Self-Care Behaviours and Glycemic Control among Adults with Type 2 Diabetes

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Abstract - **Aim: To explore self-care behaviours and glycemic control among adults with type 2 diabetes. Design: A descriptive cross-sectional design was used for the study. Methods: The revised summary of diabetes mellitus questionnaire was used to collect data and glycated haemaglobin. A random sample comprising of 350 Omani adults with type 2 diabetes were selected between January-June 2010. Structural equation modelling and ANOVA were used for analysis. Results/Findings: One-third of the adults with type 2 diabetes followed diet, foot care and medications (on an average of 3 days/7 days) compared to half percentage of them adhering to foot care. 27% of the total variance in self-car activities was accounted by diet, 32% by exercise and 17% by medications. Blood glucose monitoring, foot care, and smoking and HbA1c accounted for 60%, 78%, and 51% variances. The standardized path coefficients of diet, exercise, smoking, foot care, blood sugar monitoring and medications had a significantly positive influence on self-care behaviours. Conclusion: There were inadequate self-care behaviours among the majority of adults with type 2 diabetes with poor glycaemic control. Nurses should use the self-care management model when designing tailored educational interventions to enhance glycemic control.**

Key words- self-care management; self-care behaviours; glycemic control; type 2 diabetes; nurse; nursing.

Key points

1. Younger age groups, females, high school education, excellent knowledge of diabetes and management and short duration of diabetes have good glycemic control.
2. Socio-cultural norms and gender play a role in low adherence to medication, diet and exercise and low glycemic control among Omani adults with T2D.
3. Barriers to self-care are decreased ability to adjust insulin dosages, increased fat and red meat intake and decreased physical activity affect self-care among T2D.
4. Nurse educators should understand the different socio-cultural practices and self-care behaviors affect glycemic control among Omani adults.

I. INTRODUCTION

The burden of chronic diseases is profoundly affecting developing nations. Diabetes mellitus (DM) is a chronic illness where adults need to maintain self-management behaviors for life. Nearly 80% of the world's 250 million people with Diabetes Mellitus (DM) reside in developing countries [1]. Unhealthy lifestyle behaviours and socio-economic changes have contributed to an increase in the incidence of T2DM to a rate of 13.2% and its complications [2]. The peak rate of DM prevalence is found in the Middle East countries [3] with 12.5% of adults aged 20–79 years (32.8 million). This prevalence is likely to double in 20 years [2]. Tight metabolic control can delay or prevent the progression of complications and disability limitation associated with type 2 diabetes mellitus (T2DM) [4, 5]. Preservation of normal glycemic control is needed to diminish the risk of complications related to T2DM [6] through appropriate food choices, physical activity, medications, and glucose monitoring.

There will be an estimated 190% increase in the number of people with DM in Oman over the next 20 years [7]. The prevalence of DM in Oman is among the top 10 countries in the world [2, 3]. The prevalence of T2DM increased from 12% to 22% of the population from 1990 to 2011 [8, 9]. There are more than 170,000 with DM and similar cases not yet diagnosed [10, 11]. It is estimated that by 2030 the rate of DM will double in the Oman [3]. Oman has had high rates of diabetes-related complications like diabetic retinopathy (14%), micro albuminuria (27%), and amputations (50%) compared to the Middle East countries. Hence T2DM requires behavioral change and adequate self-care practices (lifestyle, physical activity and dietary habits) for better glycemic control [12].

A. Background

Self-care behaviours (SCB) and behavioral strategies help to promote lifestyle changes among T2DM [1]. Adults above 60 years with T2DM were completely compliant with the use of medication, diet and self-glucose monitoring and least compliant to exercise [8]. 60% of them reported that diet self-efficacy was a barrier to glycemic control. The mean number of days per week for diet behavior was 3.16 and for exercise were 3.34 among T2DM [3]. 82% of the

