

Glycemic control in type 2 diabetes: role of health literacy and shared decision-making

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Background: Improving glycemic control requires that patients actively participate in decisions about how to best live with the disease and adapt to the realities of self-care. Limited health literacy (HL) is related to poorer health outcomes and may make it difficult for patients to participate in shared decision-making (SDM). As such, understanding the relationship between HL and SDM and its impact on diabetes control is an urgent issue.

Methods: A cross-sectional survey was conducted among outpatients with type 2 diabetes in a regional teaching hospital. Purposive sampling was used to recruit eligible 372 patients via self-administered questionnaires. HbA1C values were obtained from each patient's laboratory assay.

Results: Among the 372 participants, 50.4% of patients preferred physician decision-making, 39.3% preferred SDM, and 10.3% preferred patient decision-making. The physician explaining the illness in colloquial language, having adequate time for discussion, and encouragement from the healthcare provider were the major factors influencing patients' involvement in SDM. Interactive HL and critical HL had positive correlations with patients' perceived involvement in SDM. Educational attainment and HL were positively related. The HbA1C values for patient decision-making and physician decision-making were approximately 1.4 times and 1.24 times higher than those of SDM, respectively.

Conclusion: SDM led to better glycemic control. HL increased patients' perceived involvement in SDM. Therefore, it is necessary to improve levels of HL based on the educational attainment of patients. Physicians explaining illness in colloquial language is the key factor in promoting patients' perceived involvement in SDM.

Keywords: health literacy, shared decision-making, type 2 diabetes

Introduction

“Our health underpins our happiness”¹ is especially appropriate for people with diabetes, as diabetes is a chronic disease that can only be controlled, not eradicated, and patients have to live with it for the duration of their lives. Each patient is unique in terms of their illness, new problems (complications), social contexts, beliefs,² values, and preferences.³ In order to effectively control diabetes, management plans should be personalized for each patient in order to provide the most appropriate control program.² Studies have shown that most medical professionals have expressed frustration at their patients' noncompliance;⁴ their attitudes toward diabetes were more serious than those of their patients,⁵ although they tended to underestimate patients' perceptions of the seriousness of diabetes.⁶ Therefore, the management of diabetes by medical professionals is not enough; it is also necessary for patients to actively participate in decisions about how to best live with the

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disease and adapt to the realities of self-care. The phrase “nothing about me without me”⁷ applies here.

Shared decision-making (SDM) is an important indicator of good medical care in the world today and is a key component in achieving quality medical care.⁸ The Institute of Medicine (IOM) defined patient-centered care as “providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions”.⁹ SDM has been described as “the pinnacle of patient-centered care,”¹⁰ which highlights that a collaboration between patients and physicians that takes patients’ values and preferences into consideration will help inform the best decisions.¹¹ When patients actively participate in disease management and understand the reasons behind care decisions, the results of their treatment improve. This is due in part to the patient’s participation and their improved compliance and satisfaction.¹² However, not every patient may be willing to actively participate, or they may not share the views and choices of their physician. For patients with diabetes who face life-long decisions, it is even more necessary to consider their willingness to participate in order to achieve effective outcomes.

In order to increase patient participation and responsibility in self-care, their role must shift from passive informed consent to active participation within the health care system.¹³ Health literacy (HL) has been widely discussed and has attracted interest in the context of the importance of self-management of chronic diseases.¹⁴ The IOM defined HL as “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions”.¹⁵ According to the World Health Organization, HL involves “the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health”.¹⁶ Therefore, HL is essential in order for people to understand medical information, promote health and effectively use healthcare resources. Although the definition is broad in scope, many studies have shown a relationship between a lack of HL and poorer health outcomes, including high mortality, high hospitalization rates, high emergency room visits, high medical costs, and poor accessibility to healthcare systems,¹⁷ as well as difficulty with SDM, low medication compliance, and poor self-management.^{18,19} As such, the demand for HL is expected to continue to increase, and it will have an important role for people with diabetes when

faced with the care of multiple complications and complex care systems.

