

Relationship between Type 2 Diabetes Self-Efficacy and Quality of Life: Analysis Under Varying Glycated Hemoglobin Conditions

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Abstract

Purpose: To investigate the correlation between self-efficacy and quality of life (QoL) in patients with diabetes under varying glycated hemoglobin (HbA1c) conditions.

Methods: The 177 outpatients with Type 2 diabetes were included in this study at a regional teaching hospital in central Taiwan. We reviewed the results of the patients' HbA1c test results from the preceding 3 months and recorded these data. HbA1c levels were divided into three control groups: good, moderate, and poor. In multiple regression analysis, the relationship between overall self-efficacy and QoL, then stepwise added HbA1c and demographic variables.

Results: This study revealed a strong relationship between self-efficacy and QoL. In comparison to the overall sample (referred to as the baseline group), the relationship between self-efficacy and QoL was significant. In the good control group, the relationship between self-efficacy and QoL intensified.

However, the correlation between the two in the moderate control group weakened, and the correlation between the two in the poor control group was the lowest. Therefore, as HbA1c levels increased, the correlation between self-efficacy and QoL weakened and tended to decline steadily. In addition, the relationship between the self-efficacy dimensions of medication control, foot care, and QoL intensified in the poor control group. However, regression analysis showed that the partial regression influence of HbA1c on mental QoL and environmental QoL was not significant.

Conclusions: Self-efficacy and QoL were significantly correlated under various HbA1c conditions. Therefore, improving self-efficacy to achieve appropriate blood glucose control can help increase the QoL of patients with Type 2 diabetes.

Keywords: Type 2 diabetes; Self-efficacy; Quality of life; Glycated hemoglobin

Introduction

Diabetes is currently one of the most common chronic diseases. In 2000, 170 million people globally had diabetes. This number increased to approximately 285 million in 2010, and is projected to increase to 439 million by 2030 [1]. Taiwan is currently facing the rapid aging of its population. The incidence of Type 2 diabetes increases with age. The causes of Type 2 diabetes include deteriorating insulin secretion/function with aging, poor metabolism, obesity, and reduced exercise [2].

Taiwan's Health Promotion Administration, Ministry of Health and Welfare, Executive Yuan, has investigated adult and geriatric diseases, as well as hypertension, hyperglycemia, and hyperlipidemia. According to their findings, the diabetic population in Taiwan continues to grow at an average rate of 25000 people per year. More than 95% of these

people have Type 2 diabetes. The current number of people with diabetes in Taiwan is estimated to be approximately 1.4 million.

The prevalence of diabetes is 8% of the population. Diabetes has also continuously been the fifth most common cause of death in Taiwan [3]. In recent years, medical personnel have attempted to control patients' blood sugar levels and prevent comorbidity, demanding that patients restrict their diets, regularly exercise, measure their blood pressure, and use medication appropriately to control their blood glucose to acceptable levels.

For patients with diabetes, HbA1c is an indicator of whether blood glucose has been controlled appropriately during the preceding 3 months. Patients should begin by changing their health management behaviors; they must control their diets and use medication and exercise to control their diseases and effectively avoid worsening symptoms [4].

In this study, we investigated the relationship between self-efficacy, in terms of patients with diabetes implementing self-care behavior, and quality of life (QoL). Patients with Type 2 diabetes were the

participants in this study. An indicator of glycemic control, HbA1c, was used as a conditional variable. We also examined major demographic variables to explore the relations between the dimensions of self-efficacy and QoL.

Material and Methods

The subjects of this study were outpatients with Type 2 diabetes in the department of metabolism of a regional teaching hospital in central Taiwan. We used questionnaires to collect data related to self-efficacy and QoL. After the consent of the patients was obtained, their test reports were reviewed for their HbA1c levels during the preceding three months.

After we recorded these data, we performed correlation analysis on self-efficacy and QoL. Regarding research ethics, after the cases were identified, we explained the study to the patients and their families, and received their written consents.

The Institutional Review Board of the Kuang Tien General Hospital approved the study protocol and ethical aspects of the present study. We adopted structured questionnaires for this study. The content comprised the patients' demographic data, self-efficacy of the patients, and QoL. We adopted the Diabetes Control Self-Efficacy Scale for Patients, which was developed by Wang, Wang, and Lin [5] in reference to Hurley and Shea's Insulin Management Diabetes Self-Efficacy Scale [6].

The Cronbach's alpha for the internal consistency of the Chinese version of the scale was 0.87. Test-retest reliability after 2 weeks was 0.96. The 3rd, 15th, 17th, 19th, 20th, 21st, and 25th items on the scale addressed medication control; the 18th, 22nd, 23rd, and 24th items addressed blood glucose monitoring; the 5th, 6th, 7th, 8th, 9th, and 10th items addressed diet; the 2nd, 11th, 12th, and 26th items addressed exercise; and the 1st, 4th, 13th, 14th, and 16th items addressed foot care.

We scored the questionnaire using a 6-point scale. The respondents answered each item with a score from 1 to 6 depending on their capabilities. Higher scores indicated higher self-efficacy.

Yao divided the Taiwan Brief Version of the WHO Quality of Life scale into the four categories of physical health, mental health, social relationships, and environmental, simplifying the WHO's original six categories and adding two localized items for a total of 28 items. This scale was administered to 1068 respondents comprising both healthy and ill participants from 17 hospitals in Taiwan. Regarding the scale's reliability and validity, the Cronbach's alpha for the internal consistency of the questionnaire as a whole was 0.97.

