

The Association Between Health Literacy and Quality of Life and Its Associated Factors Among Adults with Type 2 Diabetes Mellitus in Public Primary Care Clinic

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ABSTRACT

Introduction: Low health literacy (HL) is one of the contributing factors that leads to negative diabetic outcome. Quality of life (QOL) is a state of complete physical, mental and social well-being. There is limited evidence on association of HL and QOL among type 2 diabetes mellitus (T2DM), therefore the objectives of this study were to identify the HL and QOL status, to determine the association between HL and QOL and factors associated with QOL among T2DM patients. **Methods:** This was a cross sectional study involving patients with T2DM from two public primary care clinics. HL and QOL were measured using translated and validated HLS – Asia Q16 and DQoL-BCI questionnaires respectively among T2DM patients. **Results:** The mean HL score was 12.39 (± 3.34), 17.7 % had "inadequate HL", 25.7% had "problematic HL" and 56.6% had "sufficient HL". The mean DQoL-BCI score was 32.09 (± 6.51). Lower QOL level was negatively associated with age ($b = 0.140$; CI: -0.190, -0.090; $p < 0.001$), not obese ($b = -1.476$; CI: -2.605, -0.347; $p < 0.011$), and HL level ($b = -0.425$; CI: -0.59, -0.259; $p < 0.001$). Lower QOL level was positively associated with uncontrolled glycaemic status (HbA1c > 6.5%) ($b = 1.308$; CI: -0.042, 2.659; $p < 0.058$), treatment with insulin ($b = 4.163$; CI: 1.538, 6.788; $p < 0.002$) and combination treatment of insulin and oral hypoglycaemic agents (OHA) ($b = 2.450$; CI: 1.145, 3.756; $p < 0.001$). **Conclusions:** This study demonstrated that age, body mass index, HL, glycaemic control, treatment with OHA and insulin were significantly associated with QOL. This suggest the importance of identifying high risk patients with poor QOL for targeted intervention.

KEYWORDS: Health Literacy, Quality of Life, Type 2 Diabetes Mellitus, Primary Care, Malaysia

INTRODUCTION

The rising prevalence of T2DM is alarming. It has doubled since 1980 from 4.7% to 8.5% in 2014[1]. There are 425 million people with T2DM in 2016 [1]. It is growing most rapidly in low- and middle-income countries. Eighty percent of DM patients are in low and middle income countries and out of that, more than sixty percent live in Asia including Malaysia [2]. Based on The National Health and Morbidity Survey of Malaysia (NHMS), the overall prevalence of diabetes was 17.5% in 2015 and it is expected that in 2020, the estimated prevalence is 21.6% [3].

The advancement of diabetes particularly with poor glycaemic control will lead to microvascular and microvascular complications. In order to halt the

progression of diabetes, patients need to constantly maintain good glycaemic control. This is an undeniably demanding process and challenging task which require proper planning on food selection, exercise regime, medication adherence, glucose monitoring, and clinic's follow ups. To achieve this, patient's involvement or patient's health literacy is extremely important.

Health literacy (HL) is the degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions [4]. Based on literature reviews, low HL is associated with negative diabetic outcome such as lack of self-management skills, poor understanding of own medical



condition, overutilisation of medical facilities, poor glycaemic control, and higher healthcare burden [5, 6]. Whereas, higher HL is associated with higher diabetes-specific knowledge [7, 8], self-efficacy and self-care behaviours. Therefore, it is important to improve patient's health literacy as it can possibly improve patient's diabetic outcome specifically their QOL.

Apart from glycaemic control, QOL is one of the most important outcomes that we should pay attention to. Due to the complications and continuous demanding task of being T2DM patients, their QOL can be affected [9]. Negative associations were found between QOL and smokers[10], duration of diabetes [11, 12], poor glycaemic control [9, 13], uncontrolled blood pressure, uncontrolled lipid profile [14] and higher body mass index (BMI) [11]. Pertaining to mode of treatment, patient who were under diet control alone had better QOL than those on treatment [9]. Between these group of patients treated with insulin were found to have lower QOL compared to those on oral hypoglycaemic treatment [12]. Age was found to have negative association with QOL but, socioeconomic status and being married had positive association with QOL[15]. Ethnicity was another important sociodemographic factor that affected QOL. Different ethnicity was found to have different QOL level. A study conducted in Malaysia found Chinese ethnicity to have higher QOL and HL level as compared to Malay and Indian ethnicity [16].

