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The Factor of Association of Diabetes Knowledge in Diabetes Mellitus type 2 Patients

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ABSTRACT

Background: T2DM is a chronic illness associated with numerous comorbidities and leads to chronic complications, resulting in high morbidity and mortality, rising health care costs. However, patients with this disease, through self-care, can significantly mitigate the risk, or delay the onset of these T2DM complications. This research aims to investigate factors along with Diabetes Knowledge. **Method**: A cross-sectional study was carried out among T2DM patients living in both rural and urban areas from the Central and Northeastern regions of Thailand were recruited from outpatient diabetes clinics of both community and university hospitals in both the Khon Kaen and Bangkok provinces of Thailand. Patients were sampled using a stratified sampling design where strata were based on locality (Province) -hospital size combinations. Firstly, we had translated all questionnaires from English to the local language then again back-translated simultaneously. Then, the third step was to perform psychometric testing of the DK instrument. Lastly, binary logistics mixed-effect regression was used to investigate the clustering effect of the participant's characteristics on this study. **Results**: After adjusting for covariates derivate that age, KK, and smaller hospitals, higher education, monthly income, underweight and overweight, DM treatment, and smoking nor alcohol were all found to be associated with various DK. **Conclusion**: In the future DK measurement is likely to provide valuable insights into the epidemiology of diabetes self-management and may also be used to evaluate interventions to reduce poor self-care in T2DM patients, in turn, politically reducing the incidence of, and mortality from, type 2 diabetes mellitus complications.

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1. Introduction

Diabetes mellitus (DM) and its complications in adults remain a global health problem and ranks fifth among causes of death in the world [1]. Currently, there are approximately 366 million people worldwide with diabetes, of which over 90%-95% of these have type 2 diabetes (T2DM) [2]. The burden of T2DM globally is increasing. Approximately 280 million adults are estimated to have impaired glucose tolerance, also known as "pre-diabetes". The global prevalence of T2DM among adults (aged 20–79) will be 6.4% or 285 million adults in 2010, and will reach 7.7% or 439 million adults by 2030 [3-4]. Diabetes mellitus is one of the most common chronic diseases in

almost all countries about 11.9 million adults in the U.S. aged ≥ 40 have been diagnosed with diabetes. In the most recent report from the Centers for Disease Control and Prevention (CDC), over 25.8 million populations 8.3%in the US have been affected by the said disease [5-7]. In low- and middle-income countries like Thailand, diabetes was the Seventh leading cause of death in year 2016 and prevalence among adults has risen from 2.3% in 1991 to 8.0% in 2015. Approximately12.4% have pre-diabetes, 4.8% are newly diagnosed, and one-half of Thais with diabetes remain undiagnosed. The majority of T2DM patients are 35 years old and over, and 58% (1.4 million) reside in urban areas [5,8-10]. T2DM is the most common endocrine disease and persistently affecting various organs, such as heart, brain, kidney, foot, and eyes. Perhaps the most important aspect of T2DM is the downstream chronic complications of T2DM lead to significant problems. Microvascular complications like Diabetic Retinopathy, Nephropathy and Neuropathy, and macrovascular complications like coronary artery disease and peripheral arterial disease and stroke are major sources of morbidity and mortality in the T2DM population [11].