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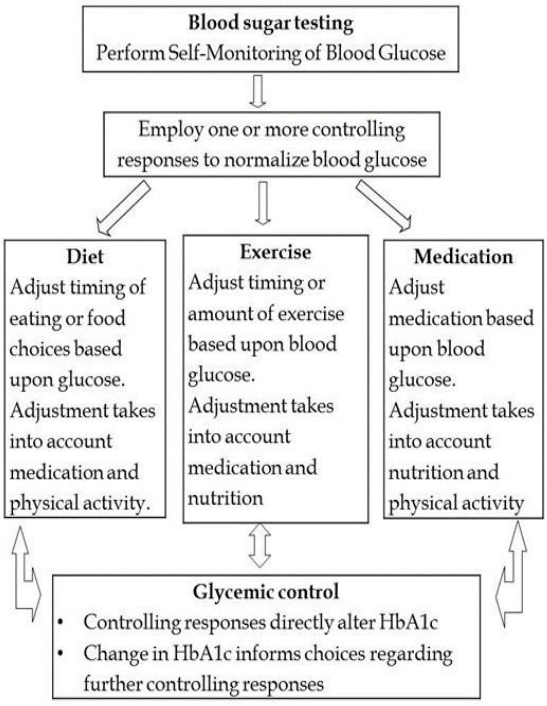
T2DM reported poor diet behaviors while 52% of them reported reduced exercise behaviors. Efficacy with self-care management by persons with T2DM will enable them to manage their illness [14, 15]. Hence SCB is crucial to maintain near-normal glycaemic control among Omani adults.

B. Conceptual Model

The self-care deficit nursing (SCDN) Theory developed by Dorothea Orem was adopted to appreciate the SCB among Omani adults with T2DM (Figure 1). People want to take care of themselves [16], their needs related to T2DM (universal self-care requisites), needs that relate to their development (developmental self-care requisites), and needs arising from their illness (health deviation requisites) [17]. The four concepts integrated were self-care activities, self-care agency's ability to perform self-care, self-care requisites and therapeutic self-care demand [18]. This model identifies adults with T2DM who are unable to meet his/her own self-care requisites. Thus the nurses can evaluate their needs, plan and provide appropriate self-care management [19].

Figure 1. Diabetes self-care management behaviours among Omani adults



C. Significance

There is a lack of comprehension of determinants associated with self-care behaviours among Omani adults with T2DM. The importance of regular follow-up among Omani adults with T2DM with the diabetes nurse educators (DNE) is significant in averting any long term complications since they provide direct care in the diabetes clinics. However, the perception of adults with T2DM regarding their self-care are important to encourage participation in decision-making in daily activities. This study explores the perceptions of adherence to SCB and its associated factors among Omani adults with T2DM. These findings will be needed to collate socio-cultural factors that influence glycosylated haemaglobin (HbA1c) for improving the quality of life.

D. Aim

The aim of the study was to determine the self-care behaviours and glycemic control among Omani adults living with Type 2 Diabetes Mellitus.

II. METHODOLOGY

A. Design

A cross-sectional design was conducted among adults with T2DM in the outpatient clinics at a public hospital.

B. Sample/Participants

Accessible population included 2000 adults with T2D registered at the diabetes clinics for checkups and controlling blood glucose in a selected public hospital during 2010. For structural equation modelling to test the path model, 300 participants were adequate [20, 21]. A random sample of 350 adults with T2DM was recruited in the diabetes clinic to reduce loss of data. Inclusion criteria were adults aged above 18 years diagnosed with T2DM since 2 years and those who were able to understand, communicate or converse in Arabic language. The exclusion criteria were undiagnosed type 1 diabetes, or cognitive impairment, physical disability, or life threatening complications of T2DM.

C. Data collection

Data were collected using a standardized survey after the pilot study between March- June in 2010.

The Revised Summary of Diabetes Self-Care Activities Scale (SDSCA): The SDSCA was used to assess aspects of the self-care management skills of the participants. The SDSCA scale is a self-reporting measure of the frequency of performing 13 diabetes self-care tasks and consisted of six subscales of the DSM behaviors: diet, exercise, blood glucose testing, medication taking, foot care, and smoking behavior [22]. The SDSCA asked the subjects to report on an 11-item questionnaire, the frequency in which they perform the above-mentioned self-care behaviors over the prior 7 days. If they were sick during the past 7 days, they were asked to reflect on the 7 days before they became sick. Inter-item correlations ranged from r = 0.20-0.76 (mean=0.47) for four SDSCA subscales and 6-month test-retest reliability ranged from r = 0.00-0.58 (mean= 0.40).

Factor analyses showed a three-factor structure accounting for 70–80% of variance, with food, exercise, and blood glucose testing items defining the factors [22].

