

# Association of health literacy and self-management practices and psychological factor among patients with type 2 diabetes mellitus in Saudi Arabia

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## ABSTRACT

**الأهداف:** تحديد العلاقة بين المتغيرات الديموغرافية أو الاجتماعية أو الإكلينيكية والتنور الصحي أو المزاج المكتئب أو فقد الاستمتاع بالحياة والرعاية الذاتية لدى مرضى السكري من النوع الثاني في المملكة العربية السعودية.

**المنهجية:** شارك في هذه الدراسة المستعرضة 352 مصاب بالسكري من النوع الثاني من مستشفيات مرجعيين في السعودية. جميع المصابين بالسكري من النوع الثاني تم الوصول لهم ومقابلتهم بالباحثين من ديسمبر 2016م إلى فبراير 2017م في عيادات السكري. جميع المشاركين اجابوا على استبيان مكون من 4 أجزاء تشمل معلومات أساسية و استبيان الرعاية الذاتية لمرضى السكري (DSMQ) واستبيان للكشف عن المزاج المكتئب أو فقد الإستمتاع بالحياة (PHQ-2) واختبار تحديد التنور الصحي (STOFHLA). تم عمل الاختبارات الإحصائية المناسبة لدراسة العلاقة والمحددات بين المتغيرات والرعاية الذاتية لدى مرضى السكري.

**النتائج:** أظهرت الدراسة أن الغالبية من المشاركين لديهم نقص في التنور الصحي الوظيفي. الرعاية الذاتية لدى مرضى السكري كانت جيدة بشكل عام. كما أظهرت الدراسة وجود مزاج مكتئب في 20% من المشاركين. لم تظهر الدراسة وجود أي علاقة بين الرعاية الذاتية لدى مرضى السكري والتنور الصحي. في المقابل أظهرت الدراسة أن مستوى التنور الصحي الوظيفي يتغير بشكل ملحوظ مع العمر والجنس ومستوى التعليم والحالة الوظيفية ومستوى أعراض الاكتئاب لدى مرضى السكري من النوع الثاني.

**الخلاصة:** بينت الدراسة أن حوالي نصف المرضى المصابين بالسكري من لديهم مستوى منخفض من التنور الصحي الوظيفي لديهم انخفاض في مستوى الرعاية الذاتية. أظهرت النتائج أيضاً أن الرعاية الذاتية أعلى لدى المصابين بالسكري. كما أظهرت الدراسة أهمية تقديم المشورة المناسبة والتثقيف عن التحكم بمرض السكري لدى المرضى وعوائلهم.

**Objectives:** To determine the association between sociodemographic, clinical, and health literacy and the presence of depressed mood and their relationships to diabetes self-management among type 2 diabetes mellitus (T2DM) patients in Saudi Arabia.

**Methods:** A total of 352 T2DM patients from 2 public tertiary hospitals in Saudi Arabia participated in this descriptive cross-sectional study between December

2016 and February 2017. All respondents answered a 4-part questionnaire, which includes demographic data, Diabetes Self-Management Questionnaire (DSMQ), 36-item test based Short Test of Functional Health Literacy in Adults, and a 2-item Patient Health Questionnaire (PHQ-2). The Chi-square test and logistic regression analysis were conducted to determine the relationship and significant predictors for self-management among T2DM patients.

**Results:** The analysis showed that majority of the participants had low to marginal functional health literacy. The overall DSM-16 score was good, indicating more effective self-care, while 20% of the participants had a score of 2 or more in the PHQ-2 indicating presence of depressed mood. No significant association was found between DSM and health literacy among the study participants while age, gender, educational level, employment status, and level of the depressive symptom were significantly associated with differences in the level of functional literacy of the participants.

**Conclusion:** The study shows that nearly half of the T2DM patients that exhibited low level of functional health literacy had low diabetes self-management. Our findings also show that gender significantly affects diabetes self-management in which odds are a lot higher among females than males with diabetes self-management. This study underscores the importance of proper counselling and education about diabetes control on both patients and family members.