According to Fransen and Von Wagner, the effects of HL towards QOL, are mediated through self-efficacy and self-care behaviour and this was proven by other studies [17, 18]. In contrast, other studies have shown that HL has a rather direct effect on QOL. However, these studies were done among asthmatic and heart failure patients [19, 20].

Due to limited data available on the association of HL and QOL among T2DM patients, there is a need to study on this association. Therefore, the aims of this study were to determine the factors associated with QOL and to examine the association between HL and QOL. This study provides additional knowledge in the existing literature on the association of HL and QOL.

METHODOLOGY

Study Design and Setting

This was a cross sectional design, conducted in two public urban primary care clinics in Gombak district, Selangor, Malaysia. The data was collected from December 2017 to March 2018. The two clinics were chosen as both clinics has good multiracial diversity which reflect Malaysian ethnicity proportion in the population.

Study Population

The study population were T2DM patients who were registered in the T2DM registry. They were given diabetes health monitoring book and were identified in the clinic if they own the book or if they were listed as T2DM follow up patients. The inclusion criteria included were T2DM patients with age more than 18 years old, patients who have been diagnosed with T2DM at least 1-year duration before recruitment period, received regular follow up care at the same primary care clinic at least twice in 1-year duration before the recruitment period, able to speak and understand either Malay or English language and HbA1c level taken at least 6 months prior to the recruitment of study. The exclusion criteria were patients who were diagnosed with Type 1 Diabetes Mellitus, altered mental status, established mental disorder reviewed in medical records such as schizophrenia, bipolar disorder, Alzheimer's disease, psychosis or dementia and pregnant patients. Pregnant patients were excluded via history and last menstrual period.

Sampling

Using systematic random sampling, every 3rd patient who presented to non-communicable diseases clinic in Klinik Kesihatan Taman Ehsan and Klinik Kesihatan Sg. Buloh were approached. Every patient selected were screened for inclusion and exclusion criteria. Patients who were eligible to participate in this study were invited to participate. Written informed consent was attained and they were informed that they can withdraw from the study without any penalty at any given time. Patients were then brought to an isolated room to answer the questions themselves. Full confidentiality and anonymity were maintained.

Method of Data Collection

There were four methods of data collection which were face to face interview, retrieving the medical records, self-administered questionnaire and anthropometric measurement. The anthropometric measurements were collected by dedicated diabetic nurses who were trained prior to conducting this study. Methods of measurements of weight, BMI, waist circumference and blood pressure were informed and demonstrated to them. After the training, they were evaluated to minimise discrepancy in data collection. Height and weight were measured using a standard height and weighing scale tool, SECA 769 Digital Medical Scale stadiometer. BMI was calculated using the formula (weight in kg) divide with (height in metres)². The waist circumference measured was taken at the midpoint between lower rib margin and the iliac crest. These anthropometric measurements followed the WHO recommendations [21]. The blood pressure was measured using automated digital blood pressure (Omron HEM-757). Participants were advised to rest at least for 5 mins before the measurement of blood pressure. During the measurement the participant was seated upright and arm at the heart level. The mean of two BP reading was taken as the final BP measurement. The blood pressure measurement followed the standard in clinical practice guideline of hypertension in Malaysia [22].

The HL was assessed using Health Literacy Survey (HLS) – Asia Q16 [23, 24]. The questionnaire consist of 16 items. The original HLS consist of 47 items and it was developed by Sorenson et al. [25]. The questionnaire was then translated to Malay language by Duong et al [23]. Subsequently the questionnaire was adapted and validated to HLS Asia Q16. HLS – Asia Q16 was chosen to measure HL levels in this study because its validity and reliability was comparable with the full version 47 item. The questionnaire has high internal consistencies with Cronbach's alpha 0.775 to 0.795, high construct validity with good convergent and discriminant validity [26]. The items were assessed via Likert scale in four responses which were “very difficult”, “fairly difficult”, “fairly easy” and “very easy”. The score ranges from 0-16 marks. Higher scores indicate higher level of HL. The categories of HL were

classified into three categories: “inadequate” when the score is between 0-8, “problematic” when the score is between 9-12, and “sufficient” when the score is between 13-16 [27].