In summary, the prevention and treatment of diabetes require not only the input of medical professionals but also the participation of patients. Expertise from both stakeholders, physicians and patients, is imperative—physicians are experts in their medical profession, and patients are experts in what matters most to them.²⁰ This can change the care model from a disease-oriented to a patient-centered one, with healthcare services that are oriented to the patient’s values, preferences, and needs. SDM can help to improve care by aligning medical decisions with the patient’s goals and preferences.²¹ HL is significantly associated with decision-making preference;²² both of these may affect health outcomes. However, the relationship between HL and SDM and its impact on diabetes control have rarely been discussed in the literature. The aims of the current study were to: 1) investigate the key factors for the participation of patients with diabetes in SDM; 2) analyze the relationship between HL in patients with diabetes and perceived involvement in SDM; and 3) examine the impact of HL in patients with diabetes, perceived involvement in SDM, and preferences in decision-making regarding blood glucose control. These findings may provide support for implementing SDM, promote HL in patients with diabetes, and further inform policy intervention to control diabetes, improve the quality of care, and ensure the achievement of healthy aging in patients with diabetes.

Methods

Study participants

Study participants were outpatients with type 2 diabetes for more than one year (primary diagnoses included up to three diagnostic codes in the International Classification of Diseases, Ninth Revision, Clinical Modification: 250) visiting the Department of Metabolism of a regional teaching hospital in Hsinchu City, Taiwan. Purposive sampling was used to recruit eligible patients with consent during all clinic sessions from June through September 2017. Researchers explained the purpose of this study briefly prior to distribution of the questionnaires; a total of 400 questionnaires were actually distributed, and 372 completed self-administered questionnaires were collected.

This study was approved by the review board of National Taiwan University Hospital Hsin-Chu Branch (106-018-E). All participants were fully informed about

the content of the study, and they had the right to withdraw from the study at any time. Written informed consent was obtained prior to the interviews. This study was conducted in accordance with the Declaration of Helsinki.

Research scale design

Data were collected from patients' self-administered questionnaires. The questionnaire for this study was developed with reference to literature scales and was reviewed through discussion with an expert panel, including a specialist physician, dietitian, and health educator. The scale items were examined for applicability and could be easily administered. The details of each scale are as follows.

The HL scale used in this study was developed with reference to the multidimensional Functional, Communicative and Critical Health Literacy (CHL) scale,²³ which includes the three constructs of HL introduced by Nutbeam, and was used to assess HL skills and measure HL for patients with type 2 diabetes. The questionnaire included 14 items covering three dimensions. Functional health literacy (FHL) refers to "sufficient basic skills in reading and writing to be able to function effectively in everyday situations";²⁴ the five items in this dimension were mainly intended to assess the patient's experience in reading instructions or leaflets from hospitals or pharmacies. Interactive health literacy (IHL) refers to "advanced cognitive and literacy skills which, together with social skills, can be used to actively participate in everyday activities, to extract information and derive meaning from different forms of communication, and to apply new information to changing circumstances";²⁴ five items were prepared to evaluate the degree to which patients had extracted and communicated diabetes-related information as they were diagnosed with the disease. CHL refers to "advanced cognitive skills which, together with social skills, can be applied to critically analyze information, and to use this information to exert greater control over life events and situations";²⁴ here, four items were assessed by focusing on the degree to which patients had critically analyzed the information and used it to make decisions. Besides the three subscales, the total HL was also obtained for all 14 items. Each item was scored on a 5-point Likert scale (from 1=strongly disagree to 5=strongly agree), and each patient responded to the statement of each item based on his actual behavior. Mean scale scores of each dimension were obtained by summing the item scores and dividing by the number of items;

higher scores indicated higher HL. Reliability analysis was used to examine each dimension of the scales, using Cronbach's $\alpha=0.89$, 0.93, and 0.95, respectively.