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Diabetes mellitus is becoming a widespread health problem globally. The prevalence of diabetes is rapidly increasing, adding urgency to research addressing the underlying factors (namely, obesity, unhealthy eating, and sedentary lifestyle). It is estimated that diabetes will increase by 55% by 2035.<sup>1</sup> Type 2 diabetes mellitus (T2DM) is the most common type of diabetes, accounting for more than 90% of total cases.<sup>2</sup> Patients with T2DM must engage in continuous and specific health management recommendations for the rest of their lives. Long-term health care for T2DM patients involves greater engagement by patients in numerous actions, such as diet, exercise, and medication management in their daily lives. Self-care management practices of diabetic patients have become a major aspect of diabetes care around the world. In the United States, studies show that less than 50% of patients follow the recommended diabetes management guidelines.<sup>3,4</sup> Meanwhile, studies in China found that diabetic patients who had low income and educational levels tend to have higher glucose levels, while patients who received diabetic education scored significantly higher on self-care management.<sup>5,6</sup> Diabetes self-management is considered crucial for satisfactory diabetes control among patients with diabetes.<sup>7</sup> When patients self-manage adequately, they can decrease the level of glycated hemoglobin by 37%.<sup>8</sup> Even with an increase in the evidence supporting the benefit of diabetes self-management, the utilization of self-management actions is still low.<sup>9</sup> Psychosocial factors such as health literacy and depression can affect diabetes self-management among patients with diabetes. Another complication that might disempower diabetic patients to self-management is reduced psychological wellbeing.<sup>10</sup> Anxiety, depression, and psychological distress are associated with adverse outcomes, such as lower self-care, which might lead to patients' poorer health status and could further affect and reduce diabetes self-management.<sup>11,12</sup> If diabetic patients are exposed to tremendous psychological stress, self-care activities may compromise resulting to increased risk of many complications such as heart disease, diabetic nephropathy, leg amputation and even early death. Meanwhile, to achieve the recommended diabetes

management, it is essential for patients to clearly understand the signs and symptoms of the disease and how to properly manage and control diabetes. Health literacy influences important health outcomes, particularly in diabetes management.<sup>13</sup> Patient health literacy is important and challenging because it requires the individual's awareness and capabilities to understand specific health information.<sup>14</sup> Literacy has been defined as "an individual's ability to read, write, speak, and compute and solve problems at levels of proficiency necessary to function on the job and in society, to achieve one's goals, and develop one's knowledge and potential".<sup>14</sup> In particular, patients must have functional health literacy to apply essential knowledge, make decisions, and acquire skills for effective diabetes management.<sup>15</sup> In contrast, patients with low literacy usually have difficulty in following physician instructions<sup>7</sup> or have trouble reading medical prescriptions.<sup>16</sup> Furthermore, chronic illness management and treatment compliance might suffer among patients with low literacy resulting in a low quality of life.<sup>16,17</sup> Low levels of health literacy appear common among T2DM patients and are significantly associated with less knowledge of self-care management and poorer health outcomes.<sup>16-19</sup> In the USA, an inadequate level of health literacy was found among 402 patients, and nearly 50% of these patients lacked knowledge about the importance of lifestyle and dietary factors on glycemic control.<sup>18</sup> The lack of knowledge among patients with diabetes and its lack of health literacy are considered an obstacle to diabetes self-management.<sup>19,20</sup> However, there are inconsistent findings with the association of health literacy with self-care management of diabetes. For example, a recent study found an association of low health literacy with low diabetes self-management and poor glycemic control as well as more comorbid conditions.<sup>19</sup> In Saudi Arabia, it has been reported that misinterpretation of medical instruction is prevalent among patients in hospices. This is because the rate of health illiterate individuals in the country ranges from 13% to 30%, which possibly related to the privation of education in the Kingdom.<sup>21</sup> On the other hand, Saudis aged 18 to 40 years old had considerably better health literacy than those aged 41 years old and above, possibly because the younger age group have an advanced degree of educational attainment relative to the older age group.<sup>21</sup> Furthermore, another study shows that more than 50% of diabetic patients in Saudi Arabia admit inadequate e-health knowledge, and some of them had trouble interpreting health data published on a website.<sup>22</sup>