Validity and reliability: The SDSCA tool was translated to Arabic and given to the three experts (endocrinologist, diabetes nurse educator and nursing professor) for examining the content validity. The experts were asked to rate each item of each scale on feasibility and relevance on a 4-point rating scale. The number of items rated from 3 to 4 by experts divided by the total numbers of items was calculated as the content validity index (CVI) of the scale. The validated Arabic questionnaires were administered to 20 adults with T2DM twice in a 2-week interval. Inter-item correlations ranged from $r = 0.75$ to $r = 0.86$ for four SDSCA subscales and item-to-total correlations ranged from 0.77 to 0.91 for the SDSCA. Internal consistency of the SDSCA demonstrated moderate internal consistency ($\alpha = 0.87$). The reliability test indicated that the SDSCA was acceptable.

Clinical characteristics: HbA1c value was characterized into good glycemic control ($\leq$7%) and poor glycemic control (>7%) using a chromatography automated chemistry analyzer. Studies show glycemic control values $\leq$ 48 mmol/mol (6.5%) [23, 24] (Ford, 2005, Wild et al., 2004) or $HbA_{1c} \leq 53$ mmol/mol (7.0%) are recommended as a treatment goal. Body mass index (calculated as weight in kilograms divided by the square of height in meters [Kg/m2]) was considered as underweight ($\leq$18.5Kg/m^2), normal (BMI 18$\leq$25Kg/m^2), overweight (BMI 25$\leq$30Kg/m^2) and obese (BMI $\geq$30Kg/m^2). Waist-hip ratio $\geq$0.90 for males and $\geq$0.85 for females were considered as a risk factor of increased HbA1c [25].

Socio-demographic characteristics: This tool was used to describe the characteristics among adults with T2DM like age, gender, formal education, smoking, duration of T2DM diagnosis, diabetes education.

D. Ethical Considerations

Ethical approval was provided by the College of Nursing Ethics Committee and Sultan Qaboos University Hospital. Written and verbal consent was attained from each participant, after providing a written letter describing the purpose of the study, the risk and benefits of participation, the instructions and questionnaires. Participants were guaranteed of voluntary participation and free will to withdraw from the study at any time without any consequences on their medical care. Anonymity was preserved between the investigator and the participant. Informed consents and filled-in questionnaires were protected discretely. Confidentiality was retained by allocating code numbers and re-assigned codes to the data files.

E. Data analysis

The Statistical Packages for Social Sciences (SPSS) version 22 was used for comparing data, analysis and audited for accuracy. A confidence value of 95% and probability of <0.05 was considered statistically significant for all tests. Descriptive summaries of socio-demographic and clinical characteristics were used. ANOVA was used to determine the factors associated with glycemic control. A level of significance at 0.05 with t-value >1.96 was considered important for the study. The hypothesized path model was tested with structural equation modelling (SEM). The 18.0 version of Analysis of Moment Structure (AMOS; SPSS Taiwan Corp.) was used for SEM. Model fit was assessed using chi-square, comparative fit index (CFI), normed fit index (NFI) and the root mean square error of approximation (RMSEA). A model was considered to have a good fit if the chi-square was not statistically significant, both the CFI and NFI were >0.95, and RMSEA values approximated 0.06 [26, 27].

III. RESULTS

There was 98% response from the survey.

Socio-demographic and clinical-physiological characteristics (Table 1: The study participants with T2DM ranged between 30-39 years (51.1%) and those < 49 years (50.5%) had controlled glycated haemaglobin (HbA1c < 7%) compared to the uncontrolled glycated haemaglobin (Table 1). Adults possessing an average (51.4%) and excellent (56.1%) knowledge of diabetes and management had more glycemic control (HbA1c < 7%) compared to the less glycemic control. Short duration of diabetes, i.e., 10-19 years (50.9%) and < 19 years (47.2%) years had low HbA1c < 7%.

Factors that influence HbA1c < 7% are younger age 30-39 years (51.5%), female (3.5%), high school education (54.3%), moderate ability to manage DM positively (31.7%), mostly comfortable relationship with doctors (47.6%), excellent knowledge of diabetes and management (56.1%), short duration of diabetes, i.e., < 9 years (50.9%), and small waist-hip ratio (52.7%). Factors that escalate HbA1c > 7% are older age 50-39 years (60.9%), male (62.2%), diploma education (67.4%), moderate ability to manage DM positively (32.3%), poor knowledge of diabetes and management (56.8%), long duration of diabetes of > 20 years (70.5%), and high waist-hip ratio (60.4%). Adults who belonged to younger age groups, those who were females, had high school education, had a moderate ability to manage DM positively, had an excellent knowledge of DM and management, a shorter duration of DM < 9 years, and low waist-hip ratio had controlled HbA1c compared to those with uncontrolled HbA1c.