The QOL among T2DM was assessed using Diabetes Quality of Life- Brief Clinical Inventory (DQoL-BCI). The DQoL-BCI was developed by Burroughs et al. [28] and it was translated and validated in Malay language by Samah et al. The questionnaire was chosen because it has good exploratory factor analysis and good known-group validity. The internal consistency of the Malay version of DQoL-BCI was 0.73 and has good intraclass coefficient correlation of 0.86 [24]. The questionnaire consists of 15 questions, the first eight items enquire about patient's satisfaction on their QOL, the next four items on domain of impact of diagnosis and treatment, while the last three items under the domain of worry about the future effects of diabetes and social/vocational issues. The items were assessed via Likert scale of 1 to 5, 1 for “very satisfied”, 2 for “moderately satisfied”, “neither”, 3 for “moderately dissatisfied” and 5 for “very dissatisfied”. The total minimum score is 15 and the maximum score is 75. The higher the marks, the lower the QOL is [24, 28]. The HLS – Asia Q16 and DQoL-BCI were self-administered questionnaire. The respondents were asked to tick only one answer which suits them the best.

Sample Size Calculation

Sample size was calculated using two important factors, HL and QOL among T2DM patients. By using the percentage of “good” QOL (16.1%) the sample size was 207 [29]. Whereas, the sample size using the prevalence of “sufficient” (27%) was 302. The calculated sample size for HL was based on the prevalence study by Abha Shresta because it used the same HLS Asia Q-16 questionnaire as in this study [27]. Since the calculation using the prevalence of sufficient HL gives the highest sample size, it was chosen as the minimum required sample size. At the significant level of 0.05, power of 80%, estimated T2DM patients in these two clinics were 50,000 and the percentage of 27% having sufficient HL, the estimated sample size after considering 20% non-responder was 364 (Open Epi software- proportion).

Statistical Analysis

Data analysis was conducted using Statistical Package for the Social Sciences (SPSS) version 24.0 (IBM). For descriptive analysis, continuous variables were presented using mean and Standard Deviation (SD), while for categorical variables, the data were presented using number (n) and percentage (%). The score of HL and QOL were presented using mean (SD) as both variables were in continuous form.

The correlation between HL and QOL was analysed using Pearson correlation coefficient. The coefficient correlation (r) ranged from +1.0 to -1.0 which signify the magnitude of the linear relationship between the two variables. A $r > 0$ indicates positive relationship, $r < 0$ indicates negative relationship while $r = 0$ indicates no relationship [30]. A value of $r \geq 0.8$ or -0.8 indicates strong relationship, r between 0.5 - 0.8 or -0.5 to -0.8 indicates moderate relationship and $r \leq 0.5$ or -0.5 indicates weak relationship [31].

Multiple linear regression (MLR) was used to determine the factors associated with QOL. The

variables with P- value of less than 0.05, were identified as the associated factors after adjusting for the confounding factors. The fitting of the regression model was assessed using the significant change of R^2 , F value, ANOVA significant fit of overall data and Durbin-Watson statistic value between value 1-3.

Ethical Approval

This study has obtained approval from the National Institute of Health and Medical Research Ethics Committee, Ministry of Health (NMMR- 17-442-34545) and the Universiti Teknologi MARA Research Ethics Committee.

RESULTS

A total of 486 patients with T2DM were approached to participate in this study however only 447 patients completed the study and were included in the final analysis. The total response rate was 92 %. Figure 1 illustrate the flow chart of the conduct of the study.