The SDM questionnaire was developed based on the relevant published literature, including the nine-item Shared Decision Making Questionnaire (SDM-Q-9),²⁵ a patient's role preference in decision-making questionnaire,²⁶ and factors promoting a patient's involvement in SDM.²⁷ The degree of a patient's perceived involvement in medical decision-making was measured using nine items. Each item was scored on a 5-point Likert scale (from 1=strongly disagree to 5=strongly agree), using a Cronbach's α of 0.95 for the reliability analysis. The patient's preferences in decision-making were measured using five items: 1=like to make treatment decisions on their own; 2=like to make treatment decisions on their own after listening to physician's opinion; 3=like to make treatment decisions together with the physician; 4=like physician to make treatment decisions after talking to the patient; 5=like physician to make treatment decisions alone. Upon analysis, results were divided into three groups: patient decision-making (answers 1 and 2), SDM (answer 3), and physician decision-making (answers 4 and 5). The level of influence on patients in the process of SDM was assessed using seven factors; each factor was scored on a 5-point Likert scale (from 1=not influenced at all to 5=always influenced). Patient characteristics included gender, age, education, duration of diabetes, family history of diabetes, treatment pattern, and history of chronic disease, and perceived health status (1=poor to 5=excellent).

HbA1C measurement

HbA1C data were obtained from each patient's laboratory assay on the date closest to the patient's self-administered questionnaire date. A cation-exchange high-performance liquid chromatography method with demonstrated accuracy <0.21% and the National Glycohemoglobin Standardization Program (NGSP) Certificate of Traceability with demonstrated precision <2.91% was used.

Data analysis

Descriptive statistics, including mean, standard deviation, and frequency, were used to explore the distribution of patient characteristics, patients' preferences in decision-making, and factors affecting patients' perceived involvement in SDM, and HbA1C values were collected. Multiple regression analysis was used to analyze the independent

effects of patient characteristics on levels of HL and to analyze the independent effects of patient characteristics and levels of HL on patients' perceived involvement in SDM. Multinomial logistic regression was used to examine the relationship among HbA1C values, patients' perceived involvement in SDM, HL, and patients' preferences in decision-making. Reliability analysis was used to examine the reliability of the questionnaire. All statistics were analyzed using SPSS version 22.0.

Results

Study participant characteristics

Among the 372 participants, 61% were female and 39% were male. Those aged ≥ 65 years accounted for 61% of the study population; 64.7% had a family history of diabetes, 77.8% were taking oral medication, 52.6% had had diabetes for ≥ 10 years, and 79% had other chronic medical conditions. Less than half of participants had an elementary school education (43.9%). Mean HbA1C values were 7.22%; about half of the study group (49.7%) had values $< 7\%$, while 21.8% had values higher than 8%. In terms of patients' preferences in decision-making, approximately half of the study group (50.4%) preferred physician decision-making, 39.3% preferred SDM, and 10.3% preferred patient decision-making (Table 1).

Factors influencing patients' involvement in the process of SDM

We assessed the level of influence of seven factors on patients' involvement in the process of SDM based on patients' self-administered questionnaires; reliability analysis was used to examine the content of the questionnaire, with Cronbach's $\alpha=0.90$ demonstrating the high consistency of the scales. As shown in Table 2, the most influential factor (61.1%) was the physician explaining illness in colloquial language, followed by adequate time to discuss with the physician (56.2%), and encouragement from the healthcare provider (55.1%).

Relationships among participant characteristics, HL, and patients' perceived involvement in SDM

As shown in Table 3, patients' perceived health status had a positive correlation with HL ($\beta=0.161, 0.147, 0.197$). Level of educational attainment was related to HL, with a high school degree as the reference group. FHL, IHL, and CHL in those who had completed