TABLE 1. DEMOGRAPHIC AN CLINICAL CHARACTERISTICS AMONG ADULTS WITH T2DM (N=300)
HbA1C- glycosylated haemaglobin, DM – Diabetes mellitus, OHA – Oral hypoglycemic agents

Characteristics	**Categories**	**HbA1C ≤7%**		**HbA1C >7%**	
		Frequency	%	Frequency	%
Age (years)	30-39	24.0	51.1	23.0	48.9
	40-49	52.0	50.5	51.0	49.5
	50-59	36.0	39.1	56.0	60.9
	60 & above	26.0	44.8	32.0	55.2
Gender	Male	54.0	37.8	89.0	62.2
	Female	84.0	53.5	73.0	46.5
Education	Upto 8th grade	56.0	47.9	61.0	52.1
	High school	51.0	54.3	43.0	45.7
	Diploma/ technical	31.0	10.3	58.0	67.4
Ability to manage positively	Moderate ability	95.0	31.7	97.0	32.3
	Good ability	43.0	14.3	65.0	21.7
Doctor-patient relationship	Moderate comfort	108.0	45.6	129.0	54.4
	Mostly comfortable	30.0	47.6	33.0	52.4
Knowledge of DM and management	Poor	96.0	43.2	126.0	56.8
	Average	19.0	51.4	18.0	48.6
	Excellent	23.0	56.1	18.0	43.9
Duration of DM (years)	0- 9	57.0	50.9	55.0	49.1
	10-19	68.0	47.2	76.0	52.8
	20 & above	13.0	29.5	31.0	70.5
Previous diabetes education	No	54.0	47.0	61.0	53.0
	Yes	84.0	45.4	101.0	54.6
Body mass index	< 18.5 - Underweight	3.0	37.5	5.0	62.5
	18.5 - 24.9 - Healthy weight	87.0	43.1	115.0	56.9
	25 - 29.9 - Overweight	48.0	53.3	42.0	46.7
Waist-hip ratio	<0.90 (M) or 0.85 (F)	77.0	52.7	69.0	47.3
	>0.90 (M) or 0.85 (F)	61.0	39.6	93.0	60.4

Diabetes self-care management behaviors (Table 2): According to the SDSCA, 34.1% of the adults with T2DM expressed healthy eating plan (fruits and vegetables, less meat and dairy products, spacing carbohydrates) on an average of 3days in the past 7 days compared to 22.6% of the adults with mean of 4 days. 21% of the adults adhered to diet on an average of 5 days. Exercise regimen (30 minutes or specific exercise) was followed by these adults on an average of 2 days (35.5%) in the past 7 days compared to 22% (mean days 3). 20.9% of the adults followed exercise on an average of 1 day/week. Blood glucose testing or as recommended was adapted by 32% of the adults for mean 2 days compared to 22.3% following it for mean 3 days. While 23.3% of the adults had blood glucose testing for at least 1 day/week compared to the other adults.

Foot care was observed among half percentage of the adults (53.7%) on mean days of 3 compared to mean days of 4 among 18.9% of the adults. Nearly one-third of the adults complied with the medications recommended or insulin (29.5%) on mean days of 3 compared to 23.1% on mean days of 4. 19.3% of the adults complied with medications on average of 5 days. Less than half percentage of the adults smoked at least 1 puff (45.5%) in the past 7 days.

Less than quarter to one-third percentages of the adults with T2DM followed diet, foot care and medications (average 3 days) compared to half percentage of them adhering to foot care. While one-third of these adults adhered to exercise and blood glucose testing on an average of 2 days compared to less than a quarter of these adults adhering to diet and medication on an average of 4-5 days in the past 7 days.

