TYPE 2 DIABETES IN HULU SELANGOR: FACTORS INFLUENCING SELF-CARE PRACTICES FROM A CROSS SECTIONAL SURVEY

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TYPE 2 DIABETES IN HULU SELANGOR: FACTORS INFLUENCING SELF-CARE PRACTICES FROM A CROSS SECTIONAL SURVEY

ABSTRACT

The prevalence of diabetes in Malaysia has been increasing from 6.3% in 1986 to 17.5% in 2015. The main aim of diabetes treatment is to achieve optimal glycaemic control, thus preventing or delaying complications. Good diabetes self-care practice is needed to achieve optimal glycemic control. In Malaysia, limited information is available about diabetes self-care practices and its associated factors. This study aimed to identify and determine factors influencing diabetes self-care practices among type 2 diabetics in the district of Hulu Selangor. This was an interviewer administered, cross sectional study, involving 371 randomly selected patients with type 2 diabetes recruited from 6 health clinics in the district of Hulu Selangor, Malaysia. A conceptual model regarding the association between age, sex, education level, diabetes duration, knowledge, social support, empowerment, self-efficacy, depression and diabetes distress with diabetes self-care practices was developed and analyzed using structural equation modelling. The mean HbA1c level was 8.8 ± 2.3%. Eighteen point one percent had good glycemic control. The mean self-care score was 3.87 ± 0.82. Forty five point eight percent practiced good diabetes self-care. Self-care was not associated with diabetes control. Diabetes self-care practices were similar between sex, age group, ethnicity, and education level. The prevalence of diabetes distress and depression was 5.7% and 4.3% respectively. There was a significant direct positive effect from self-efficacy (path coefficient=0.315, $p<0.001$) to diabetes self-care. There was a significant direct negative effect from diabetes distress (path coefficient=-0.134, $p=0.007$) to self-care. Social support had a direct positive effect (path coefficient=0.399, $p<0.001$) and indirect effect via self-efficacy (path coefficient=0.078, p=0.001) on self-care. Though depression had no direct effect on self-care (path coefficient=0.024, p=0.684), there was an indirect negative effect via self-efficacy (path coefficient=-0.098, p=0.001).In summary, the glycemic control and diabetes self-care practices were poor among the study population. Having higher social support, higher levels of self-efficacy and a lower level of diabetes distress leads to better diabetes self-care practices. Higher levels of social support and being less depressed were associated with better self-efficacy. In conclusion, to improve self-care practices, effort must be focused on enhancing support and self-efficacy levels, while not forgetting to deal with depression and diabetes distress, especially among those with poorer levels of self-efficacy.

Keywords: type 2 diabetes, self-care, HbA1c, knowledge, psychosocial factors

ABSTRAK

Kadar berlakunya penyakit diabetes semakin meningkat di Malaysia, daripada 6.3% pada tahun 1986 kepada 17.5% pada tahun 2015. Tujuan utama rawatan diabetes adalah untuk mencapai kawalan glisemik yang optima dengan tujuan untuk mencegah atau melengahkan komplikasi diabetes. Penjagaan diri diabetes yang bagus diperlukan untuk mencapai kawalan glisemik yang optima. Di Malaysia, terdapat kurang maklumat mengenai penjagaan diri diabetes serta faktor yang mempengaruhinya. Kajian ini bertujuan untuk menentukan tahap dan mengenal pasti faktor yang mempengaruhi penjagaan diri diabetes dikalangan pesakit diabetes jenis kedua di daerah Hulu Selangor. Kajian ini melibatkan temubual pesakit yang dijalankan oleh penyelidik, merupakan jenis keratan rentas dan melibatkan 371 pesakit yang dipilih secara rawak daripada 6 klinik kesihatan di daerah Hulu Selangor. Satu model konsep tentang kaitan diantara umur, tempoh penyakit diabetes, pengetahuan, sokongan sosial, pemerkasaan diri, kecekapan kendiri, kemurungan dan kebimbangan diabetes telah dicipta dan seterusnya dianalisa menggunakan "structural equation modelling". Dalam kajian ini, purata kandungan HbA1c adalah 8.8 ± 2.3%, dimana 18.1% daripada jumlah pesakit mempunyai kawalan glukosa yang baik. Purata markah penjagaan diri adalah 3.87 ± 0.82, dengan 45.8% daripada jumlah pesakit mengamalkan penjagaan diri diabetes yang baik. Dalam kajian ini, penjagaan diri diabetes tidak berkaitan dengan kawalan diabetes. Penjagaan diri diabetes adalah sama diantara jantina, kumpulan umur, bangsa dan tahap pendidikan. Kadar kebimbangan diabetes dan kemurungan adalah 5.7% dan 4.3%. Terdapat kaitan langsung positif yang signifikan diantara kecekapan kendiri (pekali hubungan=0.315, $p<0.001$) dengan penjagaan diri diabetes. Terdapat kaitan langsung negatif yang signifikan diantara kebimbangan diabetes (pekali hubungan=-0.134, $p=0.007$) dengan penjagaan diri diabetes. Sokongan sosial mempunyai kaitan langsung positif (pekali hubungan=0.399, p<0.001) dan kaitan tak langsung positif (pekali hubungan=0.078, p=0.001) dengan penjagaan diri diabetes. Secara ringkas, kajian ini mendapati kawalan glisemik dan penjagaan diri diabetes adalah tidak memuaskan dikalangan populasi kajian ini. Mempunyai sokongan sosial, kecekapan kendiri yang tinggi dan mempunyai paras kebimbangan diabetes yang rendah menjurus kepada penjagaan diabetes yang lebih baik. Sokongan sosial yang lebih dan kurang perasaan murung dikaitkan dengan tahap kecekapan kendiri yang lebih baik. Kesimpulannya, untuk memperbaiki penjagaan diri diabetes, usaha perlu ditumpukan terhadap peningkatan sokongan sosial dan kecekapan kendiri sementara tidak lupa untuk menangani masalah kemurungan dan kebimbangan diabetes, terutamanya dikalangan mereka yang mempunyai kecekepan kendiri yang rendah.

Kata kunci: diabetes jenis kedua, penjagaan diri, HbA1c, pengetahuan, factor psikososial

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LIST OF SYMBOLS AND ABBREVIATIONS

For examples:

CIRS	:	Chronic Illness Resources Survey
DES	:	Diabetes Empowerment Scale
DDS	:	Diabetes Distress Scale
DMSE	:	Diabetes Management Self-Efficacy
HbA1c	:	glycated haemoglobin
MDKT	:	Michigan Diabetes Knowledge Test
PHQ-9	:	Patient Health Questionnaire – 9 item
SDSCA	:	Summary of Diabetes Self-Care Activities
SMBG	:	Self-monitoring of blood glucose
WHO	:	World Health Organization

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CHAPTER 1: INTRODUCTION

1.1 Chapter overview

This chapter begins by defining type 2 diabetes, the clinical implication of diabetes and a brief history and development in the area of diabetes treatment. The burden of diabetes in Malaysia is then discussed. This chapter ends by stating the problems, objectives, research question and the significance of the study.

1.2 Glucose metabolism

Glucose is the main fuel or energy source for our body. Glucose comes directly from the digestion of carbohydrate or can be indirectly produced from the metabolism of fat and protein via a process called gluconeogenesis by the liver. Insulin, a hormone produced by the pancreas, mediates the uptake of glucose by cells and converts excess glucose and stores them as glycogen or fat. When the blood glucose level falls, glucagon, another hormone produced by the pancreas is released, converting glycogen, fat, and protein into glucose, a process called gluconeogenesis.

In a normal healthy adult, despite the varying demands of food and physical activities, the blood glucose level is closely regulated and rarely strays outside the range of 3.5 – 8.0 mmol/L (63 – 144 mg/dL). In diabetes mellitus, due to insulin deficiency or resistance, the blood glucose metabolism is impaired, thus leading to a state of chronic hyperglycemia (Gale, 2005).

1.3 Diabetes mellitus

Diabetes mellitus is a syndrome characterized by chronic hyperglycemia (elevated blood glucose) due to absolute or relative insulin deficiency, insulin resistance, or both (Conget, 2002). Diabetes mellitus can be categorized into several categories based on its etiopathogenetics. Generally, there are two major categories, diabetes mellitus type 1 and diabetes mellitus type 2. In diabetes mellitus type 1(5-10%), there is an absolute deficiency in insulin secretion. The more common diabetes mellitus type 2 (90-95%) is due to a combination of insulin resistance and inadequate insulin secretion. The less common categories of diabetes include gestational diabetes mellitus and specific type diabetes mellitus which are due to endocrinopathies, genetic defect, infection, drug or chemical induced and those associated with other genetic syndromes (American Diabetes Association, 2017a).

Diabetes mellitus type 2 is a polygenic disorder, but genes responsible for the disease have not been identified (Prasad & Groop, 2015). Population-based studies have estimated that identical twins have about 50% chance of developing Diabetes Mellitus Type 2 while in non-identical twins the chances are between 15-25%. Risk factors for developing diabetes include ; age more than 45 years old, being overweight (BMI>25kg/m^2 or >23 kg/m^2 in Asian Americans) and having a positive family history of type 2 diabetes mellitus in a first-degree relative, having a history of previous IGT (impaired glucose tolerance) or IFG (impaired fasting glucose), women who had diabetes during pregnancy or have polycystic ovarian syndrome, hypertension and deranged lipid profile (American Diabetes Association, 2017a).

Diabetes can be diagnosed based on the venous plasma glucose level, either the fasting plasma glucose (FPG) or 2-hour plasma glucose (2-h PG) value after a 75-g oral glucose tolerance test (OGTT) or according to the HbA1c levels. According to the American Diabetes Association, diabetes is diagnosed when the fasting plasma glucose is (FPG) ≥ 7.0 mm0l/L or the 2-hour plasma glucose (2-h PG) following an OGTT is ≥11.1 mmol/L, or a random plasma glucose of ≥ 11.1mmol/L in a symptomatic individual, or if the HbA1c value is ≥6.5% (American Diabetes Association, 2017a) in both symptomatic and asymptomatic patient. The American Diabetic Association defines a normal fasting blood glucose level as <5.6 mmol/L while the WHO (World Health Organization) defines a normal fasting blood glucose level as <6.1 mmol/L (Sacks et al., 2011).

The HbA1c value in normal people is $< 5.6\%$. HbA1c (glycated hemoglobin) is hemoglobin which has undergone non-enzymatic glycosylation (attachment of free aldehyde groups of glucose or other sugars to the un-protonated free amino groups of proteins). HbA1c is widely measured in clinical practice to monitor diabetes control (Miedema, 2005).

The OGTT (Oral Glucose Tolerance Test) requires 2 venous plasma glucose samples, one at 0-hour and another at 2 hours later following the ingestion of glucose solution (Salmasi & Dancy, 2005). For an OGTT, an individual is required to drink a solution containing 75 grams of glucose in 300 ml of water within 5 minutes. In children, the amount of glucose to be consumed is 1.75 gram of glucose per kilogram body weight (Phillips, 2012). The OGTT requires the individual to fast for 8 – 12 hours (zero calories allowed), be on his/her regular diet, avoid alcohol and caffeine for 48 hours and not perform any unusual excessive physical activities as these situations may not reflect a person's actual routine glucose metabolism. The OGTT is performed in the morning as glucose tolerance can exhibit a diurnal rhythm with a significant decrease in the afternoon (Dugdale, 2013; Robinson et al., 2004).

The classification of diabetes status according to the OGTT results is shown in Table 1.1. People with diabetes have 0-hour plasma glucose of ≥ 7.0 mmol/L and 2-hour plasma glucose of ≥ 11.1 mmol/L (WHO, 2006). The OGTT has an advantage of diagnosing more people with diabetes (American Diabetes Association, 2017a). In a meta-analysis of 9 studies involving 25,932 participants, compared to the OGTT, using HbA11c $>6.5\%$

as a diagnostic criterion failed to diagnose 48.7% of newly diagnosed diabetes (N. Xu, Wu, Li, & Wang, 2014).

Table 1.1: Classification of diabetes base on the OGTT (Oral Glucose Tolerance Test) results.

Category	Plasma Glucose Values (mmol/L)		
	Fasting (0-hour)		2-hours after consumption of 75gm of glucose in 300ml of water
	ADA	WHO	
Normal	< 6.1	<5.6	< 7.8
Impaired Fasting Glucose (IFG)	6.1 – 6.9	5.6 -6.9	-
Impaired Glucose Tolerance (IGT)	-		7.8 – 11.0
Diabetes Mellitus (DM)	≥7.0	≥7.0	≥11.1

ADA (American Diabetic Association), WHO (World Health Organization)

1.4 Complications of Diabetes

Chronic hyperglycemia leads to multiple organ damage. Complications associated with diabetes are generally classified into 2 major categories: (1) macrovascular (coronary heart disease, cerebrovascular disease, peripheral vascular disease) and (2) microvascular (retinopathy, nephropathy, and nephropathy) (Fowler, 2008). Diabetes is also associated with other problems such as dental complication, feto-maternal complications, mortality, hospitalization, poorer quality of life and economic issues.

1.4.1 Coronary Heart Disease (CHD)

Diabetes mellitus is an established risk factor for CHD (coronary heart disease). Findings from a 2014 meta-analysis of 64 prospective population studies reported that female and male diabetics were approximately 2.8 (95% CI 2.35, 3.38) and 2.1 (95% CI 1.82, 2.56) times more likely to develop CHD. People with diabetes age biologically faster compared to non-diabetics. This may be the reason for diabetic men and women being at high risk for CHD as early as 47.9 and 54.3 years, respectively (Booth, Kapral, Fung, & Tu, 2006).

1.4.2 Peripheral vascular disease (PVD)

Diabetes is a risk factor for PVD (peripheral vascular disease). Findings from a meta-analysis of 34 studies reported that diabetics had almost double the risk of developing PVD (Fowkes et al., 2013). The incidence of PVD is directly related to the level of HbA1c (Muntner et al., 2005). For every increase of HbA1c by 1%, the risk of PVD increases by 28% (Adler et al., 2002). Diabetics usually suffer from a more severe form of PVD. Compared to non-diabetics, diabetics have a greater segment of their arteries affected by PVD and are more prone to complications such as rest pain, foot ulcer, foot gangrene, amputation and early mortality associated with PVD (Jude, Oyibo, Chalmers, & Boulton, 2001). Following surgical intervention for PVD, diabetics have up to 55% increased risk of developing major amputation or death compared to the non-diabetics (Malmstedt et al., 2008).

1.4.3 Stroke

Findings from the 2010 meta-analysis of 102 prospective studies showed that diabetics have an approximately twofold increased risk for all types of stroke (Sarwar et al., 2010). Diabetics with stroke have 1.5 times increased risk of subsequent stroke when compared to those without diabetes (Shou, Zhou, Zhu, & Zhang, 2015). When compared to non-diabetics, after adjusting for smoking, alcohol, weight and lipid profiles, diabetic males have a 2 fold increased risk of developing a stroke across all ages, whereas female diabetics, in the first post-menopausal decade, have up to 6.5 fold increased risk of developing a stroke (Almdal, Scharling, Jensen, & Vestergaard, 2004). The risk of developing stroke is dependent on the glycemic control of an individual. The incidence and severity of stroke are higher among diabetics with poor control of diabetes (H. Li et al., 2012). Diabetics with stroke have a higher rate of mortality, longer hospital stay, poorer recovery and higher disability rate (Kaarisalo et al., 2005).

1.4.4 Diabetic nephropathy

CKD (chronic kidney disease) is defined as a declining kidney function with or without proteinuria. Diabetes is the most common cause of CKD (Pecoits-Filho et al., 2016). The National Health and Nutrition Examination Survey, a population based study in the United States involving over 8,000 individuals reported the prevalence of CKD among undiagnosed diabetics, diagnosed diabetics, pre-diabetics, and non-diabetics as 41.7%, 39.6%, 17.7% and 10.6% respectively (Plantinga et al., 2010). In a systematic review of 33 studies, the risk of developing CKD among diabetics have been reported to vary from 6.2 times in the white population to 62.0 times among Native Americans (Narres et al., 2016). The incidence of CKD increases with HbA1c value (C. C. Lin et al., 2013). The incidence of CKD increases linearly starting at HbA1c value of > 6.4% and reaches more than 3 folds at HbA1c value of >10% (Schottker, Brenner, Koenig, Muller, & Rothenbacher, 2013).

1.4.5 Neuropathy

Diabetes is the commonest cause of neuropathy globally (Albers & Pop-Busui, 2014). Neuropathy generally refers to disease of the peripheral nerves which refers to a range of clinical syndromes affecting a variety of peripheral nerve cells and fibers, including motor, sensory, and autonomic fibers leading to complications such as unremitting pain, unsteadiness, foot ulceration, amputation and death (Kasznicki, 2014). Neuropathy of the cardiovascular autonomic nervous system increases the risk of mortality over 3 folds (Maser, Mitchell, Vinik, & Freeman, 2003). Based on the review of 29 studies, the estimated prevalence of neuropathy in the general population ranges from 1 to 3 % and increases to 7 % in the elderly (Hanewinckel, van Oijen, Ikram, & van Doorn, 2016). A meta-analysis of 27 studies involving 16,337 diabetics estimated the global prevalence of neuropathy among patients with type 2 diabetes at 35.78%. The incidence and severity of neuropathy are higher among those with poor glycemic control (Martin, Albers, & Pop-Busui, 2014).

1.4.6 Diabetic retinopathy

Diabetic retinopathy is a complication of diabetes, of which the prevalence is strongly correlated to both the duration of diabetes and level of glycemic control. Diabetic retinopathy worsens with longer diabetes duration, higher HbA1c, and higher blood pressure levels (Bloomgarden, 2002). Diabetic retinopathy is the leading cause of blindness among adults aged 20–74 years in developed countries (Solomon et al., 2017). For every 1% increase in HbA1c, retinopathy frequency is almost doubled and the frequency of visual loss increases by 30% (Bloomgarden, 2002). A meta-analysis of 35 studies worldwide involving over 20,000 estimated the global prevalence of diabetic retinopathy was 35.4% (93 million people) in 2010 (Yau et al., 2012).

1.4.7 Feto-maternal complications

About 16% of diabetes in pregnancy is due to pre-gestational diabetes (Hod et al., 2015). Pre-gestational diabetes is associated with more fetal anomaly when compared to gestational diabetes, and the odds of fetal anomaly increases as a diabetic mother gains weight (Correa et al., 2008). Among mothers with pre-gestational diabetes, the risk of developing a major congenital malformation is about 3 to 5 times when compared to non-diabetic mothers (Balsells, Garcia-Patterson, Gich, & Corcoy, 2012). Diabetic mothers are more likely to require a caesarean section or induction of labour, have large for gestational age or macrosomic babies and have a higher risk of shoulder dystocia for all glucose exposures across the distribution of glucose concentration (Farrar et al., 2016).

1.4.8 Diabetes and mortality

People with diabetes have higher all-cause mortality. A population based cohort study in the United States with samples from the National Health Interview Survey (NHIS) between 1997 and 2009 (N = 282,322) and in the National Health and Nutrition Examination Survey (NHANES) between 1999 and 2010 (N = 21,814) estimated that the mortality rate was almost double among diabetics (Stokes & Preston, 2017). A meta-analysis of 26 studies found that for every 1% increase in HbA1c, there was a 15% increase risk in all-cause mortality, 25% increase risk in cardiovascular related mortality and 17% increase risk in coronary heart disease fatality (Y. Zhang, Hu, Yuan, & Chen, 2012). The highest risk for death among people with diabetes is due to CVD, more than double in magnitude compared to the non-diabetic population. Other causes of death, which is seen more among diabetics, include cancers, kidney disease, liver disease, infectious diseases, pulmonary disease and central nervous system (Seshasai et al., 2011).

1.5 Burden of diabetes

Diabetes is a global pandemic. WHO (World Health Organization) reported that the global prevalence of diabetes has increased from 4.7% (108 million > 18 years old) in 1980 to 8.5% (422 million > 18 years old) in 2014. With the advancement in science and technology, and with the achievement in public health where many communicable diseases have been eliminated, people are living longer (Zimmet, Alberti, & Shaw, 2001). Couple this with urbanization which is related to increased obesity and a sedentary lifestyle, the number of people with diabetes is increasing faster than projected. The prevalence of diabetes has risen faster in low- and middle-income countries than in high-income countries with the Eastern Mediterranean region and the South East Asian region having the highest prevalence (World Health Organization, 2016).

Globally, in the year 2012, diabetes caused the direct death of an estimated 1.5 million people, with another 2.2 million deaths were attributable to high blood glucose (World Health Organization, 2016). Ischemic heart disease and stroke caused 15.5 million deaths globally in 2015 (GBD 2015 Mortality and Causes of Death Collaborators, 2016). In the United States, 68% of ischemic heart diseased death and 16% of stroke death was associated with diabetes (Matheus et al., 2013). In 2010, diabetes caused 73,000 non-traumatic lower limb amputations among Americans above 20 years old (American Diabetes Association, 2017b).

In the year 2010, diabetes was the cause of 2.6% (0.8 million) of all blindness and 1.9% (3.7 million) of all visual impairment worldwide (Leasher et al., 2016). The United States has the highest number of people with renal failure requiring renal replacement therapy. In the United States, in 2013, the incidence of renal failure was 363 per million/year (117162 people), with a prevalence of almost 2000 / million population

(661,648 people). Diabetes was the primary cause of almost 50% of renal failure in the United States (American Diabetes Association, 2017c; National Institutes of Health, 2015).

In the United States, the estimated cost to treat diabetes was USD 245 billion in 2012, including USD176 billion in direct medical costs and USD 69 billion in reduced productivity. The largest component of medical expenditure was hospitalization (43% of total cost), followed by prescription medications to treat the complications of diabetes (18%), medications and diabetes supplies (12%), physician office visits (9%), and nursing/residential facility stays (8%). Indirect costs include increased absenteeism (USD5 billion) and reduced productivity while at work (USD 20.8 billion) for the employed population, reduced productivity for those not in the labor force (USD 2.7 billion), inability to work as a result of disease related disability (USD 21.6 billion), and lost productive capacity due to early mortality (USD 18.5 billion) (American Diabetes Association, 2013).

1.6 Diabetes in Malaysia

Malaysia is a developing country and just like the rest of the world, is heading towards a diabetes epidemic (Hussein, Taher, Gilcharan Singh, & Chee Siew Swee, 2015). Malaysia has transformed rapidly in economic and in sociodemographic characteristics (Zaini, 2000). With rapid industrialization and mechanization, coupled with higher income level, people are more sedentary and becoming more obese. Being physically inactive and obese are risk factors for developing diabetes (G.-L. Khor, 2012).

Since 1986, a series of population survey, the National Health and Morbidity Surveys (NHMS) has been conducted in Malaysia. NHMS I, NHMS II and NHMS III conducted in 1986, 1996 and 2006 showed a dramatic rise in the prevalence of diabetes among those age 30 years and above; 6.3%, 8.2%, and 14.9%, respectively (Letchuman et al., 2010). Malaysia's fourth NHMS (National Health and Morbidity Survey) in 2011 estimated the prevalence of diabetes among those 18 years and above at 15.2% (2.6 million people). In 2015, the fifth HNMS reported that the prevalence of diabetes among those 18 years and above has risen to 17.5% (3.5 million people) (Institute of Public Health Malaysia, 2015b).

In Malaysia, 56% of those with diabetes seek treatment in the government primary care health clinics, 24.6% in government hospital-based clinics while the rest in private facilities (S. P. Chan, 2015). Data from the National Diabetes Registry report (2009-2012, n= 653,326 people with type 2 diabetes) showed that for the year 2009, 2010, 2011 and 2012, the percentage of patients achieving clinical target (HbA1c<6.5%) was 19.4%, 24.8%, 22.6% and 23.8% respectively (Ministry of Health Malaysia, 2013).

In 2014, an estimated 146,000 Malaysians died due to non-communicable diseases. Diabetes caused 3% of the total death, with cardiovascular disease, a major complication of diabetes responsible for 36% of total death (World Health Organization, 2014). In 2012, an audit of Malaysia's National Diabetes Registry involving over 650,000 type 2 diabetics attending 625 government health clinics nationwide found that the complications of diabetes were nephropathy (7.6%), retinopathy (6.5%), ischaemic heart disease (4.8%), diabetics foot ulcer (1.2%), stroke (1.1%) and amputation (0.5%) (Ministry of Health Malaysia, 2013).

In 2010, the Malaysian government spent 16% (USD 600 million) of the health expenditure to treat diabetes, averaging about USD 325 per diabetic patient (P. Zhang et al., 2010). The hospitalization cost per diabetic patient ranged from USD 694 to USD 4,151 while for the outpatient treatment, the cost ranged between USD 78 to USD 362 (Wan Norlina Ibrahim, Syed Aljunid, & Ismail, 2010).

1.7 Malaysian government's response to the diabetic epidemic

The prevalence of diabetes among Malaysian's above 18 years old more than doubled from 8.3% in 1996 to 17.5% in 2015 (Institute of Public Health Malaysia, 2015a). Diabetes, cardiovascular diseases, chronic respiratory diseases, and cancer are the four main types of NCD (Non-communicable diseases) that poses a public health burden to Malaysia. Despite all of the efforts that have been undertaken since the 1990's, the prevalence of NCD and NCD risk factors such as obesity continues to rise at an alarming rate (Ministry of Health Malaysia, 2017).

At the global and regional level, WHO has already produced several mandates that support the prevention and control of NCDs. The documents relevant to Malaysia include (Ministry of Health Malaysia, 2010):

i. Global Strategy for the Prevention and Control of Non-Communicable Diseases (2000)
ii. WHO Framework Convention on Tobacco Control (2003)
iii. Global Strategy on Diet, Physical Activity, and Health (2004)
iv. Resolution WHA60.23 on Prevention and control of non-communicable diseases: implementation of the global strategy (2007)

v. 2008-2013 Action Plan for the Global Strategy for the Prevention and Control of Non-communicable Diseases (2008)

vi. Western Pacific Regional Action Plan for Non-communicable Diseases (2009)

In Malaysia, a national diabetes registry was started in 2009 and went web-based in 2011. It supported the implementation of the annual "Diabetes Clinical Audit" amongst patients with type 2 diabetes attending the government health clinics (S. P. Chan, 2015). In 2010, Malaysia launched the NCD Prevention – 1 Malaysia (NCDP-1M), a programme under the National Strategic Plan for Non-Communicable Diseases (NSP-NCD) (Mustapha et al., 2014).

All of the mandates, policies and programmes adopted by Malaysia pertaining to non-communicable diseases have focused on (Ministry of Health Malaysia, 2010):

1. Health Promotion – increasing awareness, reducing risk factors and promoting healthy lifestyle (diet and exercise) at all levels e.g. schools, media campaign, work place, community setting, supermarkets
2. Strengthening the health delivery system – better clinical care including better treatment, risk factor screening, and rehabilitation services
3. Increasing patient compliance – empowering patients in disease self-care
4. To foster multi-sectoral partnerships and encourage stakeholder participation in developing, implementing, evaluating and advocating non communicable diseases preventions and interventions
5. Monitoring, research and surveillance – diabetes and other non-communicable diseases are monitored with ongoing research and surveillance to identify progress and effectiveness of policies adopted.

6. Capacity building – continuously improving the skills, knowledge and attitude of all health care personnel, both in primary care and hospital settings, to deal with the challenge of chronic disease management.
7. Policy and regulatory interventions – merging non-communicable diseases prevention and control into related health and non-health policy areas, such as those that address urban development (e.g. Healthy Cities), poverty alleviation, and sustainable development needs to be identified and utilised. There is also a need to establish economic policies that reinforce healthy lifestyle choices through pricing, taxation, subsidies and other market incentives.

Malaysia continued the commitment to tackle diabetes as part of the Ministry of Health's Plan of Action 2016-2020 with the aim of reducing the prevalence of diabetes from 17.5% in the year 2015 to 15.0% in the year 2020 among adults above 18 years old (Ministry of Health Malaysia, 2015b).

1.8 Diabetes self-care

People with diabetes require lifelong medical treatment and lifestyle modification for diabetes control, which are provided by themselves on a daily basis with the aim of preventing or delaying diabetes-associated complications (Ayele, Tesfa, Abebe, Tilahun, & Girma, 2012). Four main activities, collectively known as diabetes self-care activities which affect diabetes control are dietary control, medication adherence, physical activity and self-monitoring of blood glucose (SMBG) (Zhou, Liao, Sun, & He, 2013). People with type 2 diabetes who perform adequate regular physical activity have better diabetes control (Umpierre et al., 2011). Similarly, adherence to a healthy diet, e.g., low carbohydrate, low glycemic index, and high fiber have been shown to effectively improve diabetes control (Ajala, English, & Pinkney, 2013). More SMBG practice and coupled with medication intensification and adherence leads to better diabetes control (Glen H. Murata et al., 2009; Rozenfeld, Hunt, Plauschinat, & Wong, 2008). Knowledge has been identified as the foundation in decision making on diet, exercise, blood glucose monitoring and medication adherence (Yee Cheng Kueh, Morris, Borkoles, & Shee, 2015). Patients need the knowledge and skills to make informed choices and to facilitate self-directed changes in behaviour and ultimately to reduce the risk of the associated complications. However, in most developing countries, Malaysia included, several studies reported that the knowledge of diabetes was non-satisfactory and requires improvement through continuous education by health care professionals (Chinnappan, Sivanandy, Sagaran, & Molugulu, 2017).

Studies have shown that the adherence to diabetes self-care practices has not been consistent and is influenced by diverse factors. Sociodemographic background, attitude, psychosocial factors and patient-provider communication skills are just some of the factors influencing diabetes self-care (Luo et al., 2015).

1.9 Statement of Problem

Type 2 diabetes is a major non-communicable disease worldwide, and it is associated with high morbidity and all-cause mortality (Bertoni, Krop, Anderson, & Brancati, 2002). The main aim of diabetes management is to achieve and maintain good glycemic control. Ideally, to be in good control, the HbA1c level among the diabetic patients must be < 6.5% (Ministry of Health Malaysia, 2015a).

Chronic hyperglycemia leads to multiple complications such as coronary heart disease, cerebrovascular disease, peripheral vascular disease, retinopathy, and nephropathy. Diabetes and its related complications is a heavy financial burden on the healthcare cost worldwide. The effects of diabetes also have a major impact on the quality of life among the diabetic patients. Among the diabetics, self-care is a very important aspect of care and is the cornerstone of overall diabetes management. Good diabetes self-care is a prerequisite to achieving optimal glycemic control, and it normally involves activities such as healthy eating, physical activity, blood glucose monitoring, taking medications, problem-solving, and adaptive coping.

In Malaysia, the prevalence of diabetes is high, especially among those above 30 years old. Over 56% of those with diabetes receive treatment from government primary care clinics. Despite the support of the government and the advancement in the field of medicine and pharmacology, the prevalence of type 2 diabetes is on the rise. In Malaysia, glycemic control among diabetes patients is very poor. Previous studies have indicated that only 20 to 30% of the diabetic patients have good glycemic control. As a result of poor glycemic control, many diabetic patients suffer from various complications. This increases the healthcare burden of the government.

Currently, little is known about the diabetes self-care practices among Malaysians with type 2 diabetes. The reasons why individuals with diabetes do not adhere to the recommendations need to be explored (Gunggu, Thon, & Whye Lian, 2016). This study aims to assess the diabetes self-care and identify factors influencing it among Malaysian with type 2 diabetes mellitus attending government health clinics in the district of Hulu Selangor.

1.10 Objectives

1.10.1 General objective

To assess and identify factors influencing diabetes self-care practices among type 2 diabetics in the district of Hulu Selangor.

1.10.2 Specific objectives

1. To systematically review the literature on factors associated with diabetes self-care practices.
2. To translate and validate the English language version of the Diabetes Empowerment Scale, Diabetes Distress Scale, and the Chronic Illness Resources Survey Scale into the Malay language version.
3. To determine if diabetes self-care practices are associated with glycaemic control.
4. To determine if knowledge is associated with diabetes self-care practices and glycaemic control.
5. To determine the association between psychosocial factors and diabetes self-care practices.
6. To determine the direct and indirect effects of age, diabetes duration, knowledge and psychosocial factors with diabetes self-care practices.

In this study, the first objective will be answered in Chapter 2 (Literature Review) while the second objective will be answered in Chapter 3 (Methods). The third, fourth, fifth and sixth objectives are answered in chapter 4 (Results).

1.11 Research questions

This study addresses the following questions. How well is the diabetes control among Malaysian with type 2 diabetes attending government health clinics in the district of Hulu Selangor? How well are they practicing diabetes self-care activities? Does knowledge level associate with diabetes self-care and glycemic control? What are the factors influencing diabetes self-care practices among Malaysian with type 2 diabetes attending government health clinics in the district of Hulu Selangor? These are the questions which will be answered in this study. How these factors relate to each other and their impact on diabetes self-care activities will be uncovered in this study.

