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaacob Latif, Bandar Tun Razak, Cheras 56000, Kuala Lumpur, Malaysia, Email: Khadijah@ppukm.ukm.edu.my

Diabetes mellitus is among the most common non-communicable diseases. The Middle East and North Africa (MENA) region suffers a high prevalence of diabetes (1). Libya is one of the MENA countries, and according to the International Diabetes Federation estimates, the prevalence of diabetes among adults in Libya is 9.86% (1). However, the Libyan national non-communicable diseases survey in 2009 reported a prevalence of diabetes of 16.4% (2). These figures show a significant burden to the Libyan health care system.

Achieving good glycaemic control is an important target in diabetes management. Research has shown that poor glycaemic control was associated with diabetes complications (3, 4), while the decrease in glycosylated haemoglobin level reduced the risk of developing diabetes-related morbidities (3, 5). Glycaemic control as measured by glycosylated haemoglobin (HbA1c) is one of the clinical indicators of the quality of diabetes care (6, 7) that has been widely used (8, 9). Specifically, HbA1c is one of the markers of the intermediate outcome component of diabetes care quality (6, 7).

However, poor glycaemic control is widely reported. Several studies showed low frequencies of good glycaemic control among T2DM patients (10–14). A multinational study that involved insulin-treated type 2 diabetics from 28 countries showed that the failure to achieve optimal

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glycaemic control is a global issue (15). In Africa, an Ethiopian study reported a poor glycaemic control prevalence of 81.7% among insulin-treated diabetics (12). Levels of poorly controlled diabetes are high in the Arab countries. A study among type 2 diabetic Lebanese reported that only 31.8% of them had achieved the glycaemic control target (13). In an Omani study among type 2 diabetics in Muscat, 46% had controlled diabetes (16), while in a national sample of T2DM patients, only 30% of the patients had good control (17). In Libya, a study conducted in the largest diabetes centre in Benghazi reported an alarmingly higher prevalence of poorly controlled diabetes (79.8%) among T2DM patients (18) than those reported in several Arab countries.

Diabetes is amenable to control. Strategies based on Chronic Care Model (CCM) have been proven to be an effective approach in improving diabetes control at primary care settings (19). CCM requires a comprehensive change in health services for diabetic control for optimal results. However, improvement in individual components in the CCM approach is also shown to have positive impacts on diabetic control, albeit with varying effects in different contexts (19). Self-management support is one of the six pillars in the CCM approach (19). The importance of self-management concurs with several studies that demonstrated that glycaemic control could be achieved through medication adherence as well as the engagement in a set of self-care practices (20, 21). However, some studies could not show the impact of some self-care practices on diabetes control (11, 12, 14). For instance, in a Malaysian study among type 2 diabetics, self-care behaviours like exercise and dietary engagement were not associated with glycaemic control status (11). In an Ethiopian study among insulin-treated diabetics, adherence to dietary recommendations of eating vegetables and fruits contributed to glycaemic control, but being adherent to insulin and self-care was not a predictor of good glycaemic control status (12).

This article looked at the glycaemic control status and impact of diabetes coping behaviours on diabetes control among type 2 diabetic Libyans attending a large diabetic centre in Tripoli, Libya. We estimated the prevalence of uncontrolled and poor glycaemic control and investigated the role of diabetes coping behaviours, focusing on diet care, exercise, foot care, blood glucose testing, and medication adherence. Specifically, the article aimed to assess the relative contribution of these coping behaviours to glycaemic control status in the Libyan context, after controlling for selected socio-demographic and clinical characteristics.

Methodology

The study is a part of a larger diabetes research that investigated diabetes perceptions (22), behaviours and glycaemic control in the Libyan diabetes context. This research was approved by the Universiti Kebangsaan Malaysia Research and Ethics Committee, and permission to conduct the study was also obtained from the management of the National Centre for Diabetes and Endocrinology (NCDE) in Tripoli. A cross-sectional survey was undertaken at the NCDE in the period from October 2013 to December 2013. The NCDE provides diabetes follow-up services at its outpatient clinics to diabetic patients, especially from Tripoli.