Table 1 Patient characteristics, HbA1C, and preference for SDM

	N	%		N	%
Sex			Family history of diabetes		
			Yes	224	64.7
Female	227	61.0	No	122	35.3
Age (years)			Duration of diabetes		
			≤ 4	80	26.0
			5–9	66	21.4
			10–14	55	17.9
			≥ 15	107	34.7
Educational level			Treatment pattern		
			Oral medication	266	77.8
			Insulin use	35	10.2
			Both of above	41	12.0
College or above	59	16.5	History of chronic disease		
HbA1C	298		No	76	21
			Yes	286	79
Mean (SD): 7.22 (1.50)			Preference of SDM		
< 7	148	49.7	Patient decision	38	10.3
7–8	85	28.5	SDM	145	39.3
≥ 8	65	21.8	Physician decision	186	50.4

Abbreviation: SDM, shared decision-making.

elementary school were inferior to those who had completed high school ($\beta=-0.216, -0.219, -0.194$). FHL in those who had middle school education was lower than that who had completed high school education ($\beta=-0.209$). Those with college degrees or above had higher FHL and CHL than those who had only completed high school ($\beta=0.133, 0.140$). Overall, HL in those with elementary and middle school education was not as high as those with high school education ($\beta=-0.276, -0.165$), and those with college degrees or above had higher HL than those with high school education ($\beta=0.166$). Patients' perceived health status was also significantly positively correlated with patients' perceived involvement in SDM ($\beta=0.213, 0.174, 0.159$). As the correlation coefficient between IHL and CHL was 0.75, we analyzed separately the relationships among the three dimensions of HL, patient characteristics, and patients' perceived involvement in SDM. The results showed that both IHL and CHL had a significant positive correlation with patients' perceived involvement in SDM (Model 2, $\beta=0.236$; Model 3, $\beta=0.251$). However, there was no obvious correlation in the

Table 2 Factors influencing patients' involvement in the process of shared decision-making

Factors	Mean (SD)	Positive % ^a	Negative % ^b
1. Information on related treatment options	3.22 (1.04)	46.4	26.5
2. Encouragement from healthcare provider	3.39 (1.06)	55.1	23.5
3. Relevant health knowledge was delivered via interesting ways (such as brochures, videos, DVDs, and websites)	3.21 (1.02)	45.1	24.5
4. Enough time to discuss with the physician	3.44 (1.06)	56.2	20.0
5. Physician explained illness in colloquial language	3.53 (1.13)	61.1	21.3
6. Influenced from non-medical pathways (eg, media, news, etc)	3.10 (1.13)	40.9	28.4
7. Opinions of the main caregiver (family)	3.22 (1.16)	47.6	27.6

Notes: ^aPositive % = number of patients that answered "frequently influenced" or "always influenced"/total number of patients. ^bNegative % = number of patients that answered "not influenced at all" or "a little influenced"/total number of patients.

Table 3 Multiple regression analysis for the relationships among participant characteristics, HL, and patients' perceived involvement in SDM

Independent variables	Dependent variables				Perceived involvement		
	FHL	IHL	CHL	Total HL	Model 1	Model 2	Model 3
Sex	0.018	-0.004	0.005	0.009	-0.014	-0.014	-0.016
Age	-0.083	-0.059	-0.040	-0.081	-0.065	-0.048	-0.052
Education							
Elementary school	-0.216**	-0.219**	-0.194**	-0.276***	-0.066	-0.008	-0.011
Middle school	-0.209**	-0.051	-0.106	-0.165**	-0.031	-0.013	0.002
High school	0	0	0	0	0	0	0
College or above	0.133*	0.140*	0.103	0.166**	0.019	-0.018	-0.010
Perceived health status	0.161**	0.147**	0.197***	0.219***	0.213***	0.174**	0.159**
HL							
FHL					-0.028		
IHL						0.236***	
CHL							0.251***
F	11.99***	8.94***	7.94***	18.17***	3.03**	5.69***	6.12***

Notes: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Abbreviations: CHL, critical HL; FHL, functional HL; HL, health literacy; IHL, interactive HL; SDM, shared decision-making.

relationships among age, gender, and HL. Also, age, gender, and educational attainment had no impact on patients' perceived involvement in SDM (Table 3).