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Meanwhile, a different study revealed no association between glycemic control and functional health literacy.<sup>23</sup> This inconsistency could be due to factors such as stress, hostility, depression, hopelessness, and other demographic factors that might affect patients' health literacy.<sup>24</sup> Nevertheless, this association suggests that improving patient health literacy will enable T2DM patients to self-manage their disease and lead to better glycemic control.<sup>25</sup> The relationship between diabetes self-management and health literacy and depression in Saudi Arabia is unknown. Here we aimed to determine the association and differences between level of health literacy, presence of depressed mood or anhedonia, and their relationships with diabetes self-management among type 2 diabetes mellitus patients in Saudi Arabia.

**Methods.** This descriptive cross-sectional study was conducted between December 2016 and February 2017 at 2 public tertiary hospitals in Riyadh, Saudi Arabia. To be eligible for the study, patients must have had a confirmed diagnosis of T2DM in their clinical file and be 18 years old or older. Ethical approval was obtained from the local ethics committee, and each hospital selected from the study (E-16-2143). The selected hospitals were chosen because they are considered referral hospitals for patients with T2DM and because the hospitals were easily accessible to the respondents.

A convenience sample of 352 T2DM patients participated in this study. Before distributing the survey questionnaires, consent was obtained from the medical director and head of the nursing department. Before the data gathering began, 2 researchers (trained nurses) explained the purpose of the study to all eligible participants attending the outpatient diabetes clinics. The researchers also seek approval from the physicians to set a time to interact with the patients and distribute the survey questionnaire. The survey questionnaires were distributed as hard copies by the 2 researchers at each hospital under the supervision of one of the authors. The 2 researchers also ensured that written informed consent was obtained for access to the patients' latest clinical records. To ensure confidentiality, the researchers informed all of the participants that they could choose to remain anonymous, that participation was voluntary, and that they had the option to decline to participate at any time or not to complete the survey questionnaire. After providing informed consent, participants were given a four-part survey questionnaire to complete. If the body mass index (BMI) was not available in their clinical records, the researchers

measured the participants' height, weight, and waist and hip circumferences to calculate their BMI. Participants reported no problems identified with the questionnaire and it took about 10-15 minutes to complete the survey. No incentives were offered to those who participated in this study.

**Instruments and measurement.** All eligible participants answered a 4-part self-administered questionnaire that included demographics, information on diabetes self-management, depression, and health literacy. The first part of the questionnaire collected demographic information and clinical characteristics, such as BMI and hemoglobin A1c (HbA1c) (glycated hemoglobin). The second part of the questionnaire was a 16-item Diabetes Self-Management Questionnaire (DSMQ) that measured the self-care management practices (glucose management, dietary control, physical activity, and healthcare use) of the patients. The DSMQ was scored using a Likert-type scale, ranging from zero (does not apply to me) to 3 (applies to me very much). The instrument is a valid instrument used to assess patients' self-care behaviors associated with glycemic control.<sup>25</sup>

The functional health literacy of the participants was assessed using a 36-item Short Test of Functional Health Literacy in Adults (STOFHLA) questionnaire which was translated into Arabic version with the help of a professional language translator.<sup>26</sup> The instrument was used to analyze functional health literacy scores and categorize scores into adequate (scores 23-36), marginal (scores 17-22), and inadequate (scores 0-17) functional health literacy.

The Patient Health Questionnaire (PHQ-2 English version) was used in this study to assess the presence of depressed mood and anhedonia.<sup>27</sup> The PHQ-2 is a 2-item questionnaire that is considered the first approach to screen patients for the presence of depressed mood and anhedonia. Patients chose from 4 response options: "not at all", "several days", "more than half the days", and "nearly every day". Patient responses were scored as 0, 1, 2, or 3, and the overall score could range from 0 to 6 with higher scores indicating the presence of anhedonia.

The 4-part survey questionnaire was translated by a professional Arabic-English language translator from English to Arabic and back to English. The survey questionnaire was also pilot-tested and modified before the start of data collection.