The sample size was calculated using Fleiss formula (23). We calculated the minimum sample size needed for testing a difference in the prevalence of poor glycaemic control across males and females, where sex is one of the control variables in our study. Calculations were based on a proportion of poor control among females of 58% and a proportion of poor control among males of 45% (24), with margin of precision at 5%, and a power of 80%. The calculated sample size was 498, but 150 was added to cater for a 30% anticipated non-eligibility and non-response. Therefore, the required sample size for the study was 648. Respondents were recruited at the waiting area of the laboratory, where the patients first commute before proceeding into the follow-up clinics. Systematic random sampling was used in patient recruitment, and every fourth patient was approached and invited to participate in the study. Eligible patients included type 2 diabetic Libyans, with a diabetes history of at least one year. Other eligibility criteria were age of 18 years and above, ability to read and write in Arabic, and absence of any visual impairment that could prevent independent self-reporting. Exclusion criteria were being on dietary plan only, being very ill, and having a cognitive impairment. Pregnant women were also excluded. Participation in the study was voluntary, and all potential respondents were provided with a briefing on the study, reassured on the confidentiality, and informed about their participation and withdrawal rights. Written consents were required from eligible patients who agreed verbally to participate.

Measures

Self-reporting questionnaire was used for data collection. It included socio-demographic and diseases profile data sheet, the revised Summary of Diabetes Self-Care Activities scale (SDSCA), and the eight-item Morisky Medication Adherence Scale (MMAS-8©).

The data sheet was meant to collect data on the socio-demographic characteristics and the disease profile of the respondents, specifically on age, sex, marital status, education, employment, income, duration of diabetes, current diabetes medications, number of long-term medications other than those for diabetes, and presence or absence of co-morbidity.

The respondents were also required to report their latest glycosylated haemoglobin (HbA1c %) result (3 months

and less), which was verified during the collection of the completed questionnaires through viewing the laboratory results brought by the patients for follow-up. Glycaemic control status was defined according to the HbA1c target of <7% as recommended by the American Diabetes Association for non-pregnant adults (25). Accordingly, HbA1c level of <7.0% was defined as 'good glycaemic control'. HbA1c level in the range from 7.0 to 8.0% was defined as 'uncontrolled' diabetes, while HbA1c level of >8.0% was defined as 'poor' glycaemic control.

The revised Summary of Diabetes Self-Care Activities

The revised Summary of Diabetes Self-Care Activities (SDSCA) is a brief measure of a group of diabetes self-care activities (26). The core part of this scale comprises of 11 items. The first 10 items measure the level of diet care (general and specific), exercise, blood glucose testing, and foot care. Each of these items is about performing a specific activity in the last one week, and is attached to an eight-point scale (0–7). Scoring is done by taking the mean number of days across the items representing each activity. The higher the mean number of days per week, the higher the level of performing that activity. The revised SDSCA scale is in public domain, though permission to use in this project was obtained from the author (26). The core part of the scale was translated into Arabic by two bilingual translators using a foreword-backward method. Prior to the main study, the Arabic version was pretested for its content validity by a group of Libyan experts and then distributed to 10 diabetic Libyan patients to assess its face validity. A few amendments were considered to improve the clarity of the version. The produced version was then piloted on 125 diabetic patients on follow-up at the NCDE. Out of the 125 distributed questionnaires, only 101 relevant questionnaires were returned and considered for analysis. With the exception of specific diet, all of the other subscales showed adequate internal consistency and split-half reliability. Alpha coefficient ranged from 0.648 for foot care subscale to 0.936 for general diet subscale, and the average inter-item correlations were optimal and ranged from 0.507 for foot care subscale to 0.884 for general diet subscale. An exploratory factor analysis using principal component analysis was run to evaluate the construct validity. The factor structure was similar to the original scale except for the deletion of items 3 and 4. Item 3 is about the consumption of fruits and vegetables, while item 4 is about fat foods intake, the two items represent the specific-diet aspect of diabetes self-care in the English version. Thus, the final solutions were general diet, exercise, blood glucose testing, and foot care. Similarly, the specific diet subscale had displayed poor reliability (27) and factor loading issues (27, 28) in some other versions, like in the Malay version (27), and the

Arabic version that was produced and evaluated in the Saudi diabetes context (28).

The eight-item Morisky Medication Adherence Scale

The eight-item Morisky Medication Adherence Scale (MMAS-8) is a self-reporting medication adherence tool, which is a valid, unidimensional scale, with eight items (29, 30). MMAS-8 is a widely used instrument, and its few-item construct is helpful when data are collected in busy clinical settings (31). Each of the first seven items has two possible responses (yes or no), while the eighth item is attached to a five-response Likert scale. The total medication adherence score could range from zero to eight. A total score of less than 6 refers to low adherence, a total score that ranges from 6 to below 8 refers to moderate adherence, while a score of 8 refers to high adherence (29). An Arabic version of MMAS-8 was obtained with permission from the copyright owner. This version displayed satisfactory reliability and known group validity when tested in a sample of type 2 diabetic Libyans (32).