TABLE 2.SUMMARY OF DIABETES SELF-CARE BEHAVIOURSDURING PAST 7 DAYS AMONG ADULTS WITH T2DM
N=300

Self-care Behaviours/ Days	**0**	**%**	**1**	**%**	**2**	**%**	**3**	**%**	**4**	**%**	**5**	**%**	**6**	**%**	**7**	%
Diet: Healthy eating plan, fruits/ vegetables, space carbohydrates, fat/ dairy products	1.0	0.3	1.0	0.3	59.0	19.9	101.0	34.1	67.0	22.6	63.0	21.3	4.0	1.4	0.0	0.0
Exercise: Least 30 minutes of physical activity/ specific exercise session	6.0	2.0	62.0	20.9	105.0	35.5	65.0	22.0	52.0	17.6	4.0	1.4	1.0	0.3	1.0	0.3
Blood glucose testing or as recommended	3.0	1.0	70.0	23.3	96.0	32.0	67.0	22.3	56.0	18.7	6.0	2.0	1.0	0.3	1.0	0.3
Foot care: Checked feet, inspected shoes, wash feet, soak feet, dry between toes after washing.	1.0	0.3	23.0	7.8	52.0	17.6	159.0	53.7	56.0	18.9	3.0	1.0	1.0	0.3	1.0	0.3
Medications: Recommended medications, insulin injections or pills	0.0	0.0	24.0	8.1	43.0	14.6	87.0	29.5	68.0	23.1	57.0	19.3	15.0	5.1	1.0	0.3
	No	**%**	**Yes**	**%**												
Smoking cigarette/ puff	163.0	54.5	136.0	45.5												

TABLE 3. ASSOCIATION BETWEEN DEMOGRAPHIC AS WELL AS CLINICAL CHARACTERISTICS AND SELF-CARE MANAGEMENT USING ANOVA
N=300

Self-care	**Diet**		**Exercise**		**Blood glucose**		**Foot care**		**Medications**		**Smoking**		**Total SCA**	
Characteristic	**F**	**Sig.**	**F**	**Sig.**	**F**	**Sig.**	**F**	**Sig.**	**F**	**Sig.**	**F**	**Sig.**	**F**	**Sig.**
Age	9.006	0**	0.471	0.702	1.36	0.255	6.049	0.001**	1.759	0.155	19.933	0**	4.054	0.008*
Gender	0.072	0.788	0.821	0.366	1.695	0.194	1.029	0.03*	0.301	0.584	0.321	0.571	1.268	0.261
Education	0.745	0.526	0.096	0.962	1.961	0.12	4.879	0.003*	0.249	0.862	2.588	0.05*	0.141	0.936
Body mass index	0.759	0.469	0.341	0.711	0.344	0.709	0.302	0.739	0.198	0.82	4.35	0.014*	1.61	0.202
Waist-hip ratio	0.163	0.05*	0.185	0.668	0.911	0.341	0.01	0.921	0.18	0.672	0.465	0.496	0.869	0.352
Glycated haemaglobin	0.797	0.373	0.754	0.386	0.041	0.839	0.327	0.568	0	0.988	0.8	0.372	0.788	0.03*
Duration of diabetes	8.457	0**	0.833	0.436	3.199	0.042*	6.477	0.002*	0.195	0.823	2.399	0.093	0.004	0.996
Diabetes education	14.913	0**	0.985	0.322	0.018	0.894	5.619	0.018*	2.159	0.143	5.508	0.02*	0.187	0.666
Knowledge of diabetes and management	3.848	0.001**	2.956	0.008*	1.656	0.132	3.079	0.006	2.57	0.019*	3.984	0.001**	4.146	0.001**
Positive attitude to management	0.743	0.527	5.833	0.001**	1.737	0.159	2.592	0.05*	0.403	0.751	0.732	0.534	2.873	0.037*
Doctor-patient relationship	1.019	0.398	1.241	0.293	1.448	0.218	0.716	0.582	1.145	0.03*	1.086	0.364	0.401	0.808

*p<0.05, **p<0.001 level of significance (sig.). SCA- self-care activities

Demographic and clinical characteristics and self-care behaviours (Table 3): Age was significantly associated with diet (50-59 years), foot care (< 39 years), smoking (> 60 years) and total self-care activities (> 60 years).Females had significant association with foot care. Diploma education was significantly associated with foot care and smoking. Normal body mass index (< 24.9) was significantly associated with smoking. Smaller waist-hip ratio was significantly associated with blood glucose. Controlled glycated haemaglobin (< 7%) was significantly associated with total self-care activities. Duration of diabetes is significantly associated with diet (< 9 years), blood glucose and foot care (> 20 years each).Previous diabetes education was significantly associated with diet, foot care and smoking. Excellent knowledge of diabetes and management is significantly associated with diet, exercise, foot care, medications, smoking and total self-care activities. Good ability and positive attitude towards management was significantly associated with exercise, foot care, and total self-care activities. Mostly comfortable doctor-patient relationship was significantly associated with medications.