The test-retest reliability after 2 weeks was between 0.68 and 0.85 for each dimension. Higher scores represented this questionnaire increased QoL [7]. We collected outpatient cases from the department of metabolism.

In addition, we reviewed the patients' medical records to obtain their HbA1c values from the preceding 3 months and recorded them in the questionnaire data files. A total of 201 patients were gathered for this study, 177 of whom completed valid questionnaires, achieving a

completion rate of 88%. We used SPSS for Windows 18.0 to analyze the research data.

Results

Demographic data

This study comprised 102 women (57.6%) and 75 men (42.4%). The largest age group was 60 to 69 at 31.6%, followed by 50 to 59 at 29.4%. A plurality (40.1%) of the patients had experienced diabetes for between 0 and 4 years.

In addition, 24 (13.6%) of the patients had HbA1c lower than 6.4%, 79 (44.6%) had HbA1c between 6.5% and 8.4%, and 74 (41.8%) had HbA1c higher than 8.4% (Table 1). We divided these participants into three groups.

The good control group had HbA1c between 4.4% and 6.4% [8], the moderate control group between 6.5% and 8.4%, and the poor control group 8.5% or higher.

Variable	Number (%)
Sex	
Male	75 (42.4%)
Female	102 (57.6%)
Age	
40-49 y	26 (14.7%)
50-59 y	52 (29.4%)
60-69 y	56 (31.6%)
70+ y	43 (24.3%)
Number of years with diabetes	
0-4 y	71 (40.1%)
5-9 y	54 (30.5%)
10+ y	52 (29.4%)
Glycated hemoglobin (HbA1c)	
Good control (4.4%-6.4%)	24 (13.6%)
Moderate control (6.5%-8.4%)	79 (44.6%)
Poor control (8.5%+)	74 (41.8%)

Table 1: Demographic data analysis (N=177).

Self-efficacy and quality of life scores

We divided self-efficacy for the participants into five dimensions: medication control, blood glucose monitoring, diet, exercise, and foot care.

Quality of life was divided into four dimensions: physical health, mental health, social relationships, and environmental (Table 2) shows that overall self-efficacy was 71.33%, whereas overall QoL was 70.01%.

Category (Number of items) [The numbers within the brackets represent the number of items.]	Average score (±SD)	Score index (%)
	[The average score for each item was calculated through standardized conversion on a 6-point scale.]	[Score Index=(average score/highest possible score) × 100%.]
Overall self-efficacy (26)	4.23 (± 0.88)	71.33
	4.38 (± 0.94)	73.00
Blood glucose monitoring (4)	4.70 (± 1.20)	78.33
Diet (6)	4.67 (± 1.22)	77.89
Exercise (4)	3.29 (± 1.59)	54.83
Foot care (5)	4.02 (± 1.40)	66.93
Overall quality of life (26)	4.20 (± 3.54)	70.01
Physical health (7)	3.71 (± 3.16)	61.97
Mental health (6)	3.62 (± 3.03)	60.37
Social relationships (5)	3.30 (± 2.78)	54.92
Environmental (8)	4.72 (± 3.95)	78.65

Table 2: Self-efficacy and quality of life scores (N=177).

Analysis of the correlation between self-efficacy and quality of life

We analyzed the correlation between the overall self-efficacy (i.e., medication control, blood glucose monitoring, diet, exercise, and foot care) and QoL of three groups of diabetes patients divided based on HbA1c. The results in (Table 3) indicated that the overall self-efficacy of the baseline group (the overall sample) was significantly correlated with the patients' overall QoL ($r=0.432$, $p<0.001$).

Self-efficacy	Overall glycated hemoglobin in (Baseline group-full sample)	Glycated hemoglobin in (Good control group)	Glycated hemoglobin in (Moderate control group)	Glycated hemoglobin in (Poor control group)
Overall self-efficacy (baseline group)	0.432***	0.660***	0.397***	0.379***
Medication control	0.301***	0.510***	0.250*	0.291***
Blood glucose monitoring	0.299***	0.487***	0.274*	0.268*
Diet	0.288***	0.493***	0.258*	0.253*
Exercise	0.360***	0.579***	0.437***	0.17
Foot care	0.390***	0.445***	0.289**	0.442***

* $p<0.05$ (2-tailed); ** $p<0.01$ (2-tailed); *** $p<0.001$ (2-tailed)

Table 3: Comparative analysis of the correlations between the dimensions of self-efficacy and QoL at various HbA1c levels.

The self-efficacy of the good control group was also significantly correlated with QoL. However, the correlation coefficient was stronger ($r=0.660$, $p<0.001$). In contrast, although the self-efficacy of the moderate control group remained significantly correlated with QoL,

this correlation declined ($r=0.397$, $p<0.001$). The self-efficacy of the poor control group was also significantly correlated with QoL, but this correlation was weaker ($r=0.379$, $p<0.001$). These results indicated that with HbA1c as a conditional variable, the correlation between self-efficacy and QoL weakened as HbA1c levels increased. The trend was one of consistent decline.

We further analyzed the correlations between the five dimensions of self-efficacy (i.e., medication control, blood glucose monitoring, diet, exercise, and foot care) and the self-efficacy and QoL of the four groups divided based on HbA1c (i.e., the baseline group, the good control group, the moderate control group, and the poor control group). The results indicated that the correlation between each dimension of self-efficacy and QoL was stronger in the good control group than it was in the baseline group, the moderate control group, and the poor control group, with a consistent downward trend. Exercise and QoL were not significantly correlated ($r=0.170$) in the poor control group. In contrast, foot care and QoL remained significantly correlated ($r=0.442$, $p<0.001$) in the poor control group.