Data analysis

The Statistical Package of Social Science (SPSS), release 22, was used to perform data analysis. Preliminary data analysis, which included management of missing data, was conducted. The percentage of cases with missing data on HbA1c was 8.6%. Cases with missing values on this variable were removed using list wise deletion. List wise deletion was deemed appropriate for our data as the percentage of cases with missing values on HbA1c was below 10% (33). Frequency and percentage were used to summarize categorical variables, while mean (SD) was used to describe the continuous variables. Chi-square and independent t-tests were used to test the bivariate association between the independent variables and glycaemic control status (good vs. uncontrolled and poor). The variables that displayed associations with glycaemic control status with a p-value ≤ 0.25 were included in the multiple regression analysis. A hierarchical logistic regression model was built to test for the contribution of behavioural variables to glycaemic control status (good vs. uncontrolled and poor). Statistical significance was based on $p < 0.05$.

Results

Out of the 648 patients approached, 566 (87.3%) patients were eligible and agreed to participate in the study. Only 525 (81.0%) completed questionnaires were received and two were excluded for probably being type 1 diabetes. Thus, 523 (80.7%) questionnaires were considered for analysis. The average age of the patients was 54.4 years (± 10.0), and 58.9% of them were women. Mean HbA1c was above 7.0%, and of the 523 patients, only 21.8% had

good glycaemic control. The remaining respondents had either uncontrolled diabetes (14.9%) or poor control (54.7%). Low-medication adherers represented 36.1%, and the best-practiced self-care activity was diet care, with mean days of practicing of 2.9 ($\pm$2.6) per week, while the least practiced activity was blood glucose testing with mean days of practicing of 1.2 ($\pm$1.9) per week (Table 1).

Several socio-demographic and disease profile variables displayed statistically significant associations with glycaemic control status. Being female ($p = 0.002$), unmarried ($p = 0.024$), having primary education level ($p = 0.022$), and being unemployed ($p = 0.041$) were significantly associated with uncontrolled and poor glycaemic control (HbA1c $\geq$7). The frequency of patients with uncontrolled and poor glycaemic control was significantly higher among the respondents who were on insulin only or on insulin and oral hypoglycaemic agents (OHA) than among those who were on OHA ($p < 0.001$). A significant difference in duration of diabetes was reported across the good control group and the uncontrolled and poor control group ($p < 0.001$). Medication adherence was significantly associated with glycaemic control status ($p = 0.008$), and a statistically significant difference in the mean days of exercise engagement per week was observed across the good control group and the uncontrolled and poor control group ($p < 0.001$) (Table 2).

In multivariate analysis (Table 3), a hierarchical logistic regression model was built for the predictors of uncontrolled and poor glycaemic control (HbA1c $\geq$7). All socio-demographic and disease profile variables that showed bivariate associations with glycaemic control status with $p \leq 0.25$ were entered in the first step model. Based on the block Omnibus test, the contribution of this model to uncontrolled and poor glycaemic control variance compared with the model with the constant was significant ($\triangle \chi^2$ (df) = 39.726 (8), $p < 0.001$). This model explained 12.0% of the variance of this outcome. In the second step, all the behaviours that displayed bivariate associations with glycaemic control status with $p \leq 0.25$ were entered in the model. The addition of these behavioural variables improved the model predictivity significantly as indicated by a significant chi-square increment ($\triangle \chi^2$ (df) = 25.431 (3), $p < 0.001$). This model explained an additional 7.1% of the variance of uncontrolled and poor glycaemic control. The model showed four significant predictors of uncontrolled and poor glycaemic control outcome, and these were sex, type of diabetes medications, medication adherence, and exercise. Females were almost twice more likely to have uncontrolled and poor glycaemic control than males (OR = 1.74, 95% CI = 1.03–2.91). Patients who were on insulin and OHA were almost two times more likely to have uncontrolled and poor control than those who were on OHA (OR = 1.92, 95% CI = 1.05–3.54), while patients who were

Table 1. Socio-demographic characteristics, disease profile, diabetes coping behaviours and glycaemic control status ($n = 523$)

