The association of health literacy with glycemic control in Saudi patients with type 2 diabetes

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ABSTRACT

الأهداف: لتحديد مدى انتشار التنور الصحي لدى البالغين السعوديين المصابين بمرض السكري من النوع 2 (T2DM) وتحديد العوامل الأكلينيكية المرتبطة بالتنور الصحي بما في ذلك السيطرة على نسبة السكر في الدم.

الطريقة: شملت هذه الدراسة المستعرضة 249 مريض سعودي بالغ يعانون من داء السكري «من النوع الثاني» (99 ذكر و150 أنثى) ممن زاروا العيادات المتخصصة في داء السكري بمركز الغدد الصماء في مدينة الملك فهد الطبية بمدينة الرياض – المملكة العربية السعودية من سبتمبر 2017م إلى يناير 2018م. استخدم الاختبار الموجز للتنور الصحي الوظيفي لدى البالغين (النسخة العربية) لتصنيف المرضى إلى 3 مستويات من حيث التنور الصحي الوظيفية: غير كافي – هامشي – كافي. لوحظت الخصائص الديموغرافية وتم تقييم الهيموجلوبين الجليكوزيلاتي بصفة دورية. أُجرى تحليل الانحدار لتحديد ما إذا كان التنور الصحي مرتبطًا بالتحكم في مستوى السكر في الدم.

النتائج: لدى أغلب المشاركين معرفة كافية من التنور الصحي (68.7%). المجموعة التي تتمتع بمعرفة كافية هي دائمًا أصغر سنًا (48.4±12.8) مقارنة بالنسبة الهامشية (54.2±13.3) والمجموعة التي لا تتمتع بالمعرفة الكافية (54.1±9.1). الإناث في المجموعة التي تتمتع بمعرفة كافية كانوا أقل بكثير (54.6%) مقارنة بالنسبة الهامشية (66.7%) والمجموعة التي لا تتمتع بمعرفة كافية (81.8%). بالنسبة إلى الإناث، تقل احتمالات المستويات الكافية من التنور الصحي – نسبة الأرجحية: 1.24– / مجال الثقة: 1.97– – 0.50؛ p=0.001). يرتبط مؤشر كتلة الجسم ارتباطًا إيجابيًا بمدى كفاية المعرفة الصحية، ولكن بدرجة محدودة (نسبة الأرجحية: 0.04 / مجال الثقة: 0.003 – 0.09؛ p=0.045)

الخاتمة: التنور الصحي مرتفع بين مرضى داء السكري من السعوديين (من النوع الثاني) ولا يرتبط بالتحكم في نسبة السكر في الدم.

Objectives: To identify the prevalence of health literacy among adult Saudi with type 2 diabetes mellitus (T2DM) patients and determine the clinical factors that are associated with health literacy scores including glycemic control.

Method: A cross-sectional study that included 249 adult Saudi patients with T2DM (99 males and 150 females) who visited the Diabetes Clinic of the Endocrine Center at King Fahad Medical City, Riyadh, Saudi Arabia between September 2017 and January 2018. The short test of Functional Health Literacy in Adults (Arabic version) was used to classify patients into 3 levels of functional health literacy: inadequate, marginal, and adequate. Demographic characteristics were noted and glycosylated hemoglobin was assessed routinely. Regression analysis was carried out to determine whether health literacy is associated with glycemic control.

Results: Majority of the participants had adequate literacy rate (68.7%). The adequate group is significantly younger (48.4±12.8) than the marginal (54.2±13.3) and inadequate group (54.1±9.1). Females in the adequate group were significantly lesser (54.6%) than the marginal (66.7%) and inadequate (81.8%) groups. Being female has a lesser odds of having an adequate health literacy level (odds ratio [OR] -1.24, confidence interval [CI] -1.97-0.50; p=0.001). Body mass index was positively associated with adequate health literacy level, but the significance was modest (OR 0.04; CI 0.003-0.09; p=0.045).