Previous studies involving Malaysians with diabetes have failed to explore the array of possible factors influencing diabetes self-care practices. If any, these factors were studied individually, thus disabling analysis of the possible association between them and diabetes self-care.

In reality, many of these factors interact with each other and have a varying degree of association with diabetes self-care. This study aims to identify the factors that are commonly associated with diabetes self-care practices and investigate the association between them.

1.12 Significance of this study

A study in the area of diabetes self-care practices, and specifically factors influencing them among Malaysian with type 2 diabetes is essential. At present, there is very limited information regarding the self-care practices of Malaysians with type 2 diabetes. Despite many years of health campaigns, especially those advocating for a healthy lifestyle to prevent chronic illnesses, not much is known if the message actually reached the target audience. From the abundance of available literature regarding clinical status and diabetes control among Malaysians, it is clear that we are not progressing much concerning glycemic control.

Firstly, this study will provide us with the information about self-care practices among Malaysians with diabetes. Most importantly, this study will seek to find what factors influence diabetes self-care and how these factors interact with one another.

The information gathered from this study will benefit everyone. As we all know, the high morbidity and mortality associated with diabetes do not only affect the patient alone, it further strains the presently limited public healthcare budget. By knowing, working and putting emphasis on the right factors influencing diabetes self-care, the outcome will be better glycemic control, lesser morbidity and mortality related to diabetes, and a reduction in public healthcare expenditure and a healthier and more productive workforce.

The information gained from this study will enable healthcare providers to have an overall view of how an array of factors influence diabetes self-care practices, and subsequently to manage each patient individually.

This study will have the most significant impact on the patients themselves, as the identification of factors influencing diabetes self-care should be the target of health care providers, health programs, and health policies. Thus, the delivery of healthcare services will be more effective, and with a better understanding between the healthcare provider and the patient, ultimately this will translate into better health outcome.

CHAPTER 2: LITERATURE REVIEW

2.1 Chapter overview

This chapter discusses the management of diabetes in Malaysia and the need for proper diabetes self-care to achieve good glycaemic control. The importance of knowledge in diabetes self-care and glycaemic control are discussed. This chapter then describes the process of the systematic search which was undertaken to identify the relevant studies, and ultimately factors which influence diabetes self-care. Age, sex, education level, duration of diabetes, knowledge, support, empowerment, self-efficacy, diabetes distress, and depression were then modeled about how these factors influenced diabetes self-care and each other.

2.2 Control and management of type 2 diabetes

Diabetes leads to multiple harmful complications, including death. These complications are mainly associated with poor glycemic control (Olokoba, Obateru, & Olokoba, 2012). People with diabetes require proper and optimal blood glucose management, risk factor identification and reduction, and comprehensive management of comorbidities and complications.

The findings from landmark studies such as; the Diabetes Control and Complications Trial (DCCT), the DCCT Epidemiology of Diabetes Interventions and Complications (EDIC), the United Kingdom Prospective Diabetes Study (UKPDS) and post-Trial Monitoring, the Action in Diabetes and Vascular Disease: Preterax and Diamicron Modified-release Control Evaluation (ADVANCE) and Veterans Affairs Diabetes Trial (VADT) have been the basis for most of the diabetes control and management recommendations by the American Diabetes Association (American Diabetes Association, 2017a).

The DCCT(1982-1993) was a controlled clinical trial involving 1441 subjects with type 1 diabetes, comparing near normal glucose control (average HbA1c= 7.2%) with safe asymptomatic glucose control (average HbA1c=9.1%). The DCCT found that near normal glucose control reduced the risk of retinopathy by 76%, nephropathy by 50% and neuropathy by 60% (Nathan, 2014).

The EDIC study is a continuation study of the DCCT study, with the involvement of over 90% of the original study participants. After 30 years of follow-up in the DCCT and EDIC studies, intensive therapy reduced the incidence of major cardiovascular events (nonfatal myocardial infarction, stroke, or cardiovascular death) by 32% (DCCT/EDIC Research Group, 2016). Findings from the DCCT and EDIC studies are important for people with type 2 diabetes because the complications development process is likely to be similar for both type 1 and type 2 diabetes (National Institutes of Health, 2008).

The UKPDS (1977-1991) was a multicenter controlled trial involving 5102 people with type 2 diabetes, comparing the outcome between intensive glucose control (mean HbaA1c=7.0%) with conventional therapy (mean HbA1c=7.9%). Other factors such as blood pressure control, weight management, and treatment modalities were also studied. Data from 30 years of the UKPDS and the post-trial monitoring study concluded that intensive glucose control reduces; 25% risk for microvascular disease, 12% risk for any diabetes-related endpoint compared to conventional diet therapy, and a 16% risk of myocardial infarction (UKPDS, 2017). Intensive glucose control with metformin decreased the risk of diabetes-related complications in obese people with type 2 diabetes while tight blood pressure control resulted in reductions of diabetes-related deaths, complications related to diabetes, progression of diabetic retinopathy and deterioration in visual acuity. The use of ACE-inhibitors was also associated with lesser diabetes related death and microvascular complications (UKPDS, 2017).

The blood pressure arm of the ADVANCE study (randomization in 2003, follow-up 4.5 years) involving 11140 participants reported that a modest reduction in blood pressure by an average of 5.6/2.2 mm Hg with perindopril/indapamide compared with placebo reduced cardiovascular death and nephropathy by 18% (Poulter, 2009).

The Hypertension Optimal Treatment (HOT) study, a multicenter study trial involving 18790 patients from over 26 countries found that among their study population with diabetes, those with a diastolic blood pressure of ≤80mmHg had a 51% risk reduction in major cardiovascular event than those with a diastolic blood pressure of ≤90mmHg. Those on aspirin had a reduction in major cardiovascular event and myocardial infarction by 15% and 36% respectively (Hansson et al., 1998). The main message from these trials was improved glycemic control and management of risk factors reduces both microvascular and macrovascular complications.

The American Diabetes Association recommends the use of specific pharmacotherapy to achieve clinical targets. Angiotensin Converting Enzyme inhibitor (ACE-i) or Angiotensin Receptor Blocker (ARB) should be the first line antihypertensive of choice among diabetics. Meta-analysis of 10 randomized controlled studies, including landmark studies such as the UKPDS and ADVANCE studies (n= 21,871 participants) found that treatment with ACE-i/ARBs in hypertensive patients with type 2 diabetes resulted in a reduction of 17% in cardiovascular mortality (J. Cheng et al., 2014). ACE and ARB's have a renal protecting effect in diabetes when compared to other classes of antihypertensive medication, independent of the blood pressure changes (Carlos, Giuseppe, & Piero, 2005; Ganesh & Viswanathan, 2011).

People with diabetes have an increased risk of lipid abnormalities (Vijayaraghavan, 2010). Along with lifestyle modification, the American Diabetes Association has recommended the use of statins among diabetics above 40 years old regardless of any additional risk factors (American Diabetes Association, 2017a). A meta-analysis of 14 randomized trials of statin therapy (n=18686 diabetics, followed up over a period of 4.3 years) reported that the use of statin as a lipid lowering therapy among diabetics reduces the risk; of all-cause mortality by 9% per mmol/L of LDL reduction, vascular mortality by 13%, myocardial infarction by 22%, coronary vascularization by 25% and stroke by 21% (Kearney et al., 2008). Statins also have a role in renal function as it is able to reduce albuminuria and maintain the glomerular function rate (Geng, Ren, Song, Li, & Chen, 2014; Shen et al., 2016).

The use of aspirin, an anti-platelet as a secondary preventive measure for cardiovascular event is well established. However, the use of aspirin as primary prevention for cardiovascular disease has not been consistent, with findings differing between subpopulation (Antithrombotic Trialists Collaboration, 2009; Nicolucci, 2011; C. Zhang et al., 2010). As such, the American Diabetes Association has recommended the use of aspirin as primary prevention among diabetics aged ≥50 years old with at least one additional major risk factor (family history of premature atherosclerotic cardiovascular disease, hypertension, dyslipidemia, smoking, or albuminuria) and are not at increased risk of bleeding (American Diabetes Association, 2017a).

Data from the National Health and Nutrition Examination Survey (NHANES) of the United States have estimated that in between 2011 to 2012, the national prevalence of diabetes was at between 12% to 14% among adult Americans. The prevalence of diabetes was higher among ethnic minorities. The prevalence of diabetes among Blacks and

American Indians almost double that of Whites. The increase in prevalence of diabetes was also associated with higher prevalence of obesity (Menke, Casagrande, Geiss, & Cowie, 2015).

In the United States, data from the National Health and Nutrition Examination Survey (NHANES): 1999–2000, 2001–2002, and 2003–2004 showed a decline of mean HbA1c among those with diabetes from 7.82% in 1999–2000 to 7.47 and 7.18% in 2001–2002 and 2003–2004, respectively (Hoerger, Segel, Gregg, & Saaddine, 2008). Though there was an improvement in the HbA1c level, control has not been satisfactory. Data from the National Health and Nutrition Examination Survey (NHANES): 1988–1994, 1999–2004, and 2005–2012 showed that among those who took medications for diabetes, the prevalence of HbA1c <7.0% increased from 39.7% in 1988–1994 to 43.7% and 54.2% in 1999–2004 and 2005–2012 respectively (Selvin, Parrinello, Daya, & Bergenstal, 2016)

China, being the most populous developing country in the world has reported a similar increase in the prevalence of diabetes. From a national prevalence of about 0.67% in 1980, the prevalence of diabetes has steadily increased to 2.3%, 5.5%, and 9.7% respectively in the year 1994, 2001 and 2008 (Zuo, Shi, & Hussain, 2014). In a national survey in China involving 98,658 diabetics, Y. Xu, Wang, He, and et al. (2013) reported that the prevalence of well controlled diabetes (HbA1c<7%) was 39.7%

To reduce diabetes associated complications, the American Diabetes Association has emphasized on the need of tight glycemic control and proper risk factor management (American Diabetes Association, 2017a). Similarly, the Ministry of Health, Malaysia has been developing Clinical Practice Guidelines to treat type 2 diabetes since 1992 with reference to landmark studies worldwide. Currently, the 5th Clinical Practice Guidelines on Management of Type 2 Diabetes Mellitus has been available since 2015. Updated guidelines are required to allow timely changes to recommendations for improving diabetes care and aligning clinical decision making according to prevailing evidence (S. P. Chan, 2015). To achieve glycemic control and risk reduction, the Malaysian Clinical Practice Guidelines (CPG) on Management of Type 2 Diabetes Mellitus has recommended (Ministry of Health Malaysia, 2015a):

1. The use of metformin as first line therapy if not contra-indicated
2. To use either ACE-I or ARB as first line antihypertensive if not contraindicated
3. To start statin therapy for all patients above 40 regardless of baseline LDL level

In the current guideline, the targets for control of type 2 diabetes is summarized below (Refer Table 2.1).

Table 2.1 : Clinical targets for type 2 diabetes control

Clinical targets	Levels
Diabetes control	
Fasting	4.4-7.0 mmol/L
Post-prandial	4.4-8.5 mmol/L
Hba1c	≤6.5%
Lipid control	
Triglyceride	≤1.7 mmol/L
HDL-Cholesterol	>1.0 mmol/L (male), >1.2 mmol/L (female)
LDL-Cholesterol	≤2.6 mmol/L
Blood pressure	≤135/75 mmHg
Body weight	If overweight or obese, aim for 5-10% weight loss in 6 months

In Malaysia, 56% of those with diabetes seek treatment in the government primary care health clinics, 24.6% in government hospital-based clinics while the rest in private facilities. The National Diabetes Registry (NDR), started in 2009 and went web based in 2011 supported the implementation of the annual “Diabetes Clinical Audit” amongst patients with type 2 diabetes attending the government health clinics facilities (S. P. Chan, 2015) .

Data from the National Diabetes Registry report (2009-2012, n= 653,326 people with type 2 diabetes) showed that for the year 2009, 2010, 2011 and 2012, the percentage of patients achieving clinical target (HbA1c<6.5%) was 19.4%, 24.8%, 22.6% and 23.8% respectively. For the year 2012: only 40.9% achieved the recommended blood pressure target; 28.5% achieved recommended cholesterol level; 60.8% achieved recommended TG level; 65.7% achieved recommended HDL level; 35.7% achieved recommended LDL level, and 16.6% had normal BMI. For the year 2012, the use of metformin was 82.5%, ACE-i 49%, ARB 4.2% and statins 62.3% (Ministry of Health Malaysia, 2013).

In Malaysia, DiabCare-Asia has been conducting periodical studies to assess the status of diabetes care and prevalence of diabetic complications in government hospitals. DiabCare-Asia, a multi-national project initiated in 1997, is dedicated to the improvement of health care and finding new strategic approaches in the management of diabetes.

In 1998, DiabCare-Asia reported that among 1037 Malaysian diabetics nationwide attending public hospitals, only 14% achieved good glycaemic control (HbA1c<6.5%) (Chuang, Tsai, Huang, & Tai, 2002; Mafauzy, 2006).

In 2003, another DiabCare-Asia study involving 1099 randomly selected Malaysian with diabetes from 19 public hospitals found that 32.6% of the patients had HbA1C level of <6.5%. Although there was an improvement in the diabetes control among those attending public hospitals, the level of control was still inadequate (Mafauzy, 2006).

Data from subsequent DiabCare studies in 2008 and 2013 showed that the percentage of patients achieving glycaemic target (HbA1c<6.5%) was 11.8% and 12.2% respectively; achieving blood pressure control (BP<130/80 mmHg) was 40.7% and 32% respectively; achieving good total cholesterol (≤5.2mmol/L) was 75% for both years, achieving target triglyceride level (<2.2 mmol/L) was 79% and 79.8% respectively and achieving target LDL level (<2.6mmol/L) was 55.1% and 57.4% respectively.

Other studies in Malaysia reported similar non-satisfactory findings regarding glycaemic control. A nationwide study involving 70899 Malaysian diabetics found that only 18% attained a HbA1c value of <6.5% (Mastura I, 2011). Similarly, in another study, Nur Sufiza Ahmad, Islahudin, and Paraidathathu (2014) reported that among 557 diabetics recruited from 7 primary health clinics from the district of Hulu Langat in Selangor, Malaysia, only 23% had HbA1c levels of <6.5%.

Mahmood, Daud, and Ismail (2016) reported that among 706 Malaysian with type 2 diabetes, 31.7% did not achieve the target blood pressure while a staggering 58% did not achieve recommended lipid targets. Among 540 diabetics recruited from 6 primary care clinics around Kuala Lumpur, Ai Theng Cheong, Tong, Sazlina, Azah, and Salmiah (2015) reported that the prevalence of good blood pressure control was 24.3%. Patient demographics such as being female, being in the younger age group and belonging to the Malay ethnicity were associated with poorer lipid control (B. H. Chew et al., 2012) while poor blood pressure control was associated with being female, being older and having lower levels of education (Abougalambou & Abougalambou, 2013).

Demographic factors such as age, sex, education level, and ethnicity has been implicated in influencing diabetes control among Malaysians. B. Ahmad, Khalid, Zaini, Hussain, and Quek (2011) reported that the Chinese had the best glycaemic control compared to the Malays and Indians. Furthermore, among the Indians, lower level of education may have worsened the diabetes control. Similarly, A. T. Cheong et al. (2013) reported that diabetes control was best among the Chinese as opposed to the Indians and

Malays. A. T. Cheong et al. (2013) also reported that those with longer duration of diabetes had higher odds of poor glycaemic control.

2.3 Diabetes self-care

Diabetes mellitus is a chronic disease requiring lifelong medical treatment and lifestyle changes. The main treatment goal in diabetes is to avoid or delay complications associated with diabetes (Ayele et al., 2012). For those experiencing complications of diabetes or having other comorbidities, diabetes management will be more challenging.

The management of diabetes is largely dependent on the individual. Diabetics may only spend about 5 minutes per visit to discuss about their self-care issues with their doctors, but may need an average of 58 minutes per day to carry out diabetes self-care activities (Kruse et al., 2013; Safford, Russell, Suh, Roman, & Pogach, 2005). With more focus on complication prevention, adherence to diabetes self-care can be a daunting task.

The demands of living with diabetes can be taxing. Not every diabetic have the chance of receiving good support from healthcare providers such as in the DCCT program or the UKPDS program. Furthermore, it is very difficult to perfectly manage factors affecting blood glucose levels or other risk factors. Despite all the hard work one puts in, there is no guarantee that the desired HbA1c levels can be achieved (Rubin, 2001). As most of the diabetes care is managed by the patient, the need for appropriate "diabetes self-care" is vital.

"Self-care" has been defined by WHO in 1983 as "Activities individuals, families and communities undertake with the intention of enhancing health, preventing disease, limiting illness, and restoring health. These activities are derived from knowledge and skills from the pool of both professional and lay experience. They are undertaken by lay people on their own behalf, either separately or in participative collaboration with professionals" (World Health Organization, 1984).

The definition of self-care has undergone a few changes and updates. In the recently updated 2013 version, WHO has defined self-care as "The ability of individuals, families, and communities to promote health, prevent disease, and maintain health and to cope with illness and disability with or without the support of a health-care provider (David Webber & Stephen, 2013).

Diabetes self-care activities are behaviors undertaken by people with or at risk of diabetes in order to successfully manage the disease on their own (Srinath, Basavegowda, & Tharuni, 2016). The American Association of Diabetes Educators (AADE), a multidisciplinary professional association dedicated to providing diabetes educators with the tools, training, and support necessary to help patients change their behavior and accomplish their diabetes self-management goals have defined "Diabetes Self Care" as consisting of at least 7 activities – which are healthy eating, being active, taking medication, glucose monitoring, problem solving, healthy coping and reducing risks (American Association of Diabetes Educators, 2009).

Among these management strategies, dietary intake, medication use, physical activity and self-monitoring of blood glucose (SMBG) are the four main cornerstones of overall diabetes management (Zhou et al., 2013).

2.4 Diabetes self-care activities

2.4.1 Physical Activity

Physical activity is any bodily movement produced by the contraction of skeletal muscle that requires energy expenditure in excess of resting energy expenditure. Exercise is a structured, and repetitive bodily movement performed to improve or maintain one or more components of physical fitness (Colberg, 2017).

Physical activity increases the uptake of glucose by the muscle tissue, thus leading to a transfer of glucose from the blood into the muscle and lowering of the blood glucose level (Richter & Hargreaves, 2013). The uptake of glucose by the muscle occurs during exercise and remains well post exercise. The duration, type, and intensity of an exercise will influence the blood glucose level. Aerobic exercise performed for a week can improve whole-body insulin sensitivity in individuals with type 2 diabetes (Colberg et al., 2010).

Many studies have shown that physical activity benefits diabetic patients. Apart from improving glycemic control, epidemiological studies have shown that regular exercise can reduce the incident of diabetes. The Iowa Women's Health Study which followed up approximately 34,000 women aged between 55 to 69 years old, with no prior history of diabetes, for 12 years, found that those who were categorized as being moderately or vigorously active had a lower incidence of diabetes, being almost 50% lesser chance of developing diabetes across all ages (Folsom, Kushi, & Hong, 2000). In the United States, the Nurses Health Study involving around 70,000 diabetes free nurses aged between 40 – 65 years old, which were followed up for 8 years, reported that the incidence of diabetes reduces across the gradient of amount of physical activity performed, where being more active is associated with lower incidence of diabetes (Hu et al., 1999).

Physical activity improves glucose control. In a meta-analysis of 20 trials (n=866), S. Qiu et al. (2014) reported that diabetics enrolled in a structured walking program were able to reduce the HbA1c level by 0.58% when compared to control group. In a multicenter study involving 18,028 adults with diabetes from Germany and Austria, Bohn et al. (2015) reported that physical activity was inversely associated with HbA1c level, BMI, lipid levels, blood pressure and the development of retinopathy and micro-albuminuria.

In 2010, WHO has estimated that 23% of adults above 18 years were physically inactive (World Health Organization, 2017). In a pooled analysis of 76 studies comprising almost 300,000 individuals using the International Physical Activity Questionnaire to assess physical inactivity, Dumith, Hallal, Reis, and Kohl (2011) reported that physical inactivity was highest among high income countries and among females. Worldwide, physical inactivity is responsible for an estimated 7% of new diabetes cases (I. M. Lee et al., 2012).

In the United States, data from 2007 Behavioral Risk Factor Surveillance Survey (n=18,370 diabetics, age>65 years) showed that only 25% of the diabetics achieved physical activity as recommended by the American Diabetes Association (G. Zhao, Ford, Li, & Balluz, 2011). Data from the U.S. National Health and Retirement Study (n=1811 diabetics, age >50 years) showed that only 43% was physically active, with those having complications being less likely to meet physical activity guidelines compared to those complications (Janevic, McLaughlin, & Connell, 2013).

In Malaysia, the National Health and Morbidity Survey 2015 data, estimated that 66.5% (14.0 million) of adults 16 years and above are physically active (Institute for Public Health, 2015). In a cross sectional study involving 132 Malaysians with diabetes, (Nor Shazwani et al., 2010) reported that 67% were physically active (moderate and high). Another cross sectional study involving 104 Malaysians with diabetes found that only 10.6% exercised daily (Firouzi, Barakatun-Nisak, & Azmi, 2015).

Factors inhibiting adequate physical activity self-care includes having negative attitude towards exercise such as perceived difficulty in performing exercise, feeling of tiredness, poor planning of time, physical discomfort and being distracted by other nonproductive things such as watching the television (A.M. Egan et al., 2013; Thomas, Alder, & Leese, 2004). Compared to non-depressed diabetics, those with depression perform lesser exercise. On the other hand, good social support and high levels of self-efficacy are predictors of performing exercise (Didarloo et al., 2011; Miller & DiMatteo, 2013).

Studies in India have highlighted that there was a difference in exercise practice between males and females. This is due to the gender social role and local culture and tradition which favours males and children. Females with diabetes will forgo self-care practices such as exercise as it does not benefit the family and seems selfish to do so. For them, family needs and priorities are more important than their health. This is made worse by the salient nature of diabetes (Raithatha, Shankar, & Dinesh, 2014; Sachdeva et al., 2015).

In the United States, ethnic minorities with diabetes performed lesser exercise. Compared to the Whites, ethnic minorities usually have lesser education and poor paying jobs. Worsened by the neighbourhood they live in in which lacks amenity for exercise or safe public spaces, ethnic minorities, especially females have higher rates of obesity (Dutton, Johnson, Whitehead, Bodenlos, & Brantley, 2005; Robbins, Vaccarino, Zhang, & Kasl, 2000; Sundquist, Winkleby, & Pudaric, 2001).

Apart from sociodemographic factors, the lack of knowledge regarding diabetes hinders self-care activities. Brazeau, Rabasa-Lhoret, Strychar, and Mircescu (2008) reported that diabetics who had poor knowledge on how to manage hypoglycaemia avoided exercise. This problem stemmed from the lack of understanding of how medications work, and the poor problem solving skills regarding strategies to prevent or manage hypoglycaemia. Though poor knowledge is associated with poor exercise practices, good knowledge may not necessarily translate into good practice. This may be due reasons such as daily living demands or over reliance on pharmacotherapy (Awotidebe, Adedoyin, Afolabi, & Opiyo, 2016)

Evidence regarding the prevalence of physical activity must be interpreted with care as varying criteria were used across studies. Studies measuring physical activities using self-reported questionnaires and objective measurement (e.g., actigraph accelerometer) have shown that physical activity may be overestimated in self-reported measures (Hagstromer, Ainsworth, Oja, & Sjostrom, 2010). To influence glycemic control, the type, frequency, duration, and intensity of physical activity is essential (van Dijk & van Loon, 2015).

2.4.2 Dietary intake

Healthy dietary intake is an important aspect of diabetes treatment. Individuals with diabetes must strive to keep carbohydrate portions controlled, especially focusing on food with low glycemic index. At the same time, they must balance their diet by consuming adequate protein, fat, and micronutrients while maintaining a caloric intake that doesn't exceed expenditure for the purpose of weight management (American Diabetes Association, 2008). Adherence to a proper diet will help maintain good glycemic control, and individuals with poor adherence are normally associated with poorer HbA1c values (Davison et al., 2014).

Diet plays an important role in both the development of diabetes and the glycemic control among diabetics. In the Health Professionals Follow-up Study conducted in the United States which followed up around 40,000 adults without diabetes for 12 years, it was observed that those who regularly consumed a prudent diet had a lower incidence of diabetes as compared to those who consumed more western diet. Even after controlling for other factors such as physical activities, smoking, alcohol intake, family history or hypertension, the results were similar. Individuals consuming western diet are more at risk of diabetes if they were obese and not physically active (van Dam, Rimm, Willett, Stampfer, & Hu, 2002).

In Hawaii, Erber et al. (2010) followed up a cohort of over 70,000 diabetes free individuals and found that after 14 years, food high in meat and fat was associated with 1.4 times the risk of developing diabetes while food high in vegetables and fruits was associated with 0.86 times the risk of developing diabetes. A meta-analysis of 48 studies reported that unhealthy diet such as processed meat, refined grains, high-fat dairy, eggs, and fried products increased the risk of developing diabetes by over 40% (Jannasch, Kroger, & Schulze, 2017).

Among diabetics, diet-based interventions have been a method to achieve better glycemic control. In a meta-analysis of 20 randomized trials of at least 6 months duration (n=3460), Ajala et al. (2013) reported that low-carbohydrate, low glycemic index, Mediterranean diet , and high-protein diets all led reduction in HbA1c by 0.12%, 0.145%, 0.47% and 0.28% respectively.

Dietary self-care is one of the components of self-care that has been regarded as the most difficult to perform. Despite receiving dietary education from their healthcare providers, many diabetics were unable to follow the dietary recommendations. In a study involving 717 type 2 veteran diabetics, Nelson, Reiber, and Boyko (2002) reported although about 97% of the patients received dietary advice and recommendations, over 42% of the patients ate high fat diet, with only 52% of the patients reported readiness to change their habit.

The prevalence of good dietary practice among diabetics has been reported to be poor in many studies. In a cross sectional study involving 385 Nepalese with diabetes, 87.5% were reported to be non-adherent to dietary practice (Parajuli, Saleh, Thapa, & Ali, 2014). In Bangladesh, among 374 type 2 diabetic, (Mumu, Saleh, Ara, Afnan, & Ali, 2014) reported that the prevalence of non-adherence to dietary practice was 88%.

In Malaysia, the trend of food intake has changed over the past few decades, consistent with the change from an agriculture based economy to an industry based economy. Between the 1960's and 2000's, Malaysians have been obtaining fewer calories from complex carbohydrates but more from meat, fish and other sea food, as well as animal by-products such as eggs, milk, and cream. Total availability of calories (per capita per day) increased from 2,447 in 1967 to 2,923 in 2007, indicating an increase of 19.5% over the 40-year period (G. L. Khor, 2012). BMI has been recognized as an important means of objectively assessing the degree of nutritional or other socio-economic deprivation in a population (Lim, 2014).

Data on the amount of calorie intake among Malaysians are limited. However, using BMI as a proxy, previous national surveys have shown that the prevalence of overweight and obesity was 20.7% and 5.8% respectively in 1996 and has increased to 33.6% and

19.5% respectively in 2008. This increasing trend in overweight and obesity shows a positive balance trend in calorie intake (Ismail et al., 2002; Mohamud et al., 2011).

Concerning dietary self-care practices among Malaysian diabetics, S. L. Tan, Juliana, and Sakinah (2011) reported that among 61 diabetics recruited from a dietetic clinic of a university hospital, the prevalence of good dietary self-care practice was only 16.4%. Similarly, Ming Yeong Tan and Judy Magarey (2008) reported that among 126 Malaysian diabetics recruited from 4 private clinics, over 80% had poor dietary self-care.

Personal factors such as not being in the mood for diet or difficulty choosing the right type of food is associated with poor dietary practices (Worku, Mekonnen Abebe, & Wassie, 2015). Other factors which lead to poor dietary self-care includes depression which in some cases results in binge eating among diabetics (Pagoto et al., 2007). Being alone, worried and lack of proper coping skills results in poorer dietary self-care (Morse, Ciechanowski, Katon, & Hirsch, 2006).

Support is an important determinant of good dietary self-care. Individuals receiving good social support practiced better dietary self-care and had better glycemic control (Qi et al., 2015). In Uganda, a peer support program to improve diabetes care improved the dietary behavior of the participants, and this resulted in better glycemic control. Though the program lasted for 4 months only, the positive impact of dietary self-care and glycemic control was still evident even at 18 months (Baumann, Frederick, Betty, Jospehine, & Agatha, 2015). The odds of a female diabetic homemaker forgoing her dietary self-care increases if family members were not supportive of her healthy behavior, for example, if they are unwilling to share the same healthy food or if a different set of food must be prepared for the others. The task of preparing many different food may cause the diabetic female to skip preparing a proper healthy meal for herself (Miller & DiMatteo, 2013).

Diabetics with higher levels of self-efficacy perform better dietary self-care than those with lower self-efficacy. Higher self-efficacy enables one to overcome the barriers in managing diabetes. To improve the level of self-efficacy, education and reinforcement of proper care must be imparted to the patients (Bohanny et al., 2013; L. Cheng, Sit, Leung, & Li, 2016).

Those from the disadvantaged group especially the lower socioeconomic group have poorer dietary self-care. The inability to acquire adequate food or limited access to healthy food , but instead abundant of cheap high caloric food worsens dietary self-care (H. K. Seligman, Jacobs, Lopez, Tschann, & Fernandez, 2012).

Several researchers have reported older diabetics performed better dietary self-care compared to the younger age group (Bains & Egede, 2011; Y. Xu, Pan, & Liu, 2010). However, in their studies, other confounding factors which was associated with aging such as disease complications, changes in taste and diet pattern and frailty were not reported (Edfors & Westergren, 2012; Porter, 2007).

Poor dietary practices lead to poor glycemic control. Though many factors have been identified to influence dietary practices, there is limited information regarding people with diabetes in Malaysia.

2.4.3 Medication Adherence

The World Health Organization (WHO) has defined adherence as “the extent to which a person’s behavior – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider" (Chakrabarti, 2014)

Often, the terms adherence and compliance are used interchangeably. However, their connotations are somewhat different: adherence presumes the patient's agreement with the recommendations, whereas compliance implies patient passivity (M. T. Brown & Bussell, 2011). The term compliance has come into disfavor because it suggests that a person is passively following a doctor's orders, rather than actively collaborating in the treatment process. Adherence, on the other hand, requires the person's agreement to the recommendations for therapy. The term medication adherence and medication compliance have been used interchangeably in many publications (Cramer et al., 2008).

Type 2 diabetes mellitus is a chronic condition, and almost universally pharmacotherapy will be needed to reduce the blood glucose level. Medication-taking behavior is extremely complex and varies between individual, requiring numerous multifactorial strategies to improve adherence. Depending on the type of medication prescribed, different medication will have it's respective mode of action and the response to it may vary between individuals (M. T. Brown & Bussell, 2011). Poor adherence to medication has resulted in an estimated 5-8% of hospital admissions in the UK. It has been estimated that £100 million per annum is wasted on unused prescription medicines in primary and community care in the UK (Kenning, Protheroe, Gray, Ashcroft, & Bower, 2015).

Depending on the class of hypoglycemic medication, the HbA1c level can be reduced between 0.5% to 2% (Bailey & Kodack, 2011). Medication adherence is very important to keep the HbA1c level under control. For every 10% increase in adherence to medication, a 0.1% reduction in HbA1c has been reported (García-Pérez, Álvarez, Dilla, Gil-Guillén, & Orozco-Beltrán, 2013).

Many studies have emphasized on medication adherence to improve glycemic control. In Belgium, a national level randomized controlled trial involving almost 300 diabetic patients who were assigned to receive usual pharmacist care or a pre-defined pharmacist care (focusing on correct medication use and adherence) which were then followed up for 6 months found that those in the intervention group had improved HbA1c level. The result of this finding was sustainable 18 months after ending the program (Mehuys et al., 2011). In a review of 18 intervention studies to increase medication adherence and improve glycemic control, 12 studies reported a reduction in HbA1c from between 0.15 %to 1.57%. There was no increase in HbA1c in the intervention group of the remaining studies (J. L. S. Williams, Walker, Smalls, Campbell, & Egede, 2014).

Studies have shown that there is a consistent decrease in medication adherence with the complexity of medication treatment and drug related adverse effect (Joyce A. Cramer, 2004; Gellad, Grenard, & Marcum, 2011). Diabetics especially the elderly have difficulty coordinating multiple prescriptions, and poor pharmacy service quality adds to the barrier for good medication adherence (Hsu et al., 2014). In centres with an adequate number of pharmacists and a proper pharmaceutical care program, the outcome for medication adherence and subsequently glycemic control was better (Al Mazroui et al., 2009; Kocarnik et al., 2012).