Variable	f	%
Age (years) (mean $\pm$ SD)	54.4	$\pm$10.0
Sex		
Male	215	41.1
Female	308	58.9
Marital status		
Married	402	76.9
Not married	121	23.1
Level of education		
Primary	304	58.1
Secondary and higher	219	41.9
Employment status		
Employed	142	27.2
Unemployed	381	72.8
Income (LD)		
Low (600 and less)	394	75.3
Moderate–high ($>$600)	129	24.7
Diabetes duration (years) (mean $\pm$ SD)	9.4	$\pm$7.3
Diabetes medications		
OHA	199	38.1
Insulin only	154	29.4
Insulin and OHA	170	32.5
Glycaemic control[a] (mean $\pm$ SD)	8.9	$\pm$2.1
Good (HbA1c $<$7.0%)	114	21.8
Uncontrolled (HbA1c 7.0–8.0%)	78	14.9
Poor (HbA1c $\geq$8.0%)	286	54.7
Unknown	45	8.6
Presence of co-morbidities		
Absent	215	41.1
Present	308	58.9
Number of long-term medications other than those for diabetes		
0 (only on diabetes medications)	255	48.8
1–2	217	41.5
3 or more	51	9.8
Medication adherence		
Low (score less than 6)	189	36.1
Moderate and high (score of 6 and higher)	334	63.9
Self-care level (days/week) (mean $\pm$ SD)		
General diet	2.9	$\pm$2.6
Exercise	2.5	$\pm$2.3
Blood glucose testing	1.2	$\pm$1.9
Foot care	2.3	$\pm$2.6

[a]478 valid case; SD, standard deviation; LD, Libyan dinars; OHA, oral hypoglycaemic agents.

on insulin alone were three times more likely to have uncontrolled and poor control than those who were on OHA (OR = 3.14, 95% CI = 1.66–6.03). The respondents who were low adherents to their medications were twice

Table 2. Glycaemic control status by socio-demographic characteristics, disease profile and diabetes coping behaviours, and their bivariate associations ($n = 478$)[a]

Variables	Good (HbA1c <7%)		Uncontrolled-poor (HbA1c ≥7)		χ^2	p
	f	%	f	%		
Socio-demographic factors						
Age (years) (mean ± SD)	55.3	± 10.5	54.2	± 9.6	−1.0[b]	0.284
Sex						
Male	60	31.1	133	68.9		
Female	54	18.9	231	81.1	9.3	0.002**
Marital status						
Unmarried	18	15.9	95	84.1		
Married	96	26.3	269	73.7	5.1	0.024*
Education						
Primary	55	20.0	220	80.0		
Secondary and higher	59	29.1	144	70.9	5.2	0.022*
Employment status						
Employed	40	30.3	92	69.7		
Unemployed	74	21.4	272	78.6	4.1	0.041*
Income (LD)						
Low (600 and less)	78	21.9	278	78.1		
Moderate−high (>600)	36	29.5	86	70.5	2.8	0.089
Disease profile						
Diabetes duration (years) (mean ± SD)	7.3	± 7.0	10.0	± 7.2	3.5[b]	0.001***
Diabetes medications						
OHA	67	36.8	115	63.2		
Insulin only	20	14.1	122	85.9		
Insulin and OHA	27	17.5	127	82.5	27.6	0.001***
Presence of co-morbidity						
Absent	45	22.4	156	77.6		
Present	69	24.9	208	75.1	0.4	0.523
Number of long-term medications other than those for diabetes						
0 (only on diabetes medications)	55	23.6	178	76.4	0.1	0.911
1−2	49	24.6	150	75.4		
3 or more	10	21.7	36	78.3		
Diabetes coping behaviours						
Medication adherence						
Low	33	17.5	156	82.5	7.0	0.008*
Moderate and high	81	28.0	208	72.0		
General diet (mean ± SD)	3.3	± 2.9	2.8	± 2.5	−1.9[b]	0.055
Exercise (mean ± SD)	3.3	± 2.6	2.3	± 2.2	−3.7[b]	0.001***
Blood glucose testing (mean ± SD)	1.1	± 1.8	1.2	± 2.0	0.6[b]	0.502
Foot care (mean ± SD)	2.5	± 2.7	2.3	± 2.5	−0.7[b]	0.470

*p < 0.05; **p < 0.01; ***p < 0.001; [a]478 valid cases with HbA1c value; [b]t-statistic 'independent t-test'; SD, standard deviation; LD, Libyan dinars; OHA, oral hypoglycaemic agents.

more likely to have uncontrolled and poor controlled diabetes compared with those who were moderate and high adherents (OR = 2.25, 95% CI = 1.36–3.73). Exercise contributed to glycaemic control status as a protective factor, with each one day increase in the mean days of exercise per week showing 15% (OR = 0.85, 95% CI = 0.77–0.94) decrease in the odds of uncontrolled and poor glycaemic control.