Conclusion: Health literacy is high among Saudi T2DM patients and is not associated with glycemic control.

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Health literacy is the degree to which individuals have the capacity to obtain, process, and understand basic health information that is needed to make appropriate health decisions.[1] While it is a part of general literacy, it is more specifically related to the understanding of medical information, both in spoken and written forms.[2] The scope of health literacy includes listening, culture, conceptual knowledge and the ability to apply numbers whenever necessary, to manage one's personal health.[3-5] Recent studies have found that health literacy is an important predictor of health behaviors, outcomes, self-care activities and the use of healthcare services.[5,6] The prevalence of low health literacy and numeracy are common even among industrialized nations, affecting approximately one-third of adults in the United States,[1] where approximately 90 million adults have basic or below basic literacy skills.[1] Here in the Kingdom of Saudi Arabia, health literacy was found to be mostly within the basic and intermediate levels, with men having a higher literacy level than women.[7]

In 2010, the global prevalence of diabetes mellitus (DM) among adults aged 20-79 years was 285 million (6.4%), and this figure is estimated to increase by as much as 439-552 million by 2030.[8] In the Kingdom of Saudi Arabia, the latest prevalence of type 2 diabetes mellitus (T2DM) is 32.8%[9] and is predicted to be 35.4% in 2020, 40.8% in 2025, and 45.8% in 2030.[9]

Patients with T2DM and with low health literacy are at higher risk of facing difficulty in properly managing their disease because of complex information and medical jargons that can confuse them in making the right decisions relative to their treatment.[10,11] These decisions require the ability to locate health information, evaluate the credibility and quality of the information, calculate medication dosages and analyze the relative risks and benefits.[12] Consequently, patients with T2DM that have low health literacy and numeracy were shown to have lesser knowledge about their disease, lower participation in self-care activities and worse glycemic control than patients with higher health literacy.[13-15] Having a low health literacy therefore puts these patients at a disadvantage and are at risk of developing multiple DM complications, including diabetic nephropathy, neuropathy, ophthalmopathy, diabetic foot, and mortality from poor self-management.[13] Moreover, T2DM patients having low numeracy have been observed to have higher body mass index (BMI) and have poor glycemic control.[14]

Higher levels of knowledge about DM and self-efficacy were associated with better outcomes relative to self-care behaviors and glycemic control.[16] Diabetes education programs for patients with limited health literacy were found to be effective in improving self-care activities, diabetes knowledge, glycemic control as well as in reducing disparities in diabetes outcomes related to literacy status.[17]

In Saudi Arabia, there have been limited studies conducted to evaluate the health literacy of T2DM patients. Therefore, the present study aimed to identify the prevalence of health literacy among adult Saudi T2DM patients and determine the clinical factors that are associated with health literacy scores including glycemic control.

Methods. A cross-sectional study was conducted on adult Saudi patients with T2DM, attending the Diabetes Clinic of the Endocrine Center at King Fahad Medical City (KFMC), Riyadh, Saudi Arabia between September 2017 and January 2018.

Saudi adults with known or newly diagnosed T2DM, male and female, aged 20-75 were invited to participate. Patients with vision or hearing problems as well as those who did not provide consent were excluded from the study. Informed consent was obtained from each participant prior to inclusion.

A general Arabic questionnaire was used to collect data from the patients, under the supervision of data collectors. This questionnaire contains demographic information including age, gender, income, and educational level, duration of T2DM and presence of complications.

Information on anthropometrics such as weight and height were taken from patient's hospital records. Body mass index (BMI) was calculated as kg/m^2. The latest glycated haemoglobin (HbA1c) reading within the last 3 months and history of diabetes complications were also taken from the patient records.