Healthcare cost is an important issue associated with medication adherence. Diabetics acquiring treatment via out of own pocket have a lower rate of medication adherence. This is worse among those with poorer financial state (Park et al., 2010). However, financial constraint alone does not explain the poor medication adherence among those covered by a healthcare plan (Tiv et al., 2012).

Depression is a risk factor for poor medication adherence among diabetics (Jeffrey S. Gonzalez et al., 2008). Depressed people are almost twice more likely to be non-adherent to medication (Grenard et al., 2011). Family and social support are important to increase adherence to medication therapy (Miller & DiMatteo, 2013). Those with poor family support were almost 2 times more likely to be non-adherent to medication therapy (Danielle, Niteesh, Kellie, Olga, & Will, 2012).

The association between demographics and medication adherence has not been consistent. While Kocurek (2009) reported that older diabetics had better medication adherence, (Ho et al., 2006) reported otherwise. In the younger age group, the demands of work cause them to forget more often about taking their medication. Similarly, education level has not shown a consistent association with medication adherence. While studies by Burge et al. (2005) and Taşkaya and Şahin (2015) have associated higher education with better medication adherence, others have found no association between education level with medication adherence (Bagonza, Rutebemberwa, & Bazeyo, 2015; Wai et al., 2005).

According to a report in 2003 published by the World Health Organization (WHO), adherence rates to medication in developed countries averaged at only about 50% (World Health Organization 2003). It is estimated that patients with chronic conditions adhere only to 50-60% of medications as prescribed despite evidence that medical therapy prevents death and improves quality of life (Bosworth et al., 2011). In a review of 27 studies, the prevalence of good medication adherence among diabetics has been reported to range from 38.5% to 93.1% (Krass, Schieback, & Dhippayom, 2015).

In Malaysia, medication adherence among people with diabetes is poor. Ming Yeong Tan and Judy Magarey (2008) reported that among 126 Malaysian type 2 diabetics with poor glycemic control attending general and district hospitals, 46% of them were not adherent to their medications. N. S. Ahmad, Ramli, Islahudin, and Paraidathathu (2013) reported similar finding involving 557 Malaysian type 2 diabetics from primary care clinics and with a prevalence of non-adherence at 53%. Another Malaysian study involving 752 people with diabetes recruited from 3 primary health clinic reported only 27% had good medication adherence (B.-H. Chew, Hassan, & Sherina, 2015).

Medication adherence is essential in diabetes care to achieve optimal glucose level. The non-consistent association between adherence and HbA1c values may have been due to the method adherence was measured (Doggrell & Warot, 2014). Interventional studies to improve medication adherence and subsequently glycemic control had varying methods, follow-up duration, and a heterogeneous study population which may have influenced the outcome (Sapkota, Brien, Greenfield, & Aslani, 2015).

2.4.4 Self-monitoring of blood glucose (SMBG)

Self-monitoring of blood glucose (SMBG) is an integral part of overall diabetes management and as it provides real time and reliable blood glucose level. Self-monitoring of blood glucose (SMBG) enables a patient to assess for hyper or hypoglycemia and to make the necessary therapeutic adjustment (Czupryniak et al., 2014). The technology to perform self-monitoring of blood glucose (SMBG) was discovered in the 1970’s. This has enabled diabetics to participate actively in their own care and improve how they controlled their own health. (Clarke & Foster, 2012).

Recent evidence have supported the use of SMBG to improve glycemic control. In a meta-analysis of 7 trials, Hou, Li, Qiu, and Wang (2014) reported that the implementation of diabetes management based on the SMBG findings effectively reduced the HbA1c level by 0.42%. In a meta-analysis of 15 controlled trials (n=3383 people with type 2 diabetes), Zhu, Zhu, and Leung (2016b) reported that SMBG was associated with a reduction in mean HbA1c by 0.33%, mean BMI by 0.65 kg/m^2, and mean total cholesterol by 0.12 mmol/L.

Personal factor such as attitude plays an important role in determining the practice of self-monitoring of blood glucose (SMBG). Individuals regarding SMBG as burdensome, as of no benefit or giving excuses such as keep forgetting to perform SMBG have lower rates of SMBG practice (Tenderich, 2013). Individuals who see that SMBG is beneficial, who finds SMBG makes them feel in control of their diabetes and those who know how to respond accordingly to the results of SMBG perform more SMBG (Barnard & Loveman, 2008).

Diabetics with high levels of self-efficacy perform better SMBG than those with poor self-efficacy. Those with high levels of self-efficacy sees the responsibility of performing SMBG as their own instead of that of their caregiver (Rose, Harris, Ho, & Jayasinghe, 2009). Diabetes increases the risk of developing depression, especially among those with complications (Andreoulakis, Hyphantis, Kandylis, & Iacovides, 2012). Depression has been associated with the poor practice of SMBG (Mirela, Cristian, Andrada, & Cristian, 2013). Having to finance the cost of glucose test strips personally is associated with poorer SMBG practice (Negrato & Zajdenverg, 2012). This is more pronounced among those with poor income (Wambui Charity et al., 2016). Another important factor determining the adherence to SMBG is social support. Costa, Pereira, and Pedras (2012) reported that diabetics perceiving positive support from their partners had better intention, action, coping plan and adherence to SMBG. Previous studies have reported that ethnicity may influence SMBG practice, especially among ethnic minorities due to the cultural background (P. J. Johnson, N. Ghildayal, T. Rockwood, & S. A. Everson-Rose, 2014). However, this may have been due to the poorer socioeconomic status among the minority. Courtney A. Rees, Andrew J. Karter, and Bessie A. Young (2010) reported that when emotional, financial and network support were equal between ethnicities, SMBG practices was similar between ethnicities.

Patients receiving intensive insulin regimes may require between 6 to 10 SMBG per day, while those on less intensive insulin or oral hypoglycemic agents alone may benefit from fasting or before/after meal SMBG (American Diabetes Association, 2017a). The DAWN study, an international study involving 5104 type 1 and 2 people with diabetes from 13 countries reported SMBG adherence to be as low as 44% for adults with type 1 diabetes and 24% for adults with type 2 diabetes (M. Peyrot et al., 2005).

In Malaysia, the situation is not much different. M. Y. Tan and J. Magarey (2008) reported that out of 126 diabetic patients recruited from hospital and rural health care centers, only 15% of the patients performed self-monitoring of blood glucose. Mastura, Mimi, Piterman, Teng, and Wijesinha (2007) reported similar finding in their study which involved 556 diabetic patients recruited from 2 government health clinics and found that only 16.5% of patients monitored their blood glucose daily. The DiabCare, a multicenter study involving 1549 type 2 diabetics from all over Malaysia reported the prevalence of regular SMBG to be at 58.7% (Mafauzy, Hussein, & Chan, 2011).

Studies reporting the prevalence SMBG have to be interpreted with caution, as there are no well-defined standards for SMBG especially among those with type 2 diabetes. In summary, the practice of SMBG is suboptimal. The studies regarding the prevalence of SMBG and it’s associated factors in Malaysia were very limited.

2.5 Knowledge with diabetes self-care and control

Diabetes knowledge is defined as "Knowledge possessed by diabetics regarding their comprehension of the disease, its progression, and self-care practice necessary for keeping diabetes under control" (Thomas T. H. Wan, Rav-Marathe, & Marathe, 2016). Self-care concepts that can benefit patients from possessing diabetes knowledge include adherence to diet, physical activity, blood glucose monitoring and medication adherence (Saleh, Mumu, Ara, Begum, & Ali, 2012).

Various sources for diabetes knowledge includes receiving health information from health care providers, family and friends, newspapers and magazines, and the internet (X. Zhao, 2014). Despite the various available sources for information, several studies have reported that knowledge about diabetes is generally poor among patients with diabetes (Al-Maskari et al., 2013; Deepa et al., 2014; Saleh et al., 2012). In a study involving 515 Bangladeshi's with diabetes, Islam et al. (2015) reported that only 45.6% had good basic diabetes knowledge. Higher education level was reported to be associated with better knowledge. Another study involving 184 Nigerians with diabetes reported that only 56.5% had good diabetes knowledge. Better knowledge was associated with having higher education level, attending more health seminar, being employed and being wealthy (Unyime Sunday Jasper et al., 2014). In India, Solanki, Sheth, Shah, and Mehta (2017) reported that among 200 diabetics, only 33% knew that insulin deficiency was the cause of diabetes while 67% had the misconception that diabetes could be cured by consuming bitter food. In another study in India involving 366 diabetics, Shriraam et al. (2015) reported that only 68% knew that missing meals was one of the precipitating factors for hypoglycemia while around one third knew the complications of hypoglycaemia.

Lack of information and knowledge about diabetes care has been regarded as a drawback in diabetes self-care (Onwudiwe et al., 2011). Many studies have incorporated knowledge as an intervention to improve self-care and diabetes control. Generally, tailored interventions incorporating knowledge improves diabetes self-care and diabetes control (Glazier, Bajcar, Kennie, & Willson, 2006; Thomas T. H. Wan, Terry, McKee, & Kattan, 2017). However, observational studies have not shown consistent findings between knowledge with diabetes self-care and diabetes control (Karen, Thomas, & Marathe, 2016)

In a cross sectional study in Saudi Arabia involving 570 individuals with type 2 diabetes, Saadia, Rushdi, Alsheha, Saeed, and Rajab (2010) reported that despite having a good level of knowledge about diabetes, the diabetes self-care practices were non satisfactory. In a nationwide survey in China involving 5961 type 2 diabetics with the aim of characterizing the impact of diabetes education on glycemic control and to assess the attitude, knowledge and self-care behavior in patients with type 2, X. H. Guo et al. (2012) found that the glycemic control was poorer among those with lesser diabetes knowledge. In another cross sectional study in China involving 365 type 2 diabetics with the aim to investigate the prevalence and associated factors of diabetes knowledge and diabetes self-care practices, X. Zhong, Tanasugarn, Fisher, Krudsood, and Nityasuddhi (2011) reported that diabetes knowledge was closely associated with education level and better diabetes knowledge was associated with better diabetes self-care practices. In Turkey, among 164 type 2 diabetics, Ozcelik et al. (2010) reported that diabetics with lesser knowledge had higher levels of fasting blood sugar and overall poorer glycemic control.

In a cross sectional study aimed at assessing the association between knowledge, attitude and practices with glycemic control among 75 Malaysians with type 2, Shu et al.

(2012) reported a high score in diabetes knowledge was not associated with better glycemic control. In Malaysia, Muhammad-Lutfi, Zaraihah, and Anuar-Ramdhan (2014) reported that among 157 diabetics hospitalized for foot infection, 58% had poor foot care knowledge with over 60% practicing poor foot care. The foot care knowledge was not associated with education level but may have been due to the lack of diabetes awareness and inadequate information regarding diabetic foot care.

In a randomized interventional study involving 256 American Mexican type 2 diabetics utilizing education as the intervention with a follow-up period of 12 months, S. A. Brown, Garcia, Kouzekanani, and Hanis (2002) reported that in the intervention group, improvement in diabetes knowledge scores was associated with better glycemic control. Another randomized interventional study involving 430 Arabs with type 2 diabetes utilizing education based on the health belief model as intervention reported that after 12 months, the improvement in knowledge level among the individuals in the intervention group was associated with better diabetes self-care practices, better glycemic control and improvements in other bio-clinical markers such as weight, body mass index, lipid profile and renal function (Mohamed, Al-Lenjawi, Amuna, Zotor, & Elmahdi, 2013). These interventional studies were tailored according to the local setting, thus may have led to its success. When tailoring diabetes intervention to suit the local community, to ensure the success of future intervention programs, apart from increasing one's knowledge, factors such as language fluency, age of participants, education background and other socioeconomic factors such as being a minority group must be taken into consideration (Bruce, Davis, Cull, & Davis, 2003).

2.6 Systematic review of factors influencing diabetes self-care

Currently, limited information is available regarding diabetes self-care practices among Malaysian with type 2 diabetes. On the contrary, in other parts of the world, there are abundant studies regarding factors influencing diabetes self-care practices among type 2 diabetics. Thus, a review seemed appropriate to identify factors influencing diabetes self-care.

The aim of this review was to identify factors influencing diabetes self-care among type 2 diabetics and to use the information as a basis to create a model regarding factors influencing diabetes self-care among Malaysians with type 2 diabetes.

A search protocol was developed for systematic extraction of relevant articles. Figure 2-1 summarizes and illustrates the flow of the article selection. The MeSH database in Pubmed and the Emtree subject heading in Embase bibliographic databases were searched for relevant literature. The searched terms were "Diabetes Mellitus Type 2" OR "Non-Insulin Dependent Diabetes Mellitus" AND "self-care" OR "self-management" (Figure 2.1). The search was limited to articles in English. The search period was updated until 31st December 2017. Eligible studies were those meeting the following inclusion criteria:

1. Observational studies
2. Quantitative studies
3. Involving adults with diabetes mellitus type 2
4. Outcome measured was diabetes self-care practices which must involve at least 4 activities – physical activity, diet, medication adherence and self-monitoring of blood glucose.

5. Proper data analysis with correlation as the minimal statistical analysis. The highest order statistical analysis will be used as the final finding.
6. Validated tools/ questionnaires used
7. Full article must be available

The exclusion criteria were;

1. Pregnant patients
2. Studies focusing on pharmacotherapy
3. Studies focusing on psychiatric disorder, cognitive disabilities, physical disabilities, medical comorbidities or diabetics complications
4. Reviews or intervention studies

The search yielded 3,414 titles in Pubmed and 2,572 in Embase. After screening for repeated titles, there were 4689 titles. After the screening of the titles, 4050 titles were excluded while the abstracts of the remaining 639 titles were obtained and the process of screening continued. Out of the 639 abstracts, only 253 were relevant. The corresponding relevant full articles were retrieved. Finally, only 33 full articles were chosen for the review. Table 2-2 summarizes the main findings of the selected articles.

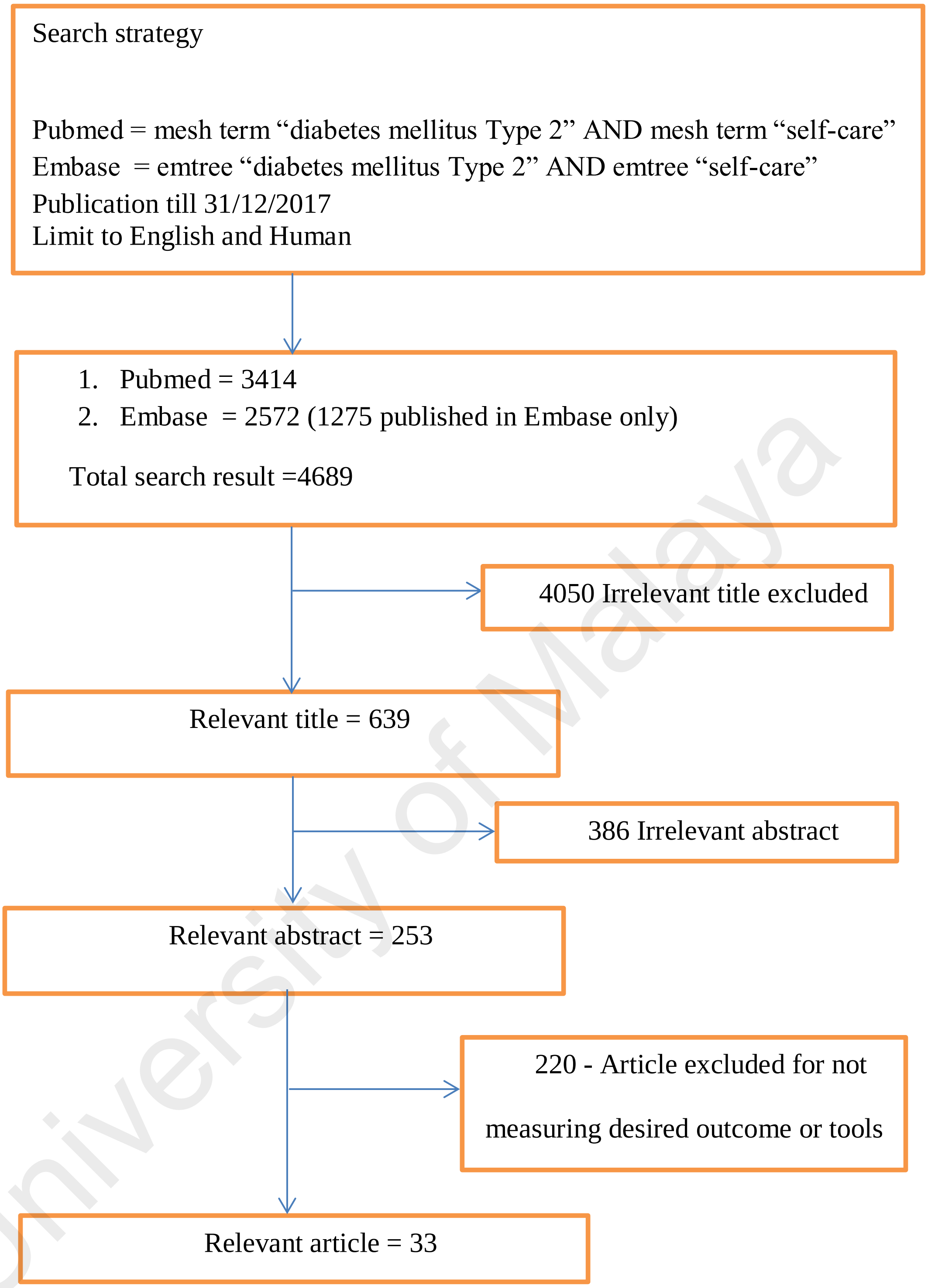


Figure 2.1 Flow chart of the literature search

Table 2.2 : Evidence table of selected articles.

First author, year, country	Objective	Sample	Measures/Tools	Results
Lee et al., 2016, Taiwan	To validate a hypothesized model exploring the influencing pathways of empowerment perceptions, health literacy, self-efficacy, and self-care behaviors to glycosylated hemoglobin (HbA1c) levels in patients with type 2 diabetes (T2DM).	N=295 Age =58.2±11.8 Sex Male= 57.3% Female=42.7% Education Elementary school=23.7% Junior school=13.6% Senior school=31.9% College=30.8% Duration of diabetes (years)=9.9±7.2 Estimated sample size – 197 Sampling method - convenience	1.Demographics 2.Diabetes empowerment – Chinese Diabetes Empowerment Scale 3.Diabetes health literacy – translated and validated (Japanese version) diabetes health literacy scale 4.Self-efficacy-validated 14-item Chinese self-efficacy scale 5.Self-care- validated tool	Self-efficacy had a significant positive association with self-care. Patient empowerment and health literacy were not associated with self-care.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Tregea et al., 2016, Australia	To examine the indirect role of diabetes-specific self-efficacy (DSE) and generalized self-efficacy (GSE) in mediating the cross-sectional relationship between self-reported QoC and diabetes self-management	N=944 Age = 58.9 ±8.65 yrs Sex Male = 49.7% Female=50.3% Diabetes duration =9.2±7.2 Estimated sample size – NA Sampling method – random	1.Demographic 2.Self-care- Diabetes Self-Care Inventory and SDSCA 3.Medication adherence- Medication Adherence Rating Scales (MARS) 4.Quality of care- 6 items (measures patient provider communication adapted from the 49-item Group Health Association of America Consumer Satisfaction Survey) 5.Diabetes self-efficacy--Diabetes Empowerment Scale Generalized self-efficacy- Generalized Self-Efficacy scale	Better perceived quality of care (communication) was associated with better diet practice, more exercise but poorer medication adherence.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
K.A. Al Johani et al., 2016 Saudi Arabia	To estimate the frequency of self-management activities among people who have type 2 diabetes in Saudi Arabia	N=210 Age 26-65 years=82% >65=18% Sex Male = 50% Female= 50% Education No formal education =33% Formal educated = 67% Diabetes duration <8 yrs=15% ≥8 yrs=85% Estimated sample size – NA Sampling method - convenience	1.Demographic 2.Self-care- Arab SDSCA	Female were significantly more likely than men to perform self-care activities. Age, income, education level, diabetes duration and glucose control was not associated with self-care practices.

‘Table 2.2, continued’

First author, year, country	Objective	Sample	Measures/Tools	Results
Rebekah et al., 2015, USA	To develop and test latent variables of the social determinants of health that influence diabetes self-care.	N=615 Age 18–34 years = 1.6% 35–44 years = 5.2% 45–64 years = 53.6% 65+ years = 39.6% Male = 61.6% Female = 38.4% Race Non-Hispanic black= 65.7% Non-Hispanic whites= 33.0% Hispanic/other = 1.3% Educational <HS= 13.0 HS= 28.2% College = 47.1% More than college =11.7% Diabetes duration -NA Estimated sample size – 600 Sampling method – NA Clinic setting	1.Demographics 2.Self-care-SDSCA 3. Serious psychological distress – Kessler Psychological Distress Scale (K6) questionnaire 4. Social support – Medical Outcomes Study (MOS) 5. Diabetes distress-DDS 6.Self-efficacy – Perceived Diabetes Self-Management Scale(PDSMS) 7.Perceived measure of social status - Subjective Social Status (SSS)	Social support and self-efficacy had a significantly positive association with self-care while psychological distress had a significantly negative association with self-care. Perceived social status was not associated with self-care.

‘Table 2.2, continued’

First author, year, country	Objective	Sample	Measures/Tools	Results
Brittany et al., 2015, USA	To determine whether neighbourhood factors have direct or indirect effects, via self-care behaviours on glycaemic control.	N=615 Age 18–34 years = 1.6% 35–44 years = 5.2% 45–64 = years 53.6% 65+ years = 39.6% Male = 61.6% Female = 38.4% Race Non-Hispanic black= 65.7% Non-Hispanic whites= 33.0% Hispanic/other = 1.3% Educational <HS= 13.0 HS= 28.2% College = 47.1% More than college =11.7% Estimated sample size – 600 Sampling method – NA Clinic setting	1. Demographics 2. Self-care-SDSCA 3. Social support – Medical Outcomes Study (MOS) 4. Neighbourhood characteristics-validated questionnaire	There was a significant positive association between self-care with access to healthy food and social support.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Ahmad Sharoni SK, 2015 Malaysia	The objective of this study was to examine the social support and self-care activities among the elderly patients with diabetes.	N=200 Age=67.9±5.7 yrs Sex Male = 119 Female=81 Diabetes duration =8.2.2±4.14 yrs Estimated sample size – NA Sampling method – convenience Education Illiterate=41.0% Primary school=46.5% Secondary school=12.5% Malay=92% Chinese=7% Indian=1%	1. Demographic 2. Self-care- SDSCA 3. social support-medical outcomes study (MOS) 4. Clinical data	More social support, higher HbA1c level, more comorbid and primary education only was associated with performing poorer self-care.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Heerman et al., 2015, USA	To examine the association between food insecurity, diabetes self-care, and glycaemic control.	N=401 Age(median)=52 (45,58) Male = 39% Female = 61% White = 57% Black = 17% Hispanic = 24% Others = 2% <HS = 37% HS = 36% College = 22% >College = 6% Duration of diabetes (median)=7(3,13) Estimated sample size =NA Sampling method - NA Clinic setting	1. Demographics 2. Food insecurity – U.S. Household Food Security Survey Module 3. Self-care –SDSCA, Personal Diabetes Questionnaire (PDQ) 4. Medication adherence- Adherence to Refills and Medications scale (ARMS)	Food insecurity was negatively associated with medication adherence, diet, and exercise. There was no significant association between food insecurity with glucose monitoring.

‘Table 2.2, continued’

First author, year, country	Objective	Sample	Measures/Tools	Results
Brittany et al 2014 USA	To investigate the independent effects of socioeconomic and psychological social determinants of health on diabetes knowledge, self-care, diabetes outcomes and quality of life.	N=615 Age 18–34 years = 1.6% 35–44 years = 5.2% 45–64 = years 53.6% 65+ years = 39.6% Male = 61.6% Female = 38.4% Race Non-Hispanic black= 65.7% Non-Hispanic whites= 33.0% Hispanic/other = 1.3% Educational <HS= 13.0 HS= 28.2% College = 47.1% More than college =11.7% Estimated sample size – 600 Sampling method – NA Clinic setting	1. Demographics 2. Self-care-SDSCA 3. Fatalism- Diabetes Fatalism Scale (DFS) 4. Depression- Patient Health Questionnaire (PHQ-9) 5. Diabetes distress- Diabetes Distress Scale (DDS) 6. Serious psychological distress – Kessler Psychological Distress Scale (K6) questionnaire 7. Social support – medical outcomes study (MOS) 8. Perceived stress- Perceived stress scale 9. Diabetes knowledge- Diabetes Knowledge Questionnaire (DKQ) 10. Medication adherence- Morisky Medication Adherence Scale (MMAS-8) 11. Quality of Life – 12-Item Short Form Survey (SF-12)	Those with higher education, more self-efficacy, less depressed and from lower income exercised more. Those with more self-efficacy and having lesser stress, lesser fatalism and lesser distress practiced better diet care. Those with more self-efficacy and having lesser stress, lesser fatalism and lesser distress practiced better medication adherence. Those with lesser stress practiced more SMBG than those with higher levels of stress.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Brittany et al 2014 USA	To identify latent variables for neighbourhood factors and diabetes self-care and examine the effect of neighbourhood factors on diabetes self-care in adults with type 2 diabetes.	N=615 Age 18–34 years = 1.6% 35–44 years = 5.2% 45–64 = years 53.6% 65+ years = 39.6% Male = 61.6% Female = 38.4% Race Non-Hispanic black= 65.7% Non-Hispanic whites= 33.0% Hispanic/other = 1.3% Educational <HS= 13.0 HS= 28.2% College = 47.1% More than college =11.7% Estimated sample size – 600 Sampling method – NA Clinic setting	1. Demographics 2 .Self-care-SDSCA 3. Social support – medical outcomes study (MOS) 8. Perceived stress characteristics-validated questionnaire	Better access to healthy food and good social support was associated with better self-care. Neighbourhood aesthetic and neighbourhood problems did not influence self-care.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Walker et al., 2014, USA	To examine the effect of self-efficacy on glycaemic control, self-care behaviours, and quality of life in low-income, minority adults with diabetes	N=376 Age (years) 18 – 49 = 24.0% 50 – 64 = 53.6% 65+ =22.4% Male = 30.9% Female=69.1% Race Non-Hispanic Black = 83.2% Non-Hispanic Whites = 16.8% Education <HS= 25.8% HS= 43.8% >HS= 30.3% Estimated sample size – NA Universal sampling Clinic setting	1. Demographics 2. Self-efficacy – Perceived Diabetes Self-Management Scale(PDSMS) 3. Diabetes knowledge- Diabetes Knowledge Questionnaire (DKQ) 4. Quality of Life – 12-Item Short Form Survey (SF-12) 5. Self-care- SDSCA 6. HbA1c	Higher self-efficacy was associated with better diet, exercise, medication adherence and SMBG practices.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Mayberry et al., 2014, USA	To assess the relationships between supportive and obstructive family behaviours and patients' diabetes self-care activities and HbA1C, and potential interaction effects and differences by demographic characteristics.	N=192 Age (mean)= 51.6 ± 10.9 Men = 57 (29.7%) Women = 135 (70.3%) Race White= 65 (33.9%) African American/Black= 107 (55.7%) Other race =20 (10.4%) Hispanic ethnicity= 19 (9.9%) Education (years) =12.0±3.0 Diabetes duration (years) = 7.7±7.2 Estimated sample size - NA Sampling method – NA Clinic setting	1. Demographics 2. Family support - Diabetes Family Behaviour Checklist-II (DFBC-II) 3. Self-care -SDSCA	Supportive family behaviour was associated with better diet, exercise, medication adherence and SMBG practices. Obstructive family behaviour was associated with poorer diet, exercise, and medication adherence.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Freitas et al., 2014, Brazil	To analyse the self-care of patients with DM-2 according to the Summary of Diabetes Self-Care Activities Questionnaire (SDSCA).	N= 96 Age (years) 40 – 49 = 3.1% 50 – 59 = 11.4% 60 – 69 = 34.4% 70 – 79 = 51.1% Race Brown = 41.6% Black = 27.1% White = 23.0% Yellow = 7.3% Education duration (years) Illiterate = 18.8% 1 – 5 = 50% 6 – 10 = 23.9% Over 10 = 7.3% Sample size - NA Sampling method - NA	1. Demographics 2. Self-care-SDSCA	Lower education was associated with better self-care. Age and family income was not associated with self-care.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Gao et al., 2013, China	To determine the predicted pathways linking self-efficacy, social support and PPC to diabetes self-care and glycemic control	N = 222 Age (group); <60 =48 (21.6%)%, 60-70 =119(53.6%), >70 = 55(24.8%) Male=85(38.3%) Female=137(61.7%) Diabetes duration <4yrs= 64(28.8%) 5-10yrs= 72(32.4%), 10-15yrs =30(13.5%), >15yrs = 30(13.5%) Education level Illiterate/Elementary -21(9.5%), Junior HS -85(38.3%) Senior HS-64(28.8%) College -52(23.45%) Race- Chinese (100%) Setting; clinic Sampling method –universal Estimated sample size - NA	1.Demography 2.Clinical data 3. Self-efficacy Diabetes Management Self-Efficacy Scale (C-DMSES) 4. self-care-(SDSCA) 5.Social support and Patient Provider Communication - The Health Education Impact Questionnaire Self-administered questionnaire	Higher self-efficacy, better social support, and better patient provider communication were associated with better self-care practices.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Sharoni et al., 2012, Malaysia	To examine the correlation between self-efficacy and self-care behaviour, to determine the degree of self-efficacy and to identify the association of self-efficacy and other health variable.	N = 388 Age group; NA Women -165 Men- 223 Race/ethnicity Malay = 182 Chinese = 70 Indian = 122 Others = 14 Education level None =8 Primary education =49 Secondary education =217 Tertiary education =114 Setting; hospital setting Sampling method – convenience Estimated sample size - NA Diabetes duration – <5 yrs.=112 6-10 yrs.=70 >10 yrs.=206	1.Demographics 2.Self-efficacy – Diabetes Management Self-Efficacy scale(DMSE) 3. Self-care behaviors-SDSCA Self-administered questionnaire	Higher level of self-efficacy was associated with better performance of diabetes self-care practices. .

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Smalls et al., 2012, USA	To evaluate the emotional approach to coping and its association with diabetes self-care, diabetes knowledge, and medication adherence.	N = 378 Age group; 18–49 yrs. (24%) 50-64 yrs. (53.6%) 65+yrs. (22.4%) Women -69.1% Men- 30.9% Race/ethnicity Non-Hispanic Black-83.2% Non-Hispanic White 16.8% Education level -Less than HS graduate (25.8%), HS graduate (43.8%), Greater than HS graduate (30.3%) Setting; 2 primary care clinic Sampling method – NA Estimated sample size - NA Diabetes duration – NA	1. Demographics 2. Coping measures-emotional expression (EE) and emotional processing (EP) 3. Diabetes knowledge- Diabetes Knowledge Questionnaire (DKQ) 3. Medication adherence- Morisky Medication Adherence Scale (MMAS-8) 4. self-care -SDSCA Questionnaire administration method not specified	Better coping measures were associated with better diabetes self-care practices

‘Table 2.2, continued’

First author, year, country	Objective	Sample	Measures/Tools	Results
Hernandez-Tejada et al. 2012, USA	To evaluate the effect of empowerment on medication adherence and self-care behaviors	N = 378 Age group; 18–49 yrs. (24%) 50-64 yrs. (53.6%) 65+yrs. (22.4%) Women -69.1% Men- 30.9% Race/ethnicity Non-Hispanic Black-83.2% Non-Hispanic White 16.8% Education level -Less than HS graduate (25.8%), HS graduate (43.8%), Greater than HS graduate (30.3%) Setting; 2 primary care clinic Sampling method – NA Estimated sample size - NA Diabetes duration – NA	1. Demographics 2. Diabetes empowerment-Diabetes Empowerment Scale (DES) 3. Diabetes knowledge- Diabetes Knowledge Questionnaire (DKQ) 3. Medication adherence- Morisky Medication Adherence Scale (MMAS-8) 4 Self-care -SDSCA Questionnaire administration method not specified	Higher level of diabetes empowerment was associated with increased medication adherence, better diet practices, more physical activities, more sugar testing, better foot care practices and increased knowledge.