Table 3. Hierarchical multiple logistic regression model of uncontrolled and poor glycaemic control predictors ($n = 478$)[a]

Variable	Model 1		Model 2	
	Adj. OR (95% CI)	p	Adj. OR (95% CI)	p
Step 1: SD and disease profile				
Female versus males	1.73 (1.06–2.84)	0.028*	1.74 (1.03–2.91)	0.036*
Married versus unmarried	0.71 (0.39–1.31)	0.282	0.73 (0.39–1.36)	0.332
Secondary and higher versus primary education	0.85 (0.51–1.41)	0.538	0.75 (0.44–1.27)	0.288
Unemployed versus employed	0.95 (0.51–1.76)	0.882	1.08 (0.57–2.04)	0.797
Moderate–high versus low income	0.90 (0.50–1.61)	0.724	0.93 (0.51–1.71)	0.831
Diabetes duration (years)	1.02 (0.98–1.06)	0.225	1.02 (0.98–1.06)	0.228
Insulin only versus OHA	3.08 (1.65–5.72)	0.001***	3.17 (1.66–6.03)	0.001***
Insulin and OHA versus OHA	2.06 (1.15–3.71)	0.015*	1.92 (1.05–3.54)	0.034*
Constant	1.71			
Step 2: Behaviours				
Low versus moderate and high medication adherence			2.25 (1.36–3.73)	0.001**
General diet (mean days/week)			0.94 (0.86–1.03)	0.223
Exercise (mean days/week)			0.85 (0.77–0.94)	0.002**
Constant			2.24	

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; [a]478 valid cases with HbA1c value; SD, socio-demographic characteristics; OHA, oral hypoglycaemic agents.

Discussion

This study showed a considerable prevalence of unsatisfactory glycaemic control among Libyan type 2 diabetics who were on follow-up at the NCDE. Overall, those who had uncontrolled and poor control constituted 69.6% of the sample. This prevalence is lower than the 79.8% that was reported in a previous Libyan study among type 2 diabetic patients in Benghazi, Libya (18). Also, in another study in Benghazi Diabetes Centre among a mixed sample of type 2 and type 1 diabetics, the percentage of those who achieved the target HbA1c was only 14%, and the mean HbA1c was 9.4 (SD = 2.3), which is higher than that reported in this current study (34). The comparison of our findings with these two previous Libyan studies could reflect an improvement in diabetes care services in Libya, as indicated by the improvement in one of the outcome indicators of quality of diabetes care, the HbA1c level. However, as our findings could only be generalized to type 2 diabetics who attended the NCDE, the difference in unsatisfactory glycaemic control levels between our findings and Roaeid and Kadiki (18) and Elkharam et al. (34) findings might be merely due to the differences between the studied samples. Furthermore, unlike in our study, Roaeid and Kadiki (18) used average fasting plasma glucose and/or post-prandial plasma glucose as markers of glycaemic control status. Nevertheless, the findings from this study and the other two previous Libyan studies confirmed the high magnitude of poor control in the Libyan diabetes care settings. The reported prevalence of uncontrolled and poor controlled diabetes was higher than that reported in some other Arab settings, like 54% in an Omani study (16).

Several of the socio-demographic characteristics showed associations with glycaemic control status. However, with the exception of sex, all these associations disappeared in the adjusted analysis. Some previous research also did not support the role of the socio-demographic characteristics as determinants of glycaemic control (14, 35). Female patients were more likely to have uncontrolled and poor glycaemic control than males. This contradicts the expectations, because based on the finding from the same studied population, Libyan diabetic females were more likely to be adherent to their medications (22), and consequently, they are anticipated to have better controlled diabetes. However, the higher odds of poor control among females could have been driven by a third factor that was not covered by the study. A possible factor is the Body Mass Index (BMI). Obesity and the increase in BMI were reported to be associated with poor glycaemic control, but not with medications non-adherence in type 2 diabetes (36). In Libya, the national non-communicable diseases survey in 2009 showed that both overweight and obesity were more common in women than in men (2). Therefore, perhaps, obesity was the factor that makes females less likely to achieve better control despite being more adherents to medications. Unlike in our study, in an Omani study, type 2 diabetic females were more likely to have better diabetes control (16).