To measure health literacy and numeracy, a validated Arabic version of the Short Test of Functional Health Literacy in Adults (S-TOFHLA) was used, with permission from Al-Jumaili et al.[18] The S-TOFHLA was used to classify Arabic-speaking patients into 3 levels of functional health literacy: 1) inadequate health literacy 0-53; 2) marginal health literacy 54-66, and 3) adequate health literacy 67-100. The S-TFHLA evaluated both the numeracy and reading skills of the participants.

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The reading part had 2 prose passages, whereas the numeracy section included 4 questions that evaluated the understanding on glucose monitoring, prescription labels, and appointment slips.[19] The reading sections of the S-TOFHLA test included a statement: 'Fill in the blanks using a word from a list which best completes the sentence grammatically and contextually.' The passages were related to the preparation for an upper gastrointestinal X-ray and Medicaid rights & responsibilities.[19] When the S-TOFHLA was translated to Arabic, one of the 36 items was excluded from the passages because it did not make cultural sense after translation into Arabic. The dropped item was the third one in the X-ray passage with 4 choices (is, am, if, it). 'Medicaid' was translated as health care assistance for indigent people.[18] More information about the S-TOFHLA can be found in supplementary file 1.

The ethical approval was granted by the Institutional Review Board of the King Fahad Meidcal City Research Center, Riyadh, Saudi Arabia. The present study followed the principles outlined in the Declaration of Helsinki for Human Studies.

We expected 600 T2DM would attend the diabetes clinic of our unit in the Endocrine Center over the study period. Fifty percent health literacy was assumed, bearing that the finite population corrected sample size of 235 was sufficient to address the study objective.

Statistical analysis. Data analysis was performed by the Statistical Package for Social Sciences version 22.5 (IBM Corp, Chicago, IL, USA). Categorical variables were presented as frequencies and percentages (%) while continuous variables were presented as mean ± standard deviation (SD). Analysis of variance (ANOVA) with post-hoc analysis was carried out to compare variables according to health literacy level. Regression analysis was carried out using health literacy as independent variable and other parameters of interest as dependent variables was carried out to determine associations. Test of parallel lines was used to assess the association between health literacy and glycemic control. A *p*-value of <0.05 is considered statistically significant.

Results. A total of 249 adult Saudi patients (99 males [38.8%] and 150 females [60.2%]) with T2DM participated in the present study. **Table 1** shows the general characteristics of all as well as differences between male and female participants. The mean age of all participants was 50.2±12.7 years. The over-all mean BMI was on the obese side (33.6 kg/m^2 ± 9.1), and female participants had a significantly higher BMI than their male counterparts (p<0.001). No significant differences were observed in terms of mean HbA1c, duration of T2DM as well as presence of T2DM complications (**Table 1**).

Ordinal regression analysis revealed that health literacy level is significantly associated with age (p=0.001). The mean age of adequate group (48.4±12.8) was significantly younger than the marginal (54.2±13.3) and inadequate (54.1±9.1) groups. Females in the adequate group (54.6%) were significantly lesser than the marginal (66.7%) and inadequate (81.8%) groups. However; BMI (kg/m^2) in the adequate group (33.9±9.2) was slightly higher than the marginal (33.8±9.6) and inadequate (31.2±7.1) groups. Being female has a lesser odds of having an adequate health literacy level (odds ratio [OR)] -1.24, confidence interval [CI)] -1.97-0.50; p=0.001). Body mass index was positively associated with adequate health literacy level, but the significance was modest (OR 0.04; CI 0.003-0.09; p=0.045). The rest of the associations in the ordinal regression were not significant (**Table 2**). The test of parallel lines did not bear any significant difference (p=0.75), indicating no violation of proportional odds assumption, and the ordinal regression analysis was the best fitted model for predicting the associations (**Table 3**).