'Table 2.2, continued'

First author, year, country	**Objective**	**Sample**	**Measures/Tools**	**Results**
Walker et al. 2012, USA	To examine the association between diabetes fatalism and medication adherence and self-care behaviors in adults with diabetes.	N = 378 Age group; 18–49 yrs. (24%) 50-64 yrs. (53.6%) 65+yrs. (22.4%) Women -69.1% Men- 30.9% Race/ethnicity Non-Hispanic Black-83.2% Non-Hispanic White 16.8% Education level -Less than HS graduate (25.8%), HS graduate (43.8%), Greater than HS graduate (30.3%) Setting; 2 primary care clinic Sampling method – NA Estimated sample size - NA Diabetes duration – NA	1. Demographics 2. Fatalism- Diabetes Fatalism Scale (DFS) 3. Diabetes knowledge- Diabetes Knowledge Questionnaire (DKQ) 3. Medication adherence- Morisky Medication Adherence Scale (MMAS-8) 4. Self-care -SDSCA 5. Depression -PHQ9 Face to face interview	Correlation Higher level of diabetes fatalism was associated with poorer medication adherence, diet, exercise, foot care, SMBG and diabetes knowledge.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Primožič et al. 2012, Slovenia	To identify independent association of particular cognitive functions with diabetes self-management.	N = 98 Age mean; 63.74 ± 9.87 Women - 50 (51.0%) Men- 48 (49%) Race/ethnicity – NA Education - Primary school 34 (34.7%), Secondary school 43 (43.9%), Higher education 21 (21.4%) Diabetes duration – 15.61±10.17 yrs. Setting; University clinic Sampling method – NA Estimated sample size - NA	1. Demography 2. Self-care behaviours-SDSCA 3.Neuropsychological examination (Cognitive, memory, executive functions) 4. Mood and distress (HDI and PAID) 5. Clinical data	Female, lower BMI, better executive function, and not being depressed are associated with better diet, exercise and foot care practices.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Feil et al. 2012, USA	To examine the relationship between cognitive impairment and diabetes self-care ability in a population based community sample of older Americans.	N = 1398 Age group = mean yrs (SD) Q1=71.8 (7.7), Q2= 71.3 (7.5), Q3= 70.2 (7.1), Q4= 68.7 (6.8) Male (%) Q1=53.9, Q2= 51.0, Q3= 46.5, Q4= 37.9 Education level Less than HS- Q1=24.9 %, Q2=29.4%, Q3=37.7 %, Q4=40.5% HS- Q1=52.6 %, Q2=51.8 %, Q3=47.4 %, Q4=47.0% More than HS- Q1=22.5 %, Q2=18.8 %, Q3=14.9 %, Q4=12.5% Diabetes duration (yrs.)- Q1=12.2 (12.6), Q2=11.7 (11.4), Q3=13.8 (13.6), Q4=14.2 (11.7) Setting; national level Estimated sample size – NA Sample size calculation - NA	1.Demographics 2.Coping measures-emotional expression (EE) and emotional processing (EP) 3. Diabetes knowledge- Diabetes Knowledge Questionnaire (DKQ) 3. Medication adherence- Morisky Medication Adherence Scale (MMAS-8) 4.Diabetes self-care behaviors- SDSCA Mail/telephone interview	Better cognition is associated with better diet and exercise practices. Lesser comorbid is associated with better diet, exercise, foot care and blood glucose monitoring. Higher education is associated with better diet and foot care practices. Males were more likely to exercise but perform poorer with regard s to diet and foot care.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Song et al. 2012, USA	To characterize the primary sources of social support and the extent of unmet needs for support and to examine the effect of unmet needs for support on the self-care activities in a sample of Korean Americans.	N =83 Age (mean); 56.5 ± 7.9 Men- 48 (57.8%) Diabetes duration – 8.8 ± 6.7 yrs. Education level – more than HS 41 (49.4%) Race/ethnicity Korean Americans Setting; community residing in the Baltimore-Washington Sampling method – NA Estimated sample size - NA	1. Demography 2. Clinical data 3. Self-care – SDSCA 4. Social support - subscale of Diabetes Care Profile) 5. Self-efficacy – Stanford Chronic Self Efficacy Scale Questionnaire administration method not specified	Females, higher education level, longer duration of diabetes and lesser unmet needs for social support were associated with better self-care activities.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Bains et al., 2011, USA	To assess the associations between health literacy, diabetes knowledge, self-care, and glycemic control in a low income, predominately minority population with type 2 diabetes	N = 125 Age group; <65 yrs. (50.7%), 65 above yrs. (49.3%) Women -72.5% Race/ethnicity Black-71.4% White 28.6% Education level HS or less – 68.2% HS -31.8% Setting; university clinic Sampling method – universal Estimated sample size - NA	1. Demography 2. Clinical data(HbA1c) 3. Self-care activities – SDSCA 4. Health literacy – (REALM-R) Revised Rapid Estimate of Adult Literacy in Medicine 5. Medication adherence – Morisky Medication Adherence Scale (MMAS-4) Face to face interview	Older patients performed better diet and foot care. Health literacy, race and income level had no effect on self-care.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Zhong et al., 2011, China	To determine the knowledge of diabetes, practices of self-management (SM), and potential factors influencing patient knowledge and practices of self-management among individuals with type 2 diabetes in urban Anhui Province, China.	N = 365 Age mean; 63 (9.4) yrs. Women -49.9% Men- 50.1% Race/ethnicity Chinese Duration of diabetes =6.81±6.0 yrs. Education level HS or less – 44.4% HS -30.1% Setting; community level Sampling method – stratified cluster Estimated sample size -349	1. Demography 2. health status 3. Knowledge of diabetes 4. Self-management 5. Self-efficacy 6. Attitude towards diabetes 7. Perception about social support All the tools were adapted from the Michigan Diabetes Research Training Center (MDRTC) Face to face interview	Higher income, better knowledge, and higher self-efficacy were associated with better overall diabetes self-care. More social support was associated with better SMBG. Positive attitude was associated with better medication adherence. Better knowledge, better self-efficacy, and better social support were associated with more exercise.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Fortmann et al., 2011, USA	To evaluate and explain how support resources influences HbA1c and if this relationship can be explained by indirect effects via self care and depression	N = 208 Age mean; 50.61(10.93) Women -147(70.7%) Race/ethnicity Latinos Diabetes duration -NA Education level Education ≤ 5 yrs. 56(26.9%), 6–8 yrs. 64(30.8%) 9–12 yrs. 53 (25.5%) ≥HS/diploma/GED 35 (16.8%) Setting; community level Sampling method – universal Estimated sample size - NA	1. Demography 2. Clinical data – HbA1c 3. Social-Environmental Support resources for Disease Management – (CIRS) 4. Self-care –(SDSCA) 5.Depression – Patient Health Questionnaire(PHQ-9) Questionnaire administration method not specified	Higher level of support resource was associated with better diabetes care. Depression was associated with poorer diabetes care.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Compean-Ortiz et al., 2010, Mexico	To determine the effect of memory-learning on self-care activities in adults with type 2 diabetes moderated by previous education/ understanding of diabetes and to explore the explicative capacity of age, gender, schooling, diabetes duration, and glycaemic control in memory-learning.	N = 105 Age group; 35-45 yrs. 32 (30.5%) 46-55 yrs. 73 (69.5%) Age mean 47.93±5.49 Women -71 Men- 34 Diabetes duration - 8.26±7.5 yrs. Education level Primary or less 51 (48.6%), Secondary 30 (28.6%), Preparatory 15 (14.3%), Professional 9 (8.6%). Race/ethnicity Mexican Setting; clinic level Sampling method – randomized Estimated sample size - NA	1.Demography 2.Self-care -(SDSCA) 3.Education – Diabetes Care Profile (DCP) 4.Cognition test(Wechler Memory scale) 5.Clinical data – HbA1c Self-care measured – diet, exercise, glucose monitoring, medication adherence Interviewer administered questionnaire.	Better cognitive function was associated with better medication adherence, diet, and SMBG practices.

‘Table 2.2, continued’

First author, year, country	**Objective**	**Sample**	**Measures/Tools**	**Results**
Bell et al. 2010, USA	To assess the association of depressive symptoms with diabetes self-management regimens among older adults with type 2 diabetes in a rural, ethnically diverse community	N = 696 Age mean; CESD>9 74.1±5.9, CESD<9 74.1±5.3 CESD>9 Women -71(64.6%) CESD<9 Women -272(46.4%) CESD>9 Blacks 32 (29.1%), American Indians 38 (34.6%), White 40 (36.4%) CESD<9 Blacks 188 (32.1%), American Indians 143 (24.4%), White 255 (43.5%) Diabetes duration CESD>9 12.4 ± 11.0 yrs. CESD<9 12.5 ± 11.0yrs. Education level CESD>9 <HS -95 (86.4%), HS-13(11.8%), >HS-2 (1.8%) CESD<9 <HS-356(60.9%), HS-132(22.6%), >HS-97(16.6%) Setting; community level Sampling method –randomization Estimated sample size - NA	1. Demography 2. Self-care – SDSCA 3. Depression – Center for Epidemiologic Studies *Depression* Scale (CESD) 4. Clinical data 5. Quality of life (PCS) physical score subscale Self-care measured were diet, exercise, glucose monitoring, foot care and medication adherence Face to face interview	Depression was associated with poorer physical activity and better foot care.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Xu et al., 2010, USA	To understand diabetes self-management practices in Chinese Americans with type 2 diabetes	N = 209 Age mean; 68.28±12.11yrs. Women -127 (60.8%) Men- 82 (39.2%) Education level- No education -10 (4.8%), Less than 8th grade-102 (48.8%), High school-33 (15.8%), College- 47 (22.5%) Graduate school-17(8.1%). Race/ethnicity American Chinese Diabetes duration- 9.19±7.02 yrs. Setting; community level Sampling method – universal Estimated sample size - NA	1. Demography 2. Self-care (SDSCA) 3. Clinical data Self-administered questionnaire	Longer diabetes duration and insulin use were associated with better medication adherence and more SMBG. Older individual practiced better diet, exercise, and foot care. Higher education level was associated with more exercise, more SMBG but lesser compliance to medication. Individuals with insurance had better medication practice, while those who were married had poor medication practice. Employment was associated with lesser exercise.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Gonzalez et al 2008, USA	To examine the relationship between depressive symptoms and diabetes-specific distress and the independent relationships of each of these factors with diabetes self-care.	N = 848 Age mean; 66.21±12.42 yrs. Women -47.6% Men- 52.4% Race/ethnicity White (83.1%) Black (8.6%) Hispanic (2.9%) Asian (1.2%) Other (1.3%) Diabetes duration - 9.49±7.55 yrs. Education level -Less than HS (21.9%), HS graduate (55.0%), College or degree (23.1%) Setting; clinic level Sampling method – universal Estimated sample size – NA	1. Demography 2. Depression - Harvard Department of Psychiatry/National Depression Screening Day Scale (HANDS) 3. Diabetes specific distress - Problem Areas in Diabetes (PAID) 4. Self-care -(SDSCA) Questionnaire administration method not specified	When modeled without depression, distress was significantly associated with poorer adherence to general dietary recommendations, less spacing of carbohydrates, less frequent exercise, and non-adherence to prescribed medication. When depression was included in the model, all the association were not relevant. Depression, independent of distress, was associated with poor self-care.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Xu et al. 2008, China	To test a hypothesized model describing the effects of individual and environmental factors on diabetes self-management and if the effects differed by medication.	N = 201 Age mean; 61 yrs. Women -99 (49.3%)% Men- 102 (50.7%) Race/ethnicity Chinese Education level -Less than HS graduate 71 (35%) -HS or higher graduate 130 (65%) Duration of diabetes Non-insulin -7.8yrs. Insulin-15yrs. Setting: 1 hospital Sampling method – convenience Estimated sample size - 190	1. Self-care (SDSCA) 2. Diabetes Knowledge (DKQ) 3. Belief in treatment effectiveness (Personal Model of Diabetes Questionnaire and Perceived Treatment Effectiveness Scale) 4. Diabetes self-efficacy (SE-Type 2 scale) 5. Social support (CIRS) 6. Provider patient communication (CIRS) Questionnaire administration method not specified	Belief in treatment, higher self-efficacy, longer duration of diabetes, better communication more knowledge, and more support was associated with better diabetes self-care.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Tang et al. 2008, USA.	To examine social support and its relationship to diabetes-specific quality of life and self care behaviors in African Americans with type 2 diabetes	N = 89 Age mean; 60 ± 10.5 yrs. Women -60 (67%) Men- 29 (33%) Race/ethnicity- African American Diabetes duration - 11.3 ± 10.4 yrs. Education level –8th grade or less 2(2%), -Some high school 8 (9%), -High school graduate or GED 18 (20%), -Some college or technical school 45 (51%), -College graduate or higher 16 (18%) Setting; community Sampling method – universal Estimated sample size - NA	1. Demography 2. Diabetes distress - Diabetes Distress Scale (DDS) 3. Self-care -(SDSCA) 4.Positive and negative support- Diabetes Family Behavior Checklist (DFBC) 5.Amount of social support 6.Satisfaction with social support 7.Primary source of social support Self care practices measured were-diet, exercise, foot care, self blood glucose testing and medication adherence Questionnaire administration method not specified	Regression Having positive support was associated with better diet and exercise practices. Satisfaction with support was associated with better SMBG practice. Negative support was associated with non-adherent to medication.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Wu et al. 2007, Taiwan	To explore differences in self-care behaviour according to demographic and illness characteristics; and relationships among self-care behaviour and demographic and illness characteristics, efficacy expectations and outcome expectations of people with type 2 diabetes in Taiwan.	N =141 Age (mean); 64.4 ± 9.9 Men- 52 Female -93 Diabetes duration – 5.8 ± 6.7 yrs. Education level Illiterate -49 Primary -37 Junior HS -30 Senior HS-27 College -2 Race/ethnicity Chinese Setting; clinic Sampling method – NA Estimated sample size - NA	1. Demography 2. Self-efficacy Diabetes Management Self-efficacy Scale (DMSE) 3. Perceived efficacy Perceived Therapeutic Efficacy Scale (PTES) 4. Self-care -(SDSCA) Self-administered questionnaire	Higher self-efficacy, better outcome expectation, lesser complication and longer duration of diabetes were associated with better self-care practices.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Sarkar et al. 2006, USA	To examine the relationship between diabetes self-efficacy and self-management behavior in an urban, diverse, low-income population with a high prevalence of limited health literacy.	N =408 Age (mean); 58.1 ± 11.4 Sex –NA Education level -NA Diabetes duration – 9.5 ± 8.0 yrs. Race Asian/Pacific Islander- 75 (18%) African American- 100 (25%) Hispanic- 165 (40%) White/non-Hispanic- 51 (12%) Native American- 2 (0.5%) Multiethnic- 6 (1.5%) Other- 11 (3%) Setting; hospital database Sampling method – universal Estimated sample size - NA	1. Demography 2. Self-efficacy 3. Self-care (SDSCA) 4. Health literacy - Test of Functional Health Literacy in Adults (TOFHLA) Self-care practices measured were- diet, exercise, foot care, self blood glucose testing and medication adherence Face to face interview	Higher level of self-efficacy was associated with better diet, exercise, foot care and SMBG practices.

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Chlebowy et al. 2006, USA	To examine the relationships of psychosocial variables (social support, self-efficacy, and outcome expectations) to diabetes self-care behaviors and glycemic control in Caucasian and African American adults with type 2 diabetes	N =91 Age (mean); 54.96 ± 12.51 Male -40 (44%) Female- 51 (56%) Diabetes duration – 7.08± 6.48yrs. Education level Less than eighth grade-5 (5.8%), Some high school-10 (11.5%) High school graduate-30 (34.5%) Some college or technical school-18 (20.7%) College graduate-24 (27.6%) Race Caucasians -64 African American-27 Setting; clinic Sampling method – convenience Estimated sample size - NA	1. Demography 2. Social support- Social Support Questionnaire (SSQ) 3. Self-efficacy - Self-Efficacy Questionnaire (SEQ) 4. Outcome expectancy- Outcome Expectancy Questionnaire (OEQ) 5. Self-care - The Diabetes Activities Questionnaire (TDAQ) Self-care practices measured were-diet, exercise, self-blood glucose testing and medication adherence Self-administered questionnaire	Better outcome expectancy was associated with better self-care practices

'Table 2.2, continued'

First author, year, country	Objective	Sample	Measures/Tools	Results
Aikens et al 2005, USA	To determine whether diabetes Self-care behaviors mediate the association between patient-provider communication (PPC) and diabetes outcomes.	N =752 Age (group); <55 =33.1%, 55-64 =31.3%, 65+ = 35.6% Male =68.4%, Female-=31.6% Diabetes duration NA Education level <HS=18.8% HS/some college=57.4% College or greater =23.9% Graduate-24 (27.6%) Race White = 51.1% Black = 20.0% Hispanic=11.9% Other Setting; Multiple health centers Sampling method – Universal sampling Estimated sample size - NA	1.Demography 2.General Patient Provider communication 3.Diabetes Specific Patient Provider communication 4.Self-care (SDSCA) 5.Diabetes outcome Phone interview	Better diabetes specific patient provider communication was associated with better diet, exercise, medication adherence and SMBG practices. Better general communication was associated with better diet practices.

2.7 Description of articles selected

There were 33 relevant full articles identified from 29 individual studies. Fifteen studies were conducted in the United States, 3 in China, 2 in Taiwan, 2 in Australia, 2 in Malaysia and 1 each in Brazil, Korea, Mexico, Saudi Arabia and Slovenia. The number of participants in each study ranged from 83 to 1398 individuals. Seventeen studies reported the mean age of the participants, ranging from 47.93±5.49 to 68.28±12.11 years old. Eleven studies divided the age into groups while 1 study reported no information regarding the age of the participants. Twenty-seven studies mentioned about the proportion of male and female participants. Fifteen studies had more female than male participants.

Twenty-one studies reported the duration of diabetes among the study participants, with 14 reporting the mean duration of diabetes, 3 reporting the median duration of diabetes and the remaining 5 studies categorized the duration of diabetes. The mean duration of diabetes ranged from 5.8±6.7 years to 11.3±10.4 years. Only 5 studies mentioned about sample size calculation. Nine studies applied random sampling method while 10 other studies applied universal and convenience sampling. Ten other studies did not specify sampling method. Data collection involved investigator administered in 11 studies, self-administered in 10 studies while 8 other studies did not mention data collection methods. Twenty studies were conducted in clinics or hospitals, 8 involved community settings while 1 was a national level study.

For the outcome measurement of the studies, 30 out of the 33 articles used the SDSCA (Summary of Diabetes Self-Care Activities) questionnaire. Concerning statistical analysis, 4 articles applied correlation statistics as the highest association analysis, 22 regression while 7 applied structural equation modeling.

From the 33 articles selected, 30 variables were reported as factors that influenced diabetes self-care practices. The review identified many variables which has not been studied in Malaysia. Even though 2 studies selected were from Malaysia, they were conducted in hospital settings, using non-probability sampling method. Thus the generalizability of the studies were questionable. Bearing in mind that over 56% of people with type 2 diabetes in Malaysia seek treatment in government health clinics, it is important that this study investigates relevant variables that influences diabetes self-care among those seeking treatment in government health clinics in a more representative manner. The following section identifies the individual factors and corresponding studies associated with diabetes self-care.

2.8 Factors associated with diabetes self-care practices identified from the systematic review

2.8.1 Factors included in the conceptual model

Age

Seven studies investigated the association between age with diabetes self-care. Five studies; Al Johani, Kendall, and Snider (2015), Ahmad Sharoni et al. (2015), Freitas, Freitas da Silva, Neta, and Vilarouca da Silva (2014), Primožič, Tavčar, Avbelj, Dernovšek, and Oblak (2012) and Y. Song et al. (2012) respectively reported no association between age and diabetes self-care. Bains and Egede (2011) reported that increasing age was associated with better diet and foot care practices. However, age was not related to other aspects of diabetes self-care such as medication adherence, exercise, and self-monitoring of blood glucose. Y. Xu et al. (2010) reported that older diabetics performed better diet practices, more exercise, and frequent foot care, but found no association between age with medication adherence and self-monitoring of blood glucose.

Age has been associated with diabetes care in many studies. However, the direction of the association between age and diabetes self-care has not been consistent. Studies investigating the association between age and diabetes self-care have involved a diverse set of respondents, thus making a comparison between studies difficult. Many other uncontrolled biological factors have been associated with aging, and this can affect diabetes self-care directly or indirectly. Older individuals have a higher prevalence of cognitive dysfunction (Ali Tomlin & Alan Sinclair, 2016). However, age does not affect all area of cognition and all older adults the same way. In diabetics, the decline in cognitive function is faster than those without diabetes (Ali & Alan, 2016).

Among the elderly, medical comorbidities are common. The number, type, and severity of the comorbidities will influence the prioritization and execution of diabetes self-care practices. Kerr et al. (2007) reported that diabetics with microvascular complications have high prioritization but low self-care abilities while those with macrovascular complications have lower prioritization and self-care abilities.

Thus, when looking at the association between age and diabetes self-care activities, age-associated factors such as a decline in cognitive functions, worsening complication and comorbidities should be considered as they may influence diabetes care (Gates & Walker, 2014).

Duration of diabetes

Six studies investigated the relationship between duration of diabetes with self-care practices. Y. Song et al. (2012) and Y. Xu, Toobert, Savage, Pan, and Whitmer (2008) reported that longer duration of diabetes was associated with good overall diabetes self-care practices. Feil, Zhu, and Sultzer (2012) reported that longer duration of diabetes was associated with better diet practices while Y. Xu et al. (2010) reported that those with longer duration of diabetes were more compliant with medication and monitored their blood glucose regularly. Ahmad Sharoni et al. (2015) and Al Johani et al. (2015) found no association between duration of diabetes with self-care practices.

The association between duration of diabetes and self-care practices has not been consistent. Duration of diabetes is closely associated with the patient's age (E. S. Huang et al., 2014). However, those who are very old or have multiple comorbidities have always been excluded from studies (Kirkman et al., 2012). The heterogeneity of comorbidities, complications, cognitive abilities and functional status among the study participants may have resulted in the non-consistent finding (Geldmacher, Levin, & Wright, 2012).

Duration of diabetes has many effects on an individual with diabetes. A steady rise in plasma glucose occurs over time irrespective of the degree of control or type of treatment due to the decline in pancreatic function. Pancreatic function declines linearly with time, and after 10 years, more than 50% of diabetics require insulin therapy (Taylor, 2013). A longer duration of diabetes is associated with worsening complications, especially among those with uncontrolled blood glucose causes (Chawla, Chawla, & Jaggi, 2016). People with diabetes complications find it more difficult to perform self-care practices (Pedras, Carvalho, & Pereira Mda, 2016).

Maintaining optimal glycemic control requires diligence and continuous effort. The longer duration of diabetes associated with long-term use of medications and continuous self-management may lead to frustration in managing diabetes leading to neglect and poorer self-care (Huang, Zhao, Li, & Jiang, 2014). Patients with a long history of diabetes may be exhausted about their disease, and may not be willing to take the extra effort to improve, leading to a decline in self-efficacy levels (Dehghan et al., 2017). Longer duration of diabetes increases the risk of developing depression, which is a known factor for poor diabetes self-care (Yekta, Pourali, & Yavarian, 2010).

Education level

Nine studies investigated the relationship between education level with diabetes self-care practices. The findings regarding the relationship between education level with self-care practices were not consistent. Three studies; Al Johani et al. (2015), Primožič et al. (2012) and Bains and Egede (2011) respectively reported no relationship between education level with diabetes self-care practices. Y. Song et al. (2012) reported that those with higher levels of education performed better diabetes self-care. Walker, Gebregziabher, Martin-Harris, and Egede (2014) reported that individuals with higher levels of education exercised more than those with lower education level. Y. Xu et al. (2010) found that higher education level was associated with better medication adherence, exercise level and self-monitoring of blood glucose, but was not associated with diet or foot care. However, Feil et al. (2012) reported opposite findings. They found that higher education was associated with better diet and foot care practices but not associated with exercise, medication adherence or self-monitoring of blood glucose. Ahmad Sharoni et al. (2015) and Freitas et al. (2014) reported that those with lower education level perform better diabetes self-care practices.

There is some limited evidence to suggest that higher education level is linked to better diabetes self-care practices (Luo et al., 2015; Zeng, Sun, Gary, Li, & Liu, 2014). The influence of education level on diabetes self-care has not been consistent. Many factors play an intermediary role between education level with diabetes self-care. Education contributes to human capital by developing a range of skills such as cognitive skills, rational thinking, strategic thinking, problem-solving ability, learned effectiveness and broadly effective habits and attitudes such as dependability, judgment, motivation, effort, trust, and confidence (Ross & Mirowsky, 2010). Education level is closely associated with sociodemographic factors such as employment, poverty, neighborhood and housing area (Bosma, Lamers, Jonkers, & van Eijk, 2011). These various factors mediate the relationship between education and health (Zimmerman, Woolf, & Haley, 2015).

Diabetics with poor education background have difficulties in understanding educational materials pertaining to their problems such medical pamphlets (Ebrahimzadeh, Davalos, & Lee, 1997). This acts as a barrier for diabetics to obtain useful knowledge and to perform better diabetes self-care practices. People with lower education level have poorer health literacy which will render them less efficient in managing their diabetes (Schillinger et al., 2002). Poor health literacy results in poor self-efficacy, which is associated with poor diabetes self-care practices (Jahanlou & Alishan Karami, 2011).

Due to the direct and indirect effects of education level on health literacy, self-efficacy, and subsequently diabetes self-care and glycemic control, many have considered poor education background as being a fundamental barrier in administering diabetes intervention programs (Rhee et al., 2005).

Sex

Five studies investigated the relationship between sex and diabetes self-care practices. Ahmad Sharoni et al. (2015) and Y. Xu et al. (2010) found that diabetes self-care practices were similar between sexes. Al Johani et al. (2015) and Y. Song et al. (2012) both reported that females diabetics performed better overall diabetes self-care. Feil et al. (2012)

reported that compared to males, females practiced better diet care, more self-monitoring of blood glucose and more frequently examined their feet but exercised lesser.

An individual’s sex has been associated with many aspects of diabetes. These include self-care, care processes, glycemic control and diabetes complication. The reasons for this association include biological variation, patient-provider factors, behavior, gender roles, socio-cultural aspect and socioeconomic status (Kautzky-Willer, Harreiter, & Pacini, 2016; Siddiqui, Khan, & Carline, 2013).

The social gender role affects women more than men. Shrestha, Kosalram, and Gopichandran (2013) reported that in some societies, women played the secondary position at home with men and children holding the primary position. When it came to food preparation and serving, the men and children were prioritized to receive the more expensive and healthy food while the woman had leftovers. Siddiqui et al. (2013) reported that women might feel obliged to fulfill their social gender role in terms of being a homemaker and will put the interest of others before theirs and with the perception of poor support, this will worsen the self-care practice among women.

McCollum, Hansen, Lu, and Sullivan (2005) reported that females have poorer diabetes self-care practices and that this was the result of differences in income, education, BMI, physical and cognitive limitation. Attitude towards diabetes differs between men and women. Mathew, Gucciardi, De Melo, and Barata (2012) reported that women were more incorporative of their diabetes care into their public life, even practicing their dietary self-care regardless of social context and tend to disclose their diabetes to those around them while men were more reluctant to tell friends and family about their diabetes and were less observant of self-management practices in social settings.

Apart from biological and individual personality variation, M. K. Yu, Lyles, Bent-Shaw, and Young (2013) reported that there are discrepancies regarding diabetes care processes between men and women. These discrepancies usually favour men. Despite having a higher mean LDL cholesterol level, females were generally treated less aggressive than men. Heer et al. (2002) reported that women were more likely not to receive anti-thrombolytic therapy despite indicated when compared to men. Women were also reported to have a delayed time for treatment when compared to men (Szalat & Raz, 2008). Ryan, Gee, and Griffith (2008) reported among diabetics who reported sex discrimination by health care providers; there was a 22% lower probability for them to perform a HbA1c test. Patients who perceive or experience discrimination will less likely perform providers recommendation, and this forms a barrier towards better diabetes self-care (Piette, Bibbins-Domingo, & Schillinger, 2006).

Knowledge

Two studies investigated the relationship between knowledge with diabetes self-care. X. Zhong et al. (2011) found that diabetics with better knowledge performed better overall diabetes self-care practices. Y. Xu et al. (2008) reported that knowledge had no significant direct effect on diabetes self-care practices, but had a significant indirect effect via self-efficacy and belief in treatment effectiveness.

Diabetes knowledge is defined as "Knowledge possessed by diabetics regarding their comprehension of the disease, its progression, and self-care practice necessary for keeping diabetes under control" (Thomas T. H. Wan et al., 2016). Knowledge has been an important component in the overall assessment of individuals with diabetes. Knowledge tests have been used in research and evaluation to measure knowledge as outcomes in diabetes patient education programs (Quandt et al., 2014).

Studies investigating the association between diabetes knowledge with both diabetes self-care and glycemic control has not been consistent (Thomas T. H. Wan et al., 2016). In a cross-sectional study in Saudi Arabia involving 570 individuals with type 2 diabetes, Saadia et al. (2010) reported that despite having a good level of knowledge about diabetes, the attitude and practice of diabetic patients regarding diabetes self-care practices were nonsatisfactory. A nationwide survey in China involving 5961 type 2 diabetics with the aim of characterizing the impact of diabetes education on glycemic control, and to assess the attitude, knowledge and self-care behavior in patients with type 2, found that the glycemic control was poorer among those with lesser diabetes knowledge.

Diabetes knowledge is closely associated with education level (X. Zhong et al., 2011). People with more education are able to navigate the healthcare services better and know how to seek appropriate care (Zimmerman et al., 2015). Those with poor lower education level have been reported to have lesser access to diabetes education programs thus limiting knowledge level and resulting in poorer self-care (X. H. Guo et al., 2012). Knowledge level alone may not be sufficient to influence diabetes self-care. The right attitude must be present if knowledge were to translated into proper diabetes self-care practices (Herath, Weerasinghe, Dias, & Weerarathna, 2017).

Based on findings that support the association between diabetes knowledge and better diabetes self-care practices and better glycemic control, many interventional studies have utilized education as a tool to nurture or enhance diabetes self-care practices hoping that better glycemic control can be achieved. In a randomized interventional study involving 256 American Mexican type 2 diabetics utilizing education as the intervention with a follow-up period of 12 months, S. A. Brown et al. (2002) reported that in the intervention group, improvement in diabetes knowledge scores was associated with better glycaemic control. Another randomized interventional study involving 430 Arabs with type 2 diabetes utilizing education based on the health belief model as intervention reported that after 12 months, the improvement in knowledge level among the individuals in the intervention group was associated with better diabetes self-care practices, better glycemic control and improvements in other bio-clinical markers such as weight, body mass index, lipid profile and renal function (Mohamed et al., 2013). These interventional studies were tailored according to the local setting, which may have led to its success.

To improve diabetes knowledge and to ensure the success of future intervention programs, language fluency, the age of participants, education background, and other socioeconomic factors such as being a minority group must be taken into consideration (Bruce et al., 2003).

Support

Ten studies investigated the association between social support with diabetes self-care practices. The result of 1 study was published in 4 articles. Five studies; Brittany L. Smalls, Gregory, Zoller, and Egede (2014), Brittany L. Smalls, Gregory, Zoller, and Egede (2015), Walker, Gebregziabher, Martin-Harris, and Egede (2015), Gao et al. (2013) and Fortmann, Gallo, and Philis-Tsimikas (2011) reported that more social support was associated with better self-care practices.

Mayberry and Osborn (2014) reported more social support was associated with better diet, exercise, medication adherence, and SMBG. Tang, Brown, Funnell, and Anderson (2008) reported more social support was associated with better diet, exercise, and SMBG. Y. Song et al. (2012) reported diabetics with higher unmet needs for social support performed poorer self-care. Y. Xu et al. (2008) reported social support had an indirect association on self-care via self-efficacy.

Three studies; Chlebowy and Garvin (2006), Walker, Smalls, Hernandez-Tejada, Campbell, and Egede (2014) and X. Zhong et al. (2011) found no association between social support with self-care practices. Ahmad Sharoni et al. (2015) reported that those with higher social support performed poorer diabetes self-care.

Social support can be defined as "an exchange of resources between (at least) two persons, aimed at increasing the well-being of the receiver" (Kadirvelu, Sadasivan, & Ng, 2012). Social support can be further classified into 5 categories, (a) informational, (b) emotional, (c) esteem, (d) social network support, and (e) tangible support (Ko, Wang, & Xu, 2013). Good social support benefits health outcomes. Some of the benefits include better psychological adjustment, improved efficacy, better coping with upsetting events, resistance to disease, recovery from disease and reduced mortality (Ozbay et al., 2007).

Family and friends support determines the future direction of the diabetes self-care of an individual. Individuals receiving more support performed better self-care activities. Lack of support from family members has been reported as a barrier in performing diabetes self-care activities (Rad, Bakht, Feizi, & Mohebi, 2013). In a study involving 450 diabetics (Whites=37.5%, Black=34.8%, and Latinos=27.7%), C. A. Rees, A. J. Karter, and B. A. Young (2010) reported that individuals who received more social support performed better diet practices, exercised more and had lower cholesterol and diastolic blood pressure. However, between races, there was a stronger association between support and self-care practices among the Blacks.