The most important aspect of T2DM is the downstream chronic complications of T2DM lead to significant problems [12]. In Thailand, according to the Thailand Diabetes Registry (TDR) study (N=8,416, and the Diabetes care-Asia (Thailand) survey (N=1,078), severe complications are prevalent in both urban and rural areas. When urban and rural areas are compared, the prevalence of nephropathy (44% vs. 17%); retinopathy (31% vs. 13.6%), cardiovascular problems (8% vs. 0.7%), and stroke (4.4% vs. 1.9%) is higher in urban areas [13-15]. The specific prevalence of peripheral neuropathy is not reported but is estimated to be 34% in rural areas. The increased diabetes burden imposes a larger economic impact upon individuals and the national health care system [16]. Patients with diabetes complications have higher health care expenditures. Also, the cost of diabetes care is sharply rising in Thailand. The annual treatment of diabetes accounted for 23% of all medical costs, with the cost for treating diabetes patients reaching 4.2 times that for non-diabetes patients [17]. These statistics indicate a high mortality rate for diabetes, and economic burden for health care systems. However, patients with this disease, through knowledge, can significantly mitigate the risk, or delay the onset of these T2DM complications [18]. Thus, to reduce diabetes-related morbidity and mortality rates. The knowledge about the disease can have positive influence on attitude and practices of patients that could lead to better management of diabetes and eventually good quality of life [19]. Patients' knowledge and skills are required for communicating with their physicians and participating in making medical decisions [20]. Also, several studies have presented the effect of diabetes knowledge on self-care behaviors and clinical outcomes including drug therapy, diet, physical activity, blood glucose monitoring, and HbA1c level in T2DM [21-23]. Little is known about the factor of relationship between Diabetes Knowledge (DK) among Thai patients with T2DM, because, diabetes knowledge may also be used to evaluate interventions to reduce poor self-care or improve the achievement of clinical targets, in T2DM patients, in turn, potentially reducing the incidence of, and mortality from, T2DM complications.

2. Materials and Method

2.1. Study design and sample

This cross-sectional study included 700 T2DM patients living in either rural or urban areas from the central and northeastern regions of Thailand. Patients were recruited from outpatient diabetes clinics of both community and university hospitals in the Khon Kaen and Bangkok provinces of Thailand. Patients were sampled using a stratified sampling design with strata sizes based on locality (Province) - hospital size combinations. Questionnaires were administered in February to June, 2016 to T2DM outpatients aged at least 20 years old who had had a diagnosis of T2DM for at least 3 years, able to read and understand the Thai language and were willing to participate in the study. The authorized person of each hospital gave permission to collect the data, and all participants provided written informed consent. Participants were recruited until the data collection was complete. The study protocol was approved by the ethics committee of Khon Kaen University (HE581479), the Institutional Review Board at the Faculty of Medicine, Chulalongkorn University (IRB035/59), and the Bangkok Metropolitan Administration Ethics Committee for Human Research (U005q/59).

2.2. Measurement of diabetes knowledge

We used The Diabetes Knowledge Questionnaires (DKQ) is the multidimensional questionnaire, of which the original version was developed for using with western populations since 2003 [24].To date, the instrument has been widely used by researchers across different

countries. Past to present, a Thai translation of the DKQ has not been done and used on assessment diabetes knowledge.

As the DK instrument measures knowledge of diabetes, its items are binary (correct or incorrect answers) [25]. Consequently, standard factor analytic techniques which are designed for quantitative items are inappropriate. Instead, construct validity of the DK was examined using Multivariate Item Response Theory (MIRT) with items assumed to have a two-parameter model with no guessing (2PL) [26]. A model with a Root mean square error of approximation (RMSEA) less than 0.05, and Tucker Lewis Index (TLI) and Cumulative Fit Index (CFI) exceeding 0.929, was deemed to have adequate fit. Internal consistency reliability of the DK was assessed using the Kuder-Richardson 20 index (KR20) with a model with KR20>0.7 assumed to be sufficiently reliable [27].

2.4. Instrument Translation and Face validity

The items of the DK instruments were translated from English into Thai using the forward and backward translation technique outlined by Brislin.Four Thai-English bilingual translators were identified, and of these, two were used to forward translate the original version of the items of the three instruments into Thai, while the remaining two translators were used to independently back-translate the items from Thai back to English. The original and back translated versions of the three instruments' items were then compared by two native English speakers. Finally, the three instruments were field tested in a pilot group consisting of 20 T2D patients to evaluate the translational quality and the practical aspects of test administration. Participants were asked to read and listen to each item in order to ensure their understanding.

2.5. Other demographic variables

In addition to DK, the questionnaire included questions relating to socio-demographics including gender, marital status, age, education, religion, household income, family history of T2DM, smoking, and alcohol consumption. Also, clinical data such as comorbidities, duration of diabetes, type of diabetes treatment, weight, height and glycated hemoglobin (HbA1c) were extracted from each patient's electronic medical records using the current visit for each participant.