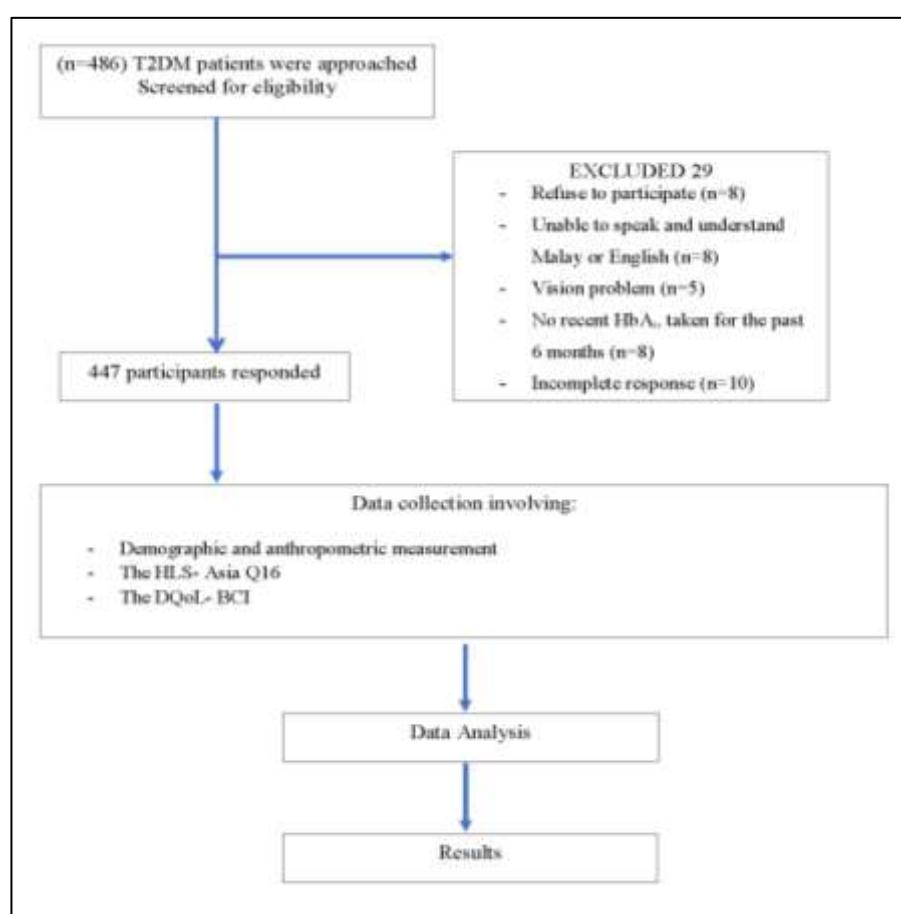


Figure 1 Flow chart of the conduct of the study

Characteristics of the study population

The sociodemographic and clinical characteristics of T2DM patients are described in Table 1. The mean age was 58.18 years old (± 11.39). Majority of the patients were female (55.3%), Malays (59.1%), Islam (62.2%),

married (80.8%), attended until secondary educational level (53.2%) and employed (64.2%). More than half of the participant had obesity (51.5%), controlled blood pressure of less than 140/90 mmHg (57.72%) and 75.4% had HbA1c more than 6.5%. The highest comorbidity was hyperlipidaemia (79.6%).

Table 1 The sociodemographic and clinical characteristics of T2DM patients (n=447)

Variable	n (%)	Mean ($\pm SD$)
Age (years)		58.18 (11.39)
Gender		
Male	200 (44.74)	
Female	247 (55.26)	
Ethnicity		
Malay	264 (59.06)	
Chinese	80 (17.90)	
Indian	90 (20.13)	
Others	13 (2.91)	
Religion		
Islam	278 (62.19)	
Buddha	73 (16.33)	
Hindu	74 (16.55)	
Others	22 (4.92)	
Marital Status		
Single	19 (4.25)	
Married	361 (80.76)	
Divorced	21 (4.70)	
Widow	46 (10.29)	
Education level		
No formal school	36 (8.10)	
Primary school (age 7 to 12)	107 (23.90)	
Secondary school (age 13 to 17)	238 (53.20)	
Tertiary (college /university)	66 (14.80)	
Occupation		
Employed	160 (35.79)	
Unemployed/ pensioner	287 (64.21)	