In another study involving 83 Korean Americans,Youngshin Song et al. (2012) reported that diabetics which have a high unmet need for social support performed poorer diabetes self-care. Higher unmet needs for social support were also associated with lesser self-efficacy.

The outcome of studies using social support as intervention has mixed results. Shaya et al. (2013) reported that in a randomized intervention study involving 138 type 2 diabetics using social network as intervention, at the end of the study (6th month), those in the intervention group had lower HbA1c levels compared to those in the control group. Furthermore, the intervention group had more favorable outcomes for weight, quality of life, self-efficacy, social network scores and diabetes knowledge, compared to the control group. In another randomized intervention study involving 104 Native Americans with type 2 diabetes utilizing family and friends support as intervention with the improvement in HbA1c at the end of the study (12th month), it was reported that in the intervention group, there was no change in HbA1c values, however in the control group, the HbA1c values deteriorated (Gilliland, Azen, Perez, & Carter, 2002).

Apart from providing support, some authors have argued that the perceived support for an individual may be more important than the actual support received. This further explains as to why despite receiving the same type and amount of support, the outcome of desire may differ between individuals (McDowell & Serovich, 2007).

Empowerment

Two studies investigated the relationship between empowerment with diabetes self-care practices. Hernandez-Tejada et al. (2012) reported that empowered diabetic patients performed self-care practices while Y. J. Lee et al. (2016) reported no association between empowerment with diabetes self-care practices.

Empowerment has been defined by Sigurdardottir and Jonsdottir (2008) as a concept which is abstract and fundamentally positive, referring to possibilities and strengths that lie within and around people rather than identifying and manipulating problems and deficiencies. Empowerment is both a process and an outcome (a developmental potential and a process of becoming). Having the necessary knowledge, skills, attitude, and self-awareness to influence one's behavior in order to improve one's life is the pre-exquisite for empowerment (Danny & Harry, 2005).

Concerning diabetes self-care, empowerment is a patient-centered, collaborative approach tailored to match the fundamental realities of diabetes care. Patient empowerment is defined as helping patients discover and develop the inherent capacity to be responsible for one's own life (Funnell & Anderson, 2004). In recent years, patient empowerment has been the focus of diabetes care, thus shifting the role of care from a paternalistic pattern where the health care provider makes the decision to a more patient-focused involvement of care (Newton, Sasha, & Koula, 2011). Diabetes self-care empowerment is regarded as an important factor for successful diabetes management due to a few reasons. Firstly, diabetes is a patient-managed disease, where the majority of daily decisions are made by the patient. Secondly, the care of diabetes should be a collaboration between patient and provider where the provider acts as an educator and consultant with the patient ultimately making informed decisions. Thirdly, patients are the one in the best position to identify self-management priorities that have the greatest impact on their lives (Tang, Funnell, Brown, & Kurlander, 2010).

Many studies have incorporated the concept of empowerment as an intervention to improve diabetes self-care and glycemic control. However, the outcome of such interventions has resulted in mixed findings. Deakin, Cade, Williams, and Greenwood (2006) used an education program as an intervention to increase the empowerment level among diabetic patients and found that following the intervention, the patients with type 2 diabetes in the intervention group were better empowered and had practiced better diabetes self-care at the end of the intervention. The improvement of diabetes self-care was seen in the areas of diet and physical activity, but not with self-monitoring of blood glucose. Cooper, Booth, and Gill (2008) reported that following an empowerment intervention involving patient education, motivation and skills development, there was an improvement in the self-monitoring of blood glucose in the intervention group. However, there was no difference between the control and intervention group regarding physical activity, diet or BMI. Regarding glycemic control, there was initially a short-term improvement at the 6th month. However, the improvement was not sustainable after 12 months. Results of the interventions varied between studies. This may have been due to the difference in methods of administrating interventions (Nazlı, Kenan, & Tanju, 2008). Interventions should be regular, well organized and consistent over a longer period of time to be more effective.

Apart from influencing diabetes self-care, some authors investigated the influence of empowerment on glycaemic control. Again, the outcome were of mixed results with some showing improvement (Iqbal, Morgan, Maksoud, & Idris, 2008) while others were non-conclusive (Shiu, Martin, Thompson, & Wong, 2005).

Despite being recognized as a factor that influences diabetes self-care, many other factors affect empowerment directly or indirectly and may play an intermediary role with regards to diabetes self-care. Empowerment itself can be regarded as a process, with the ultimate outcome being improved self-efficacy (M. I. Fisher & Howell, 2010). Diabetes empowerment has been used to enhance self-efficacy in diabetes care and has shown positive results (Pena-Purcell, Boggess, & Jimenez, 2011). Education level, duration of diabetes and age are also known to influence empowerment (Azar Tol et al., 2013).

Self-efficacy

Eleven studies investigated the relationship between self-efficacy with diabetes self-care. One study was published in 2 articles. Ten studies; Walker, Smalls, et al. (2014) , Walker, Gebregziabher, et al. (2014), Y. J. Lee et al. (2016), Sharoni and Wu (2012), Gao et al. (2013), Wu et al. (2007), X. Zhong et al. (2011), Y. Xu et al. (2008), Sarkar, Fisher, and Schillinger (2006) and Walker et al. (2015) reported that higher level of self-efficacy was associated with better diabetes self-care practices.

Two studies found no significant association between self-efficacy and diabetes self-care. Chlebowy and Garvin (2006) and Y. Song et al. (2012) found no association between self-efficacy and diabetes self-care.

Self-efficacy has been defined by Bandura as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Liu, 2012). A high sense of self-efficacy amplifies and strengthens an individual's well-being in many ways. Individuals with confidence in their capabilities look at difficult tasks as challenges to overcome rather than a problem to avoid. They set themselves challenging goals and are committed to them. In the face of failure or a setback, they heighten and sustain their efforts. They quickly recover their sense of efficacy after failures or setbacks and attribute failure to insufficient effort or deficient knowledge and skills that are acquirable. Individuals with high level of self-efficacy approach threatening situations with assurance that they can exercise control over them (Bandura, 1994)

Self-efficacy has been reported in many systematic reviews and meta-analysis as an important factor which contributes to diabetes self-care. Higher level of self-efficacy is associated with better diabetes care (Luo et al., 2015; Mohebi, Azadbakht, Feizi, Sharifirad, & Kargar, 2013).

K. E. Williams and M. J. Bond (2002) interviewed 79 mostly elderly type 2 diabetics to investigate the association between self-efficacy, social support, and diabetes self-care practices and found that higher level of self-efficacy was associated with better diet, exercise, and self-monitoring of blood glucose. This association was independent of social support. In those reported having good social support, the improvement in diabetes self-care practices was mediated by self-efficacy. In a cross-sectional study in India involving 507 type 2 diabetics, Kavita Venkataraman et al. (2012) reported that among those with high levels of self-efficacy, the odds of good medication adherence was 1.77 while the odds of good dietary practice was 2.7. Self-efficacy was reported to be influenced by educational status, employment, family support, and positive attitude.

Many interventional studies have incorporated the development or enhancement of self-efficacy in managing chronic diseases. Robertson, Amspoker, Cully, Ross, and Naik (2013) investigated the effect of diabetes self-efficacy with depression, anxiety, and stress symptoms on post-intervention glycaemic control (HbA1c) involving 87 individuals with type 2 diabetes. Robertson et al. (2013) reported that by enhancing self-efficacy, regardless of baseline level of depression, anxiety, and stress, all study participants showed improvement in glycaemic control. Marked improvement in glycaemic control was seen especially among those who had poorer baseline affective disorder.

The baseline self-efficacy level of an individual has been reported to be one of the determining factors in the success of the intervention in improving diabetes self-care practices and glycemic control. L. Fisher, Hessler, Masharani, and Strycker (2014) reported that in a randomized intervention study involving 392 type 2 diabetics, at the end of the intervention (12 months), participants that exhibited high baseline level of self-efficacy were associated with improvement in diet, physical activity and regimen distress than participants with low baseline self-efficacy.

Diabetes distress

Three studies investigated the association between diabetes distress with diabetes self-care practices.Walker, Gebregziabher, et al. (2014) found that diabetics experiencing distress were less likely to be compliant with medication and complied poorly with diet control. Both Primožič et al. (2012) and Gonzalez, Delahanty, Safren, Meigs, and Grant (2008) reported that distress was not associated with diabetes self-care.

Diabetes distress is a syndrome comprised of multidimensional components such as worry, conflict, frustration, and discouragement that can accompany living with diabetes (Thanakwang, Thinganjana, & Konggumnerd, 2014). A meta-analysis of 58 studies estimated the prevalence of diabetes distress at 22% among people with diabetes (Dennick et al., 2015).

People who perceive worsening diabetes status are more likely to experience diabetes distress (Zulman, Rosland, Choi, Langa, & Heisler, 2012). Diabetes distress, an affective disorder, is closely related to depression. Diabetes distress is a different entity when compared to depression. Patients with diabetes may exhibit a high level of depressive like affect, but may not be necessarily clinically depressed. Many studies focusing on diabetes distress have included depression as an accompanying factor in determining the outcome of diabetes, either in terms of self-care practices or glycemic control. Majority of depressed diabetics experienced diabetes distress, however, most of those experiencing diabetes distress was not depressed. This shows that diabetes distress is a significant affective disorder which must be considered when dealing with diabetic patients, especially in those who are not depressed to ensure successful diabetic management (Pouwer et al., 2005).

Zagarins, Allen, Garb, and Welch (2012) recruited 234 type 2 diabetics in an interventional study to examine the relative effects of change in depressive symptoms and change in diabetes distress on diabetes self-care practices and on glycemic control. Diabetes self-management education was used as an intervention. Following 4 sessions of diabetes self-management education, the improvement in diabetes distress was associated with better diabetes self-care practices and glycemic control. The intervention had no effect on depression. Similar results were reported by Fonda, McMahon, Gomes, Hickson, and Conlin (2009). In their study, the investigators recruited 104 type 2 diabetics from the Veterans Affairs Boston Healthcare System who had HbA1c levels of more than 9.0% and assigned them to control and intervention group. The intervention applied was diabetes self-management and an internet-based care management. At the end of the study, the diabetes distress level improved in the intervention group and was associated with a reduction in the HbA1c levels.

Diabetes distress affects an individual's problem-solving skill which is required to carry out diabetes self-care, and this may result in poorer self-care activities (Glasgow, Fisher, Skaff, Mullan, & Toobert, 2007). Apart from influencing problem-solving skills, a higher level of diabetes distress is also associated with poorer self-efficacy, poorer social support, and seen more among females (Wardian & Sun, 2014).

Depression

Six studies investigated the relationship between depression with diabetes self-care practices. Five studies; Walker, Gebregziabher, et al. (2014), Feil et al. (2012), Primožič et al. (2012), R. A. Bell et al. (2010) and J. S. Gonzalez, L. M. Delahanty, et al. (2008)

reported that depression was associated with poorer diabetes self-care practices. One study by Fortmann et al. (2011) found no association between depression with diabetes self-care.

Twenty-three percent of people with diabetes globally have comorbid depression (Hasan, Clavarino, Mamun, Doi, & Kairuz, 2016). The association between diabetes and depression is bidirectional. People with diabetes have a higher risk of developing depression, and people with depression have a higher risk of developing diabetes (Holt, de Groot, & Golden, 2014). Depression in diabetes is persistent or recurrent. Compared to non-diabetic controls, people with diabetes are reported to be about 1.4-3 times as likely to suffer from comorbid depression (Andreoulakis et al., 2012).Non-diabetic depressed people have a 32% increased risk of developing type 2 diabetes (M. Yu, Zhang, Lu, & Fang, 2015).

Data from meta-analysis studies have shown that diabetics with depression performed poorer diabetes self-care practices (J. S. Gonzalez, M. Peyrot, et al., 2008; Sumlin et al., 2014). Depression influences how an individual feels, think, act and leads to a variety of emotional and physical problems, resulting in a decrease in ability to function at work and at home (Parekh, 2017). The risk for depression among people with diabetes includes being female, younger age group, poorer self-rated health, lower education and pain which limits daily activity (Strauss, Rosedale, & Rindskopf, 2016).

Despite the strong association between depression and poor diabetes self-care, intervention to cope with depression does not necessarily result in better self-care. Robertson et al. (2013) reported that in an intervention study involving 85 type 2 diabetic patients with varying degree of depression, only those with a higher level of baseline depression showed improvement at the end of the study. Intervention to treat diabetic patients with depression via pharmacotherapy or cognitive therapy has generally resulted in better depressive symptoms. However, the change in diabetes self-care behavior and glycemic control has not been consistent (Markowitz, Gonzalez, Wilkinson, & Safren, 2011). Social support and self-efficacy have been implicated as being a major mediator between depression and diabetes self-care (E. Tovar, Rayens, Gokun, & Clark, 2013). Egede and Osborn (2010) reported that depressed diabetic patients generally have poor social support and were less motivated.

2.8.2 Factors not included in conceptual model

Ethnicity

Only one study looked at the relationship between ethnicity with diabetes self-care. Bains and Egede (2011) found that there was no association between being Black or White with diabetes self-care. The disparities between ethnicity in diabetes epidemiology, complications, self-care and care processes are mainly due to factors such as biological, behavioral, social, environmental, and health system (Spanakis & Golden, 2013).

Ethnic minorities have always been associated with poorer diabetes self-care, outcome and even care processes. Trief et al. (2013) investigated the diabetes self-care practices among African American, Hispanics and Caucasians and the effect of intervention according to ethnicities. Based on the study, despite having comparable socioeconomic attributes, the minorities performed less diabetes self-care practices, and despite undergoing intervention, the improvements seen among the minorities were still lesser when compared to the Caucasians.

In a cross-sectional study in Canada, S. Choi, Lee, and Rush (2011) reported that compared to the Caucasians, the minorities (Asians and Latinos) performed poorer diabetes self-care practices, and were less likely to receive appropriate care. However, in their study, the proficiency of the English language was lesser among the minority group and may be a contributing factor in the differences observed.

Sociocultural values associated with certain race or ethnicity influences diabetes self-care practices. Korean Americans females have been reported to make “self-sacrifices” for family members and are expected to prioritize the need of family members first resulting them to neglect their diabetes self-care (Y. Song et al., 2012).

Apart from sociocultural roles, ethnic minorities are frequently associated with poorer socioeconomic status, and this affects the outcome of diabetes self-care. Based on a study in Texas by Nwasuruba, Osuagwu, Bae, Singh, and Egede (2009) regarding diabetes self-care across different ethnic groups (Blacks, Whites, and Hispanics), it was observed that the minority group practiced poorer diabetes self-care. However, after adjusting for socioeconomic status, it was discovered that those at the lower socioeconomic strata performed poorer diabetes self-care irrespective of race. Thus, when concluding or making assumptions regarding diabetes self-care practices with relation to ethnicity or certain communities, many other factors which may be exclusive to the particular group must also be taken into consideration (Kulkarni, 2004).

Employment status

Two studies investigated the relationship between employment status with diabetes self-care practices. Y. Xu et al. (2010) reported that employed individuals were less likely to exercise while Walker, Gebregziabher, et al. (2014) reported no association between employment status with diabetes self-care.

The prevalence of type 2 diabetes has been reported to be as high as 14% among those employed (Abou-Gamel et al., 2014). This represents a major challenge since in most countries, the working class forms the major bulk of the population. Individuals facing more stress at the workplace are associated with higher prevalence of diabetes. In a cross-sectional study to look at the association between work-related stress and chronic diseases including diabetes among 989 working middle-aged men and women, Djindjic, Jovanovic, Djindjic, Jovanovic, and Jovanovic (2012) reported that higher work-related stress was associated with having diabetes, with the odds being almost double among female workers.

Employment affects diabetes self-care practices in many ways. The association of employment with the lack of time, perks and health benefits, stress at work, working based on shifts and over time, work policies and the association of work type and sociodemographic characteristics influences an individual in many ways (M. A. Kirk & Rhodes, 2011). Individuals working as professionals have more leisure physical activities compared to blue collar or manual workers. Furthermore, those working long hours are also less likely to engage in exercise when compared to those working for a shorter duration (Burton & Turrell, 2000). Among type 2 diabetics who were unemployed or retired, X. Zhong et al. (2011) reported that the rate of exercise was over 69%, which was higher than 35.6% found from previous studies involving employed adults.

Certain jobs are accompanied with benefits such as comprehensive insurance. Thus, the type and benefits of a job will influence the self-care practices of diabetic patients. Fully employed individuals with higher level of education working in an upper class of employment will more likely be covered by a more comprehensive insurance policy (Dewar, 1998). Bowker, Mitchell, Majumdar, Toth, and Johnson (2004) reported that among diabetics having insurance, the practice of self-monitoring of blood glucose was higher when compared to those not having any insurance.

In an intervention study involving 536 type 2 diabetics utilizing diabetes self-management training as an intervention, it was observed that after 1 year of follow up, the attrition rate was over 50%. One of the major reasons given for non-attendance for the training session was due to work (E. Gucciardi, DeMelo, Offenheim, Grace, & Stewart, 2007).

The association between employment and diabetes self-care has not been consistent, and much of it has to do with the nature of the job, health benefits and policies at the workplace and many other factors (John, Hayley, & Emma, 2008).

Body Mass Index (BMI)

Two studies investigated the relationship between BMI with diabetes self-care practices. Ahmad Sharoni et al. (2015) reported that BMI did not predict diabetes self-care practices while with Primožič et al. (2012) reported that diabetics with lower levels of BMI were more likely to perform better diabetes self-care. BMI is a proxy for energy intake. Higher BMI is due to excess calorie intake than expenditure. Higher BMI is seen due to overeating, physical inactivity or the combination of both resulting in positive calorie gain (Van Dyck et al., 2015).

Many studies have reported regarding the association of poorer diabetes self-care with a higher BMI among diabetic patients (Allen, Melkus, & Chyun, 2011). Among people with diabetes, those with higher BMI were more likely to be adherent to medication and SMBG but not to lifestyle measures such as exercise or proper dietary care. Compared to overweight people with diabetes, those who are obese find that exercise and diet as burdensome and put less emphasis on them (Dixon et al., 2014). Due to their weight problem, obese people may also find stigma as a barrier in performing proper healthcare activities. Stigma is independent of self-efficacy and has a similar impact on self-care behaviors to that of self-efficacy (Kato et al., 2016; Phelan et al., 2015).

Those with a higher BMI have reported that experiencing pain is one of the reasons why they don't or participate very minimally in activities such as physical exercise (Allen et al., 2011). Furthermore, those with a high BMI also might feel less confident in performing diabetes self-care practices. This is particularly true with regards to performing exercise among females with a high BMI who is embarrassed with her self-appearance (A. M. Egan et al., 2013). Kroese, Adriaanse, and De Ridder (2013) reported that compared to their non-obese counterpart, obese diabetics have poorer proactive coping skills, poorer self-control and do worse in terms of adhering to self-care guidelines.

Dixon et al. (2013) reported when compared to the overweight diabetics, those who were severely obese were more likely to; suffer from more moderate-severe depressive symptoms, live alone, earn lesser, unemployed, poorly educated, and did not have health insurance. These factors are known to be associated with poor diabetes self-care practices and eventually poorer glycemic control (Fiore et al., 2015; Kollannoor-Samuel et al., 2011).

BMI is both a determinant of diabetes self-care practice and the outcome of diabetes self-care practices. Many interventions aimed at improving diabetes self-care activities with the ultimate goal of achieving good glycemic control also included BMI as an outcome. (Kulzer, Hermanns, Reinecker, & Haak, 2007; Thoolen et al., 2007).

Income

Two studies investigated the relationship between income with diabetes self-care practices. Both Bains and Egede (2011) and Y. Xu et al. (2010) found no relationship between income level and diabetes self-care practices.

In many parts of the world, the prevalence of diabetes is higher among those who are considered to be in the lower income earning group (Rabi et al., 2006). The prevalence of diabetes has been reported to be 4 times higher in the lowest income group when compared to those in the highest income group (Dinca-Panaitescu et al., 2011)

X. Zhong et al. (2011) investigated the influence of sociodemographic factors on diabetes self-care practices among 349 Chinese with type 2 diabetes and concluded that those with lesser income performed poorer diabetes self-care practices. Similar findings were reported by another cross-sectional study involving 132 African American with type 2 diabetes looking at sociodemographic factors and the association with diabetes self-care practices. Watkins, Quinn, Ruggiero, Quinn, and Choi (2013) found that those in the lower income group had a very poor practice of self-monitoring of blood glucose. Apart from poorer testing of blood glucose, based on a cross-sectional study involving 388 Type 2 diabetics, Mark Peyrot, Rubin, Kruger, and Travis (2010) reported that diabetics with lesser income were more likely to forego insulin injection when compared to those from higher income.

The financial burden of increased health care cost may limit the access to necessary healthcare services and further intensify the effect of poverty among the lower income group, thus forcing them to make unhealthy choices (Hill, Nielsen, & Fox, 2013). The constant financial stress endured by those in the lower income group leads to psychological and biologic responses which increases the likelihood of depression, reduced self-esteem, and decreased motivation, making it difficult to perform proper diabetes self-care (Leone, Coast, Narayanan, & de Graft Aikins, 2012).

The role of lower income or lack of income on diabetes self-care should be viewed from a bigger perspective, as they are normally associated with being less educated, have lesser knowledge, stay in non-conducive neighborhood, have lesser self-efficacy and a higher level of depressive symptoms (National Research Council (US), 2013).

Employment status

Two studies investigated the relationship between employment status with diabetes self-care practices. Y. Xu et al. (2010) reported that employed individuals were less likely to exercise while Walker, Gebregziabher, et al. (2014) reported no association between employment status with diabetes self-care.

The prevalence of type 2 diabetes has been reported to be as high as 14% among those employed (Abou-Gamel et al., 2014). This represents a major challenge since in most countries, the working class forms the major bulk of the population. Individuals facing more stress at the workplace are associated with higher prevalence of diabetes. In a cross-sectional study to look at the association between work-related stress and chronic diseases including diabetes among 989 working middle-aged men and women, Djindjic et al. (2012) reported that higher work-related stress was associated with having diabetes, with the odds being almost double among female workers.

Employment affects diabetes self-care practice in many ways. The association of employment with the lack of time, perks and health benefits, stress at work, working based on shifts and over time, work policies and the association of work type and sociodemographic characteristics influences an individual in many ways (M. A. Kirk &

Rhodes, 2011). Individuals working as professionals have more leisure physical activities compared to blue collar or manual workers. Furthermore, those working long hours are also less likely to engage in exercise when compared to those working for a shorter duration (Burton & Turrell, 2000). Among type 2 diabetics who were unemployed or retired, X. Zhong et al. (2011) reported that the rate of exercise was over 69%, which was higher than 35.6% found from previous studies involving employed adults.

Certain jobs are accompanied with benefits such as comprehensive insurance. Thus, the type and benefits of a job will influence the self-care practices of diabetic patients. Fully employed individuals with higher level of education working in an upper class of employment will more likely be covered by a more comprehensive insurance policy (Dewar, 1998). Bowker et al. (2004) reported that among diabetics having insurance coverage, the practice of self-monitoring of blood glucose was higher when compared to those not having any insurance.

In an intervention study involving 536 type 2 diabetics utilizing diabetes self-management training as an intervention, it was observed that after 1 year of follow up, the attrition rate was over 50%. One of the major reasons given for non-attendance for the training session was due to work (E. Gucciardi et al., 2007).

The association between employment and diabetes self-care has not been consistent, and much of it has to do with the nature of the job, health benefits and policies at the workplace and many other factors (John et al., 2008).

Family size

Only Y. Song et al. (2012) investigated the relationship between family size with diabetes self-care practices. However, no relationship was reported between family size with diabetes self-care practices.

Family size is relevant in determining the family network where both positive and negative social exchanges exist (Walen & Lachman, 2000). Family affects a diabetic's self-care practice in many ways since eating, exercise and stress management usually take place in the setting of social activities and relationships. Family members often play a role in deciding what food to buy or keep at home, what are for meals, fitting activities into family schedule, how health is placed as a priority, and providing shelter, emotional support and help a patient handle the stress of illness. Better health can be provided if the family is considered central to the management of diabetes. Strong family bond provides an environment where the patients can receive the management with utmost satisfaction and happiness (Ahmed & Yeasmeen, 2016).

Apart from having a positive effect on a diabetic individual, family members at times do have negative influences (Umberson & Montez, 2010). Family members may have a negative attitude towards the patient's disease, such as being non-supportive or even act as a barrier in performing self-care activities (Rosland, Heisler, Choi, Silveira, & Piette, 2010; Vaccaro, Exebio, Zarini, & Huffman, 2014).

Based on a semi-structured interview involving 24 Latino and African-American with type 2 diabetes and with children in their home, Laroche et al. (2009) reported that the study participants perceived that their children play many roles in the management of their diabetes. Family members help manage the patient's diabetes self-care by monitoring the diet by advising on what to eat, including food shopping and preparation, by encouraging and exercising together, reminding and assisting with regards to medication and self-monitoring of glucose.

The role a diabetic individual play in the family household will also influence the diabetes self-care practices. In a family setting, despite the diabetic individual being the patient, the family interactions, functions and responsibilities are often bidirectional. In a structured interview study involving 70 African American with type 2 diabetes, Samuel-Hodge et al. (2000) reported that diabetics playing the role as a multi-caregiver in the family has the tendency to forsake their diabetes self-care as caring for others will interfere with their own self-care activities. Caring for others in the family may lead to stress, tiredness, and negligence of self-care.

The role of family in influencing diabetes self-care practices differs by socioeconomic status, culture, tradition, and evolves with time. When planning for long-term management of a diabetic, or any other chronic diseases, it is very important to take into account the family background and support of an individual (Fingerman, VanderDrift, Dotterer, Birditt, & Zarit, 2011).

Insurance status

Only one study investigated the relationship between having insurance coverage and diabetes self-care practices. Y. Xu et al. (2010) reported that insured individuals were more adherent to medication compared to those without insurance.

There are a few types of insurance such as private insurance, employer-provided insurance or social insurance. The importance of insurance is to avoid or reduce the financial risk associated with a health-related issue (Gruber, 2008). However, not every individual has access to insurance. For the year 2014, in the United States, the percentage of people with health insurance was 89.6%. Only 14.6% of the insurance were privately purchased, with the majority being employer-provided (Jessica & Carla, 2015).

The major factor limiting the access to insurance is financial barrier especially among those who have poor income and are not covered by social insurance leaving them without any protection (Parikh et al., 2014). Poor medication adherence has been associated with not having medical insurance. Steinman, Sands, and Covinsky (2001) reported that in a nationwide cross-sectional study involving 4896 Americans, the rate of medication restriction was 3 to 15 times higher among the uninsured as opposed to those who were partially or fully insured. In another cross-sectional study involving 405 Canadians with type 2 diabetes, Bowker et al. (2004) reported that those with insured glucose monitoring supplies practiced better monitoring of blood glucose and this led to better glycemic control.

In a change of insurance policy, a Health Management Organisation in England (serving an estimate of 300,000 patients) decided to provide its diabetics patients with glucose meters and test strip as part of the treatment package. This new policy acted as a natural interventional study to look at the changes in the rate of self-monitoring of blood glucose practice among diabetics with both oral hypoglycemic agents and/or insulin use. After 2 years of the new policy, among the 3219 patients who received the free glucose monitoring devices, it was reported that there was an increase in self-monitoring (based on strip count) of blood glucose and reduction in HbA1c level (Soumerai et al., 2004). This shows that the type of benefit covered by the insurance influences the diabetes self-care practices.

Not only does an insurance policy or coverage affect the self-care practices of an individual, but it also affects the health provider as well. Health providers have been reported to prefer patients with generous insurance coverage as opposed to those with lesser coverage. Patients with generous coverage are also known to be treated better with more comprehensive facilities (Cram, Pham, Bayman, & Vaughan-Sarrazin, 2008). Apart from financial barrier being the reason for poor self-care practices among uninsured diabetics, there are other reasons to be considered. Among those insured, those who have more chronic comorbidities tend to have a higher rate of medication non-adherence (Piette, Heisler, & Wagner, 2004). Furthermore, being a minority, having lesser education and lower income is also associated with lesser self-monitoring of blood glucose and poorer glycemic control despite having a comprehensive insurance coverage (A. F. Brown et al., 2003).

Comorbidities

Three studies investigated the relationship between medical comorbidities with diabetes self-care practices. The findings were not consistent. Ahmad Sharoni et al. (2015) reported that those with comorbidities performed poorer overall diabetes self-care. Similarly, Feil et al. (2012) found that individuals with more comorbidities were less likely to perform diabetes self-care activities such as medication adherence, self-monitoring of blood glucose, diet and exercise. However, Y. Song et al. (2012) reported no association between medical comorbidities with diabetes self-care.

Most diabetics have at least one comorbidity, with up to 40% having up to 3 comorbidities (Childs, 2007). The comorbidities among diabetic include cognitive comorbidities and non-cognitive comorbidities. Example of cognitive comorbidity includes depression. Non-cognitive comorbidity may include problems related to diabetes such as cardiovascular diseases and retinopathy or non-related to diabetes such as pulmonary disease (Coonrod, 2001). Due to the widespread use of pharmacotherapy, diabetics are living longer and are acquiring diseases associated with aging.

In a cross-sectional study involving 993 type 2 diabetics with the aim of investigating the association between chronic pain and diabetes self-care practice, Krein, Heisler, Piette, Makki, and Kerr (2005) reported that diabetics experiencing severe or very severe chronic pain had very poor diabetes self-care practices with regards to exercise, diet and medication adherence. In another cross-sectional study involving 1902 type 2 diabetics, Kerr et al. (2007) investigated the association between number, type, and severity of comorbidities and how it influences diabetes patients' self-management and treatment priorities. Based on their study, Kerr et al. (2007) reported that more comorbidity was associated with poorer diabetes self-care. Furthermore, independent of the number of comorbidities, the severity of it limits diabetes self-care practices further.

There are many ways how the number and severity of comorbidities affect a diabetic's self-care practice. Some comorbidities, for example, asthma, may act as a physical barrier with regards to exercise. Diabetics with asthma have reported being unable to exercise due to breathing difficulties associated with asthma despite wanting and trying to do so. Multiple comorbidities may also result in conflict regarding which medical problem should be prioritized. Patient with diabetes may want to diet. However this may worsen their gastrointestinal problem, and they may decide not to do so (Bayliss, Steiner, Fernald, Crane, & Main, 2003). Apart from the patient not being able to prioritize their medical problems, Crabtree et al. (2005) reported that when dealing with individuals having multiple comorbidities, health care workers were unable to provide optimal medical care due to complexity of disease and time constraint

Multiple comorbidities affect an individual financially. For those having to fork out their own money for treatment, especially among those from the lower socioeconomic group, the financial obstacle may lead to higher rates of cost-related medication underuse. Piette et al. (2004) reported that among 8765 type 2 diabetics with multiple comorbidities, almost 20% of the patients reported cutting back on medication the previous year due to financial reasons. Moreover, up to 28% reported forgoing food or other essentials to pay for medication costs.

Thus, in attempts to improve the management of diabetes, both the individual and health care provider must be able to address the ways in which patients' other chronic health problems affect their diabetes care (Piette et al., 2006).

Insulin use

Two studies investigated the relationship between medication type and diabetes self-care practices. Y. Xu et al. (2010) reported that individuals receiving insulin injections were more adherent to medication and performed more self-monitoring of blood glucose. Ahmad Sharoni et al. (2015) reported no difference in diabetes self-care practices between those on oral medication, insulin injection or the combination of both.

Although oral hypoglycemic agents are recommended as first-line agents in patients with type 2 diabetes, insulin is required in 20% to 29.8% diabetics at some stage during the management of diabetes to maintain optimal glycemic control (Selvin et al., 2016; Sharma, Nazareth, & Petersen, 2016). Insulin can be used as first-line therapy in patients with type 2 diabetes or as add-on therapy to the existing oral hypoglycemic agents or as a replacement for oral hypoglycemic agents (Qayyum et al., 2008).

Insulin use has always been associated with self-monitoring of blood glucose. Many clinical guidelines have recommended the need for self-monitoring of blood glucose among diabetic patients requiring subcutaneous insulin injection (American Diabetes Association, 2017a). Thus, it is no surprise that many studies have reported that diabetic individuals on insulin have better self-monitoring of blood glucose practice (Harris, 2001).

Apart from self-monitoring of blood glucose, the association between the use of insulin and other diabetes self-care practices have been less encouraging. In a systematic review of 23 studies regarding the rate of medication adherence between diabetics on insulin and those not on insulin, J. A. Cramer (2004) reported that the adherence to oral hypoglycemic agents ranged from 36% to 93% while for insulin, the adherence rate was reported to be lower at 62% to 64%. Ming Yeong Tan and J. Magarey (2008) reported that among 129 type 2 diabetics, the use of insulin was associated with better medication adherence when compared to those who were on oral hypoglycaemic agents only. However, in their study, those using insulin were also mostly from the higher education level group, and this may influence their findings.