2.6. Statistical analysis

Participants were described using counts and percentages for categorical variables, and means and standard deviations for continuous variables. The outcome variable in this analysis was the binary variable HbA1c control (≤7%; >7%). Glycated haemoglobin (HbA1c), an indicator of glycaemic control, was extracted from each patient's electronic medical records using the most recent value for each participant.

Consequently, Binary Logistic Regression analysis was employed. Bivariate models were run to obtain crude odds ratios for the single DK scale and participant characteristics. Multivariable modeling was performed with all study effects forced into the model, but only patient characteristics whose p <0.25 in the bivariate analysis were included in the multivariable model. It should be further noted that for reasons of comparability, all subscales of DK were normalized to a range of 0-5 prior to analysis. A p-value<0.05 was deemed statistically significant throughout all inferential analysis, and all analysis was conducted using the R statistical language (V3.2.4, R core team, 2016).

3. Results and Discussion

3.1. Results

3.1.1. Demographic characteristics of participants

In total, 700 T2DM patients completed the questionnaire (Response rate of 100%), with age ranging from 26 to 95 years old (Mean=65.16, SD=10.94). The sample consisted of 70.29% females, and average years since T2DM diagnosis was 13.53 years (SD = 8.34). The demographic characteristics of the participants are presented in Table 1.

Table 1. Patient characteristics of T2DM patients (N=700)

Characteristics	N (%)
Hospital	
Phuphaman Hospital	60 (8.57)
Srinagarind Hospital	78(11.14)
Wechkaroonrasm Hospital	242(34.57)
Chulalongkorn Hospital	320(45.71)
Gender	
Male	208 (29.71)
Female	492 (70.29)
Age (Years)	
Mean (SD)	65.16 (10.94)
Range	26-95
Marital Status	
Single	57 (8.14)
Married	465 (66.43)
Divorced	165 (23.57)
Separated	13 (1.86)
Education	
No formal education	47 (6.71)
Elementary school	381 (54.43)
High school	146 (20.86)
Bachelor degree	99 (14.14)
Master degree	25 (3.57)
Higher degree	2 (0.29)
Religion	
Buddhism	543 (77.57)
Islam	152 (21.71)
Christianity	5 (0.71)
Monthly income	
<5,000 baht (<143 USD)	318 (45.43)
5,000-9,999 baht (143 to 287 USD)	95 (13.56)
10,000-14,999 baht (287 to 413 USD)	86 (12.29)
15,000-19,999 baht (413 to 575 USD)	48 (6.86)
20,000-25,000 baht (575 to 718 USD)	48 (6.86)
>25,000 baht (>718 USD)	105 (15.00)
BMI	
< 18.5	20 (2.86)
18.5 – 24.9	279 (39.86)
25 – 29.9	219 (31.29)
≥ 30	182 (26)
(Mean =27.08; SD =6.32)	
Duration of Diabetes	
≤ 5 years	85 (12.14)
>5 years	615 (87.86)
(Mean =13.53.; SD =8.34)	
Family history of DM	
Yes	370 (52.86)
No	330 (47.14)
Co-morbidity	
Hyperlipidemia	605 (86.43)
Hypertension	603 (86.14)
Heart disease	38 (5.43)
Renal disease	188 (26.86)
Treatment of DM	
No drug	14 (2)
Oral hyperglycemic agent (OHA)	408 (58.29)
Insulin sensitizer	94 (13.43)
Both OHA & insulin sensitizer	184 (26.29)
Smoking	
No	589 (84.14)
Previously	88 (12.57)
Yes	23 (3.29)
Alcohol	
No	569 (81.29)
Previously	89 (12.71)
Yes	42 (6)
Hba1c	
≤7%	317 (45.29)
>7%	383 (54.71)
(Mean =7.58; SD =1.70)	

All effects we considered were significant or close to significant at the crude level (and all will be included in MV model) (Table 2). With age the odds of better DK went down considerably (23% reduction in odds of better DK with each additional 10 years in age). Some improvement in knowledge over the course of disease (12% increases in odds of better knowledge with each additional 5 years since diagnosis). Those living in eastern Thailand had considerably less chance of better knowledge (odds of better knowledge about 46% lower relative to BKK DM patients) those attending small(community) hospital considerably less chance of better knowledge (odds of better knowledge about 70% lower relative to large hospital clinic patients). Females also had a substantially lower chance of better knowledge. Little difference between single and married, but Widow/Separated/Divorced had considerably lower chance of better knowledge. Education gradient effect with better education leading to better odds of strong DK. Also, income gradient effect (although not as pronounced as education). Previous and current alcohol use were actually associated with better (not worse) knowledge.