This indicated that foot care became more effective as HbA1c increased. The other dimensions of self-efficacy were significantly correlated with the HbA1c groups (i.e., the baseline group, the good control group, the moderate control group, and the poor control group). These results indicated that HbA1c was a key factor that influenced QoL. However, when the patients' control of HbA1c worsened, only the correlation between exercise and QoL was not significant. This indicated that the relationship between exercise and QoL in patients with poor control HbA1c was weak, which is consistent with the findings of Pham, Fortin, and Thibaudeau [9].

Correlation and graphical change analysis between the dimensions of self-efficacy and QoL with various HbA1c conditions

To further investigate the correlations between the dimensions of self-efficacy and QoL, we analyzed the correlations between the

dimensions of self-efficacy and QoL in patients with diabetes. The patients were divided into three groups based on their HbA1c for conditional analysis (Figure 1 and 2). Self-efficacy was the explanatory variable and QoL was the explained variable.

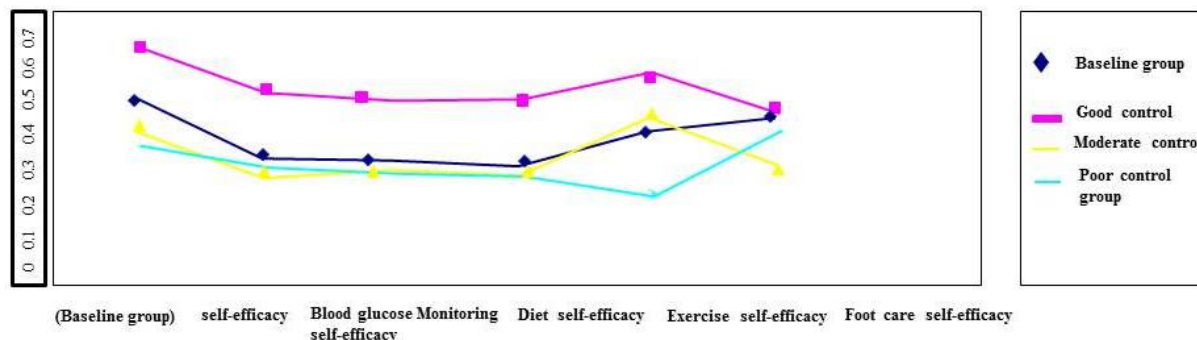


Figure 1: Comparative correlation analysis for the dimensions of self-efficacy with 3 different HbA1c levels.