Salary per month	1417.16 (2237.57)
Low income (< RM 2848)	369 (82.60)
Middle income (RM 2849 -5662)	63 (14.10)
High income (RM > 5663)	15 (3.34)
Duration of DM	
Less than 1 year	45 (10.07)
1 year to 5 year	155 (34.68)
5 year -10 year	100 (22.37)
10 years and above	147 (32.89)
Smoking status	
Smoker	51 (11.40)
Non smoker	396 (88.60)
BMI (kg/m ²) (n=444, missing value n=3)	28.54 (5.70)
Non obese (<27.5)	214 (47.90)
Obesity (≥ 27.5)	230(51.50)
Waist circumference (n=437, missing value n=10)	96.24 (12.98)
Female < 80 cm, Male < 90cm	71 (16.20)
Female > 80 cm, Male ≥ 90cm	366 (83.80)
BP (mmHg)	
BP well controlled (<140/90)	258 (57.72)
BP uncontrolled (≥ 140/90)	189 (42.28)
Glycaemic control (HbA _{1c} %)	8.12 (2.06)
HbA _{1c} less than 6.5 %	110 (24.60)
HbA _{1c} more than 6.5%	337 (75.40)
Medication	
Oral hypoglycaemic agent only	283 (63.31)
Insulin only	22 (4.92)
Combination Oral hypoglycaemic agent and insulin	122 (27.29)
Not on any medication	20 (4.47)
Comorbidities	
Hypertension	371 (83.00)
Hyperlipidaemia	356 (79.64)
Ischemic Heart Disease	48 (10.74)
Retinopathy / Cataract	127 (28.41)
Neuropathy	77 (17.23)
Sexual dysfunction	51 (11.41)
Peripheral vascular disease	12 (2.68)
Chronic kidney disease	51 (11.41)

Health literacy survey

The overall mean score of HL was 12.39 (± 3.34). The percentage of participants with “inadequate” HL (score 0-8) were 17%, “problematic” HL (score 9-12) were 25.7% and “sufficient” HL (score 13-16) were 56.6 %. Table 2 illustrate the distribution of HL score and its

mean for each subscale. It was distinguishable that the item “find information on how to manage mental health problems like stress or depression?” and item “judge when you may need to get a second opinion from another doctor?” has the highest response with “fairly difficult” answer which is 37.8% and 36.9% respectively.

Table 2 The distribution of health literacy scores among T2DM patients.

Subscales	Very Difficult n (%)	Fairly Difficult n (%)	Fairly Easy n (%)	Very Easy n (%)	Mean ($\pm SD$)
...find information on treatments of illnesses that concern you?	35 (7.80)	110 (24.60)	220 (49.20)	82 (18.30)	0.68 (0.47)
...find out where to get professional help (such as doctor, pharmacist, psychologist) when you are ill?	5 (1.10)	40 (8.90)	260 (58.20)	142 (31.80)	0.90 (0.30)
...understand what your doctor says to you?	3 (0.70)	49 (11.00)	272 (60.90)	123 (27.50)	0.88 (0.32)
...understand your doctor’s or pharmacist’s instruction on how to take a prescribed medicine?	1 (0.20)	16 (3.60)	269 (60.20)	161 (36.00)	0.96 (0.20)
...judge when you may need to get a second opinion from another doctor?	34 (7.60)	165 (36.90)	193 (43.20)	55 (12.30)	0.55 (0.50)
...use information the doctor gives you to make decisions about your illness?	10 (2.20)	60 (13.40)	282 (63.10)	95 (21.30)	0.84 (0.36)
...follow the instructions on medication?	1 (0.20)	24 (5.40)	243 (54.40)	179 (40.0)	0.94 (0.23)
...find information on how to manage mental health problems like stress or depression?	52 (11.60)	169 (37.80)	168 (37.60)	58 (13.00)	0.51 (0.50)
...understand health warnings about behaviour such as smoking, low physical activity and drinking too much?	5 (1.10)	21 (4.70)	233 (52.10)	188 (42.10)	0.94 (0.23)
...understand why you need health screenings (such as breast exam, blood sugar test, blood pressure)?	10 (2.20)	82 (18.30)	205 (45.90)	150 (33.60)	0.79 (0.41)