Relationships among HbA1C values, patients' perceived involvement in SDM, HL, and patients' preferences in decision-making

Table 4 shows that the HbA1C values of patient decision-making and physician decision-making were approximately 1.4 times and 1.24 times higher than those of SDM, respectively ($B = 0.338$, $p < 0.05$; $B = 0.213$, $p < 0.05$). Patient decision-making was associated with less perceived involvement than SDM ($B = -1.083$, $p < 0.05$), and the CHL associated with patient decision-making was also lower ($B = -1.205$, $p < 0.05$).

Discussion

This study explored the relationship between HL and SDM and its impact on glycemic control in type 2 diabetes, and factors affecting patients' participation in SDM.

According to the results, 50.4% of patients preferred physician decision-making, 39.3% preferred SDM, and 10.3% preferred patient decision-making. However, patient preferences in decision-making are variable worldwide. In Europe, a large population-based study showed that 51% of patients preferred SDM,²⁸ as did 51.9% in Malaysia.²⁹ In a study of diabetes outpatients in Japan, 71% preferred SDM.³⁰ A population-based survey in the United States found that 52% of participants preferred to leave the final decision to their doctors, but they hoped to discuss it with physicians,

Table 4 Multinomial logistic regression for the relationships among HbA1C values, patients' perceived involvement in SDM, HL, and patients' preferences in decision-making

	Patient decision-making vs SDM			Physician decision-making vs SDM		
	B	Exp. (B)	95% CI	B	Exp. (B)	95% CI
HbA1C	0.338*	1.402	1.078–1.822	0.213*	1.237	1.018–1.503
Perceived involvement	–1.083*	0.338	0.148–0.774	0.312	1.366	0.813–2.297
HL						
FHL	0.382	1.465	0.761–2.821	–0.222	0.801	0.558–1.150
IHL	0.851	2.343	0.773–7.103	0.258	1.295	0.703–2.385
CHL	–1.205*	0.300	0.091–0.987	–0.651	0.522	0.270–1.009

Note: * $p < 0.05$; *** $p < 0.001$. $F = 31.70$ ***; Cox-Snell $R^2 = 0.104$.

Abbreviations: CHL, critical HL; FHL, functional HL; HL, health literacy; IHL, interactive HL; SDM, shared decision-making.

showing a preference for physician decision-making; this may have been due to higher levels of trust in their physicians.³¹ In a study examining acute illness in Switzerland, 66% of patients preferred physician decision-making.³² Previous studies demonstrated that factors affecting patients' preferences in decision-making included the type of disease,^{29,33,34} the purpose of diagnosis or treatment of the disease,³⁵ the relationship with professionals, the type of decision-making, the experience of care, and demographic characteristics.³⁶ In this study, the rate of SDM was lower than that of studies mentioned above. This may be related to the fact that this study included a majority of older patients (61% of patients aged ≥ 65 years) and those with low educational attainment level (43.9% with elementary school level education); furthermore, under the National Health Insurance System in Taiwan, which promotes combined care plans for diabetes, the patient has a certain degree of trust the physician, and so may tend to prefer physician decision-making.^{27,37,38}

With regard to factors that influence patients' involvement in SDM, Blumenthal-Barby³⁹ found that barriers to patients' involvement included individual characteristics (education, language, culture, attitude) and contextual dynamics (lack of time, lag time between test and results were available). Furthermore, facilitating the behavior of physicians' patient-centered communication was considered an important factor in encouraging patients to actively participate.⁴⁰ Often, patients with chronic disease not only expect to actively participate in SDM but also do not wish to be troublesome. Therefore, physicians' supportive communication,⁴¹ attitudes, and time factors⁴² have a significant influence on a patient's participation and the physician–patient relationship. Mah et al,²⁷ reported that the most important motivating factor for patients regarding their involvement in SDM was encouragement from the healthcare provider, followed by knowledge of

related treatments, and adequate time for discussion with physicians. Altin and Stock⁴³ conducted a survey that indicated that patients felt most satisfied when their physician explained their illness in a way that was easy to understand, and when they spent adequate time with them. These results are consistent with those of this study, which found that the critical factor influencing patients' involvement in the process of SDM was the physician explaining the illness using colloquial language, followed by adequate time to discuss with their physician. "Listen to the patient: he is telling you the diagnosis",⁴⁴ William Osler taught his students in the late nineteenth century; this advice is still worthy of introspection and consideration.