Table 2 Crude odds ratios for T- DKQ subscales associated with patient characteristics

Effect		OR	L95	U95	P Value
age.10		0.770	0.667	0.890	0.000
dmdura.5		1.120	1.019	1.232	0.019
prov.facKK		0.547	0.368	0.813	0.003
hsize.facSmall		0.298	0.211	0.420	0.000
sex.facFemale		0.568	0.402	0.801	0.001
Marital status	X^2LRT=	8.359	*df*=2	*p*=0.015	
mart.facMarried		0.757	0.426	1.345	0.342
mart.facWDS		0.473	0.252	0.885	0.019
Education	X^2LRT=	207.760	*df*=3	*p*=0.001	
edu4.facPrimary		4.510	2.406	8.453	0.000
edu4.facSecondary		30.969	14.227	67.414	0.000
edu4.facBach+		92.141	41.739	203.404	0.000
relig.facnon bud		0.539	0.372	0.781	0.001
Income	X^2LRT=	116.715	*df*=4	*p*=0.001	
inc.fac 5-9.99K		1.245	0.751	2.062	0.395
inc.fac 10-14.99K		2.439	1.408	4.226	0.002
inc.fac 15-24.99K		4.568	2.688	7.765	0.000
inc.fac 25+K		12.702	7.636	21.131	0.000
BMI	X^2LRT=	7.032	*df*=3	*p*=0.071	
bmi.fac<18.5		0.298	0.120	0.740	0.009
bmi.fac 25-29.9		0.944	0.649	1.374	0.764
bmi.fac 30+		0.814	0.549	1.207	0.306
famhx.facYes		2.724	1.952	3.801	0.000
DM treatment	X^2LRT=	8.033	*df*=3	*p*=0.045	
dmrx.facOHA		0.620	*0.190*	*2.026*	0.429
dmrx.facIns		1.027	0.297	3.555	0.966
dmrx.facOHA+Ins		0.958	0.288	3.190	0.944
Smoking	X^2LRT=	5.027	*df*=2	*p*=0.081	
Smk.facPrev		1.655	1.035	2.646	0.035
Smk.facCurrent		0.747	0.310	1.800	0.515
Alcohol	X^2LRT=	7.060	*df*=3	*p*=0.029	
alcohol.facPrev		1.674	1.042	2.688	0.033
alcohol.facCurrent		1.805	0.954	3.416	0.069
Comob.facYes		1.117	0.575	2.169	0.745

When we adjust for other covariates, age remains strongly associated with DK with the odds of better DK decreasing by 40% with each additional decade of age. KK and smaller hospitals also remain as strongly associated with poorer DK. However, after adjustment both DM duration and gender are not associated with DK. Higher education remains strongly associated with better DK. Same with income, but only the higher income groups demonstrated better knowledge (than those with no formal education). Underweight and overweight had lower

odds of better knowledge (than healthy weight range). DM treatment, smoking nor Alcohol could be shown to be associated with DK. These results of this analysis are presented in Table 3.

Table 3. Adjusted odds ratios for T- DKQ subscales associated with patient characteristics