Type of diabetes medication was the only diabetes profile predictor of glycaemic control status. Compared with those who were still on oral medications, insulin-treated patients (on combined OHA and insulin or on insulin alone) were more likely to have uncontrolled and

poor controlled diabetes. The odds of uncontrolled and poor glycaemic control were even higher among those who were on insulin only than among those who were on the combined medications. The interpretation of this finding should consider both study design and the pathophysiology of diabetes. Basically, those who were on oral agents were those who did not require exogenous insulin yet, while those who were on insulin were those who had been shifted to exogenous insulin to control their high HbA1c levels. The cross-sectional design does not help in judging the direction of causality. Like in this study, several other research identified medication type as a predictor of glycaemic control (13, 16, 20). In an Omani study, type 2 diabetics who were on combined treatment of OHA and insulin were more likely to have poor controlled diabetes than those on OHA (16), and in a study in Lebanon, both insulin users and sulphonylurea users were more likely to have poor control (13). Similarly, a study in the United States found that type of diabetes regimen influenced HbA1c level among older adults with type 2 diabetes (20).

The relevance of diabetes coping behaviours to glycaemic control over the socio-demographic characteristics and disease profile was confirmed through the hierarchical model building approach. The final model identified two behaviours as predictors of control status, and these were medication adherence and exercise level. The contribution of both behaviours was in the theoretical expected direction. The relative contribution of medication adherence to glycaemic control status was higher than that of exercise. The importance of medication adherence as a predictor of glycaemic control was also shown by several previous studies (36, 37). Likewise, the relevance of exercise level for better diabetes outcomes was shown by other research, for instance, a study in the United States among type 2 diabetics identified physical activity as an independent predictor of lower HbA1c levels among patients who were in the middle age and older adults age categories (20).

Uncontrolled and poor control group had lower level of diet care and foot care than their counterpart, the good control group. However, these practices did not show a significant contribution to glycaemic control status in our sample. The failure to report a contribution of self-care behaviours to glycaemic control is not uncommon in the published literature (11, 14). In a study in Palestine among type 2 diabetic patients, self-care did not predict glycaemic control (14), and a Malaysian study among type 2 diabetics in primary care settings did not found that self-management behaviour contribute to glycaemic control status (11). Although this study demonstrated medication adherence and exercise are the only two significant behavioural predictors to glycaemic control, appropriate dietary pattern is still important because dietary advice to diabetic

patients has been shown to result in improvement in diabetic control (38). The reason why this contribution to glycaemic control status was not evident in this sample is likely due to the very low level of practising these activities among participants. Hence, interventions targeting medication adherence and exercise are reasonable measures to improve diabetic control, and much still has to be done to encourage dietary modification among diabetic patients.

Limitations

The study has some limitations worth noting. The cross-sectional nature of the study precludes inferring causality. Another flaw in methods is the use of self-reporting for data collection. Besides the bias inherently associated with this approach, it precluded the inclusion of diabetics who were unable to independently complete the survey; therefore, illiterates and those with low visual acuity need to be considered in further research that use face-to-face interviews. Although several criteria were used to identify the patient as eligible to participate, some factors that could influence glycaemic control like being on corticosteroids were not used. Another limitation of this study is that the HbA1c results brought by patients for follow-up were from different laboratories, because of the unavailability of the test in the Centre in the period when this study was conducted. Furthermore, as the study was conducted in one centre, this precludes the generalizability of the findings to all Libyans with T2DM. Despite these caveats, the study has several strengths that make its findings sound and robust. The use of systematic random sampling technique allows generalization of the findings to the source population, Libyans who have T2DM who were on follow-up at the NCDE during the period of study. In addition, the psychometric soundness of the scales included in the questionnaire was ensured prior to their use in the study. Although there is much remains to be done, our findings contributed to diabetes research in Libya and the MENA region and believed to impact diabetes practice in Libyan diabetes care settings.

Conclusion

The findings from this study showed a considerable prevalence of uncontrolled and poor glycaemic control among Libyans with T2DM in one of the largest diabetes care settings in Libya. Medications adherence was the most important behavioural predictor of glycaemic control, followed by exercise. Therefore, medication adherence as well as exercise promotion programs would help in reducing the magnitude of poor glycaemic control. Females and insulin-treated patients were identified as in-need groups and should be considered in future interventions. The findings pointed out to that much remains to be done. Further research is suggested to investigate

feasibility of interventions addressing self-care issues in Libya, which has its unique culture and values.

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