**Statistical analysis.** All data were analyzed using the Statistical Package for Social Sciences (SPSS) version 23. Data are presented as frequencies (%). Age, duration of diabetes, BMI, and other continuous variables

that are not normally distributed were dichotomized at the median. Furthermore, the PHQ-2 score was dichotomized and recoded into “not depressed” (0-3) and “depressed” (4-6). The Chi-square test was used to analyze the association between 2 categorical variables, and logistic regression analysis was used to identify predictors of depression and predictors of DSM (namely, age, gender, educational attainment). Also we used the Hosmer-Lemeshow to test the goodness-of-fit test or tells how well the data fits the model. P-values of less than 0.05 were considered statistically significant.

**Results.** Table 1 shows the percentage distribution of the demographic characteristics of the participants. The mean age of the participants was  $51.89 \pm 10.94$  years. Of the 352 participants, 37% of participants were aged 51-60 years and 87% of the participants were married. More than half of the participants were males (50%), and 42% of the participants were unemployed. One-third (33%) of participants held university degrees, and 33% held tertiary degrees.

Only 17% of the participants were within a normal weight range, 52% of the sample were obese (BMI:  $\geq 30$  kgm<sup>2</sup>), and 77% of the participants had an HbA1c over 7% (Table 1). With regards to diabetes self-management (DSMQ), the participants had a median score of 39 (range: 7 to 47), indicating high overall diabetes self-management; however, the participants had low to moderate self-care scores with the subscales of ‘healthcare - use’ ( $4.8 \pm 1.2$ ) and ‘physical activity’ ( $5.8 \pm 1.1$ ). Twenty percent of the participants had a score of 2 or more in the PHQ-2 suggesting the presence of depressed mood or anhedonia. With regards to health literacy, the mean functional literacy score was 16.64 (0-36) as presented in Table 1. Nearly half of the participants had low (50%) to marginal (16%) functional health literacy, while 34% had adequate health literacy.

Table 2 presents the group comparison between the level of functional health literacy and the sociodemographic, clinical, and psychological factors of the participants. The analysis showed that the majority of the participants had low to marginal functional health literacy. More than 50% of the participants in the age group of 50 years and above were unemployed, had up to primary schooling, were obese, had PHQ-2 score  $\geq 2$ , and had low functional health literacy. Surprisingly, low functional health literacy was also found among participants who had a BMI of 18.5 to 24.9 and had a high score of diabetes self-care.

**Table 1** - Demographic characteristics of 352 participants.

Characteristic	n	(%)
<i>Age, years</i>	$51.89 \pm 10.94$	
18 - 30	12	(3.4)
31 - 40	36	(10.2)
41 - 50	112	(31.8)
51 - 60	129	(36.6)
$\geq 61$	63	(17.9)
<i>Gender</i>		
Male	181	(51.4)
Female	171	(48.6)
<i>Marital status</i>		
Single	10	(2.8)
Married	306	(86.9)
Divorced	13	(3.7)
Widowed	22	(6.9)
<i>Educational level</i>		
Non-educated	36	(10.2)
Primary	35	(9.9)
Secondary	84	(23.9)
Tertiary	116	(33.0)
University	74	(33.0)
Higher	7	(2.0)
<i>Place of work</i>		
Government	92	(26.1)
Private	31	(8.8)
Retired	82	(23.3)
Unemployed	147	(41.8)
<i>Clinical characteristics</i>		
Body mass index (kg/m <sup>2</sup> )	$31.9 \pm 8.9$	
Normal	59	(16.8)
Overweight	110	(31.3)
Obese	183	(52.0)
HbA1c; (range 5.2 - 14.5)	8.2	
0 - 6.9	81	(23.0)
$\geq 7$	271	(77.0)
<i>DSMQ (sum scale) (mean<math>\pm</math>SD)</i>	$39.9 \pm 6.5$	
Subscale (glucose management)	$7.8 \pm 2.3$	
Subscale (dietary control)	$6.5 \pm 1.5$	
Subscale (physical activity)	$5.8 \pm 1.1$	
Subscale (health-care use)	$4.8 \pm 1.2$	
<i>Level of depressive symptom severity</i>		
Not depressed	279	(79.3)
Depressed	73	(20.7)
<i>Health literacy</i>		
Low functional health literacy	175	(49.7)
Marginal functional health literacy	57	(16.2)
Adequate functional health literacy	120	(34.1)

More than half (51%) of those participants who held a bachelor's degree and above had adequate functional health literacy. Age, gender, educational level, employment status, and level of the depressive symptom (PHQ-2) were significantly associated with differences in the level of functional literacy of the participants.