The use of insulin may be associated with stigma in some individuals. Thus this may be a reason why some diabetics might choose to forego or delay treatment (Farrington, 2016) . J. E. Aikens, Perkins, Piette, and Lipton (2008) reported that the use of insulin mediated the association between depression and poor glycemic control, and this association was not related to poor medication adherence. The use of insulin has been reported to be associated with poorer quality of life (Al Hayek, Robert, Al Saeed, Alzaid, & Al Sabaan, 2014).

Attitude

One study investigated the relationship between attitude and diabetes self-care practices. X. Zhong et al. (2011) used a validated modified questionnaire to assess attitude which was developed by the Michigan Diabetes Research Training Center and found that those with a positive attitude practiced better medication adherence and was physically more active.

Among diabetics, the keystone to successful management of their diabetes is to get them involved in their treatment. This involves the patient having the correct attitude in their day-to-day management of diabetes. Negative attitudes among diabetics have led to issue such as non-compliance with medication (Benroubi, 2011). The prevalence of negative attitude towards diabetes has been reported to be as high as 41% (Kiberenge, Ndegwa, Njenga, & Muchemi, 2010).

In a cross-sectional study in France involving 1092 individuals with the aim of evaluating the profiles of patients with type 2 diabetes and to identify sets of opinions and attitudes towards the disease that might influence self-care practices, Mosnier-Pudar et al. (2010) reported that there were 5 distinct attitudes among the study participants, "committed" (25%), "carefree" (23%), "bitter" (19%); "disheartened" (19%), and "overwhelmed" (15%). Diabetics who were considered as "committed" were less distressed and had better control over lifestyle changes, whereas those who were bitter were poor at implementing lifestyle changes and were unlikely to take an active role in their disease management. Those in the "carefree" group made no effort to change their behavior.

In a randomized trial utilizing an empowerment approach education program involving 64 type 2 diabetics, R. M. Anderson et al. (1995) reported that in the intervention group, participant's improvements in attitude concerning impact of diabetes on the quality of life and the decline in negative attitude towards living with diabetes was associated with improvement in glycemic control.

Though attitude is responsible for the varying degree of diabetes self-care practices between individuals and eventually glycemic control, many other factors are known to influence attitude. Social support is an important factor in determining attitude. Social support enables an individual to nurture and maintain a positive attitude in dealing with diabetes care (J. K. Kirk, Ebert, Gamble, & Ebert, 2013). To develop a positive attitude in managing a chronic disease such as diabetes, knowledge and education play an important role as the patient requires the adequate information regarding their diabetes to enable them to make changes (Gagliardino, Gonzalez, & Caporale, 2007).

Belief

One study investigated the relationship between belief in treatment effectiveness with diabetes self-care practices. Y. Xu et al. (2008) utilized a validated Chinese version of a belief questionnaire which was developed based on the Personal Models of Diabetics Questionnaire and the Perceived Treatment Effectiveness Scale and found that belief in treatment effectiveness was associated with better overall diabetes self-care practices.

Belief affects nearly all aspect of diabetes care. Belief is influenced by multiple factors such as age, education level, personal experience, stigma, family background, religion, cultural background and environmental factors (Jimenez, Bartels, Cardenas, Daliwal, & Alegría, 2012; Sweileh, Zyoud, et al., 2014). Gherman et al. (2011) summarized the type of beliefs as illness belief, treatment belief, adherence belief, self-efficacy belief, locus of control belief, perception of relationship with healthcare provider belief, and coping strategies belief. These varying beliefs have been reported to influence diabetes self-care practices and glycemic control.

In a cross-sectional study involving 803 type 2 diabetics from the lower socioeconomic group of individuals, the investigator aimed to determine how patients' beliefs about glucose-lowering agents and antihypertensive medications relate to medication underuse and health status. J. E. Aikens and Piette (2009) reported that among those who believed that their medication was harmful, the rate of underuse was higher. Despite socioeconomically deprived, the main factor for medication underuse was the belief of harm caused by treatment.

In a cross-sectional study involving 1530 type 2 diabetics aimed at investigating the association between self-assessed control over life events, subjective beliefs about longevity, and time and risk preference with diabetes self-care practices and glycemic control, Sloan, Padron, and Platt (2009) reported that individuals who believed they had control over life events and will live longer performed better diabetes self-care practices. However, the self-reported better self-care practices did not translate into better glycemic control.

In another cross-sectional study involving 2038 type 2 diabetics which aimed to assess the self-determination theory model of health behavior to predict medication adherence, quality of life, and physiological outcomes among patients with diabetes, G. C. Williams et al. (2009) reported that individuals who perceived greater autonomy support from health care providers related positively to autonomous self-regulation for medication use, which in turn related positively to perceived competence for diabetes self-management. Perceived competence was associated with better quality of life and medication adherence, which led to better glycemic control.

Diabetes Fatalism

Two studies investigated the association between fatalism and diabetes self-care practices. Walker et al. (2015) and Walker et al. (2012) reported that higher levels of fatalism were associated with poorer compliance to diet, exercise, self-monitoring of blood glucose and medication adherence.

In psychosocial and behavioral research, the definition of fatalism varies across the concept of the respective studies (Egede & Ellis, 2010). Diabetes fatalism can be defined as "a complex psychological cycle characterized by perceptions of despair, hopelessness, and powerlessness" and associated with poor glycemic control (Walker et al., 2012).

Individuals experiencing diabetes fatalism usually perform poorly with regards to diabetes self-care (Egede & Bonadonna, 2003). Diabetic patients with high level of fatalism are prone to poor diabetes self-care due to the belief that it is not possible to alter the course of the disease, thus dismissing the idea that diabetes can be prevented or managed (Lange & Piette, 2006).

Even though diabetes fatalism is associated with poorer diabetes self-care, many other factors may influence fatalism directly or indirectly and will eventually lead to poorer diabetes self-care. Depression is known to worsen diabetes fatalism and will lead to poor self-care. In some individuals, depression may overwhelm diabetes fatalism (Egede & Ellis, 2010). Other factors worsening diabetes fatalism include poor health literacy or poor knowledge (Osborn, Bains, & Egede, 2010).

Better communication between at-risk individuals with family members will enable them to relate and understand better regarding diabetes and thus will reduce fatalism. This will also enable them to increase their engagement in risk-reducing behaviors (Pijl et al., 2009). Calhoun et al. (2010) reported that in an intervention study involving 26 American Indian with type 2 diabetes utilizing motivational interview as the intervention, improvement in diabetes fatalism was associated with better diabetes self-care.

Cognition

Three studies investigated the relationship between cognition with diabetes self-care practices. Compean-Ortiz et al. (2010) reported that those with poor verbal memory were more likely not to perform self-monitoring of blood glucose while those with poor visual memory were more likely to perform poorly in areas such as diet, self-monitoring of blood glucose and medication adherence. Primožič et al. (2012) reported that poorer performance in the general cognitive abilities, specific cognitive abilities, and specific executive functions was associated with worsening overall diabetes self-care practices. Feil et al. (2012) reported that among the elderly patients with cognitive impairment, it was most difficult to adhere to the diet and exercise practices.

Cognition refers to the mental process by which external or internal input is transformed, reduced, elaborated, stored, recovered, and used. As such, it involves a variety of functions such as perception, attention, memory coding, retention and recall, decision making, reasoning, problem-solving, imaging, planning and executing actions (Maria, Nicola, & Simona, 2006). A meta-analysis of 10 studies reported that poor cognition was associated with a decline in diabetes self-care practices (A. Tomlin & A. Sinclair, 2016).

The prevalence of cognitive impairment is higher among diabetics when compared to non-diabetics (Gregg et al., 2000). The prevalence of cognitive impairment in the general population for those above 75 years old has been reported to be between 11% - 14% while among diabetics the prevalence of cognitive impairment was more than 20% (Bischkopf, Busse, & Angermeyer, 2002; Hewitt, Smeeth, Chaturvedi, Bulpitt, & Fletcher, 2011). The reason for a higher prevalence of impaired cognitive function among diabetics are multifactorial, ranging from an interaction between metabolic abnormalities intrinsic to diabetes, diabetes-related complications and other disorders (Feinkohl, Price, Strachan, & Frier, 2015). Among diabetics, the deterioration of cognitive abilities occurs faster. The risk factors for developing cognitive impairment include increasing age, having poor educational background, cardiovascular disease, depression and poor social support (J. Hugo & M. Ganguli, 2014).

Due to the adverse effect of poor cognition towards diabetes self-care, many interventions have been aimed at improving the cognitive capabilities of individuals with type 2 diabetes. In an intervention study incorporating lifestyle changes as an intervention without the use of pharmacotherapy which lasted for 2 years involving 55 diabetics and 74 non-diabetics, Yamamoto et al. (2009) reported that despite the diabetics having lower level of cognitive function at the early stage of the study, the level of cognition improved similarly to the levels of non-diabetics at the end of the 2 years. The glycaemic control improvement was associated with better cognitive function. Trento et al. (2004) reported that following a randomized intervention study involving 120 type 2 diabetics using systematic education as intervention, and after 5 years of follow up, those in the intervention group improved their glycemic control and had better cognitive function compared to the baseline level. For those in the control group, the deterioration in glycaemic control was associated with poorer cognitive function. Apart from reversing cognitive impairment, the least benefit of better glycemic control was the delay of the cognitive impairment. Luchsinger et al. (2011) reported that in a study using telemedicine as intervention involving 2169 type 2 diabetics above the age of 55 years old, and followed up for about 5 years; it was observed that those in the intervention arm had better glycemic control compared to those in the control arm. Despite participants in both group experiencing worsening cognitive impairment, those in the intervention group had much-delayed progress of cognitive impairment.

Diabetic individuals with impaired cognitive have poorer health literacy (Nguyen et al., 2013). Furthermore, diabetic individuals with a poorer level of cognition require more help with activities related to personal care, assistance in activities of daily living and a higher rate of hospitalization (Sinclair, Girling, & Bayer, 2000). Cognitive impairment affects diabetes self-care via disabling an individual to fully understand and execute the management of diabetes (Hewitt et al., 2011).

Coping style

Only one study investigated the association between coping styles with diabetes self-care practices. B. L. Smalls et al. (2012) reported that better emotional coping (emotional expression and emotional processing) was associated with better diet, exercise, and self-monitoring of blood glucose.

Coping can be defined as "cognitive and behavioral efforts to manage specific external and internal demands that are appraised as taxing or exceeding the person's resources (Degazon & Parker, 2007). They are many types of coping practiced by an individual, with each one resulting in different outcomes.

Samuel-Hodge, Watkins, Rowell, and Hooten (2008) investigated the association between coping styles among 185 type 2 diabetics African Americans with diabetes self-care behaviors, diabetes appraisals, and health-related quality of life and found that demography influences coping mechanism, and based on the coping mechanism approach adapted, individuals perform differently with regards to self-care practices, diabetes appraisal and quality of life. The authors reported that younger diabetics tend to adopt emotive (coping by emotional strategies such as worrying, getting mad, being nervous or depressed) and passive (coping through strategies of acceptance) coping styles while the older diabetics predominantly practiced passive coping styles. The least applied coping method among the study participant was active coping (coping with actions or making plans to act). Both passive and active coping methods were associated with better diabetes self-care practices, better quality of life, more competence and higher self-efficacy. Other studies have reported similar findings. In a study involving 256 Japanese type 2 diabetics, Nakahara et al. (2006) reported that among diabetics practicing emotive coping, their daily hassle and distress level were reported to be higher, and this was indirectly associated with poorer diabetes self-care and glycemic control via poorer level of self-efficacy.

In a study involving 100 type 2 diabetics in Boston, Yi, Yi, Vitaliano, and Weinger (2008) reported that poor glycemic control was associated with anger coping style (anger and an emotion-focused) and diabetes-related psychological distress. Furthermore, those with anger coping style had higher levels of diabetes distress which worsened glycemic control.

As mentioned above, apart from directly influencing diabetes self-care practices and glycemic control, coping methods influences many other psychosocial aspects of a diabetic. Diabetics practicing negative coping skills have been reported to have a higher anxiety level and more depressive symptoms when compared to those who practice positive coping skills (C. X. Zhang et al., 2009). Apart from looking at the coping styles practiced by an individual, it is also important to look at other associated psychosocial factors as these can give rise to non-adherence to diabetes self-care practices and poor glycemic control (Kendzor et al., 2014).

Patient-provider communication

Four studies assessed the association between patient-provider communication with diabetes self-care practices. Gao et al. (2013) and James E. Aikens, Bingham, and Piette (2005) reported that better patient-provider communication was associated with better overall diabetes self-care activities. Y. Xu et al. (2008) reported that better patient-provider communication was indirectly associated with diabetes self-care via self-efficacy and knowledge. Tregea, Lee, Browne, Pouwer, and Speight (2016) reported that better patient-provider communication and experience was associated with better diet and exercise but poorer medication adherence.

Patient-provider communication is the verbal and non-verbal processes through which a doctor obtains and shares information with a patient, thereby developing a therapeutic relationship (Haftel, Lypson, & Page, 2008). Successful medical encounters require effective communication between the patient and the health provider. Improvement in patient-provider communication can result in better patient care and help patients adapt to illness and treatment (S. J. Lee, Back, Block, & Stewart, 2002).

In a cross-sectional study involving 752 American with type 2 diabetes, aimed at explaining the association between diabetes self-care practices with general communication and diabetes-specific communication, Piette, Schillinger, Potter, and Heisler (2003) reported that despite being distinctively different from each other, both general communication and diabetes-specific communication were independently associated with diabetes self-care practices. This finding was true across all races and sociodemographic background. In another cross-sectional study in the United States involving a national sample of 1588 type 2 diabetics aged above 50 years old, Heisler, Cole, Weir, Kerr, and Hayward (2007) reported that better provision of information and more participatory decision making was associated with overall improvement of diabetes self-care practices (medication adherence, diet, exercise, blood glucose monitoring, and foot care).

The impact of a good patient-provider communication can go a long way in chronic diseases such as diabetes. Polonsky et al. (2010) reported that type 2 diabetics who recalled having reassuring health care providers upon diagnosed with diabetes, along with a clear plan of action were more likely to perform better diabetes self-care practices 1 to 5 years after diagnosis. A retrospective cohort study involving 2962 type 2 diabetics from the general population in Israel reported that the lack of effective patient-provider communication was the reason for some individuals to have poor glycemic control. This was evident as based on the analysis of their study; the health care provider was the main determining factor for the patient's HbA1c outcome (Shani et al., 2008).

Many factors influence the patient-provider communication. The reluctance of patients to discuss their diabetes self-care practices can lead to poor patient-provider communication. The reluctance may be due to factors such as fear of being judged and shamed, particularly shame surrounding food intake and weight (Ritholz, Beverly, Brooks, Abrahamson, & Weinger, 2014). Reluctant patients have been reported to perform poorer diabetes self-care, have more diabetes-related distress, were more depressed and may have higher levels of anxiety (Beverly et al., 2012).

Outcome expectation

One study investigated the association between outcome expectations and diabetes self-care practices.Chlebowy and Garvin (2006) reported that patients with higher outcome expectation performed better overall diabetes self-care practices.

Outcome expectation has been defined as “beliefs that a given behavior will produce a specific outcome” (Wójcicki, White, & McAuley, 2009). Outcome expectation has been associated with many socio-behavioral theories and has been considered as an important factor in determining specific behaviors or intervention (D. M. Williams, Anderson, & Winett, 2005). Many studies have incorporated outcome expectation as part of the theoretical model to improve certain behaviors in an individual. Outcome expectancies have been reported to be both positive and negative, with positive outcome expectation being associated with more effort or desire to undertake a certain behavior while negative outcome expectation is associated with reluctance or failure or avoidance to perform or behave in a certain way (E. S. Anderson, Winett, & Wojcik, 2007; Salmon, Owen, Crawford, Bauman, & Sallis, 2003).

Wu et al. (2007) studied the association between outcome expectation and diabetes self-care practices among 145 Taiwanese above 30 years old with type 2 diabetes and reported that those with positive outcome expectation performed better diabetes self-care practices. Cosansu and Erdogan (2014) investigated the effect of psychosocial factors on diabetes self-care practices and glycemic control among 350 Turkish people with type 2 diabetes and found that outcome expectancy was not directly associated with diabetes self-care but rather indirectly via enhancing diabetes self-efficacy. Better self-efficacy and diabetes self-care were directly associated with better glycemic control.

K. E. Williams and M. J. Bond (2002) investigated the association between self-efficacy, outcome expectation and social support with diabetes self-care practices and found that positive outcome expectation was directly associated with better exercise and self-monitoring of blood glucose and was indirectly associated with diet via self-efficacy. Outcome expectation also moderated the influence of self-efficacy on diabetes self-care practice where better outcome expectation was associated with higher self-efficacy and subsequently better self-care practice.

Many studies regarding the influence of psychosocial factor on diabetes self-care practices have studied both outcome expectation and self-efficacy as these two factors are closely associated with one another. Believing in the outcome of certain behavior may enhance the self-efficacy level of that particular behavior to achieve the desired outcome. Thus, outcome expectation alone should not be considered as the only predictor for diabetes self-care, but as part of a more complex socio-behavioral interaction (Iannotti et al., 2006).

Neighborhood factors

One study investigated the association between neighborhood factors with diabetes self-care practices. The study was published in 2 articles. Brittany L. Smalls et al. (2015) and Brittany L. Smalls et al. (2014) reported that poor access to healthy food in the neighborhood was associated with poorer diabetes self-care.

The neighborhood where one resides has been shown to influence the health outcomes. Neighborhood with poor resources or one which is busy with traffic and exposed to hazardous materials have been reported to negatively influence health outcome (Matthews & Yang, 2010). Similarly, the incidence of diabetes has been reported to vary according to neighborhood factors. Christine, Auchincloss, Bertoni, and et al. (2015)

reported that individual who stays in a neighborhood with healthy food resources and better physical activity infrastructure had a lower incidence of diabetes.

Neighborhood factors published in the available literature varies. de Vries McClintock et al. (2015) investigated the association between neighborhood social environments with diabetes self-care and found that diabetics living in neighborhoods with high social affluence, high residential stability, and high neighborhood advantages were more adherent to medication. Hajna, Ross, Joseph, Harper, and Dasgupta (2016) investigated about neighborhood walkability and reported that diabetics living in a neighborhood which enhances walkability were more likely to be physically active. Apart from influencing diabetes self-care, neighborhood factors such as the availability of green spaces help prevent psychological disorders such as depression among diabetics (Gariepy, Kaufman, Blair, Kestens, & Schmitz, 2015).

The association between neighborhood factors with diabetes self-care has not been consistent. Many other factors influence the outcome of diabetes care such as ethnicity, education level, and cultural level, thus explaining the variation in diabetes care despite staying in the same neighborhood (Piccolo, Duncan, Pearce, & McKinlay, 2015).

Food insecurity

One study investigated the association between food insecurity with diabetes self-care practices. Heerman et al. (2016) reported that diabetics experiencing food insecurity performed poorer diet, exercise, and medication practices.

Food security is an important social determinant of health and has a direct relationship with physical, mental, and social health (Enza Gucciardi, Vahabi, Norris, Del Monte, & Farnum, 2014). Food insecurity exists whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies) is limited or uncertain (H. K. Seligman et al., 2012).

The prevalence of food insecurity ranges from 8.3% to 12% in developed countries to as high as 50% in developing countries (Bawadi et al., 2012; Berkowitz, Baggett, Wexler, Huskey, & Wee, 2013; Shirin & Emma, 2015). The odds of developing diabetes doubles among those with food insecurity (Hilary K. Seligman, Bindman, Vittinghoff, Kanaya, & Kushel, 2007).

Individuals experiencing food insecurity are more likely not to adhere to a proper diet, check their glucose level lesser and have poorer glycemic control (H. K. Seligman et al., 2012). Food insecurity is often associated with poor socioeconomic background. Food-insecure populations are at risk for less diverse, lower quality diets, reduced micronutrient intake, iron-deficiency anemia, and low intake of fruits and vegetables. Due to the inability to afford a healthy and more expensive diet, food which are cheap, and usually calorie dense are preferred (Nweze & Gloria, 2013). The need to forgo medication to buy food poses further problems for a diabetic as this result in poor glycemic control.

Many times, apart from poorer bio-clinical control of diabetes, diabetics experiencing food insecurity has a lower level of self-efficacy and higher levels of diabetes distress. Difficulty following a healthy diet and emotional distress partially mediates the association between food insecurity and glycemic control (H. K. Seligman et al., 2012). The prevalence of depression, more medication affordability challenges, and more food and healthcare practices trade-off becomes worse as food security worsens (Ippolito et al., 2017).

Subjective social status

The relationship between subjective social status with diabetes self-care practice was investigated in 1 study. The results were published in 2 articles. Walker et al. (2015) and Walker, Smalls, et al. (2014) found no association between subjective social status with diabetes self-care practices.

Subjective social status reflects the relative perception that individuals have of their place in the social hierarchy. This indicator expresses the feelings of individuals belonging to a certain social stratum, and capture current and past socioeconomic situations, future prospects, family resources, life opportunities, the way people experience society and how they perceive themselves in relation to others (Giatti, Camelo, Rodrigues, & Barreto, 2012). The predictors of subjective social status include employment grade, household income, education, satisfaction with standard of living and feeling of financial security that reflects an assessment of current and future economic/material conditions (Singh-Manoux, Adler, & Marmot, 2003). Socioeconomic status constitutes the basis of subjective social class (Demakakos, Nazroo, Breeze, & Marmot, 2008).

The association between social status and diabetes incidence has been reported to be inconsistent. In developed countries, an inverse relationship has been reported while in developing countries, the trend is opposite (Rabi et al., 2006; Skar et al., 2013; Tanaka, Gjonça, & Gulliford, 2012). Diabetics with poor social status face financial obstacles, social obstacles, and competing health and family concerns, are barriers to performing diabetes self-care practices. Poor social status has also been associated with poor knowledge and the failure to act upon information available to improve diabetes self-care (von Goeler, Rosal, Ockene, Scavron, & De Torrijos, 2003). Within the respective class of socioeconomic stratum, those with low subjective social class are reported to have poor health-related quality of life irrespective of age, sex, residential region, income, education, marital status, and employment status (Kim & Park, 2015).

Diabetics from the lower social status usually live in disadvantaged neighborhoods where facilities such as parks or playground are usually limited or unsafe, thus acting as a barrier for activities such as exercise or relaxation. Moreover, such neighborhood may lack big malls or supermarkets which sells a variety of healthy food at a lower price, thus limiting the chances of eating healthily (Krishnan, Cozier, Rosenberg, & Palmer, 2010). Subjective social class mediated fully or partially the associations between education, occupational class and wealth with health outcomes (Demakakos et al., 2008).

Psychological Stress

One study investigated the association between psychological stress with diabetes self-care practices. According to Walker, Gebregziabher, et al. (2014) diabetics who experienced stress over the past month practiced poorer diet, poorer self-monitoring of blood glucose and was less compliant with medication.

Stress occurs when an individual perceives that environmental demands exceed his or her adaptive capacity (Cohen, Janicki-Deverts, & Miller, 2007). There are many sources of stress, such as financial issues, workplace issues, personal issues, study issues, health-related issues and family issues (Lynne, 2013). Wiegner, Hange, Björkelund, and Ahlborg (2015) reported that in a study involving 587 Swedish working adult attending primary health clinics, the prevalence of stress was 59%. The odds of being stress among diabetics has been reported to be up to 4 times more than non-diabetics. Females are more prone to stress (Atiq & Syeda, 2015).

Individuals respond differently to stress, and this is partly due to the variation of stress faced. However, reactions towards stress such as anxiety or depression may lead to difficulties with diabetes self-care manifested through less physical activity, poorer diet or difficulties with taking medication (Lloyd, Smith, & Weinger, 2005). Apart from behavioral changes, chronic stress leads to biological changes in one's body such as the increased secretion of cortisol thus leading to elevated blood glucose and poor diabetes control (Faulenbach et al., 2012). In people with diabetes, excessive psychological stress is harmful because it increases blood glucose, incites negative emotions, impairs sound thinking and decision-making and may lead to compulsive behavior such as excessive eating (Napora, 2013).

People with high levels of self-efficacy manage stress better (Schönfeld, Brailovskaia, Bieda, Zhang, & Margraf, 2016). Positive social support of high quality can enhance resilience to stress possibly by moderating genetic and environmental vulnerabilities for mental illness, fostering effective coping strategies, and through effects on multiple neurobiological factors (Giesbrecht, Poole, Letourneau, Campbell, & Kaplan, 2013; Ozbay et al., 2007).

Psychological distress

One study investigated the association between psychological distress with diabetes self-care practices. Walker, Gebregziabher, et al. (2014) reported no association between psychological distress with diabetes self-care.

Psychological distress is largely defined as a state of emotional suffering characterized by symptoms of depression (e.g., lost interest; sadness; hopelessness) and anxiety (e.g., restlessness; feeling tense) (Aline, Alain, & Dominic, 2012).

Psychological distress is a normal reaction to a "stressor". However, when it is accompanied by other symptoms that, when added up, satisfy the diagnostic criteria for a psychiatric disorder, psychological distress would be a medical concern. Psychological distress can be transient or chronic, lasting up to years. Psychological distress depends on the type of stressor and is associated with personality type and cultural norms (Drapeau, Marchand, & Beaulieu-Prévost, 2012). Psychological distress influences diabetes self-care via negatively affecting the performance on attention and information processing tasks, as well as on tasks tapping executive functions and working memory (Moretta et al., 2017).

The presence of psychological distress predisposes an individual to develop diabetes. Among those with pre-diabetes, psychological distress accelerates the rate of developing full-blown diabetes (Eriksson et al., 2008). The incidence of developing diabetes among pre-diabetes and the high-risk group doubles among those with psychological distress (Virtanen et al., 2014).

In a nationwide study involving 220,235 participants in the United States, C. Li et al. (2009) reported that the prevalence of psychological distress among diabetics (n=24, 039) was 7.6% while among non-diabetics (n=196,196) it was 3.6%. Apart from a higher prevalence of psychological distress among diabetics, those with multiple comorbidities suffer worse psychological distress (Fortin et al., 2006).

When compared to those without psychological distress, Shin, Chiu, Choi, Cho, and Bang (2012) reported that diabetics with psychological distress performed lesser physical activities. Education level, age, duration of diabetes, comorbidities and social support are among factors that are closely associated with psychological distress (Okoro et al., 2009; Shuang Qiu et al., 2017)

2.9 Studies in Malaysia regarding factors influencing diabetes self-care practices

The review found that many factors influenced diabetes self-care practices. Based on the review, 2 studies were carried out in Malaysia; (Sharoni & Wu, 2012) and (Ahmad Sharoni et al., 2015). Apart from the 2 Malaysian studies included in the review, there were other studies that have investigated factors influencing diabetes self-care practices among Malaysians with type 2 diabetes but did not fulfill the selection criteria.

Chin, Cai, Muniyandy, and Kadirvelu (2015) reported that self-efficacy, anxiety, and optimism were associated with diabetes self-care. Gunggu et al. (2016) reported that support, self-efficacy, and belief were associated with self-care while Y. C. Kueh, Morris, and Ismail (2017) reported that age, knowledge, and duration of diabetes were associated with self-care. S. L. Tan et al. (2011) investigated the pattern of dietary compliance and its association with glycemic control and sociodemographic factors among 61 Malaysians with type 2 diabetes. M. Y. Tan and J. Magarey (2008) previously examined the association between diabetes self-care practices and glycemic control among Malaysians. Mastura et al. (2007) investigated the prevalence of self-monitoring of blood glucose (SMBG) among 556 Malaysian with type 2 diabetes attending government health clinics and ascertained the factors influencing self-monitoring of blood glucose (SMBG). However, in these studies, not all 4 of the most important diabetes self-care practices were studied. Furthermore, the self-care scales were not scored as recommended and the questionnaires used were not validated.

The four main diabetes self-care activities; exercise, healthy diet, medication adherence and self-monitoring of blood glucose is the cornerstone of diabetes management. The reasons are the blood glucose level in any person is influenced by three major factors;

1. The glucose that originates from ingested food
2. The production of glucose by the liver
3. The utilization of glucose by the muscle and cells

Dietary intake allows the assessment of the first factor. Medication intake allows control of second and third factor. Physical activity allows partial control of the third factor. Self-monitoring of blood glucose allows the individual to know his blood glucose level and adjust his diet, medication or exercise accordingly.

The limited studies pertaining to diabetes self-care activities among Malaysians with type 2 diabetes and the associated factors served as a basis for this thesis. This thesis aims to fill in the gap and answer the questions; "What are the diabetes self-care practices activities among Malaysian with type 2 diabetes and what are the factors influencing them?"

2.10 Conceptual model for factors influencing diabetes self-care practices and hypothesis testing

Based on the review; age, sex, education level, diabetes duration, knowledge, depression, diabetes distress, support, empowerment, and self-efficacy were included in a conceptual model which aimed to investigate factors influencing diabetes self-care practice. The variables included in the model were arbitrarily selected based on the frequency it was studied in the systematic review. The common variables identified were included in the model. A conceptual model on how these variables relate to self-care practice and each other was hypothesized based form the articles retrieved. Figure 2.2 illustrates how the selected factors influence diabetes self-care practices and how they are associated with one another.

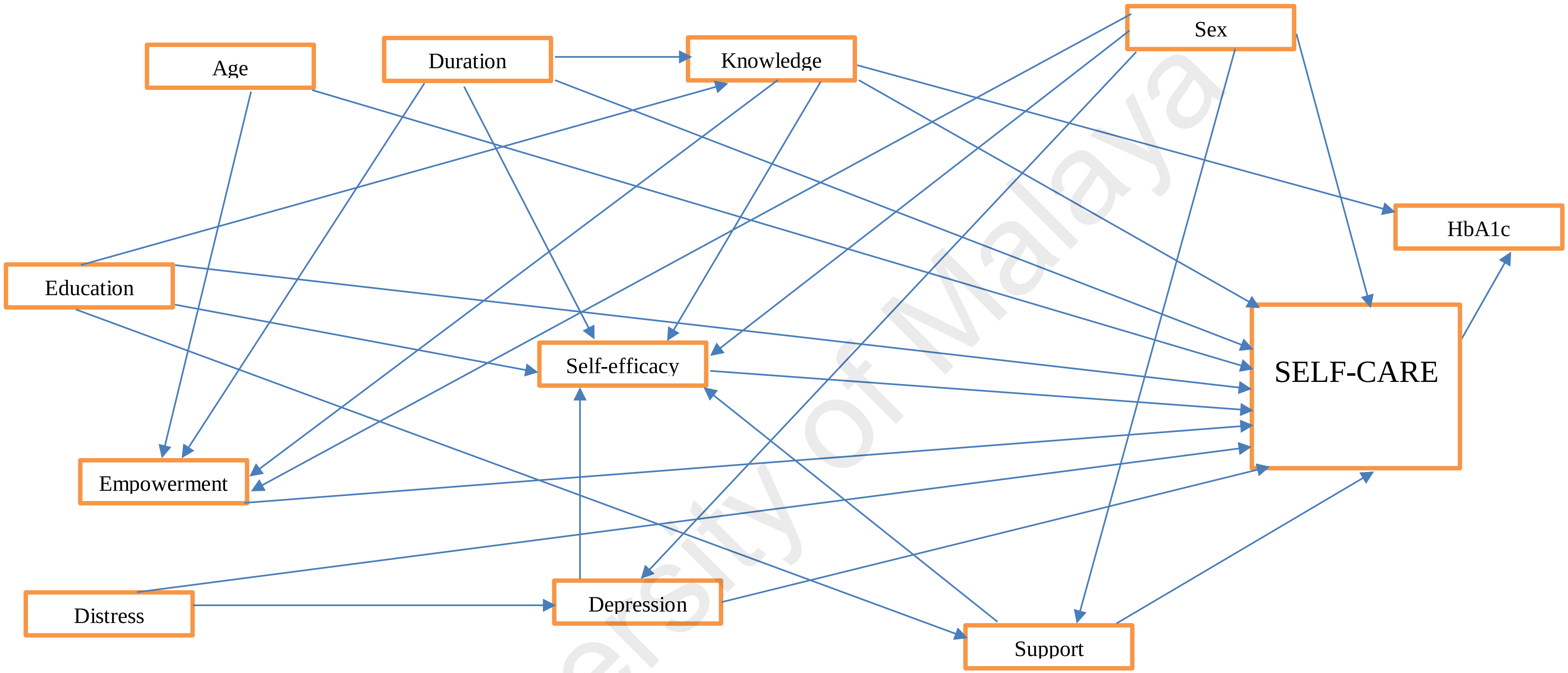


Figure 2.2 : Conceptual model of the path between age, sex, education, diabetes duration, knowledge, psychosocial factors and diabetes self-care.