...judge if the information on health risks in the media (such as TV, Internet or other media) is reliable?	36 (8.10)	127 (28.40)	194 (43.40)	90 (20.10)	0.64 (0.48)
...decide how you can protect yourself from illness based on information in the media (such as Newspaper, leaflets, Internet or other media)?	32 (7.20)	116 (26.00)	219 (49.00)	80 (17.90)	0.67 (0.47)
...find out about activities (such as meditation, exercise, walking, Pilates etc.) that are good for your mental well-being?	45 (10.10)	134 (30.00)	194 (43.40)	74 (16.60)	0.60 (0.49)
...understand advice on health from family members or friends?	5 (1.10)	51 (11.40)	275 (61.50)	116 (26.00)	0.87 (0.33)
...understand information in the media (such as Internet, newspaper, magazines) on how to get healthier?	36 (8.10)	110 (24.60)	185 (41.40)	116 (26.00)	0.67 (0.47)
...judge which everyday behaviour (such as drinking and eating habits, exercise etc.) is related to your health?	4 (0.90)	24 (5.40)	295 (66.00)	124 (27.70)	0.94 (0.24)
Total mean HLS -Asia Q16 score					12.39 (3.34)

Quality of Life

As for QOL, the overall mean score was 32.09 (\pm 6.51). Table 3 shows the mean score of each DQoL- BCI items. More than half (60%) of the participants “moderately satisfied” with the amount of time to manage their diabetes and 55.5% of them “moderately satisfied” with their current diabetes treatment. Of all the items, it was noticeable that the item “knowledge about diabetes” got the highest “moderately dissatisfied” respond, and significant number of participants (17.4%) often experienced bad night’s sleep because of diabetes.

Factors Associated with Quality of Life

Table 4 revealed the factor associated with QOL. The analysis showed that older age, not obese, and higher HL scores were significantly associated with higher QOL, while having uncontrolled glycaemic status, using insulin and using combination of insulin and oral

hypoglycaemic agents were significantly associated with lower QOL. Although uncontrolled glycaemic status was found not statistically significant ($p < 0.05$), the factor was kept in the model during the backward method in the multivariable analysis. It could be that the factor being a clinically significant factor to be kept in the model.

The R^2 was 0.172 which means the associated factors contributed to 17.2% of the variability of QOL among T2DM patients. The other 82.8% was contributed by other factors which were not considered in this study. The final model equation is:

$$\text{Quality of life} = 44.344 - 0.140 * \text{Age} - 1.476 * \text{Not obese} + 1.308 * \text{uncontrolled glycaemic status} + 4.163 * \text{insulin only} + 2.450 * \text{combination oral hypoglycaemic agent and insulin} - 0.425 * \text{health literacy score}.$$

The fit of the regression model was assessed using the significant change of R^2 , (F value), ANOVA significant fit of overall data and Durbin - Watson

statistic value between value 1-3. The change of F value was 0.253, which was not significant (significant value less than 0.05). However, the ANOVA revealed

significant fit with $p<0.001$ and Durbin -Watson value was 1.279 which was between value 1-3. Hence, it was concluded that the model reasonably fits well.

Table 3 The distribution of quality of life scores among T2DM patients.

Subscales	Very satisfied	Moderately satisfied	Neither	Moderately dissatisfied	Very dissatisfied n(%)	Mean ($\pm SD$)
	n(%)	n(%)	n(%)	n(%)		
How satisfied are you with your current diabetes treatment?	136 (30.40)	248 (55.50)	29 (6.50)	31 (6.90)	3 (0.70)	1.92 (0.84)
How satisfied are you with the amount of time it takes to manage your diabetes?	79 (17.70)	268 (60.00)	41 (9.20)	56 (12.50)	3 (0.70)	2.19 (0.89)
How satisfied are you with the time it takes to determine your sugar level?	83 (18.60)	223 (49.90)	106 (23.70)	32 (7.20)	3 (0.70)	2.21 (0.85)
How satisfied are you with the time you spend exercising?	59 (13.20)	192 (43.00)	140 (31.30)	49 (11.00)	7 (1.60)	2.45 (0.91)
How satisfied are you with your sex life?	40 (8.90)	161 (36.00)	210 (47.00)	29 (6.50)	7 (1.60)	2.56 (0.81)
How satisfied are you with the burden your diabetes is placing on your family?	65 (14.50)	232 (51.90)	101 (22.60)	43 (9.60)	6 (1.30)	2.31 (0.88)
How satisfied are you with time spent getting check-ups for your diabetes?	88 (19.70)	227 (50.80)	53 (11.90)	73 (16.30)	6 (1.30)	2.29 (1.00)
How satisfied are you with your knowledge about your diabetes?	80 (17.90)	229 (51.20)	54 (12.10)	79 (17.70)	5 (1.10)	2.33 (1.00)
How often do you find that you eat something you shouldn't rather than tell someone that you have diabetes?	49 (11.00)	151 (33.80)	173 (38.70)	68 (15.20)	6 (1.30)	2.62 (0.92)
How often do you have a bad night's sleep because of diabetes?	78 (17.40)	187 (41.80)	97 (21.70)	78 (17.40)	7 (1.60)	2.44 (1.02)