**Table 2** - Difference of functional health literacy levels by participants' characteristics.

Characteristic	Low functional health literacy	Marginal functional health literacy	Adequate functional health literacy	P-value
<i>Age, years</i>				
Less than 50	65 (40.6)	29 (18.1)	66 (41.3)	0.007
50 and above	110 (57.3)	28 (14.6)	54 (28.1)	
<i>Gender</i>				
Male	66 (36.5)	35 (19.3)	80 (44.2)	<0.001
Female	109 (63.7)	22 (12.9)	40 (23.42)	
<i>Marital status</i>				
Single	26 (56.5)	8 (17.4)	12 (26.1)	0.464
Married	149 (48.7)	49 (16.0)	108 (35.3)	
<i>Educational level</i>				
Up to primary schooling	54 (76.1)	8 (11.3)	9 (12.7)	<0.001
Secondary & tertiary schooling	93(46.5)	38 (19.0)	69 (34.5)	
Bachelor and above schooling	28 (34.6)	11 (13.6)	42 (51.9)	
<i>Place of work</i>				
Unemployed	127 (55.5)	34 (14.8)	68 (29.7)	0.009
Employed	48 (39.0)	23 (18.7)	52 (42.3)	
<i>Clinical characteristics</i>				
<i>Body mass index</i>				
Healthy (BMI of 18.5 to 24.9)	33 (55.9)	14 (23.7)	12 (20.3)	0.034
Overweight (BMI of 25 to 29.9)	46 (43.8)	13 (12.4)	46 (43.8)	
Obese (BMI of 30 or higher)	93 (50.8)	29 (15.8)	61 (33.3)	
<i>Hba1c</i>				
(Low >7%)	33 (40.7)	18 (22.2)	30 (37.0)	0.115
(High, <7%)	142 (52.4)	39 (14.4)	90 (33.2)	
<i>DSMQ 'Sum scale': Low up to 35</i>				
High 36 - 60	33 (45.8)	14 (19.4)	25 (34.7)	0.645
	142 (50.7)	43 (15.4)	95 (33.9)	
<i>Level of depressive symptom severity</i>				
Not depressed	138 (49.5)	39 (14.0)	102 (36.6)	0.036
Depressed, n (%) PHQ-2 score ≥2	37 (50.7)	18 (24.7)	18 (24.7)	

Values are expressed as number and percentage (%).

Note: Chi-square analysis was used in this table; *p*-value significant at *p*<0.05;

**Table 3** - Predictors of low health literacy in type 2 diabetes mellitus (T2DM) patients.

Variables	Odd ratio (95% CI)	Std error (SE)	P-value
Age	0.03 (0.33 - 0.94)	0.26	0.030
Gender	0.48 (2.73 - 0.86)	0.29	0.013
Educational attainment (reference: more than secondary schooling secondary schooling)			<0.001
Up to primary schooling	0.33 (0.18 - 0.59)	0.38	
Secondary & tertiary schooling	0.16 (0.07 - 0.35)	0.29	
Marital status	1.27 (0.60 - 2.71)	0.40	0.524
Employment status	1.22 (0.70 - 2.11)	0.27	0.467
Body mass index (obese), n (%)	1.24 (0.75 - 2.04)	0.25	0.391
Hba1c; (high, <7%), n (%)	0.97 (0.55 - 1.69)	0.28	0.920
Level of depressive symptom severity depressed	0.61 (0.32 - 1.14)	0.32	0.126