CHAPTER 3: METHODOLOGY

3.1 Chapter overview

In this chapter, details about the study methodology are discussed. The study site, study population, sample size calculation, sampling method, study design, case definition, inclusion criteria, study instruments, data collection and statistical analysis are explained in detail. The translation process, pretest, pilot test results are explained.

3.2 Study population

The study population was patients with type 2 diabetes mellitus attending and receiving health care services from the government health clinics outpatient department in the state of Selangor. In this study, three types of clinics that do not provide diabetes treatment were excluded. These clinics were the Klinik 1 Malaysia (One Malaysia Clinic), Klinik Desa (Rural Clinic) and the Klinik Ibu dan Anak (Maternal and Child Health Clinic).

3.3 Study area

This study was conducted in the district of Hulu Selangor. This was the biggest district in the state of Selangor, measuring about 174,047 hectares. Based on the 2010 census, the population in Hulu Selangor was 194,387 people, out of which 26,608 are above 50 years old (Hulu Selangor District Council, 2012).

There were a total of 6 government health clinics with out-patient department services. The health clinics were; KK Serendah, KK Rasa, KK Ulu Yam Bharu, KK Kalumpang, KK Selisek and KK Soeharto. As of the year 2012, there were 6,396 diabetic patients registered and receiving care from the six government health clinics.

3.4 Sample size

The objectives of this study were to assess the glycemic control, determine the level of diabetes self-care practice and ultimately identify factors influencing diabetes self-care practice. The sample size was calculated to ensure it was sufficient to answer the objectives of the study.

The Open Epi version 3.01 software was used to determine the sample size required to assess glycemic control and the level of diabetes self-care practice. The Open Epi software requires parameters such as the estimated population size, the power of the study, the confidence level and the anticipated proportion of the variable of interest to be determined and keyed into the software to enable sample size estimation. In this study, the population size was 6,396. The power of 80% and a confidence level of 95% were selected. Based on previous studies, the prevalence of good glycemic control among Malaysians with type 2 diabetes was 22% (Mafauzy et al., 2011), thus giving a sample size of 254. According to M. Y. Tan and J. Magarey (2008), the prevalence of good diabetes self-care practices among Malaysians with type 2 diabetes was 52%, giving a sample size of 361.

To perform the regression analysis, Green (1991) recommended a sample size of $n \geq 104 + k$ (k = number of independent predictor). In this study, the maximum independent variable was 6. Thus the sample size needed was ≥ 110.

To perform partial least square analysis, Henseler, Ringle, and Sinkovics (2009) recommended a 10 to 1 ratio of sample size to the model parameter, with a minimum sample size of 200 considered as good. The theoretical model in this study had 27 model parameters. Thus with a ratio of 10 to 1, the sample size required was 270.

The sample size to determine the prevalence of good diabetes self-care was the largest, and was able to answer the study objectives. After taking into account an anticipated non-response rate of 30%, the final sample size for this study was increased to 480.

The number of participants recruited from the health clinics was proportional to the number of clinic attendees. Table 3.1 describes the number of patients attending each health clinic and the numbers to be recruited from each clinic. The number of patients with type 2 diabetes attending KK Serendah, KK Ulu Yam Bharu, KK Rasa, KK Soeharto, KK Kalumpang and KK Selisek were 2731, 1277, 837, 559, 531 and 461 respectively. The number of patients to be recruited from each health clinic were 205, 95, 63, 43, 39 and 35 respectively.

Table 3.1 : Number of patients with type 2 diabetes and the numbers of participants to be recruited from each health clinic

Name of health clinic	Number of patients treated	Numbers to be recruited
KK Serendah	2731	205
KK Ulu Yam Bharu	1277	95
KK Rasa	837	63
KK Soeharto	559	43
KK Kalumpang	531	39
KK Selisek	461	35
Total	6396	480

3.5 Study period

The pretest and pilot test were conducted in May and June 2013. The actual data collection started from July 2013 to January 2014.

3.6 Sampling procedure

The sample frames were obtained from the respective health clinic's appointment book between July 2013 and January 2014. The appointment book contained the names of the patients who were supposed to attend the health clinic on the specified dates. From the appointment book name list, every 10th patient was selected as a participant in the study. Every 10^{th} patient was selected based on the pilot test experience, as it allowed sufficient time for patients to be interviewed, and it allowed the sampling of all clinic attendee on the sampling day. Thus this will minimize selection bias, if any, especially if a particular group of patients attend the clinic at a particular time. When a designated individual from the name list declined to participate, the next name in the list was selected. The number of participants recruited from each health clinic was proportionate to the number of patients attending the respective clinics. Selected participants were approached by the interviewer.

The objectives of the study, the importance, the interview method, the estimated duration of the interview, the confidentiality of information and the option of stopping or refusing the interview at any point of time were explained to the participants.

The participant's clinical case notes were reviewed by the researcher. The clinical case note contained information about the type of diabetes, weight, height, diabetes complication screening, medication, plasma blood glucose, lipid profile, and HbA1c levels. After obtaining their consent, the participants were required to answer an interviewer administered questionnaire with a total of 91 items. The interview was conducted in a designated room in the clinic to ensure the participant's comfort and privacy.

3.7 Study design

A cross sectional study design was selected for this study. This study design was chosen because the prevalence of uncontrolled type 2 diabetes was common and we did not seek to identify a cause and effect relationship.

3.8 Case definition

The inclusion criteria for this study were:

1. Age more than 18 years
2. Malaysian citizen
3. Diagnosed as having type 2 diabetes
4. Able to at least understand and speak the Malay language
5. Not diagnosed as having any psychotic or cognitive disorder
6. Does not suffer from hematological disorders
7. Well on the day of interview (no fever, no acute illnesses)
8. Agreed to participate in the study

3.9 Study variables

3.9.1 Sociodemographic variables

1. Age
2. Sex
3. Race
4. Education level
5. Marital status

3.9.2 Clinical data

1. Years diagnosed with type 2 diabetes
2. Height in meters
3. Weight in kilograms
4. BMI
5. Blood pressure (systolic and diastolic blood pressure)
6. HbA1C level
7. Fasting lipid profile - Cholesterol, Triglyceride
8. Diabetes related complication (retinopathy, foot ulcer, nephropathy, ischaemic heart disease, cerebrovascular disease)
9. Medications (Diabetic medications / Anti-hypertensive medications / Anti platelet / Lipid lowering agents)

3.9.3 Instruments used

1. MDKT (Michigan Diabetes Knowledge Test) - Malaysian version
2. CIRS (Chronic Illness Resources Survey)
3. DDS (Diabetes Distress Scale)
4. DES (Diabetes Empowerment Scale)
5. PHQ – 9 (Patient Health Questionnaire)
6. SDSCA (Summary of Diabetes Self-Care activities)

3.10 Variable definition

3.10.1 Socio-demographic data

1. Age - The age of the participant was calculated based on the year he/she was born as stated on the identification card. For example, a participant born on

16th September 1969 was considered to be 45 years old in the year 2014, regardless of the month in that year. According to Malaysia's National Policy on Senior Citizens, the study participants were then grouped into those 60 years old and younger and those above 60 years old (senior citizen) (Abdul Rashid et al., 2016; Post Service Division Malaysia, 2005).

2. Sex - Participants were categorized as male or female.
3. Ethnic group - The ethnic groups were classified as Malay, Chinese, Indian and others. Others include all races apart from the three main races in the district of Hulu Selangor.
4. Education level - The education level was recorded as the highest attained education level. For example, if a participant studied until Form 2 only, and later dropped out, the highest attained education level was considered as the secondary level. There were three groups of education levels; primary (highest up to Primary 6), secondary (from Form 1 to Form 5) and tertiary (beyond Form 5).
5. Marital status - Marital statuses were single, married, divorced or widowed.

3.10.2 Clinical data

1. Years diagnosed with type 2 diabetes - The information regarding the duration of diabetes was obtained from the clinical notes.
2. Height - The height of the patient was obtained from the clinical notes. Height was measured with a height bar by the nurses. It was reported in meters, up to 2 decimal points (example: 1.73 meters). The measurement was taken with the participant standing erect, occiput, shoulders, buttock, and heels against the wall. Participants were barefooted when their heights were measured.

3. Weight - The weight of the patient was obtained from the clinical notes. Weight was measured on the same day the patient attended the clinic. Weight was recorded in kilograms, up to 1 decimal point by the nurses. During weighing, the participants were barefooted. All pockets were emptied, and patients were not allowed to carry or keep with them any items during weighing.
4. Body mass index (BMI) - The body mass index (BMI) was calculated by dividing the weight in kilograms with the square of height in meters, BMI=kg/m2.
5. Blood pressure - The blood pressure of the patient was obtained from the clinical notes. The blood pressure was measured using a digital blood pressure machine by the nurses in the clinic. Prior to recording the blood pressure, the participants rested for at least 10 minutes. The blood pressure was divided into systolic and diastolic blood pressures. Good blood pressure control among people with diabetes was defined as systolic blood pressure of ≤130 mmHg and diastolic blood pressure of ≤80 mmHg (Feisul, Rohana, Alexander, Wan Mohd Izani, & Chee, 2014)
6. Glycosylated Hemoglobin (HbA1c) - The HbA1c level of the patient was obtained from the clinical notes. Venipuncture was performed to obtain venous blood samples to enable the measurement of the HbA1c level. The HbA1c measurement for the last 3 months were obtained from the medical records. If it was not available, venous blood sample for was taken to measure the HbA1c level on the same day. HbA1c provides a better reflection of chronic glucose exposure (of up to 3 months) and correlates well with diabetes-related complications. (Kahlon & Pathak, 2011; Yan et al., 2015). Among non-diabetics, the HbA1c level is <5.6%,

while among the diabetics the HbA1c is >6.3%. In this study, participants with HbA1c<6.5% were categorized as having good glycemic control while those with ≥6.5% were categorized as having poor glycemic control (Feisul et al., 2014).

7. Lipid profile test - The lipid profile test result of the patient was obtained from the clinical notes. In this test, the total cholesterol and triglyceride levels were measured. This test required the patient to fast for at least 8 hours overnight before a venipuncture was performed the next morning as this test required a venous blood sample. According to Malaysia's Clinical Practice Guideline for the management of type 2 diabetes, among diabetics, the desirable total cholesterol value was <5.2mmol/L while the desirable triglyceride level was <1.7mmol/L (Ministry of Health Malaysia, 2009). In this study, the participants were categorized as having good lipid profile when both the total cholesterol and triglyceride levels were <5.2mmol/L and <1.7mmol/L respectively. The total cholesterol and triglyceride measurement for the last 3 months were obtained from the medical records. If it was not available, venous blood sample for lipid profile was taken on the same day for patients who came fasted. For those who were not fasted, they were given an appointment for blood taking on a later date.

8. Diabetes related complications - The information regarding the complication of diabetes was obtained from the clinical notes. Complications of diabetes include diabetic foot, retinopathy, nephropathy, stroke and ischemic heart disease. Patients are routinely screened for foot ulcers during each visit and between 2 to 3 times a year

for nephropathy. They are annually assessed for retinopathy, ischemic heart disease and peripheral neuropathy.

9. Medication - The information regarding the type of medication prescribed was obtained from the clinical notes. In this study, the medication of interest were hypoglycemic agents, antihypertensive medications, lipid lowering agents and anti-platelet medication as these are the commonly prescribed among diabetics (Ministry of Health Malaysia, 2009).

3.11 Data collection

Prior to data collection in the health clinics in the Districts of Hulu Selangor, clearance and approval from the relevant authorities were obtained. The steps in gaining approval from the relevant authorities are stated below;

1. Study proposal being supported by the panel of lecturers.
2. Obtaining the ethical clearance and approval from the UM Research Centre.
3. Obtaining the permission and approval from the respective health clinics, Hulu Selangor District Health Office, and the Selangor State Health Department
4. Final approval from the NMRR. The approval letter from the NMRR was forwarded to the Selangor State Health Department, the Hulu Selangor District Health Office and the relevant health clinics.

For this study, an interviewer administered questionnaire was used. Four interviewers were involved in data collection. Prior to data collection, the interviewers were trained on how to conduct the interviews to reduce bias and increase reliability. Some of the guidelines which were adhered to by the interviewers were;

1. Introduce themselves, to explain the aim of the study and to obtain the participant's consent.
2. Dress appropriately and look pleasant
3. Be confident in approaching the participant and able to keep them interested during the interview
4. Ask question strictly as in the questionnaire
5. Complete all the questions in the questionnaire.
6. Not to provide cues to answer

There are many advantages of an interviewer administered questionnaire. An interviewer administered questionnaire allows;

1. Longer questionnaire to be answered with lesser "non-completed" returns
2. Increases response rate
3. Able to assess patients psychosocial expression when answering questionnaire
4. Allows for participation of those who cannot read or write

3.12 Data entry

In this study, Microsoft Excel and IBM SPSS version 20 software were used. First, all data were double entered using Microsoft Excel. Two identical templates were created in Microsoft Excel. Two individuals were assigned to enter the data separately using the same template. Complete and correct data were exported to SPSS for analyses.

3.13 Data cleaning and preparation

Data was cleaned prior to analysis. Data cleaning involved identifying missing values or possible wrong values. This was achieved by using the frequency command in the SPSS program to determine any missing values and looking at the measure of central tendency to detect any out of range values. In the data view of the SPSS program, input variables were arranged in ascending and descending order to identify any possible out of range values. Data preparation involved assessing the regression assumptions; the linear relationship between independent and dependent variables, multivariate normality, no multi-collinearity between independent variable, no autocorrelation, and homoscedasticity. Linear relationship between the predictor variable and outcome variable was tested with scatter plots. Multivariate normality was tested with the inspection of the histogram and distribution (mean, mode, median, skewness, and kurtosis). For non-normally distributed data, the regression equations were modelled with and without outlier data to identify any influential data. Appendix A shows the scatter plots, histograms, distribution statistics and the regression equations of the variables included in the regression analysis.

3.14 Statistical Analysis

Data analysis started with the evaluation of baseline characteristics of responder and non-responder. Continuous variables were described as mean ± standard deviation, while categorical variables were described as frequencies and percentages. Differences in continuous data were tested using either t-test or ANOVA. Differences in categorical data were measured using Chi square statistics. The significance level, p was set at <0.05.

To answer objective 2, reliability analysis and factor analysis were performed on the DDS, DES and CIRS questionnaire.

Reliability analysis

Reliability analysis of the translated was estimated via internal consistency (inter-item correlations, corrected item total correlations (CITC), and the Cronbach's alpha values), and the test-retest reliability.

Internal consistency

Internal consistency indicates the ability of the items in an instrument to measure a similar construct. A good internal consistency model must have several properties.

1. The Cronbach's alpha describes the extent to which all the items in a test measure the same concept or construct. It is expressed as a number between 0 and 1. Value of >0.7 is considered as good (Tavakol & Dennick, 2011).
2. The inter item correlation describes information about the correlation of each item with the remaining items. An acceptable value for the inter item correlation is 0.3-0.9. Low values indicate that the item is poorly correlated with each other while high value might indicate poor discriminance between items (van Leeuwen, Tiesinga, Middel, Post, & Jochemsen, 2009).
3. The corrected item total correlations (CITC) is the correlation of the designated item with the summated score for all other items. The acceptable value is >0.3. A low corrected item total correlations (CITC) means the item is little correlated with the overall scale and needs to be excluded from the scale (Gliem & Gliem, 2003).

Test-Retest Analyses

The test-retest reliability examines the stability and consistency of a measure over time. It refers to the temporal stability of a measurement from one measurement session to another. A questionnaire with adequate test-retest reliability will produce similar results while the individual remains in a steady state. In this study, 24 patients agreed for test-retest. The patients were given the same questionnaires to answer one week apart. The questionnaires were either personally delivered to the participants or posted to them. The home and working site of those involved in the test-retest were close enough for the questionnaire to be delivered personally.

For the test retest analysis, the Spearman's rho correlation coefficient and intraclass correlation coefficient (ICC) were measured. The Spearman's rho measures the association between two variables. For the purpose of test retest, the Spearman's rho acts as a measure of consistency. It is a non-parametric measure that avoids assumptions that the variables have a linear relationship and can be used when one or both measures are measured on an ordinal scale (McDonald, 2014). It can also be used for non-normally distributed data. The values for the Spearman's rho lies between -1 and +1, similar to its parametric counterpart, the Pearson correlation. Unlike the Pearson correlation, the Spearman's rho refers to the ranked values rather than the original measurements. A value of 0 indicates no association at all, while a value of either positive or negative 1 indicates perfect positive or negative association (Mukaka, 2012). Table 3.2 describes the value and strength of the Spearman's rho statistics (Mahtab, 2015).

Table 3.2 : Spearman's rho values and strength of association

Spearman's rho	Strength of association
0 - < 0.2	Very weak
0.2 - < 0.4	Weak
0.4 - < 0.6	Moderate
0.6 - < 0.8	Strong
0.8 – 1.0	Very strong

The ICC is a measure of agreement. The ICC value ranges from "0 = totally unreliable" to "1= perfectly reliable" (Al-Dubai, Alshagga, Rampal, & Sulaiman, 2012). Interpretation of the ICC value is shown in Table 3.3 (C. L. Tan et al., 2015).

Table 3.3 : ICC values and strength of agreement

ICC (Intraclass Correlation Coefficient)	Agreement
ICC > 0.75	Good agreement
ICC 0.5 – 0.75	Moderate agreement
ICC < 0.5	Poor agreement

Factor analysis

Factor Analysis is a statistical method commonly used during instrument development to cluster items into common factors. Generally, given a set of items, factor analysis can be used to test the underlying structures. In social research, concepts are often defined apriori and operationalized using several items. In such cases, factor analysis can be used to test the dimensionality of the items in the construct. Factor analysis can also be used as a data reduction technique (reducing number of unnecessary items) and to test proposed theories (Taherdoost, Sahibuddin, & Jalaliyoon, 2014). A good factor analytical model must have several properties. In this study, the guidelines provided by Hair et al. (2010) were used.

1. The correlation values between the items must be adequate. The maximum correlation value for an item with at least one other item in the construct must be

between 0.3 and 0.9. Values less than 0.3 indicates that the item does not converge in the construct, hence should be dropped. On the other hand values, more than 0.9 indicates lack of discriminance between the two items. Hence it is better to drop either one.

2. The Kaiser-Meyer-Olkin (KMO) value must be checked. KMO is a measure of sampling adequacy. The following are the interpretations of KMO values:
   Less than 0.5, Poor
   0.5 to less than 0.6, Mediocre
   0.6 to less than 0.7, Acceptable
   0.8 and above, Excellent

3. Factor loadings (FL) are the standardized regression weights between the latent construct correlation and the items. Ideally, the values must be more than 0.7, but not less than 0.5.
4. Average variance extracted (AVE) is the average of the squared FL values. It is one of the measures of convergence validity of the items in the construct. The preferred values are more than 50%. When some of the FL values are less 0.7, the AVE value can be less than 50%.
5. When there are subdomains, the correlation values between constructs should not be too high. Correlation values of more than 0.85 indicate lack of discriminant validity between constructs.

For objective 3, correlation analysis was used to determine the correlation strength between self-care scores and HbA1c levels. The HbA1c level was modelled using linear regression. In addition, glycaemic control was also defined as good (<6.5%) and poor (≥6.5%). Logistic regression was used to model glycaemic control.

For objective 4, correlation analysis was used to determine the correlation strength between knowledge scores with self-care scores and HbA1c level. Self-care score and HbA1c level were modelled using linear regression. In addition, self-care score was defined as good (≥4) and poor (<4). Glycaemic control was also defined as good (<6.5%) and poor (≥6.5%). Logistic regression models were used to model self-care practice and glycaemic control, respectively.

For objective 5, correlation analysis was used to determine the correlation strength between psychosocial scores (support/empowerment/self-efficacy/distress /depression) and self-care scores. Self-care score was modelled using linear regression. In addition, self-care score was also defined as good (≥4) and poor (<4). Logistic regression was used to model self-care practice into good and poor.

For objectives 3, 4, and 5, the multivariable linear regression models and multivariable logistic regression models were adjusted for age (years), sex (male/female), race (Malay/Chinese/Indian), education level (Primary/Secondary/Tertiary), insulin injection (yes/no) and clinic location (KK Serendah/KK Ulu Yam Bharu/KK Rasa/KK Soeharto/KK Kalumpang/KK Selisek), respectively.

For objective 6, pathways between the selected variables were conceptualized based on the articles from the review. The direct effects (age and self-care, duration of diabetes and self-care, sex and self-care, education level and self-care, knowledge and self-care, support and self-care, empowerment and self-care, self-efficacy and self-care, distress and self-care, depression and self-care, duration of diabetes and empowerment, duration of diabetes and self-efficacy, duration of diabetes and knowledge, age and empowerment, knowledge and empowerment, knowledge and self-efficacy, depression and self-efficacy, distress and depression, support and depression, support and self-efficacy) and indirect effects (social support to self-care via self-efficacy, depression to self-care via self-efficacy) between the variables were tested using structural equation modelling. Structural equation modelling is a second generation multivariate data analysis that allows researchers to model, simultaneously estimate and test complex theories with empirical data (Haenlein & Kaplan, 2004). The partial least square method of structural equation modelling (PLS-SEM) is a prediction oriented approach with no assumption about data distribution (Sarstedt, Ringle, Smith, Reams, & Hair, 2014). For every relationship in the conceptual model, the path coefficient was estimated via the PLS Algorithm command while the significance level was determined via the Bootstrapping command. The number of bootstrap samples was set at 500. The two-sided significance level, α, was set at <0.05. Figure 3.1 refers to the path model diagram of the association between age, sex, education, diabetes duration, knowledge, psychosocial factors and diabetes self-care.

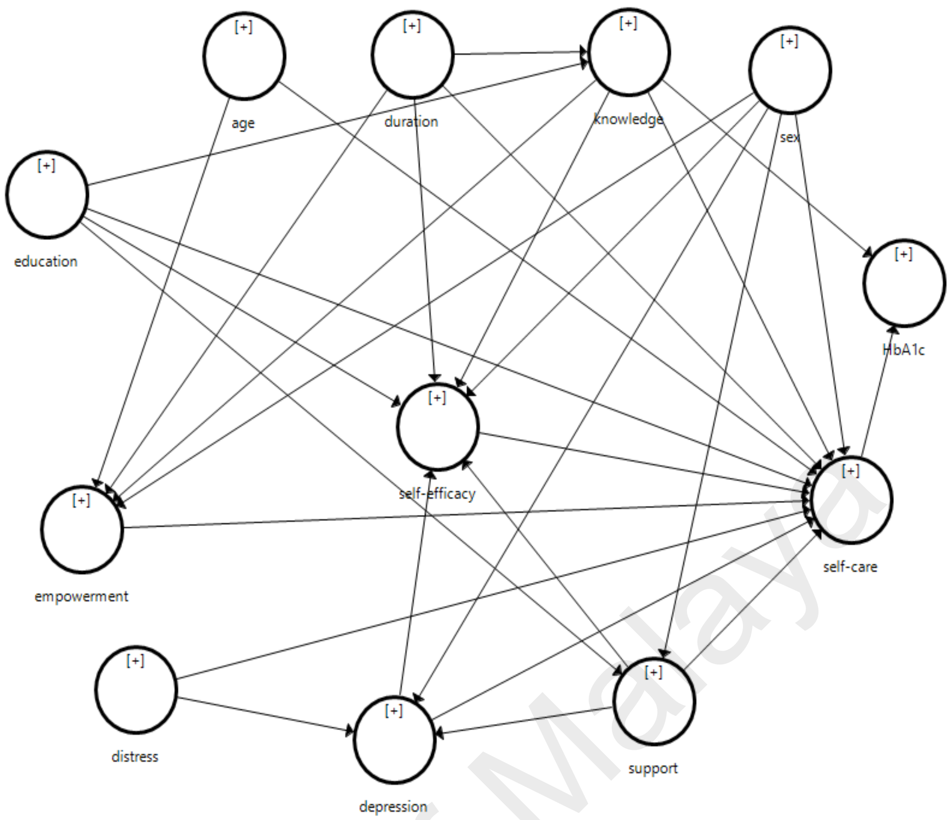


Figure 3.1 : Path model of the association between age, sex, education, diabetes duration, knowledge, psychosocial factors and diabetes self-care.

3.15 Instruments

Some of the criteria which were applied in choosing the tools or questionnaires were;

1. Relevant
2. Short and simple
3. Reliable and validated
4. Have been applied across heterogeneous community
5. If possible, previously translated and validated in the Malay language

The questionnaires selected are described below.

1. MDKT (Michigan Diabetes Knowledge Test) Malaysian version - The MDKT (Michigan Diabetes Knowledge Test) Malaysian version has 14 items. Each item has multiple choices of answers, with only 1 being correct. For every correct answer, a score of 1 was given. There is no negative scoring for wrong answers or unanswered questions. The questionnaire is scored by calculating the total score of all 14 items. The possible score ranges from 0 to 14, and the knowledge level is categorized as poor (MDKT < 7), average (MDKT 7–11) or good (MDKT > 11) (HK Al-Qazaz, 2010). The Cronbach's alpha of the original English version was >0.7 while the Cronbach's alpha of the Malaysian version was 0.702, with a test-retest value of 0.894 (J. T. Fitzgerald et al., 1998; HK Al-Qazaz, 2010).
2. CIRS (Chronic Illness Resources Survey) - The CIRS (Chronic Illness Resources Survey) assesses support and resources from 7 domains; family and friends, health care providers, the neighbourhood, the community, organizations, the workplace, and media and policy. The CIRS (Chronic Illness Resources Survey) scale has 22 items. Each item is measured on a Likert Scale of 1-5, with 1 being "Not at all" while 5 being "A great deal". The CIRS scale allows the measurement of overall

support or support from each domain. The total score of all items is divided by the total number of items in the scale to assess overall support. Similarly, to assess support for individual domains, the total score of the items in the domain is divided by the number of items in the domain. The possible score of this scale is between 1 to 5. The higher the score, the higher the perceived support. The Cronbach's alpha of the original English CIRS subscales ranged from 0.71 to 0.91 (Russell E. Glasgow, 2000).

3. DDS (Diabetes Distress Scale) - The DDS (Diabetes Distress Scale) has 17 items, encompassing four domains of diabetes distress; emotional burden, physician related distress, regiment related distress and interpersonal distress. Each item is measured on a Likert Scale from 1-6. Higher values indicate more distress. The DDS allows overall distress or distress within the respective domain to be measured. The score of all items are summed up and divided by the total number of items to assess overall diabetes distress. Similarly, to assess distress for individual domains, the scores of all items within the domain are summed up and divided by the number of items within that domain. The possible score of this scale is between 1 to 6. Scores of 3 or more are considered as an indication of distress. The Cronbach's alpha for the original DDS subscales ranged from 0.88 to 0.90 (Wlliam H. Polonsky, 2005).
4. DES (Diabetes Empowerment Scale) - DES, an 8-item questionnaire, was used to measure the patient's self-empowerment level related to managing the psychosocial aspects of diabetes. Each item is measured on a Likert scale of 1 to 5, where a response of 1 indicates strong disagreement to the self-empowerment statement, while a response of 5 indicates strong agreement. The DES questionnaire is scored by dividing the total score of all items with the number of total items. The possible score of this scale was between 1 to 5. A higher score is

associated with better self-empowerment. The Cronbach's alpha of the original English version was 0.85 (Robert M. Anderson, Fitzgerald, Gruppen, Funnell, & Oh, 2003).

5. PHQ-9 (Patient Health Questionnaire) Malay version - The Patient Health Questionnaire-9 (PHQ-9) is a self-report measure to screen for depression, consisting of 9 questions with each item being scored from 0 to 3. The PHQ-9 is scored by calculating the total score of all 9 items. The PHQ-9 score ranges from 0 to 27, with the scores of 5, 10, 15, and 20 representing mild, moderate, moderately severe, and severe levels of depression (M S Sherina, 2012). The original English version with a Cronbach's alpha of 0.85 had a sensitivity of 88% and a specificity of 88% for major depression (Adewuya, Ola, & Afolabi, 2006; Kroenke, Spitzer, & Williams, 2001). The Malay version with a Cronbach's alpha of 0.7 had a sensitivity of 87% and a specificity of 82% for major depression (M S Sherina, 2012).
6. DMSE (Diabetes Management Self efficacy) Malay version - The DMSE (Diabetes Management Self efficacy) Malay version has 14 items and measures self-efficacy in 4 major areas; diet, exercise, medication adherence and blood glucose control. Each item is scored between 0 to 10. The scale is scored by summing up the score of all 14 items. The total DMSE score ranges from 0 to 140. Higher score indicates better self-efficacy. There is no scoring for individual areas of self-efficacy. The Cronbach's alpha of the original English version was 0.81 with the test retest reliability, r=0.79. The Cronbach's alpha of the Malay version was > 0.8 (Bijl, Poelgeest-Eeltink, & Shortridge-Baggett, 1999; Sharoni & Wu, 2012).
7. SDSCA (Summary of Diabetes Self Care Activities) Malay version - The SDSCA (Summary of Diabetes Self Care Activities) Malay version has 12 items. It

measures five areas of diabetes self-care; exercise, diet, adherence to medication, blood glucose testing and foot care. Each area of diabetes care has a varying number of items. Every item measures the number of days each diabetes self-care activities were practiced in the last seven days and is scored between 0 to 7. For assessment of overall diabetes self-care, the mean score of all 12 items was calculated. Similarly, to assess self-care for individual areas of diabetes care, the score of all items within the respective areas of diabetes care was divided with the corresponding number of items. The possible score of this scale was between 0 to 7. Higher score indicates better self-care. Scores of 4 and above were considered as good practice. The Cronbach's alpha of the Malay SDSCA was 0.735 (Jalaludin MY, 2012).

3.16 Translation of questionnaires

All the questionnaires used in this study were originally developed in the English language. Four of the questionnaires have been translated into the Malay language and have been validated in Malaysia. Questionnaires which have been translated into the Malay language and validated were;

1. SDSCA (Summary of Diabetes Self Care Activities)
2. MDKT (Michigan Diabetes Knowledge Test)
3. PHQ-9 (Patient Health Questionnaire)
4. DMSE (Diabetes Management Efficacy Scale)

Three questionnaires which have not been translated and validated into the Malay language were

1. DDS (Diabetes Distress Scale)
2. DES (Diabetes Empowerment Scale)

3. CIRS (Chronic Illness Resources Survey)

For this study, the English version of the DDS (Diabetes Distress Scale), DES (Diabetes Empowerment Scale) and CIRS (Chronic Illness Resources Support) were translated into the Malay language and validated.

A forward translation of the English versions of the DDS, DES and CIRS scales into the Malay language was done by three individuals. All three were native speakers of the Malay language; two were certified translators, and the third was a medical personnel. A medical personnel was chosen as the third translator to ensure the translations were appropriate conceptual ones instead of word for word translation. The WHO (World health Organization) stated that at least one of the translator, who is familiar with the terminology must be involved in a translation (WHO, 2014).

All three copies of the forward translation of the DDS, DES, and CIRS scale were reviewed by a panel consisting of the investigator, two clinicians and two pharmacists. The translations which were deemed as most appropriate and conveyed the original concept of the questions were chosen. The finalized forward translations of all three questionnaires were then reviewed by two physicians, two diabetes educators, two medical assistants and four diabetic patients for content validity. This was to ensure that the final translation was applicable in the local setting. All issues regarding the questionnaire were discussed, and appropriate amendments were made. The panel which reviewed the questionnaires unanimously agreed that they were acceptable for use in the local setting and the items were relevant. Then a backward translation into the source language was done by a freelance translator and an English school teacher. The backward translation was reviewed by the panel and considered to be acceptable.

3.17 Pre-test of DDS, DES, and CIRS

The questionnaire was pre-tested among 16 type 2 diabetic patients from the target population. The pre-test dealt with issues such as time needed to answer the questionnaire, the clarity of the items, the appropriateness of the number of items in the questionnaire and the best method to collect data. Pre-test showed that the time needed to answer the questions was about 1 hour. During the pre-test, the investigator interviewed 10 patients while 6 patients self-administered the questionnaire. Missing data was observed among those who self-administered the questionnaire. Upon further questioning, all the participants preferred to be interviewed instead of self-administering the questionnaire.

3.18 Pilot test of DDS, DES, and CIRS

The questionnaire was pilot tested among 48 type 2 diabetic patients at Klinik Kesihatan Rasa and Klinik Kesihatan Serendah. For the pilot test, a universal sample was recruited.