How often do you have pain because of the treatment for your diabetes?	235 (52.60)	127 (28.40)	65 (14.50)	19 (4.30)	1 (0.20)	1.71 (0.88)
How often do you feel physically ill?	87 (19.50)	135 (30.20)	149 (33.30)	74 (16.60)	2 (0.40)	2.48 (1.00)
How often do you worry about whether you will pass out?	248 (55.50)	99 (22.10)	73 (16.30)	26 (5.80)	1 (0.20)	1.73 (0.95)
How often do you worry about whether you will miss work?	345 (77.20)	45 (10.10)	37 (8.30)	16 (3.60)	4 (0.90)	1.41 (0.86)
How often do you feel diabetes limits your career?	342 (76.50)	45 (10.10)	33 (7.40)	21 (4.70)	6 (1.30)	1.44 (0.92)
Total mean DQoL-BCI score					32.09 (6.51)	

Table 4 The factors associated with quality of life among T2DM patients using multiple linear regression

Variable	Adjusted B (95%CI)	Standardized Coefficients Beta	t	P value ^a
Age	-0.140 (-0.190, -0.090)	-0.244	-5.476	0.001*
Not obese	-1.476 (-2.605, -0.347)	-0.113	-2.569	0.011*
Uncontrolled glycaemic status (HbA _{1c} ≥ 6.5)	1.308 (-0.042, 2.659)	0.087	1.904	0.058
Insulin only (versus no treatment)	4.163 (1.538, 6.788)	0.138	3.117	0.002*
Combination oral hypoglycaemic agent and insulin (versus no treatment)	2.450 (1.145, 3.756)	0.168	3.689	0.001*
Health Literacy Score	-0.425 (-0.59, -0.259)	-0.220	-5.018	0.001*

^a Multiple linear regression coefficient of determination, R² = 0.172.

*significant value of p value < 0.05

DISCUSSION

Health Literacy and Quality of Life Status

This study found that 17.7% had inadequate HL. In Nepal poorer HL was observed as evidenced by 41% of them had inadequate HL [32]. Contrary to the findings, in Denmark only 11% had inadequate HL which was better than our study [33]. The possible reason for the discrepancy was due to social gradient that was influenced by financial deprivation, social status, education, age and gender [34]. A local study revealed that 85.8% of the respondents had limited HL [35]. Possible reason for this is, the questionnaire used in that study was Newest Vital Signs score (NVS). NVS measured specific skills which requires respondents to interpret a food label. Whereas, the HLS – Asia Q 16 is a self-perceived questionnaire that measures patient's perception on their HL. The lowest HL score was for finding information on how to manage mental health problems and activities that are good for mental well-being. These indicates that mental HL is an area that might need an extra attention when managing patients with T2DM. This findings was supported by a study, which revealed that mental HL among Malaysian was the lowest compared to British and Hong Kong citizens [36]. A significant number of participants (44.5%) find it difficult to "judge when they may need to get second opinion from another doctor" This might reflect that our participant's might have problems in accessing and understanding health information that has eventually made them difficult to appraise the information.