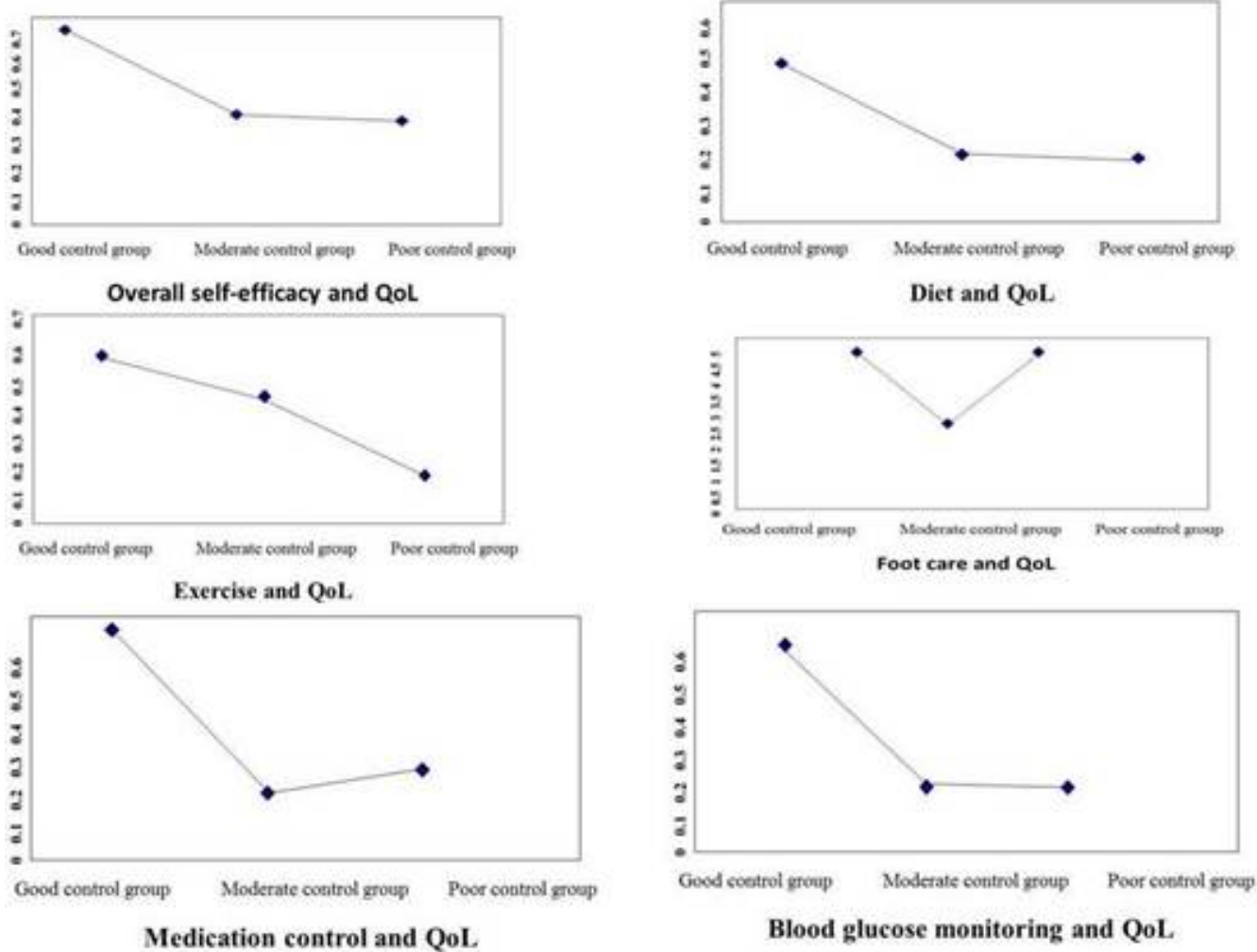


Figure 2: Comparative analysis of the correlations between the dimensions of self-efficacy and QoL at three different HbA1c levels.

Our results indicated that the correlation coefficient between self-efficacy and QoL responded in three patterns to changes in HbA1c: rapid decline, gradual decline, and U-shaped. The rapid decline pattern occurred when the relationship between self-efficacy and QoL weakened as HbA1c became more severe. We found that overall self-efficacy and diet exhibited a pattern of rapid decline, with these correlations declining rapidly and steadily under poor control HbA1c level before slowing down after reaching the moderate control group. Exercise exhibited a gradual decline pattern, with this correlation declining steadily under poor control HbA1c level before declining rapidly after reaching the moderate control group. Foot care exhibited the U-shaped pattern, declining rapidly and steadily under poor control HbA1c level before increasing rapidly after reaching the moderate control group. Medication control and blood glucose monitoring declined rapidly and steadily with poor control HbA1c level before increasing gradually after reaching the moderate control group.

These results indicated that the correlations between the dimensions of self-efficacy and QoL in the group with good control HbA1c were generally higher than those of the moderate and poor control groups. The correlations between each dimension of self-efficacy and QoL varied. Therefore, HbA1c was a key conditional analysis variable that had various performance results for various conditions.

Standardized regression analysis of overall self- efficacy and the dimensions of QoL

Introducing HbA1c and demographic variables for stepwise analysis: In addition to comparing the relations between self-efficacy and QoL with varying HbA1c levels, we also performed multiple regression analysis on the overall self-efficacy, HbA1c, and demographic variables (i.e., sex, age, and number of years ill) of the patients with diabetes to review and compare the results for the explanatory factors. The framework was the basic logic model. We used this model to address the multiple regression results to more clearly understand the relations between the changes in the independent and dependent variables (Table 4). The primary function of regression analysis was to introduce key relations of the independent variables into regression models to examine whether the original relationships substantially changed when variables were introduced. Model 1 introduces self-efficacy, whereas Model 2 also includes a second independent variable, HbA1c, to examine changes in the coefficient of self-efficacy. Model 3 addresses the effects of introducing demographic variables on the explanatory factors with greater depth. We used these three models to understand the regression results for each of the four dimensions of QoL.

	Overall QoL			Physical health QoL			Mental health QoL			Social relationship- aspect QoL			Environmental QoL		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Overall self-efficacy	0.432***	0.430***	0.430***	0.255***	0.253***	0.256***	0.335***	0.334***	0.337***	0.336***	0.335***	0.332***	0.379***	0.378***	0.377***
Glycated hemoglobin		0.182**	0.179*		0.186**	0.184**		0.128	0.125		0.139*	0.136*		0.103	0.103
Sex			0.049			0.136*			0.096			-0.006			-0.02
Age ^a			-0.043			-0.1			-0.06			-0.017			0.005
Number of years ill ^a			-0.074			-0.07			-0.09			-0.046			0.015
R2	0.186	0.219	0.219	0.065	0.1	0.14	0.112	0.129	0.153	0.113	0.132	0.135	0.144	0.154	0.155

^{*}p<0.05 (2-tailed); ^{**}p<0.01 (2-tailed); ^{***}p<0.001 (2-tailed)

The coefficient in the table is the standardized partial regression coefficient (β)

^aAge and number of years ill were highly correlated. We converted age using the natural logarithm to avoid collinearity

Table 4: Standardized regression analysis of overall self-efficacy and QoL: Introducing glycated hemoglobin, sex, age, and number of years ill as variables for stepwise analysis.

Regression analysis of overall self-efficacy and overall QoL

The multiple regression analysis results for overall self-efficacy and overall QoL in Model 1 (β=0.432, p<0.001) indicate positive and significant standardized partial regression coefficient effects. This means that as the patients overall self-efficacy improved, their overall QoL also improved. Explanatory power R² was 0.186. In addition to overall self-efficacy, which is the independent variable in Model 1, Model 2 includes HbA1c to the regression equation.

The results indicated that the relationship between overall self-efficacy and overall QoL weakened but remained significant (β=0.430, p<0.001). The observed HbA1c (β=0.182, p<0.01) also showed a significant positive effect as the second-highest coefficient with explanatory power R² of 0.219. Finally, Model 3 includes multiple potentially relevant demographic variables: sex, age, and number of years ill. The results indicated that none of these variables had a significant influence on the relationship with overall QoL. Therefore,

they did not significantly influence the coefficients of self-efficacy and HbA1c with QoL. This indicated that the original coefficients were stable with an explanatory power R^2 of 0.219. Therefore, self-efficacy and QoL were significantly correlated and HbA1c was the second most critical explanatory variable. The other explanatory variables did not significant effects. In the next section, we perform regression analysis on overall self-efficacy and each dimension of QoL to clarify the effects of the four dimensions of QoL.