Omani adults in the middle age group, low waist-hip ratio, long duration of diabetes, diabetes education, knowledge and management of DM was significantly associated with dietary SCB. Knowledge, management of DM and attitude towards was significantly associated with exercise SCB. Long duration of diabetes was significantly associated with blood glucose SCB. Younger age, females, diploma education, long duration of diabetes, diabetes education, and positive attitude to DM was significantly associated with foot care SCB. Knowledge, management of DM and doctor-patient relationship was significantly associated with medications SCB. Older age, diploma education, normal body mass index, diabetes education, knowledge and management of DM was significantly associated with smoking. Age, knowledge of DM and management and positive attitude of management were significantly related to the total self-care activities.

Structural Equation Model (SEM)

H0: Diet (DET), exercise (EXR), blood glucose monitoring (BSR), foot care (FTC), medications (MED) and smoking (SMK) are positively correlated with the Self Care (SLFCR) of the respondents (Figure 2) as seen in the hypothetical model.

Manifest and latent variables of self-care activities/management

Manifest variable are diet, exercise, blood glucose test, foot care, medications and smoking. Latent variables are self-care of participants (Figure 3 and 4). In the model, 27% of the total variance in self-car activities (SCA) was accounted by diet, 32% by exercise and 17% by medications (Figure 4). Blood glucose monitoring, foot care, and smoking and HbA1c accounted for 60%, 78%, and 51% variances.

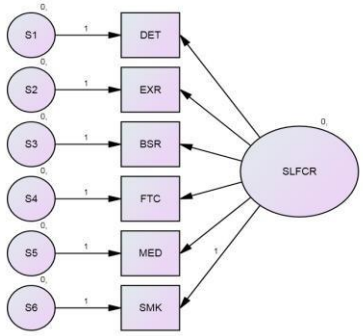


Figure 2: Hypothetical Model of SCA among T2DM

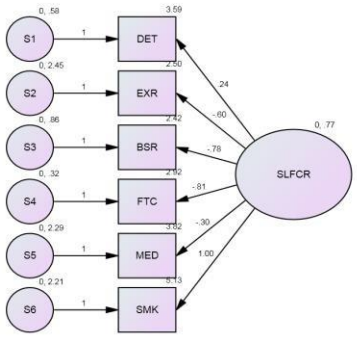


Figure 3: Unstandardised Estimat

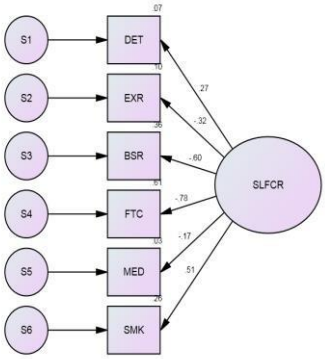


Figure 4: Standardised Estimates

Testing of hypotheses for measuring the SCM-Standardized estimates

H01: There is a positive impact of diet, exercise, blood glucose monitoring, medications and smoking and the self-care of the adults with T2DM.

The hypothetical relationship of Diet and Smoking was found to be positive with SCA. Chi-square =2690.672, Degrees of freedom = 9, $p<0.001$. From the path diagram (Figure 2 and 3) Diet and Smoking are influenced with the latent variable of successful operation for measuring the Self-care management. There is a positive relationship between Diet, Smoking and Self- care management ($p<0.01$ and $P<0.05$). The other variables like Exercise, Blood glucose monitoring, Foot care and Medications have a negative relationship while determining the Self-care management.

Regression weights and lisrel maximum likelihood estimates (Table 4)

The regression coefficient of the exogenous variables is shown in Table 4. The critical ratio of diet and smoking are above the table value 2.962 and significant at $p<0.001$. The other variables exercise, blood glucose monitoring, foot care, medications are not significant for measuring Self-care management ($p>0.01$).