The mean DQoL- BCI score for this study was 32.09 (\pm 6.51). The QOL status is comparable with other studies done among T2DM patients in Malaysia and Greece using the same tool. The mean score was 31.29 (\pm 6.27) and 35.21 (\pm 11.24) respectively. [24, 37]. Significant number of participants (21.37%) were dissatisfied on their diabetes knowledge. These findings in concordance with a study done in Malaysia, found that as high as 73.5% of the T2DM patients had low level of diabetes knowledge [13]. Therefore, it is important for health care provider to allocate time to deliver diabetic education.

Factors Associated with Quality of Life

Increasing age was associated to have positive association with better QOL, similar findings were also found by other studies [9, 37-39]. This could be due to higher social role in a younger age group such as social responsibilities, hectic work schedule, financial constraint or burden taking care of growing children that contributed to this findings [40]. Non-obese participants have better QOL and this is supported by a few cohort studies [38, 41]. Uncontrolled HbA1c >6.5% was associated with poorer QOL, as supported by other studies [42, 43].These findings are expected because poor glycaemic control is associated with diabetes complications.

Participants who were on insulin with or without oral hypoglycaemic agents are associated with poorer QOL. Similar findings were noted by Khalili et al. where the descriptive comparative study showed that QOL score was poorer in the insulin-received group compared to non-insulin group [44].

Relationships Between Health Literacy and Quality of Life

Currently, limited literature review is available on the direct association of HL and QOL. Through structural equation model (SEM) analysis study by Lee et al., they found that the relationship between HL and QOL are mediated by self-efficacy and self- care activity rather than direct association. [45]. In contrast, Soleyman et al. revealed no association of HL status with QOL [29]. Due to limited evidence, more studies are needed to examine the link of HL and QOL.

Strengths and Limitations of the Study

To our knowledge, this was the first study to describe the HL level among T2DM in Malaysia using translated tools with valid and reliable psychometric evaluation. This study was also the first, that examined the association between HL and QOL among T2DM patients in Malaysia. Due to the setting of the research conducted in two semi urban clinic, the result could not be generalised to represent the Malaysian population setting. The other limitation was, the study was conducted using self-report HL and QOL which could

be susceptible to information bias [46]. Since this is a cross sectional study and involved only two clinics, results should be interpreted cautiously, and causal effect relationship could not be established.

Implications for Clinical Practice and Future Research

This study showed that high HL associated with high QOL level. Thus, it is important to include assessment of HL level in the management of T2DM patients aiming to improve their QOL. Apart from HL, age, obesity, uncontrolled HbA1c and usage of insulin has been found to have association with QOL. As a family physician, efforts to control HbA1c, improving HL and educating patient prior to starting on insulin need to be taken seriously to improve patients' QOL. It was also noticeable that significant number of participants were dissatisfied about their knowledge of diabetes. From this result, action to improve diabetes knowledge should be taken seriously by delivering an effective patient education.

Study about HL and QOL among T2DM patients is still limited. Therefore, a more structured and nationwide study among T2DM patients need to be done in order to provide overall picture of HL and QOL status.

Factors studied in this research only contributes 17.2% of the variability of QOL. The other 82.8% is contributed by other factors which are not considered in this study. The importance of mediating factors such as self-efficacy and self-care behaviour was notably important as per literature review. Future research should include self-efficacy and self-care behaviour as a mediator and a structural equation model analysis could be done to test and establish a model.

CONCLUSIONS

In conclusion, this study has shown that more than half (56%) of the participants had sufficient HL and relatively high QOL level. The relationship between HL and QOL was proven to be positively associated in this study. Even though the interaction between HL and QOL is more complex rather than just a direct effect, this study has added on the knowledge of association between HL and QOL among T2DM patients in Malaysian population. Five factors identified to be

associated with QOL are HL, age, glycaemic control and insulin usage. Identifying these factors are essential in managing T2DM as targeted intervention can be done to improve their QOL.

Conflict of Interest

Authors declare none.

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Author's contribution

NS, NMN, MMY, MRI conceptualised and design the study. NMN supervised the study. NS collected the data, NS and MRI analysed and interpreted the data. NS drafted the manuscript. NS, MMY, MRI edited the manuscript. All authors agreed to be accountable for all aspects of the work.

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