Regression analysis of overall self-efficacy and physical health

The multiple regression analysis results ($\beta=0.255$, $p<0.001$) for overall self-efficacy and physical health in Model 1 indicated a significant positive relationship. This showed that as the overall self-efficacy of the patients improved, their physical health also improved. The explanatory power R^2 was 0.065. Model 2 further introduced HbA1c into the multiple regression equation as an independent variable. The results for physical health in Model 2 ($\beta=0.253$, $p<0.001$) declined but remained significant.

The HbA1c results ($\beta=0.186$, $p<0.01$) revealed a positive correlation. The explanatory power R^2 was 0.100. Demographic variables of sex, age, and number of years ill were added as variables in Model 3. The results for sex ($\beta=0.136$, $p<0.05$) showed a significant positive relationship. In contrast, the other variables did not differ significantly in physical health. The explanatory power R^2 was 0.137. These results showed that self-efficacy was significantly associated with physical health. The key variable was HbA1c and sex was also an influential factor.

Regression analysis of overall self-efficacy and mental health

The multiple regression analysis results for overall self-efficacy and mental health in Model 1 ($\beta=0.335$, $p<0.001$) indicated a positive relationship. This showed that as the overall self-efficacy of the patients improved, their mental health also improved. The explanatory power R^2 was 0.112. Model 2 further introduced HbA1c into the multiple regression equation as an independent variable. The results for mental health in Model 2 ($\beta=0.334$, $p<0.001$) declined but remained significantly correlated. The HbA1c results did not show a significant relationship. The explanatory power R^2 was 0.129. Demographic variables of sex, age, and number of years ill were added as variables in Model 3. None of these variables was correlated with mental health. The explanatory power R^2 was 0.153. These results indicated that self-efficacy was significantly related to mental health. However, HbA1c did not influence mental health, indicating "objective" HbA1c control appeared to influence overall QoL, whereas it did not significantly affect "subjective" mental health.

Regression analysis of overall self-efficacy and social relationships

The multiple regression analysis results for overall self-efficacy and social relationships in Model 1 ($\beta=0.336$, $p<0.001$) indicate a significant positive relationship. This showed that as the overall self-efficacy of the diabetes patients improved, their social relationships also improved. The explanatory power R^2 was 0.113. Model 2 further introduces HbA1c into the regression equation as an independent

variable. The results for social relationships in Model 2 ($\beta=0.335$, $p<0.001$) declined but remained significantly correlated.

The results for HbA1c ($\beta=0.139$, $p<0.05$) also showed a significant correlation. The explanatory power R^2 was 0.132. Demographic variables of sex, age, and number of years ill were added as variables in Model 3. None of these variables was associated with social relationships. The explanatory power R^2 was 0.135. These results indicated that the relationship between overall self-efficacy and social relationships remained significant. The second most critical explanatory variable was HbA1c. The other explanatory variables had not significant effects.

Regression analysis of overall self-efficacy and environmental QoL

The multiple regression analysis results for overall self-efficacy and environmental QoL in Model 1 ($\beta=0.379$, $p<0.001$) indicated a positive net associated influence. This indicated that as the overall self-efficacy of the diabetes patients improved, their environmental aspect also improved. The explanatory power R^2 was 0.144. Model 2 further introduces HbA1c into the regression equation as an independent variable. The results indicated that the original results declined in Model 2 but continued to show a significant relationship ($\beta=0.378$, $p<0.001$).

The results for HbA1c revealed no significant relationship. The explanatory power R^2 was 0.154. Demographic variables of sex, age, and number of years ill were added as variables in Model 3. Environmental aspects did not vary with any of these variables. The explanatory power R^2 was 0.155. These results showed a significant relationship between self-efficacy and environmental aspects. The other explanatory factors did not have significant effects. Changes in HbA1c were not significant.

Standardized partial regression analysis of the dimensions of self-efficacy and QoL

Introducing HbA1c and demographic variables for stepwise analysis: In addition to comparing the correlations between overall self-efficacy and QoL, we also performed multiple regression analysis on the dimensions of self-efficacy, HbA1c, and demographic variables (i.e., sex, age, and number of years ill) to examine and compare the results for the explanatory factors. The logic model was adopted to address the multiple regression results and to more clearly understand the coefficient between the changes in the independent and dependent variables (Table 5).

The primary function of regression analysis is to introduce key relation of the independent variables into regression models to examine whether the original relationships change substantially when variables are introduced. Model 1 introduces the dimensions of self-efficacy, whereas Model 2 also adds a second independent variable, HbA1c, to examine changes in the coefficient of the dimensions of self-efficacy. Model 3 addresses the effects of introducing demographic variables on the explanatory factors with greater depth. We used these three models to understand the regression results for each of the four dimensions of QoL.