Nagelkerke  $r^2 = 0.177$ . Hosmer-Lemeshow goodness-of-fit for the model: Chi-square = 11.784, df = 8, and  $p = 0.161$ . (Nagelkerke  $r^2$ , test the goodness of fit test or tells how well the data fits the model. It scaled from 0 to 1.0, the smaller this ratio, the greater the improvement of goodness-of-fit measure)

**Table 4** - Predictors of low diabetes self-management in T2DM patients.

Variables	Odds ratio (95% CI)	Std error (SE)	P-value
Age	1.05 (0.58 - 1.91)	0.30	0.865
Gender	2.16 (1.10 - 4.24)	0.34	0.029
Educational attainment (reference: secondary schooling)			0.681
Up to primary schooling	1.09 (0.56 - 2.12)	0.33	
More than secondary schooling	1.49 (0.60 - 3.70)	0.46	
Marital status	0.96 (0.41 - 2.24)	0.42	0.939
Employment status	0.69 (0.37 - 1.30)	0.32	0.258
Body mass index (BMI) (obese), n (%)	1.09 (0.62 - 1.90)	0.28	0.759
HbA1c; (high, <7%), n (%)	1.19 (0.64 - 2.22)	0.31	0.566
Level of depressive symptom severity depressed	1.87 (0.86 - 4.06)	0.39	0.112

Nagelkerke  $p=0.062$ , Hosmer-Lemeshow goodness-of-fit for the model:  
 Chi-square = 11.383, df = 8, and  $p=0.181$ , (Nagelkerke  $R^2$ , test the goodness of fit test or tells how well the data fits the model. It scaled from 0 to 1.0, the smaller this ratio, the greater the improvement of goodness-of-fit measure)

Table 3 presents the association of factors influencing low health literacy. In the logistic regression analysis, age, gender, and educational attainment emerged as predictors and significant factors of low health literacy. The analysis showed that those participants aged more than 50 years were more likely to have low health literacy (OR 0.03, 95% CI: 0.33 to 0.94). The educational level was also found to have a significant association with the level of functional health literacy of the participants ( $p<0.001$ ). The model showed that participants with up to primary schooling were more likely to have low health literacy (OR: 3.12, 95% CI: 1.17 to 8.30), (OR: 0.33, 95% CI: 0.18 to 0.59). The analysis also shows that there was a significant relationship between low functional health literacy and the gender of the participants ( $p<0.050$ ). Table 3 also shows that there was no significant relationship between low functional health literacy and marital status, employment status, body mass index, level of HbA1c, and level of depressive symptoms.

*Association of factors influencing low diabetes self-management.* The analysis showed that gender was significantly related and strongest predictor to diabetes self-management recording an odds ratio of 2.16 and  $p$ -value of 0.029. This indicated that the odds are a lot higher among females than males with diabetes self-management. No significant relationship was found between diabetes self-management and age, educational attainment, marital status, body mass index, level of HbA1c, and level of depressive symptoms of the participant (Table 4).

**Discussion.** This study highlights the low level of functional health literacy of nearly half of T2DM

patients in Saudi Arabia. The low health literacy noted among these T2DM patients is similar to what has been found in the USA and China.<sup>28,29</sup> Patients who had low health literacy experienced difficulty in obtaining, understanding, and applying health information to enhance their self-management capabilities.<sup>30,31</sup> Because diabetes requires extensive self-care, it is important that patients understand health information, such as the signs and symptoms of the disease and how to properly manage and control diabetes. On the contrary, a study carried out in Saudi Arabia shows that out of 123 diabetic patients, 93 respondents had sufficient health literacy.<sup>21</sup> Furthermore, another study conducted in Saudi Arabia found that although a smaller percentage of the participants had an adequate e-health literacy level, more than half of the total diabetic patients expressed a desire to obtain health knowledge through the Internet, especially the younger generation (between 18 and 40 years old).<sup>22</sup>

Our study showed a significant difference in the levels of functional health literacy with age, gender, educational level, employment status, and level of depressive symptoms of T2DM patients. The results of our study are similar to the results of studies carried out in the USA, in which low health literacy was observed in patients who were older, female, had primary or secondary education or less, and who had diabetes longer.<sup>21</sup> It is possible that these populations did not fully understand the self-care practices and adherence to medication, as evidenced by the number of patients in this sample who were obese and had an HbA1c over 7%. Given the high number of patients with low functional

health literacy, it might be valuable for clinicians to consider assessing all their patients' health literacy and to make sure that patients clearly understand the instructions of the physicians about how to carry out diabetes self-management practices.