TABLE 4.REGRESSION WEIGHTS AND LISREL MAXIMUM LIKELIHOOD ESTIMATES

Latent Variable		**Measured Variables**	**Estimates**	**SE**	**CR**	**P**
SLFCR	<---	DET	.772	.201	3.834	0.001*
SLFCR	<---	EXR	2.212	.215	1.269	1.007
SLFCR	<---	BSR	2.291	.190	1.078	1.121
SLFCR	<---	FTC	.324	.069	0.701	0.003*
SLFCR	<---	MED	.857	.093	1.174	0.521
SLFCR	<---	SMK	2.448	.211	11.576	0.001*

*$p<0.001$ level of significance

TABLE 5.MODEL FIT INDICES

No	Model Fit Indices	Calculated Value	Acceptable Threshold Levels
1	Comparative Fit Index(CFI)	0.881	0-1
2	Normed Fit Index (NFI)	0.561	0-1
3	Relative Fit Index (RFI)	0.733	0-1
4	Incremental Fit Index (IFI)	0.566	0-1
5	Parsimonious Normed Fit Index (PNFI))	0.711	0-1
6	Parsimony Comparative Fit Index (PCFI)	0.623	0-1
7	Tucker Lewis Index (TLI)	0.522	0-1
8	Root Mean Squared Error of Approximation (RMSEA)	0.04	$\leq$0.05 indicate a close fit of the model

Model fit indices (Table 5)

The model fit indices of the variables is shown in Table 5. The entire test has the range of 0 to 1 [26, 21]. The Root Mean Squared Error of Approximation (RMSEA) secured 0.04 that indicates a close fit of the model. The SCA were correlated with the dependent observed variables in the modified model. The fit indices of the modified model were adequate and fit the data. The calculated values were within the acceptable thresholds. The standardized path coefficients of Diet, exercise, smoking, foot care, glucose monitoring and medications have a significantly positive influence on SCA. This indicated better Diet, exercise, smoking, foot care, blood glucose monitoring and medications, higher the SCA and glycemic control. Participants with better SCA had better control of HbA1c.

IV. DISCUSSION

This study provides an understanding of the self-care management behaviors (SCB) contributing to glycemic control in adults with type 2 DM in Oman. Greater adherence to the diet, exercise, smoking, foot care, blood glucose monitoring and medications, led to better the SCB of adults with T2MD. Self-care management involves a series of behaviours among adults with T2DM who have to be critical decision makers and understand how to balance medication, diet and exercise to achieve glycemic control. Better self-care behaviours [28] leads to better glycemic control and quality of life [13, 29]. Hence socio-cultural influences play a role in SCB related to medication, diet and exercise to achieve optimal glycemic control among Omani adults with T2DM. This is also supported by other studies that show longer duration of illness and insulin regimen was more likely to take medicines [30]. Exercise levels increased with age and education level [30]. Adults reported positive attitudes with foot care (mean 6.16) and least positive attitudes to medication taking (mean 5.53) [14, 31]. Adults with T2DM in this study demonstrated low levels of self-care behaviors that may have contributed to their higher levels of HbA1c.

The low-moderate levels of SCB behaviors are attributed to socio-cultural and gender influences and subsequent poor glycemic control. Stronger perceptions of diet, exercise, blood glucose testing and medication self-efficacy were associated with higher levels of diet, exercise, blood glucose testing and medication taking SMB [32]. Social support, education level and duration of diabetes explained 35.6% of the total variances and were significantly predictive of SCB [33]. Healthy balanced diets (e.g. fruits and vegetables, spacing complex carbohydrates, increased servings/day) are the foundation for control of T2DM. Males are more likely to involve in specific resistance (e.g. using weights) and non-resistance (e.g. walking, swimming) physical activity for 30 minutes than females. Regular medications (oral and injectable forms) taken appropriately in specific intervals is facilitated by increasing easy access to health care. Barriers are decreased ability to adjust insulin dosages, high fat and red meat intake and decreased physical activity due to gender and cultural norms affect SCB among Omani adults.

In this study some adults with T2DM had increased adherence to diet, foot care and medications, while some adults adhered to exercise and blood glucose testing. This shows that diet, foot care and medication were considered important for self-care management. Most frequently reported DSM behaviours were taking medications (mean 6.1) and diet (mean 4.4) [31, 32]. Highest self- efficacy score was for efficacy to take medications (mean 8.9) and the lowest self-efficacy score was for efficacy to exercise (mean 6.2) [32]. Individuals with higher education level, longer duration of illness and insulin regimen were more likely to monitor their blood glucose [30]. Adults who had most frequent meals a day had higher fasting glucose ($p<0.02$) [14]. Each of these self- care behaviours requires higher levels of knowledge, skills and confidence.