	Overall QoL			Physical health QoL			Mental health QoL			Social relationship-aspect QoL			Environmental QoL		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Medication control	0.06	0.084	0.098	-0.057	-0.035	-0.010	-0.052	-0.039	-0.021	0.183*	0.203*	0.214*	0.103	0.114	0.109
Blood glucose monitoring	0	-0.002	-0.004	0.01	0.007	0	0.032	0.03	0.029	-0.087	-0.090	-0.093	0.025	0.024	0.021
Diet	0.09	0.097	0.104	0.035	0.048	0.061	0.052	0.06	0.069	0.146*	0.157*	0.161*	-0.004	0.003	0
Exercise	0.212**	0.198*	0.191*	0.091	0.077	0.067	0.205*	0.196*	0.186*	0.085	0.072	0.068	0.275***	0.267***	0.273***
Foot care	0.234**	0.212**	0.198*	0.275**	0.253**	0.236**	0.234**	0.221*	0.208*	0.123	0.102	0.087	0.128	0.117	0.12
Glycated hemoglobin		0.162*	0.163*		0.162*	0.166*		0.098	0.1		0.148*	0.147*		0.084	0.083
Sex			0.049			0.140*			0.095			-0.003			-0.026
Age ^a			-0.038			-0.070			-0.040			-0.038			0.001
Number of years ill ^a			-0.057			-0.059			-0.069			-0.044			0.039
R ²	0.19	0.21	0.204	0.102	0.127	0.157	0.15	0.16	0.177	0.127	0.148	0.152	0.177	0.184	0.186

*p<0.05 (2-tailed); **p<0.01 (2-tailed); ***p<0.001 (2-tailed).

*p<0.05 (2-tailed); **p<0.01 (2-tailed); ***p<0.001 (2-tailed).

^aAge and number of years ill were highly correlated. We converted age using the natural logarithm to avoid collinearity.

Table 5: Regression analysis of the dimensions of self-efficacy and QoL.

Regression analysis of the dimensions of self-efficacy and overall QoL

Model 1 reveals the multiple regression analysis results for the dimensions of self-efficacy and overall QoL. Only exercise ($\beta=0.212$, $p<0.01$) and foot care ($\beta=0.234$, $p<0.01$) were significant. The explanatory power R^2 was 0.188. Model 2 adds HbA1c to the regression equation. The results indicated that the relationship of foot care ($\beta=0.212$, $p<0.01$) and exercise ($\beta=0.198$, $p<0.05$) weakened but continued to be significant. The partial regression coefficient of HbA1c ($\beta=0.162$, $p<0.05$) was also significant. The explanatory power R^2 was 0.210. Finally, demographic variables of sex, age, and number of years ill were added as variables in model 3. None of the partial regression coefficients between these variables and overall QoL were significant. The explanatory power R^2 was 0.204. These results indicated that exercise and foot care were significantly correlated with overall QoL, whereas none of the other variables had significant effects.

Regression analysis of the dimensions of self-efficacy and physical health

Model 1 reveals the multiple regression analysis results for the dimensions of self-efficacy and physical health. Only foot care ($\beta=0.275$, $p<0.01$) was significant. The explanatory power R^2 was 0.102. Model 2 adds HbA1c to the regression equation. The results indicated that the relationship of foot care ($\beta=0.253$, $p<0.01$) declined

but remained significant. Glycated hemoglobin ($\beta=.162$, $p<.05$) was also significant. The explanatory power R^2 was 0.127. Finally, demographic variables were added. The analysis results indicated that sex ($\beta=0.140$, $p<0.05$) was significant, whereas age and number of years ill were not significantly correlated with physical QoL. The explanatory power R^2 was 0.157. These results indicated that foot care, HbA1c, and sex had significant relationships with physical health. The other variables did not have significant effects.

Regression analysis of the dimensions of self-efficacy and mental health

Model 1 reveals the multiple regression analysis results for the dimensions of self-efficacy and mental health. Exercise ($\beta=0.205$, $p<0.05$) and foot care ($\beta=0.234$, $p<0.01$) were significant. The explanatory power R^2 was 0.150. Model 2 adds HbA1c to the regression equation. The results for exercise ($\beta=0.196$, $p<0.05$) and foot care ($\beta=0.221$, $p<0.05$) declined but continued to have significant relationships. The results for were not significant. The explanatory power R^2 was 0.160. Finally, demographic variables of sex, age, and number of years ill were added as variables in Model 3. None of these variables was significantly correlated with overall QoL. The explanatory power R^2 was 0.177. These results indicated that exercise and foot care were significantly correlated with mental health, whereas HbA1c and the other variables had not significant effects.

Regression analysis of the dimensions of self-efficacy and social relationships

Model 1 reveals the multiple regression analysis results for the dimensions of self-efficacy and social relationships. Medication control ($\beta=0.183$, $p<0.05$) and diet ($\beta=0.146$, $p<0.05$) were significant. The explanatory power R^2 was 0.127. Model 2 adds HbA1c to the regression equation. The results indicated that medication control ($\beta=0.203$, $p<0.05$) and diet ($\beta=0.157$, $p<0.05$) increased slightly and remained significantly correlated. Significant relationship was also observed for HbA1c ($\beta=0.148$, $p<0.05$). The explanatory power R^2 was 0.148. Finally, demographic variables of sex, age, and number of years ill were added as variables in model 3. None of these variables was significantly correlated with overall QoL. The explanatory power R^2 was 0.152. These results indicated that medication control and diet had significant effects on social relationships. The second most critical explanatory variable was HbA1c. The other variables had not significant effects.

Regression analysis of the dimensions of self-efficacy and environmental QoL

Model 1 reveals the multiple regression analysis results for the dimensions of self-efficacy and environmental QoL. Only exercise ($\beta=0.275$, $p<0.001$) was significant. The explanatory power R^2 was 0.177. Model 2 adds HbA1c to the regression equation. The results indicated that exercise ($\beta=0.267$, $p<0.001$) declined but remained significantly correlated. HbA1c was not significantly correlated. The explanatory power R^2 was 0.184. Finally, demographic variables of sex, age, and number of years ill were added as variables in model 3. None of the variables was significantly correlated with overall QoL. The explanatory power R^2 was 0.186. These results indicated that exercise had significant effects on environment. However, HbA1c and the other variables had not significant effects.