Discussion. The present study is one of the few study to determine the prevalence of health literacy and its associations among adult Saudis with T2DM using the validated Arabic version of the S-TOFHLA questionnaire. Majority of the participants had adequate health literacy and that their scores were inversely associated with age. Furthermore, T2DM patients who had no complications had higher scores than their counterparts with complications. Health literacy however was not associated with glycemic control. The present findings are in accordance with the study of Alkhaldi et al,[20] who also found a high prevalence of adequate health literacy among the general Saudi urban population using the same questionnaire. Findings from the present study however is in opposition from a similar cross-sectional study carried out by Alothman et al,[21] who reported that more than half of Saudi T2DM patients have low e-health literacy levels. The disparity in results is largely due to the method tools used, as the former study utilized e-health literacy as opposed to the standardized Arabic version of S-TOFHLA in the present study.

The results of our study were consistent with those of Morris et al[22] who conducted a large cross-sectional study of more than a thousand patients who were randomly selected from the Vermont Diabetes Information System. The study also found no relationship between

Table 1 - Clinical and demographic characteristics including short test of functional health literacy in adults score and health literacy level of all subjects (N=249).

Characteristic	Inadequate	Marginal	Adequate	Total	*P*-value			
	33 (13.3)	42 (16.9)	174 (69.9)	249 (100)	Overall	Inadequate and marginal	Inadequate and adequate	Marginal and adequate
Age (year)								
Mean±SD	54.1±9.1	54.2 ± 13.3	48.4±12.8	50.2±12.7	0.004	0.564	0.023	0.006
(min, max)	(35, 75)	(15, 75)	(14, 78)	(14, 78)				
Gender								
Female	27 (81.8)	28 (66.7)	95 (54.6)	150 (60.2)	0.009	0.143	0.004	0.157
Male	6 (18.2)	14 (33.3)	79 (45.4)	99 (39.8)				
Education level								
Illiterate	2 (6.1)	4 (9.5)	17 (9.8)	23 (9.2)				
Primary	6 (18.2)	8 (19.0)	26 (14.9)	40 (16.1)				
Intermediate	8 (24.2)	3 (7.1)	23 (13.2)	34 (13.7)	0.498	0.512	0.27	0.721
Secondary	9 (27.3)	13 (31.0)	41 (23.6)	63 (25.3)				
University	8 (24.2)	14 (33.3)	67 (38.5)	89 (35.7)				
Income (SR/month)								
<3000	5 (15.2)	7 (16.7)	38 (21.8)	50 (20.1)				
3000-5999	11 (33.3)	8 (19.0)	29 (16.7)	48 (19.3)	0.424	0.594	0.715	0.825
6000-8000	4 (12.1)	9 (21.4)	30 (17.2)	43 (17.3)				
≥9000	13 (39.4)	18 (42.9)	77 (44.3)	108 (43.4)				
Body mass index								
Mean ± SD	31.2±7.1	33.8±9.6	33.9±9.2	33.6±9.1	0.364	0.202	0.176	0.92
(min, max)	(15.6, 46.8)	(18.2, 59.9)	(17, 97)	(15.6, 97)				
DM complications								
No	13 (39.4)	19 (45.2)	88 (50.6)	120 (48.2)	0.457	0.614	0.24	0.536
Yes	20 (60.6)	23 (54.8)	86 (49.4)	129 (51.8)				
DM duration (year)								
Mean ± SD	10.4±6.9	10.7±8.2	10.8±9.4	10.7±8.9	0.854	0.86	0.623	0.727
(min, max)	(0, 30)	(0, 35)	(0, 45)	(0, 45)				
HbA1c %								
Mean ± SD	8.3±2.0	8.5±2.1	8.3±2.1	8.3±2.1	0.725	0.627	0.792	0.44
(min, max)	(4.8, 13.3)	(4.9, 13.5)	(4.9, 15.7)	(4.8, 15.7)				