As for the relationships among participant characteristics, HL, and patients' perceived involvement in SDM, this study showed that educational attainment, perceived health status, and HL were positively related; HL in those with elementary and middle school education was inferior to that in those with high school education, while those with a college degree or higher had higher HL than those who had only completed high school. These results were consistent with those in the literature. However, there was no obvious correlation in the relationships among age, gender, and HL. Also, age, gender, and educational attainment had no impact on patients' perceived involvement in SDM in this study. Studies have demonstrated that HL is negatively correlated with age, but positively correlated with educational attainment and perceived health status; the correlation between gender and HL remains controversial to date.⁴⁵ Younger patients and those with higher educational attainment were more actively involved in decision-making.⁴⁶ Further exploration of this topic may be warranted. IHL and CHL are very important for people with diabetes, who should have the ability to integrate blood

glucose monitoring, regular exercise, diet control, compliance, and other self-management techniques into their daily lives, and to shift from FHL to CHL depending on the context.⁴⁷ This high level of HL can enable patients to have a more active role in participating in healthy activities.⁴⁸ Brabers et al,⁴⁹ reported that HL was related to patients' involvement in SDM, especially CHL. This study found that both IHL and CHL were significantly positively correlated with patients' perceived involvement in SDM, consistent with the literature. However, FHL was less important in this study, possibly because the National Health Insurance System in Taiwan promotes combined care plans for diabetes, and patients have acquired basic information and competencies.

With regard to the impact of patients' perceived involvement, HL, and SDM on HbA1C, this study indicated that HbA1C values for patient decision-making or physician decision-making were approximately 1.4 times and 1.24 times higher than those of SDM, respectively; in other words, SDM led to better glycemic control. The paradigm of SDM requires patients to play a more active part in decision-making,⁵⁰ and physicians encourage patients to participate in the way in which they are most comfortable.⁵¹ Such management plans help promote patients compliance with the treatment plan and promote better outcomes for medical care aligned with patients' preferences and values.⁵² Therefore, SDM is now described as "the pinnacle of patient-centered care,"¹⁰ because it considers patients' preferences, values, and need for decision-making. When physicians make decisions on behalf of patients, they need to ensure the maximum benefit for the patients. After all, it is the patients that have to live with the disease after the treatment decisions. Physicians are not patients; there are gaps between physicians' judgment and patients' preferences, values, and needs that cannot be negated.⁵³ Although patients are often willing to participate in the discussion about treatment options and may have adequate HL, without patients' involvement (determination, perseverance, and accountability) in the final decision stage, the outcomes of physician decision-making are naturally inferior to those of SDM.

Limitations of this study include the fact that participant inclusion was based on patient consent, so there may have been a selection bias. This study sample from a single regional hospital may not be generalizable, and the impact of drug therapy on HbA1c was not considered here. Further study is needed to clarify the

pathways of patient characteristic, HL, and patients' perceived involvement in SDM to glycemic control.

Conclusion

This study provides insight into the role of HL and SDM in glycemic control in type 2 diabetes. Comparing the effects of patient decision-making, physician decision-making, and SDM on HbA1C showed that SDM led to better glycemic control. HL increased patients' perceived involvement in SDM. Therefore, these results represent a call to action for clinical and healthcare professionals and the public health system to ensure that patients' preferences, values, and needs are understood. It is necessary to improve levels of HL based on the educational attainment of patients. The physician explaining the illness in colloquial language is the key factor in promoting patients' perceived involvement in SDM.

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Disclosure

The authors report no conflicts of interest in this work.

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