Discussion

Diabetes is a progressive disease with long term complications that include cardiovascular, renal, ophthalmologic, peripheral vascular, and neurological side effects. These severe consequences may have a very detrimental impact on the QoL of patients with diabetes. However, these untoward complications may be delayed or even prevented by effective management [10]. To control their disease, patients with diabetes have to understand the importance of dietary control, exercise, blood glucose monitoring, foot care, and drug treatment. Numerous studies performed in Taiwan have indicated that when patients with Type 2 diabetes receive strict glycemic control, the incidence of comorbidity is reduced. Therefore, early diagnosis and control of blood sugar levels are critical methods for avoiding comorbidity [11].

Self-efficacy was first proposed by the psychologist Albert Bandura. According to Bandura, self-efficacy is a belief of individuals in their abilities to carry out a successful practice and is a theory in itself, as well as a structure of the social cognitive theory [12,13]. Bandura believes that self-efficacy is the main structure in predicting individuals' behavior change and usually the ones that show a high level of behavioral changes have higher efficacy [14].

Studies on self-efficacy in health behavior include those by Prochaska and DiClemente, who administered self-efficacy training courses to 872 smokers in the process of smoking cessation. After 6

months of tracking, the results indicated that changes in the self-efficacy of the smokers at each behavioral stage were positively correlated with the training courses [15]. In addition, Pham, Fortin, and Thibaudeau examined diabetes treatment self-efficacy in outpatient patients with diabetes and found that patients with stricter medication adherence were more able to practice self-medication than patients who did not comply as strictly when taking their medication. In addition, among the various factors, dietary self-efficacy and exercise efficacy were the most and least related factors to QoL, respectively [9]. Numerous studies on the effects of self-efficacy have confirmed that it is a predictor of health behavior. Studies on diabetes patients have indicated that self-efficacy is significantly correlated with self-care behavior in patients, such as timely medication administration, regular blood glucose testing, and dietary control [16,17].

The World Health Organization (WHO) has established a QoL research group. This group defined quality of life as "individuals' perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, level of independence, social relationships, personal beliefs, and their relationship to salient features of their environment" [18].

Numerous studies have investigated the health-related QoL of patients with diabetes. Research showed that gender (female), age (older adults), high levels of blood glucose, and HbA1c are negatively correlated with QoL [19-21], and that QoL worsens as the duration of diabetes increases and glycemic control worsens [20]. Treatment effects and the occurrence of comorbidity are key factors influencing QoL in patients with diabetes [20,22]. Wang, Chiang, Juang, and Tsay measured patients with diabetes by using the Taiwan Brief Version of the WHO Quality of Life scale. Their results indicated that average QoL remained high [23]. In addition, multiple studies have used the Short Form Health Survey to examine the QoL of patients with Type 2 diabetes. The results of these studies have indicated that age, gender, and complications influence QoL [24,25]. Therefore, research has shown that disease control and the presence of comorbidity are key factors influencing QoL. Whether strong self-efficacy in treatment and HbA1c control are correlated with QoL in diabetes patients is a topic that demands in-depth review.

According to the results of a joint clinical trial on diabetes control and chronic diseases in the United States and Canada (N=1441), HbA1c is a useful indicator of glycemic control in patients with diabetes. Effective glycemic control can reduce the occurrence of comorbidity. HbA1c has also been proven to reflect the changes in blood glucose in the human body over 2 to 3 month period (The Diabetes Control and Complication Trial) [26]. The United Kingdom Prospective Diabetes Study tracked 3687 patients diagnosed with Type 2 diabetes for 10 years, and found that those with strict glycemic control had an HbA1c level of 7% or less, whereas those with less strict control had a HbA1c level of 7.9% or more. When blood glucose was strictly controlled, the risk of diabetes-related comorbidity decreased by 12%, the mortality rate decreased by 10%, and QoL was relatively improved [27]. Numerous studies on the QoL of patients with diabetes have indicated that it is negatively correlated with high blood glucose levels, high HbA1c, and the occurrence of comorbidity in patients [20,24,25]. In addition, multiple studies have shown that patients with diabetes who sustain their glycemic control show a positive relationship between QoL and self-efficacy in terms of self-care [17,28].

Wang, Wang, and Lin investigated 130 patients with diabetes in southern Taiwan and found that their average HbA1c was 7.12%, and that 63.1% of the patients had sufficient glycemic control. The male patients had lower HbA1c than the female patients did. The men also had a better QoL than the women did [5,19]. Research has shown that poor control of HbA1c influences moods, thereby affecting QoL [29]. In summary, these studies have indicated that patients' self-efficacy is closely associated with their QoL. Self-efficacy may have varying effects on various levels of HbA1c. Effects may also differ depending on demographic variables [30]. In this study, we used HbA1c control as a conditional variable. Numerous demographic variables were also introduced to address the relation between self-efficacy and QoL, as well as how this relationship changed under various conditions.