In this study younger age, smaller waist-hip ratio, short duration of diabetes, prior DM education, and knowledge and management of diabetes was significantly associated with diet. Males had significantly higher SCB scores than females ($p<0.01$) [33]. Older adults were more likely to follow dietary pattern and foot care [30]. Knowledge and management, and positive attitude to diabetes were significantly associated with exercise. Those with mean fasting glucose <9 mmol/L were more active than those with >11 mmol/L ($p<0.02$) [14]. 13-22% of the variance in diet, exercise, blood glucose testing and foot care was found [34]. 12-20% of the variance in medication adherence, knowledge, diet and exercise and blood glucose testing was found [34]. Here short duration of diabetes was significantly associated with blood glucose testing. Self-care behavior was positively correlated with duration of diabetes and social support ($p<0.001$) [35].

Younger age, females, diploma education, short of diabetes, prior DM education, and positive attitude to DM was significantly associated with foot care. Senior high school, college education had revealed higher SCB ($p<0.001$) [33].Knowledge and management of diabetes and mostly comfortable doctor-patient relationship was significantly associated with medications in the study. Younger age, diploma education, normal body mass index, DM education, knowledge and management of DM were significantly associated with smoking. Adults with tertiary education and longer duration of illness were more confident about performing blood glucose testing [36]. Patients reported higher perceive self-care and self-efficacy and better HbA1c than those who did not have a

diabetes education [37]. Some adults with T2DM test their blood glucose levels frequently and few adjust their medication/ insulin dosages.

Younger to older age, controlled glycated haemaglobin (< 7%), knowledge and management of diabetes and positive attitude to DM was significantly associated with total self-care activities. Adults on OHA and insulin, tobacco users, higher education [38], stronger perceptions of DM preventing ADL and mostly comfortable doctor-patient relationship were significant independent predictors of high HbA1c (uncontrolled). Adults who had diabetes education performed more regular exercise and stopped smoking than the other group [37]. Age, HbA1c, knowledge of DM and management and positive attitude of management were significantly related to the total self-care activities.

The study indicated 27% of the total variance in SCA was accounted by diet, 32% by exercise and 17% by medications. Blood glucose monitoring, foot care, and smoking and HbA1c accounted for 60%, 78%, and 51% variances. Self-efficacy scores were significant predictors of SCB behaviors [35, 40]. 39.1% of variance in SCB was due to duration and diabetes education [35].

49% of the variance was accounted for by age, gender, medication, education and social support [31]. Thus the study indicates that better the Diet, exercise, smoking, foot care, blood glucose monitoring and medications, the higher the SCB and better control of HbA1c. This implies that factors related to SCB are important in glycemic control and in recommending SCM among adults.

Limitations

Factors that could have influenced HbA1c levels like co-morbid conditions, inherited hemoglobinopathies and personal characteristics like empowerment and quality of life have not been studied and could be explored in greater depth.

V. CONCLUSION

The findings of this study can guide diabetes nurse educators to understand the extent to which different self-care behaviors that affect glycemic control. To be more effective standardized education based on recommended guidelines should be used for providing evidence based best practices in diabetes care. SCB approach is a key empowerment strategy [39] that requires essential SCB care abilities and skills to be responsible. Medication adjustment into the daily routine over long periods, smoking cessation, foot care, prevention and monitoring for serious complications/ end organ failure is important in planning diabetes interventional programs [41]. The study demonstrates that adults with higher levels of HbA1c reported that they were better able to manage their self-care behaviors. This supports the SEM to integrate the concept of SCB in the designing of education for Omani adults with varying socio-cultural practices, gender influences, fasting, and observance of holy days, which requires adherence to healthy diet, regular exercise, weight control and self-monitoring of blood glucose.

The standardized path coefficient from perceptions of diet, medications and exercise on the diabetes self-management (SCB) was high. This information can assist nurse educators develop tailored education and behavior skills incorporating self-efficacy to enhance individualized interventions. DNE should work collaboratively with dieticians, podiatrists and physiotherapists to plan specific interventions to develop a sense of control and enhance decision-making abilities among adults. Adults should be empowered to interpret and use the data to adjust food intake, exercise, or pharmacological therapy to achieve specific glycemic goals. While physical activity is known to be an important aspect of SCB, those who did even minimal levels of exercise reported walking as the most common form of exercise. The results suggest that nutrition; exercise and medication should be assessed and evaluated regularly to monitor the accuracy of titration of medication/insulin dosing. This assessment may assist in determining individualized goals and strategies for glycemic control and long term self-care behaviours.

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