Interestingly, although the majority of T2DM patients in this sample displayed low to marginal functional health literacy, the findings showed the patients' had high overall DSM-16 scores, which indicated more effective self-care. This might be explained by patients' awareness of the mortality of diabetes, motivating them to adhere to a regiment of self-care. In this study, patients had high overall DSM-16 scores; however, on the subscale of health-care use and physical activity, these T2DM patients had low scores. Specifically, the subscale of health-care use assessed the patient's adherence to (versus avoidance of) appointments with healthcare professionals. The subscale indicated that their adherence to medical appointments was low. The low scores on the subscale of physical activity indicated that the participants skipped physical activity and were not aware of the importance of physical activity in managing diabetes. Studies show that exercise, particularly with regard to diabetes treatment, is effective in improving HbA1c levels and metabolic control.<sup>32-34</sup> Furthermore, a higher frequency of patient contact with their physicians is associated with better glycemic outcomes.<sup>35</sup> Our findings suggest that diabetes management education needs to address the discordance in perceptions of patients about diabetes control, particularly about physical activity. Concerning health care use, diabetes management education might be an effective means for health educators to motivate patients to make frequent physician visits for monitoring and to increase patient adherence.

Several studies have addressed the link between health literacy and self-management actions for diabetes control and the findings have been inconsistent. For example, a study in Finland found an association between poor diabetes control among English and Spanish speaking patients and low health literacy.<sup>23</sup> A study carried out in the USA among adults with T2DM found that those who had higher diabetes knowledge scores had higher DSM while those who were highly educated had high health literacy but reported low DSM.<sup>24</sup> Our present study supported the above results, showing no significant association of health literacy with diabetes self-management. Although low health literacy was found among T2DM patients in this study, it might

not necessarily reflect on their self-management actions and practices. A possible recommendation could be proper counseling and recommendation about diabetes control from time to time via reliable sources, such as a dietician or physician.

The major findings of this study are that participants with limited health literacy appeared to practice more diabetes self-management techniques, perhaps because of the awareness of the risks of complications from diabetes. Of note, because of the complexity of diabetes self-management, clinicians, and practitioners should assess their patients' diabetes self-management and monitor their adherence as well as to detect potential patient self-care skills in need of improvement. For example, clinics might need to provide a support system (namely, a visiting nurse) that can monitor and assist patients with diabetes management, particularly with their physical activity. More importantly, further assessments that will use a specific diabetes health literacy scale might provide a clear understanding of determining the association of health literacy on different facets of glycemic control and other aspects of diabetes outcomes.

The authors acknowledge some limitations of the study, such as the small sample size, which means the results cannot be generalized and do not reflect the health literacy and diabetes self-management of T2DM patients in Saudi Arabia. Another limitation was the cross-sectional design of the study; therefore, the reported association of health literacy and diabetes self-management with sociodemographic and clinical characteristics and depression could not establish causality. These findings might help future researchers in the clinical field by establishing a baseline of the level of functional health literacy and diabetes self-management of patients with T2DM in Saudi Arabia. This study might also help as a criteria for comparison for futures studies if it is possible.

In conclusion, the study shows that nearly half of the T2DM patients that exhibited low level of functional health literacy had low diabetes self-management. Notably, the findings show that the level of depressive symptoms severity was not significantly associated with health literacy and diabetes self-management. Age, gender, and educational attainment emerged as predictors and significant factors of low health literacy. Moreover, our findings show that gender significantly affects diabetes self-management in which odds are a lot higher among females than males with diabetes self-management. Finally, we detected no significant association of health literacy with diabetes self-

management. This study underscores the importance of proper counselling and education about diabetes control on both patients and family members. With appropriate support from family members and counselling of healthcare providers this may engage patients in improving compliance or adherence in facilitating self-care activities and managing their condition.

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