Effect		OR	L95	U95	P
age.10		0.603	0.489	0.743	0.000
dmdura.5		1.117	0.984	1.267	0.088
prov.facKK		0.245	0.145	0.412	0.000
hsize.facSmall		0.435	0.267	0.709	0.001
sex.facFemale		1.342	0.790	2.279	0.276
Marital status	X^2LRT=	5.745	*df*=2	*p*=0.057	
mart.facMarried		2.186	1.133	4.217	0.020
mart.facWDS		2.246	1.080	4.669	0.030
Education	X^2LRT=	82.085	*df*=3	*p*=0.001	
edu4.facPrimary		5.910	2.910	12.001	0.000
edu4.facSecondary		24.865	10.393	59.487	0.000
edu4.facBach+		64.455	24.480	169.708	0.000
relig.facnon bud		0.903	0.525	1.552	0.711
Income	X^2LRT=	10.047	*df*=4	*p*=0.040	
inc.fac5-9.99K		1.315	0.741	2.334	0.350
inc.fac10-14.99K		1.761	0.957	3.242	0.069
inc.fac15-24.99K		1.834	1.002	3.359	0.049
inc.fac25+K		2.722	1.400	5.295	0.003
BMI	X^2LRT=	8.460	*df*=3	*p*=0.037	
bmi.fac<18.5		0.330	0.114	0.955	0.041
bmi.fac25-29.9		0.629	0.413	0.958	0.031
bmi.fac30+		0.639	0.398	1.025	0.063
famhx.facYes		1.559	1.070	2.270	0.021
DM treatment	X^2LRT=	5.687	*df*=3	*p*=0.0128	
dmrx.facOHA		1.698	*0.437*	*6.600*	0.445
dmrx.facIns		2.513	0.602	10.496	0.206
dmrx.facOHA+Ins		2.596	0.649	10.385	0.177
Smoking	X^2LRT=	2.970	*df*=2	*p*=0.226	
Smk.facPrev		0.879	0.382	2.023	0.762
Smk.facCurrent		0.386	0.131	1.139	0.085
Alcohol	X^2LRT=	1.436	*df*=3	*p*=0.488	
alcohol.facPrev		1.155	0.480	2.778	0.748
alcohol.facCurrent		1.693	0.697	4.111	0.245

3.2. Discussion

T2DM is a chronic illness associated with numerous comorbidities leading to chronic complications, resulting in high morbidity and mortality rate, raising health care costs. However, patients with this disease, through self-care, can significantly mitigate the risk, or delay the onset of these T2DM complication [28].

In this study, we also translate and validate the DKQ in the Thai T2DM patient population. The Diabetes Knowledge Questionnaires (DKQ) [29], also investigated factor that associated with Diabetes Knowledge. When we adjust for other covariates age, KK and smaller hospitals, higher education, monthly income, underweight and overweight, DM treatment, and smoking nor alcohol where all found to be associated with various T- DKQ subscales. These results are support several studies. However, after adjustment both DM duration and gender are not associated with DK. These results are support by another study. In contrast some studies shown that duration and gender of diabetes associated with DK. Finally, we investigated, how DKQ relate to blood sugar control. Up to date no previous research has been conducted in Thailand for HbA1C clinical target. After adjusting for covariates, the present study demonstrated that DK was not directly associated with HbA1c control. This result consisted with several studies. Our result indicated that greater patient knowledge alone does not correlate with improved glycemic control. In contrast with other studies shown that patients with greater understanding and

knowledge demonstrated better HbA1c control. But, in our study, individuals who had more education had greater diabetes knowledge. Patients with higher education levels tended to have more knowledge to manage their disease, more confidence in self-management of disease, and were more likely to engage in self-management behaviors such as regular exercise, watching their diet and foot care, and adherence to medication leads to better HbA1c control [17,19]. This support by Persell and collected showed that knowledge patients were more likely to perform self-management activities, patients with T2DM would be more likely to follow a diabetes diet, to self-monitoring their blood glucose level and have regular exercise when their diabetes knowledge was improved [30].

The present study did have some limitations such as since the study recruited T2DM patients only from the Central and Northeastern region of Thailand, our sample may not be representative of all T2DM patients in Southeast Asia in general, or even all areas of Thailand T2DM patients. Our study also had some strength as well. First, our validation of T-DMSES, T-DSMS, and T-DKQ is the most comprehensive validation and evaluation of psychometric properties of the DMSES, DSMS, and DKQ instrument ever conducted in any population.

4. Conclusion

In future T-DKQ is likely to provide valuable insights in to the epidemiology of diabetes knowledge and may also be used to evaluate interventions to reduce poor self-care in T2DM patients, in turn, politically reducing the incidence of, and mortality from, type 2 diabetes mellitus complications.

Declaration

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