Data is presented as number and percentage (%). SR - Saudi riyals, Min - minimum, Max - maximum, SD - standard deviation, DM - diabetes mellitus, HbA1c - glycated haemoglobin

health literacy, which was measured by the S-TOFHLA, and glycemic control.[22] This finding somehow supplements the association between core literacy and glycemic control. In a cross-sectional study of 256 patients in Bandar Abbas, south of Iran, Jahanlou et al[12] divided their patient cohorts into 3 groups based on literacy level: 1) illiterates, 2) low-literates (<7 years of schooling), and 3) literates (>7 years of schooling) and again, found no relationship between literacy level and glycemic control. Conversely, in a study conducted on 408 diverse, low-income patients with T2DM in a public hospital setting, Schillinger et al[11] reported that limited health literacy, as measured by the S-TOFHLA, was independently associated with greater odds, by 2-fold, for very poor glycemic control. Similarly, Powell et al[23] found among 68 patients with T2DM that low health literacy, as measured by the Rapid Estimate of Adult Literacy in Medicine score, was significantly associated with poor glycemic control. The conflicting results between this study and the above-mentioned studies may be explained by the differences in the patients' characteristics. Another possible explanation is the limitations on the use of S-TOFHLA. It has been observed that it does not properly capture the health literacy in the dimension of numeracy, rather it is more focused on processing capacity, as with other available health literacy tools, it lacks the information on key psychometric properties.[24-26]

The authors acknowledge some limitations. While the present findings confirm several and local studies in terms of health literacy, the single-center design as well as the adequate yet small sample size mean that findings cannot be generalized in both the general and the T2DM population in Saudi Arabia. The results however are suggestive that the significant associations are worthy of further investigation. Since higher health literacy levels tend to be more common among younger patients with T2DM, they will have a better

Table 2 - Ordinal regression of health literacy level with independent variables.

Variables	Estimate	Sig.	95% Confidence interval	
			Lower bound	Upper bound
Age (yr)	-0.048	0.001	-0.076	-0.021
Body mass index (kg/m^2)	0.045	0.036	0.003	0.087
DM duration (yr)	0.027	0.161	-0.011	0.064
HbA1c %	-0.064	0.392	-0.21	0.082
Gender				
Female	-1.239	0.001	-1.972	-0.505
Male	0	-	-	-
Education level				
Illiterate	-16.521	0	-18.305	-14.738
Primary	-16.176	0	-17.375	-14.977
Intermediate	-15.212	0	-16.142	-14.282
Secondary	-0.415	0.47	-1.541	0.711
University	0	-	-	-
DM complications				
No	0.363	0.25	-0.256	0.982
Yes	0	-	-	-
Threshold health literacy level				
Inadequate	-3.978	0.002	-6.507	-1.45
Marginal	-2.792	0.029	-5.291	-0.292

DM- diabetes mellitus, HbA1c - glycated haemoglobin, Sig - significant

Table 3 - The test of parallel lines (function link: logit). The Null hypothesis states that the location parameters (slop coefficients) are the same across response categories.

Model	-2 Log likehood	Chi-square	DF	Sig
Null hypothesis	368.590			
General	359.240	9.350	13	0.746

DF –degree of freedom, Sig - significant

cognitive function and less complications as compared to their older counterparts. Other factors that were not considered includes the adherence to medications and other lifestyle factors which may have more impact on glycemic control than the parameters measured in the present study. Lastly, causality cannot be determined because of the retrospective nature of the data from the files of the patients. Longitudinal studies are needed to verify whether increasing health literacy will translate to better glycemic control.

The present study may provide evidence for key policy makers in designing better educational programs. Recognizing patients with low health literacy and the factors that affect it can encourage health care providers to pay more attention to their way of communication. In addition, the provision of educational materials with clear communication principles and low-grade reading level using color coding, pictures, and step-by-step instructions can enable interactions between patients and providers to promote patient understanding, empowerment, and improved self-efficacy with self-care behaviors.

In conclusion, majority of adult Saudis with T2DM have adequate health literacy, particularly in men, but this is not associated with glycemic control. Higher health literacy scores are associated with younger age and less DM complications. Further studies are required to assess whether longitudinal improvement in health literacy scores will translate in better T2DM management.

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