The results for the effects of self-efficacy and HbA1c in the three groups of patients with diabetes indicated that QoL decreased as HbA1c grew more severe. This result was consistent with the findings of other studies [19-21]. In addition, we found that HbA1c was a key conditional analysis indicator influencing the relationship between self-efficacy and QoL. This finding was consistent with those of past research, which has shown that HbA1c is an indicator of diabetes control and a critical factor influencing QoL [17,19,26,27,31-33]. When we used overall HbA1c (the overall sample) as the baseline group, the relationship between self-efficacy and QoL in the group of patients with good control HbA1c was stronger than it was in the baseline group. This relationship remained significant in the moderate and poor control groups, but weakened with the degree of severity of HbA1c levels. We performed further analysis on the correlations between the five dimensions of self-efficacy (i.e., medication control, blood glucose monitoring, diet, exercise, and foot care), HbA1c, and QoL. The results showed a correlation between the dimensions of self-efficacy and QoL. This correlation was stronger in the good control group of patients than it was in the baseline, moderate, and poor control groups, and tended to decline consistently. The results from another correlation analysis indicated that self-efficacy and overall QoL (i.e., physical health, mental health, social relationship, and environmental) also had a statistically significant positive relationship. This was consistent with the results of an earlier study [4] that showed that improved self-care behavior was associated with improved QoL. Therefore, stronger self-efficacy in specific behaviors improved the standard for that behavior [16,34]. The present study indicated that people more able to implement diabetes-related diet control, exercise, foot care, medication control, and blood glucose monitoring are less likely to incur comorbidity. These behaviors also significantly influence QoL [5,19]. When diabetes patients maintain regular exercise, take medications in accordance with their physicians' instructions, and monitor their blood glucose, they cope more effectively psychologically and are also more able to enjoy their lives [23,29]. In summary, overall analysis and analysis of a variety of dimensions indicated that the self-efficacy and QoL of the patients were strongly correlated. Therefore, the results of this study should be a reminder to patients of the relevance of blood glucose control, which is also a key factor influencing QoL. We recommend that clinical health care workers emphasize the importance of blood glucose control in patients to achieve increased self-control.

In addition, we used the severity of HbA1c as a control variable and determined the correlation between the dimensions of self-efficacy and QoL. This relationship presented itself in three patterns depending on the severity of HbA1c: rapid decline, gradual decline, and U-shaped. Medication control, blood glucose monitoring, diet, and exercise all had correlations with QoL that tended to consistently decline. Under

varying HbA1c levels, the relationships between the various dimensions of self-efficacy and QoL did not necessarily consistently decline. The relationships between medication control and QoL and between foot care and QoL presented U-shaped patterns.

In this study, we examined whether the correlation between overall self-efficacy and overall QoL declined consistently with various levels of HbA1c. However, the relationships between self-efficacy and the dimensions of QoL had varying results. Therefore, we partially revised earlier assessments to indicate more clearly the varying correlations. Another key point was that self-efficacy and HbA1c influenced the dimensions of QoL. Overall self-efficacy and overall QoL were significantly correlated. However, the results for the subscale dimensions indicated that HbA1c was not significantly correlated with mental health or environmental QoL. Our results appeared to indicate that patients' HbA1c did not affect their intrinsic mental health or their external environment. These findings appeared to differ from those of several earlier studies, which have indicated that poor HbA1c control influence mood, thereby affecting mental health [29]. But another study, Parildar et al. applied a questionnaire to a group of 110 patients with Type 2 diabetes. They found that 55.5% of the subjects were suffering from depressive mental symptoms. The mental symptoms were correlated positively with the duration of the diabetes diagnosis, being significantly higher among Type 2 diabetes patients with an established disease when compared with newly diagnosed patients. However, there was no significant correlation between HbA1c levels and mental health [30,35]. The same as our results showed that HbA1c had little influence on mental health. These findings also indicated that HbA1c had no statistically significant effects on environmental QoL. This showed that these two factors were not significantly related.

In addition, sex was another critical topic. Sex differences in glycemic control have been reported, although the research findings have yielded mixed results. Some studies have demonstrated that women are more likely to have better glycemic control compared to men, whereas other studies have shown the opposite [36,37]. This may be related to different cultural and social norms, such as sex role and the importance of family [30,38]. This study indicated that sex and physical health were correlated. These results were consistent with the findings of earlier research [5]. One study [19] also showed that men have an improved QoL than women do. However, another study indicated that sex does not influence QoL [39]. In the present study, sex had a significant influence on the QoL dimension of physical health. We provided these results for the reference of clinical health care workers, who can provide health education and guidance for each sex.

Conclusion

In conclusion, the study found that the self-efficacy of diabetes and life of quality are closely related, the better overall self-efficacy of diabetic patients, the better the overall quality of life. and glycosylated hemoglobin is also the second most important factor affecting the quality of life. The results showed that the strengthening of self-efficacy and blood glucose control in diabetic patients is very important, but also an important impact on quality of life, under different glycosylated hemoglobin conditions, "self-efficacy" on the "quality of life" will be different.

Limitations

This study had a number of limitations. Since the diabetic patient group studied in this research was a select group of one regional teaching hospital in central Taiwan, our finding may not be representative of other areas and other populations across the country. Further study with a larger sample may provide a better understanding of the variations between self-efficacy and QoL in Type 2 diabetes under varying HbA1c. Moreover, this study was a cross-sectional research and the survey data of questionnaires were based on self-report and memory recall that has its natural limitations.

Future Directions

This study was based on the scale developed by domestic and foreign scholars, and the contents of structured questionnaire were selected with reference to domestic and foreign literatures. The relationship between self-efficacy and quality of life of patients with type 2 disease under different glycosylated hemoglobin conditions was researched by cross-sectional study whether there are any statistical differences. As diabetes is a chronic disease, the quality of life in different stages of the disease may change, there should be different stages of treatment and health care measures involved in assistance to strengthen the patient's quality of life. For chronic diabetes still need further study, the future study will be more clear and more in-depth discussion of a variety of diabetes-related factors, through the generation of research (cohort study) method of long-term follow the same group of diabetic patients, I believe that the clinical and academic will have greater contribution.

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