Table 3.4 refers to the basic socio demographic and health related variables of the respondents in the pilot test. The mean age of the study participants was 54.5 ± 9.4 years old, with a range of 37 to 76 years old. Among the participants, 15 (31.2%) were males while 33 (68.8%) were females. The majority of participants were Malays (70.8%), followed by Indians (16.7%) and Chinese (12.5%). In terms of the level of education, 47.9% of the participants had primary education only, followed by 39.6% with secondary education and 12.5% with tertiary education level. The mean duration of diabetes among the respondents was 5.8 ± 3.9 years, with a range of 2 to 18 years.

Table 3.4 : Sociodemographic variables of participants in pilot study

Variables	n (%) or Mean ± SD
Age	54.48 ± 9.39
Duration of diabetes (yrs)	5.77 ± 3.86
Sex	
Male	15 (31.2%)
Female	33 (68.8%)
Ethnicity	
Malay	34 (70.8%)
Chinese	6 (12.550
Indian	8 (16.7%)
Education level	
Primary education	23 (47.9%)
Secondary education	19 (39.6%)
Tertiary education	6 (12.5%)

Total participants = 48

3.19 Reliability Analysis of DDS, DES, and CIRS

3.19.1 Internal consistency of the Malay version of the Diabetes Distress Scale

Table 3.5 shows the number of items, inter-item correlations, corrected item total correlations (CITC) and the Cronbach's alpha values from the reliability analysis of each domain of the Diabetes Distress Scale. For all domains, the inter-item correlation values were between 0.3-0.9, the minimum CITC values were more than 0.3 and the Cronbach's alpha values were more than 0.7. Hence, the items in each domain had sufficient internal consistency.

Table 3.5 : Internal consistency result for the Malay version of the Diabetes Distress Scale

Diabetes Distress scale	Inter item correlation	Corrected item total correlation	Cronbach alpha	Number of items	
				Initial	Final
Emotional Burden	0.362 – 0.780	0.619 – 0.792	0.871	5	5
Physician Related	0.303 – 0.793	0.467 – 0.742	0.819	4	4
Regimen Related	0.351 – 0.835	0.512 – 0.812	0.877	5	5
Interpersonal	0.653 – 0.814	0.780 – 0.850	0.887	3	3

Total participants = 48

3.19.2 Test-Retest reliability of the Malay version of the Diabetes Distress Scale.

Table 3.6 shows the results from the test-retest analysis for the Malay version of the Diabetes Distress Scale. The Spearman's rho for the individual domains ranged from 0.727 to 0.776. All the Spearman's rho value were >0.6, which means good consistency. The ICC values for the individual domains ranged from 0.801 to 0.868. The ICC values were above 0.75, indicating good agreement. Thus, the Malay version of the Diabetes Distress Scale was considered as reliable.

Table 3.6 : Test–Retest reliability of the Malay version of Diabetes Distress Scale

Domain	Number of items	Spearman's rho	ICC (Intra-class correlation)
Emotional distress	5	0.727	0.868
Physician related distress	4	0.755	0.803
Regimen related distress	5	0.728	0.801
Interpersonal distress	3	0.776	0.802

Total participants = 48

3.19.3 Internal consistency of the Malay version of the Chronic Illness Resources Survey

Table 3.7 shows the number of items, inter-item correlations, corrected item total correlations (CITC) and the Cronbach's alpha values from the reliability analysis of each domain of the Chronic Illness Resources Survey. For Health Care, Personal, Neighborhood, Organization and Work domains, the inter-item correlation values were between 0.3-0.9, the minimum CITC values were more than 0.3 and the Cronbach's alpha values were more than 0.7. Hence the items in each domain had sufficient internal consistency.

However, in the "Family and Friends" domain, the correlation between two items: "*Have you shared healthy low-fat recipes with friends or family members"* and *"Family or friends bought food or prepared food for you that were especially healthy or recommended*" was more than 0.9, indicating lack of discriminance between these two items. The item "*Have you shared healthy low-fat recipes with friends or family members"* was excluded. For the "Media/Policy" domain, three items: *"Have you read articles in newspapers or magazines about people who were successfully managing a chronic illness", "Have you had health insurance that covered most of the costs of your medical needs including medicine"* and *"Have you seen billboards or other advertisements that encouraged not smoking, low-fat eating or regular exercise"* had very poor correlation between them. The Cronbach's Alpha was less than 0.7. This domain was excluded.

Table 3.7 : Internal consistency results for the Malay version of the Chronic Illness Resources Survey

Chronic Illness Resources Survey subscales	Inter item correlation	Corrected item total correlation	Cronbach alpha	Number of items	
				Initial	Final
Health Care	0.702 – 0.726	0.761 – 0.803	0.885	3	3
Family and Friends	0.610 – 0.923	0.642 – 0.881	0.788	3	2
Personal	0.718 – 0.885	0.840 – 0.905	0.921	3	3
Neighbourhood	0.348 – 0.640	0.458 – 0.686	0.767	4	4
Media/Policy	0.059 – 0.238	0.156 – 0.355	0.382	3	excluded
Organization	0.393 – 0.672	0.473 – 0.706	0.710	3	3
Work	0.547 – 0.884	0.598 – 0.845	0.854	3	3

Total participants = 48

3.19.4 Test-Retest Reliability of the Malay version of the Chronic Illness Resources Support scale

Table 3.8 shows the results from the test-retest analysis for the Malay version of the Chronic Illness Resources Survey scale. The Spearman's rho for the individual domains ranged from 0.633 to 0.906. All domains had a Spearman's rho of above 0.6 which meant that all domains had good consistency. The ICC values for all the domains ranged from 0.798 to 0.961, all being >0.75 indicating good agreement. Thus, the Malay version of CIRS was considered as being reliable.

Table 3.8 : Test–Retest reliability of the Malay version of Chronic Illness Resource Survey

Domain	Number of items	Spearman's rho	ICC (Intra-class correlation)
Healthcare support	3	0.633	0.843
Family and friends support	2	0.653	0.798
Interpersonal support	3	0.662	0.822
Neighbourhood support	4	0.720	0.877
Organisation support	3	0.806	0.917
Workplace support	3	0.906	0.961

Total participants = 48

3.19.5 Internal consistency the Malay version of the Diabetes Empowerment Scale

Table 3.9 shows the number of items, inter-item correlations, corrected item total correlations (CITC) and the Cronbach's alpha values from the reliability analysis of the

Diabetes Empowerment Scale. One item had an inter item correlation of more than 0.9, indicating lack of discriminance and was excluded. The final 7 item inter-item correlation values were between 0.3-0.9, the minimum CITC value was more than 0.3 and the Cronbach's alpha values was more than 0.7. Hence the items in this construct had sufficient internal consistency.

Table 3.9 : Internal consistency results for the Malay version of the Diabetes Empowerment Scale.

Empowerment	Inter item correlation	Corrected item total correlation	Cronbach alpha	Number of items	
				Initial	Final
Empowerment	0.702 – 0.726	0.761 – 0.803	0.888	8	7

Total participants = 48

3.19.6 Test-Retest reliability of the Malay version of the Diabetes Empowerment Scale.

Table 3.10 shows the results of the test-retest analysis for the Malay version of the Diabetes Empowerment Scale. The Spearman's rho value was 0.777, which meant it had good consistency. The ICC was 0.918, which meant that the agreement was good. Thus, the Malay version of the DES was considered as reliable.

Table 3.10 : Test–Retest reliability of the Malay version of Diabetes Empowerment Scale

Domain	Number of items	Spearman's rho	ICC (Intra-class correlation)
Empowerment	7	0.777	0.918

Total participants = 48

3.20 Finalization of the questionnaire

Table 3.11 shows the summary of the measures used and their respective number of items in the pilot study and actual data collection. The number of items in the questionnaire was finalized as per finding of the pilot study. The SDSCA, MDKT, DMSE, and PHQ-9 were available in the Malay version. The DDS-17, DES and CIRS questionnaires were not available in the Malay language, and thus underwent translation, pre-test, pilot testing and reliability analysis. For the actual data collection, the final number of items for the Malay version of the DDS, DES, and CIRS were 17, 7 and 18 respectively.

Table 3.11 : Summary of items in the questionnaires used during pilot study and actual data collection

Questionnaire	Domains measured	Number of items in pilot test	Number of items included in actual data collection
SDSCA	Self-care	12	12
MDKT	Knowledge	14	14
DMSE	Self-efficacy	14	14
PHQ-9	Depression	9	9
DDS-17	Distress	17	17
DES	Empowerment	8	7
CIRS	Support	22	18
Total number of items in questionnaire		96	91

Total participants = 48

CHAPTER 4: RESULTS

4.1 Chapter overview

There are two sections in this chapter. The first section describes the factor analysis results of the Malay DDS, Malay DES and Malay CIRS questionnaires. It then continues to discuss the finding of the reliability analysis and factor analysis. The second section begins by comparing the baseline characteristics between responders and non-responders. The characteristics of the study participants are then described. This chapter than continues to answer the study objectives.

Section 1

4.2 Factor analysis of DDS, DES, and CIRS

4.2.1 Factor analysis of the Diabetes Empowerment Scale (DES)

Table 4.1 and Table 4.2 refers to the factor loadings and the findings of the factor analysis for the concept of diabetes empowerment. There were 7 items in this construct. Each item was measured on a Likert scale of 1 to 5, where a response of 1 indicates low level of empowerment, while a response of 5 indicates high level of empowerment. Based on the Eigen value of ≥ 1 and the scree plot, only 1 factor was extracted. The minimum factor loading was 0.633. The KMO value was 0.898, which was considered to be excellent. The AVE value was 60% and the Bartlett's test of sphericity was significant, $p<0.001$

Table 4.1 : Factor loadings of items for the concept of diabetes empowerment

Domain	Communalities	Items	Factor loading
Empowerment	0.400	Item 1	0.633
	0.630	Item 2	0.794
	0.553	Item 3	0.744
	0.686	Item 4	0.828
	0.580	Item 5	0.762
	0.691	Item 6	0.831
	0.675	Item 7	0.822
Eigen			4.216

Total participants = 371

Table 4.2 : Factor analysis findings for the concept of diabetes empowerment

Variables	Values
KMO (Kaiser-Meyer-Olkin) value	0.898
AVE (Average variance extracted)	60%
Bartlett's test of sphericity	p<0.001
Items	7

Total participants = 371

4.2.2 Factor analysis of the Diabetes Distress Scale (DDS)

Table 4.3 and Table 4.4 refers to the factor loadings and the findings of the factor analysis for the concept of diabetes distress. The original English version of the Diabetes Distress Scale has 4 domains; Emotional burden, Physician related distress, Regimen related distress and Interpersonal distress. There were 17 items in this construct. Each item was measured on a Likert scale of 1 to 6, where a response of 1 indicates low level of distress, while a response of 6 indicates high level of distress. Based on the Eigen value of ≥ 1 and the scree plot, 4 factors were extracted. The minimum factor loading was 0.459. The KMO value was 0.911, which was considered to be excellent. The AVE value was 68% and the Bartlett's test of sphericity was significant, p<0.001. The factors extracted however did not correspond the original domains of the scale.

Table 4.3 : Factor loadings of items for the concept of diabetes distress

Domain	Items	Communalities	Factor loading			
			Factor 1	Factor 2	Factor 3	Factor 4
Emotional burden	Item 1	0.743				0.752
	Item 3	0.667				0.573
	Item 8	0.662		0.699		
	Item 11	0.439				0.459
	Item 14	0.683	0.610			
Physician related distress	Item 2	0.714			0.773	
	Item 4	0.637			0.612	
	Item 9	0.751			0.783	
	Item 15	0.575	0.655			
Regimen related distress	Item 5	0.718		0.725		
	Item 6	0.764		0.744		
	Item 10	0.720			0.553	
	Item 12	0.635				0.703
	Item 16	0.758	0.746			
Interpersonal distress	Item 7	0.691		0.733		
	Item 13	0.655	0.623			
	Item 17	0.758	0.763			
Eigen			8.277	1.206	1.083	1.004

Total participants = 371

Table 4.4 : Factor analysis findings for the concept of diabetes distress

Variables	Initial
KMO (Kaiser-Meyer-Olkin) value	0.911
AVE (Average variance extracted)	68%
Bartlett's test of sphericity	p<0.001
Items	17

Total participants = 371

4.2.3 Factor analysis of the Chronic Illness resources Survey scale (CIRS)

Table 4.5 and Table 4.6 refers to the factor loadings and the findings of the factor analysis for the concept of support. Six domains of the English version of the Chronic Illness Resources Survey scale (CIRS); Health Care support, Family and Friends support, Personal support, Neighbourhood support, Organisational support and Work Place support underwent factor analysis. There were 18 items in this construct. Each item in these domains were measured on a Likert scale of 1 to 5, where a response of 1 indicates low level of support, while a response of 5 indicates high level of support. Based on the Eigen value of ≥ 1 and the scree plot, 4 factors were extracted. The minimum factor loading was 0.650. The KMO value was 0.857 which was considered to be excellent. The AVE value was 73% and the Bartlett's test of sphericity was significant, p<0.001. The factors extracted however did not correspond the original domains of the scale.

Table 4.5 : Factor loadings of items for the concept of social support

Domains	**Items**	**Communalities**	**Factor loading**			
			Factor 1	**Factor 2**	**Factor 3**	**Factor 4**
Healthcare support	Item 1	0.798			0.891	
	Item 2	0.846			0.919	
	Item 3	0.826			0.903	
Family and friends support	Item 4	0.516	0.650			
	Item 5	0.572	0.699			
Personal support	Item 6	0.722	0.834			
	Item 7	0.750	0.861			
	Item 8	0.773	0.876			
Neighbourhood support	Item 9	0.701	0.807			
	Item 10	0.615	0.721			
	Item 11	0.638	0.784			
	Item 12	0.606	0.716			
Organizational support	Item 13	0.833		0.873		
	Item 14	0.890		0.900		
	Item 15	0.889		0.903		
Workplace support	Item 16	0.855				0.894
	Item 17	0.848				0.918
	Item 18	0.852				0.917
Eigen			7.206	3.128	2.334	1.327

Total participants = 371

Table 4.6 : Factor analysis findings for the concept of social support

Variables	**Initial**
KMO (Kaiser-Meyer-Olkin) value	0.857
AVE (Average variance extracted)	73%
Bartlett's test of sphericity	p<0.001
Items	18

4.3 Discussion

In the development of the Malay DDS, Malay DES and Malay CIRS questionnaires, rigorous multistep forward translation, back translation and pretesting were performed to produce a translation which was not only semantically correct but was culturally acceptable without losing its original context and information (Borsa, Damásio, & Bandeira, 2012). In this study, the forward translation and back translation were performed as suggested by the World Health Organization (WHO, 2014).

The internal consistency of the Malay DDS subscales were good ranging from 0.819 to 0.887. The internal consistency for the original DDS subscales ranged from 0.88 to 0.90 (Polonsky et al., 2005). The internal consistency of the Malay DDS subscales were comparable to the Indonesian version, Thai version, Chinese version, Norwegian version and the Mexican version with the internal consistency of the subscales ranging from between 0.78 to 0.96 (Farm et al., 2017; Graue et al., 2012; Martinez-Vega, Doubova, Aguirre-Hernandez, & Infante-Castañeda, 2016; Thanakwang et al., 2014; Ting et al., 2011). The stability of the Malay DDS was measured using the Spearman's rho and intra-class correlation which were deemed good (Mahtab, 2015; C. L. Tan et al., 2015). The intra-class correlation for the Malay DDS subscales were above 0.8, better than the Norwegian and Chinese versions of 0.74 and 0.76 respectively (Graue et al., 2012; Ting et al., 2011). This may have been due to the shorter retest period in this study.

Though the exploratory factor analysis extracted 4 factors similar to the original scale, it did not support the allocation of some of the items according to the original subscales. Similar findings were reported in the Thai version (Farm et al., 2017), Danish version (Joensen, Tapager, & Willaing, 2013) and the Norwegian version (Graue et al., 2012). In the Chinese and Mexican versions, only 3 factors were extracted via exploratory factor analysis (Martinez-Vega et al., 2016; Ting et al., 2011). Some authors have re-categorized the items and renamed the subscales. The original DDS allows the measurement of overall distress and its subdomains. In this study, in view of the misallocation of the items into its subscales, only overall distress was measured for statistical analysis.

The internal consistency of the Malay DES was 0.88 and considered to be good. The internal consistency of the original English DES was 0.84 (Robert M. Anderson et al., 2003). The internal consistency of the Malay DES was better than the Brazilian version which reported a value of 0.634 (Chaves, Reis, Pagano, & Torres, 2017). Apart from the translation into the Brazilian language, there was no other literature concerning the DES translated into any other languages.

The Spearman's rho and intra-class correlation for the Malay DES were 0.777 and 0.918 respectively, better than the Brazilian version which were 0.478 and 0.50 respectively (Chaves et al., 2017) and was considered as good (Mahtab, 2015; C. L. Tan et al., 2015). The exploratory factor analysis extracted 1 factor similar to the original scale. Similar result was reported by the Brazilian version (Chaves et al., 2017).

The Media/Policy subscale of the Malay CIRS was excluded because of the poor internal consistency, Cronbach alpha =0.38. The remaining health care, family and friends, personal, neighbourhood, organization and work domains of the Malay CIRS were retained as the internal consistency were good ranging from 0.710 to 0.921. The internal consistency of the original English CIRS subscales ranged from 0.71 to 0.91 (Glasgow, Strycker, Toobert, & Eakin, 2000). The internal consistency of the Malay CIRS subscales were generally higher than the Chinese version (0.611 to 0.851) and Spanish version (0.41 to 0.83) (Eakin et al., 2007; H. Zhong et al., 2016). The intra-class correlation for the Malay CIRS subscales ranged from 0.798 to 0.961 while the

Spearmann's correlation ranged from 0.662 to 0.906. The Spanish version had and ICC of 0.65 to 0.93 while the original English version reported a Spearmann's correlation of 0.60 to 0.91 (Eakin et al., 2007; Glasgow et al., 2000).

The exploratory factor analysis extracted 4 factors from the 18 items of the Malay CIRS which supposedly comprised of 6 subscales. The healthcare support, organization support, and workplace support were correctly identified and the items were correctly allocated. However, the personal support, family and friends support and neighbourhood support were extracted as one common factor. Studies describing the factor analysis of translated and adapted CIRS scales were not available in the literature in order to compare with our results. In this study, overall support was measured with the 18 items Malay CIRS.

For psychometric testing, the Malay DDS and the Malay CIRS demonstrated high internal consistency and high test–retest reliability. However, the factor structure differed from the original English version. The discrepancy might be attributed to the cultural difference in how the participants in this study perceive living with diabetes (Kucukdeveci, Sahin, Ataman, Griffiths, & Tennant, 2004). The Media/Policy subscale of the Malay CIRS had poor internal consistency. This may have been influenced by how media and policy are implemented to promote health in the local neighbourhood or community setting (Bou-Karroum et al., 2017).

Section 2

4.4 Response rate and baseline characteristics between responder and non-responder

Table 4.7 shows the response rate from each health clinic and the characteristics between responders and non-responders. In this study, the estimated sample size was 480 participants. However, at the end of the study, only 391 individuals consented to participate in this study, making the response rate at 81.5%. The number of patients recruited and the response rate varied between clinics. The response rate from Klinik Kesihatan Serendah, Klinik Kesihatan Rasa, Klinik Kesihatan Soeharto, Klinik Kesihatan Ulu Yam Bharu, Klinik Kesihatan Kalumpang and Klinik Kesihatan Selisek were 90.7% (186), 80.9% (51), 76.7% (33), 71.6% (68), 71.8% (28) and 71.4% 925) respectively. There was a significant difference in response rate between health clinic ($p<0.001$). Between responders and non-responders, the sex composition was similar. In both groups, the mean age of the responders and non-responders were about 55 years old. The mean weight for the responders was 72.0 ± 14.1 kg whereas for the non-responders it was slightly lower at 69.1 ± 13.1 kg. However, this difference was not statistically significant ($p=0.072$). The mean duration of diabetes between responders and non-responders was not statistically significant ($p=0.102$) with the responders having a slightly longer mean duration of diabetes at 6 ± 5 years while the non-responders at 5 ± 4 years. Concerning diabetes control, there was no statistical difference in the mean HbA1c level, the fasting blood glucose level and random blood glucose level between responders and non-responders, $p=0.296$, $p=.587$ and $p=0.971$ respectively. The mean systolic blood pressure between responders and non-responders was similar at about 139 ± 16 mmHg and 139 ± 18 mmHg respectively. The mean diastolic blood pressure for the responders was slightly higher at about 79 ± 10 mmHg whereas for the non-responders at 78 ± 10 mmHg, however, this was of no statistical significance (p=0.236). The mean cholesterol and triglyceride levels among responders were 5.0 ± 1.1 mmol/L and 1.8 ± 1.0 mmol/L respectively, while among non-responders it was 5.0 ± 1.3 mmol/L, and 1.7 ± 1.5 mmol/L respectively. Both responders and non-responders had a mean creatinine level of about 88 mmol/L. There was no statistical finding between the two groups with regards to the cholesterol and triglyceride levels.

Table 4.7 : Response rate and baseline characteristics between responder and non-responder

Variables	**Mean ± SD or %(n) Responders 81.5% (391)**	**Mean ± SD or %(n) Non- Responders 18.5% (89)**	**p-value**
Clinic location			
KK Serendah	90.7% (186)	9.3% (19)	<0.001
KK Ulu Yam Bharu	71.6% (68)	28.4% (27)	
KK Rasa	80.9% (51)	19.1% (12)	
KK Soeharto	76.7% (33)	23.3% (10)	
KK Kalumpang	71.8% (28)	28.2% (11)	
KK Selisek	71.4% (25)	28.6% (10)	
Sex			
Male	(145)	(40)	0.234
Female	(246)	(49)	
Age (yrs)	55 ± 10	55 ± 12	0.596
Weight (kg)	72.0 ± 14.1	69.1 ± 13.1	0.072
Height (m)	1.58 ± 0.09	1.58 ± 0.11	0.731
Diabetes duration (yrs)	6 ± 5	5 ± 4	0.102
HbA1c(%)	8.7 ± 2.3	8.5 ± 2.0	0.296
Fasting blood glucose (mmol/L)	8.0 ± 3.1	7.8 ± 2.5	0.587
Random blood glucose (mmol/L)	10.3 ± 5.1	10.2 ± 3.5	0.971
Systolic blood pressure (mmHg)	139 ± 16	139 ± 18	0.923
Diastolic blood pressure (mmHg)	79 ± 10	78 ± 10	0.236
Cholesterol (mmol/L)	5.0 ± 1.1	5.0 ± 1.3	0.949
Triglyceride (mmol/L)	1.8 ± 1.0	1.7 ± 1.5	0.171

Total participants = 480

4.5 Characteristics of the study participants

Table 4.8 refers to the sociodemographic characteristics of the study participants. The mean age of the study participants was 54.71 ± 9.78 years old, with 31.3% (116) being older than 60 years old. There were more females than males, 62.0% (230) vs 38.0% (141) respectively. The biggest ethnic group was Malay 58% (215), followed by Indians 29.6% (110) and Chinese 12.4% (46). Most of the study participants 50.9% (189) attained primary education only, followed by secondary education 40.2% (149) and lastly tertiary education 8.9% (33). Majority of the study participants were married 90% (330).

Table 4.8 : Sociodemographic characteristics of the study participants

Variables	Mean ± SD or n (%)
Age (years)	54.71 ± 9.78
≤ 60 years old	255 (68.7%)
> 60 years old	116 (31.3%)
Sex	
Male	141 (38.0%)
Female	230 (62.0%)
Race	
Malay	215(58.0%)
Chinese	46 (12.4%)
Indians	110 (29.6%)
Education level	
Primary education	189 (50.9%)
Secondary education	149 (40.2%)
Tertiary education	33 (8.9%)
Marital status	
Married	330 (90.0%)
Single	12 (3.2%)
Divorced	6 (1.6%)
Widowed	23 (6.2%)

Total participants = 371

Table 4.3 refers to the clinical characteristics of the study participants. The mean duration of diabetes was 6.12 ± 4.58 years. Among the study participants, of 55.4% were diagnosed with diabetes between 1 to 5 years, followed by 30.7% between 6 to 10 years and lastly 13.7% with diabetes of over 10 years. Among the 371 study participants, the prevalence of retinopathy was 11.4%, ischemic heart disease 5.8%, cerebrovascular accident 1.1% and nephropathy 0.6%.

The mean HbA1c value of the study participants was 8.8 ± 2.3%. Only 18.1% (67) respondents had good glycemic control. The mean BMI (body mass index) of the study participants was 28.8 ± 5.3 kg/m^2. Only 13.5% (50) were classified as having a healthy BMI. Fifty-nine percent (219) were classified as obese, 27.0% (100) were classified as overweight while 0.5% (2) were classified as underweight.

The mean systolic blood pressure was 138 ± 16 mmHg. Only 30.4% (109) of the study participants managed to achieve good systolic blood pressure. The mean diastolic blood pressure among the study participants was 79 ± 10 mmHg. Only 54.9% (197) of the study participants managed to achieve good diastolic blood pressure. Only 21.8% (81) of the study participant had good overall blood pressure control.

The mean total cholesterol level was 5.1 ± 1.1 mmol/L. A total of 55.3% (205) achieved the recommended level of total cholesterol. The mean triglyceride level among the participants was 1.82 ± 1.02 mmol/L. Among the participants, 56.9% (211) achieved the recommended triglyceride level. Overall, 34.5% (128) had good overall lipid level.

Table 4.9 : Clinical characteristics of the study participants.

Variables	Mean ± SD or n (%)
Duration of diabetes (years)	6.12 ± 4.58
1-5 years	206 (55.4%)
6-10 years	114 (30.7%)
>10 years	51 (13.7%)
Diabetes complications	
Ischaemic Heart Disease	21 (5.8%)
Cerebrovascular Accident	4 (1.1%)
Nephropathy	2 (0.6%)
Retinopathy	41 (11.4%)
Diabetes control	
HbA1c (%)	8.8 ± 2.3
Good control (HbA1c ≤ 6.5%)	67 (18.1%)
Poor control (HbA1c >6.5%)	304 (81.9%)
BMI	
BMI (kg/m2)	28.8 ± 5.3
Underweight (<18.5 kg/m2)	2 (0.5%)
Healthy (18.5 – 23.9 kg/m2)	50 (13.5%)
Overweight (24 – 26.9 kg/m2)	100 (27.0%)
Obese (>27 kg/m2)	219 (59.0%)
Blood pressure	
Systolic Blood Pressure (mmHg)	138 ± 16
Good (≤ 130 mmHg)	112 (30.2%)
Poor (>130 mmHg)	259 (69.8%)
Diastolic Blood Pressure (mmHg)	79 ± 10
Good (≤ 80 mmHg)	205 (55.3%)
Poor (>80 mmHg)	166 (44.7%)
Overall blood pressure control	
Good	81 (21.8%)
Poor	290 (78.2%)
Lipid profile	
Total Cholesterol (mmol/L)	5.1 ± 1.1
Good (≤ 5.2 mmol/L)	205 (55.3%)
Poor (>5.2 mmol/L)	166 (44.7%)
Triglyceride (mmol/L)	1.8 ± 1.0
Good (≤ 1.7 mmol/L)	211(56.9%)
Poor (>1.7 mmol/L)	160 (43.1%)
Overall lipid control	
Good	128 (34.5%)
Poor	243 (65.5%)

Total participants = 371

Table 4.10 refers to medication prescription trend among the study participants. Based on the medical records, 24.5% (91) of the participants were on single hypoglycemic agent, 56.6% (210) were on double hypoglycemic agents while the remaining 18.9% (70) were on triple hypoglycemic agents. For the control of hyperglycemia, 72.2% (268) were on oral hypoglycemic agents alone, followed by 22.8% (85) on a combination of both oral hypoglycemic agents and insulin injections and lastly, 4.9% (18) were solely on insulin injections. The most prescribed oral hypoglycemic agent was biguanide, 91.6% (340), followed by sulphonylureas, 67.7% (251), acarbose 4.9% (18) and lastly glitazones, 2.4% (9). Among the study participants, 80.5% (300) were prescribed anti-hypertensive medications. Among those prescribed with anti-hypertensive medications, 31.3% (116) were on single anti-hypertensive medication, 26.1% (97) were on 2 anti-hypertensive medications, 16.7% (62) on 3 anti-hypertensive medications, 5.7% (21) on 4 anti-hypertensive medications while 1.1% (4) were on 5 anti-hypertensive medications. The anti-hypertensive most prescribed was ACE-inhibitor, prescribed in 55.3% (205) participants. The second most prescribed was calcium channel blockers, 51.5% (191), followed by beta-blockers 28.8% (107), diuretics 20.2% (75), alpha-blockers 4.9% (18) and lastly centrally acting anti-hypertensive 0.5% (2) and ARB's 0.5% (2).

Two hundred and eighty-eight study participants were on lipid lowering agents. Among them, 75.2% (279) were on single lipid lowering agent while another 2.4% (9) were on double lipid lowering agents. Statin was prescribed to 73.9% (274) individuals while fibrate was prescribed to 6.2% (23) individuals.

Table 4.10 : Medication prescription trend among the study participants.

Variables	Mean ± SD or n (%)
Hypoglycemic medication	
Number of hypoglycemic medication	
1 medication	91 (24.5%)
2 medications	210 (56.6%)
3 medications	70 (18.9%)
Type of treatment options	
Insulin only	18 (4.9%)
Oral hypoglycemic agent	268 (72.2%)
Insulin and Oral hypoglycemic agent	85 (22.8%)
Hypoglycemic medication class	
Biguanide	340 (91.6%)
Sulphonyurea	251 (67.7%)
Acarbose	18 (4.9%)
Glitazone	9 (2.4%)
Insulin	103 (27.8%)
Antihypertensive medication	
Number of medications	
Prescribed anti-hypertensive	300 (80.9%)
1 medication	116 (31.3%)
2 medications	97 (26.1%)
3 medications	62 (16.7%)
4 medications	21 (5.7%)
5 medications	4 (1.1%)
Anti-hypertensive class	
ACE – inhibitors	205 (55.3%)
Beta blockers	107 (28.8%)
Calcium Channel Blockers	191 (51.5%)
Diuretics	75 (20.2%)
Alpha Blocker	18 (4.9%)
ARB	2 (0.5%)
CNS agent	2 (0.5%)
Lipid lowering medication	
Number of medications	
Not on medication	83 (22.4%)
1 medication	279 (75.2%)
2 medications	9 (2.4%)
Lipid lowering medication class	
Statin	274 (73.9%)
Fibrate	23 (6.2%)

Total participants = 371

4.6 Self-care practices and glycaemic control

4.6.1 Prevalence of self-care practices and it's subdomains

Table 4.11 displays the scores and prevalence of self-care practices and it's subdomains. The Malay version of the SDSCA has 12 items and measures 5 domains of diabetes self-care related activities which are; diet practices, physical activity, medication adherence, self-monitoring of blood glucose and foot care. Each domain has a varying number of items, with each item being scored from 0 to 7, based on days in a week the respective self-care activities were practiced. For each domain, the mean score was calculated. The overall diabetes self-care activities score was obtained by calculating the mean of all 12 items. A score of 4 and above is considered as practicing good self-care.

The overall self-care mean score was 3.87 ± 0.82. Among the 371 study participants, 45.8% (170) were categorized as having good overall self-care practices. For the respective self-care domains, the medication adherence domain had the highest score with a mean of 6.01 ± 1.98, followed by the foot care domain with a mean score of 5.63 ± 1.84, the diet domain with a mean score of 4.70 ± 1.56, the exercise domain with a mean score of 2.77 ± 1.78 and lastly the self-monitoring of blood glucose domain with a mean score of 1.38 ± 1.59.

Among the participants, 81.7% (303) were categorized as having good medication adherence practices, 78.2% (290) as having good foot care practices, 71.7% (266) as having good diet practices, 30.2% (112) categorized as having good exercise practices and lastly 8.6% (32) were categorized as having good practice with regards to self-monitoring of blood glucose.

Table 4.11 : Self-care scores and prevalence of good self-care practices

Domain	Score, (Mean ± SD)	Good practice %(n)	Poor practice %(n)
Overall self-care	3.87 ± 0.82	45.8% (170)	54.2% (201)
Diet	4.70 ± 1.56	71.7% (266)	28.3% (105)
Exercise	2.77 ± 1.78	30.2% (112)	69.8% (259)
SMBG	1.38 ± 1.59	8.6% (32)	91.4% (339)
Medication adherence	6.01 ± 1.98	81.7 % (303)	18.3% (68)
Foot care	5.63 ± 1.84	78.2% (290)	21.8% (81)

Possible self-care score ranges from 0 to 7. Good practice is defined by a score of ≥4. SMBG (Self-monitoring of blood glucose). Total participants = 371

Table 4.12 refers to the association between self-care practices by sex, age, ethnicity, and education. The self-care mean score among the males was 3.79 ± 0.77 while among the females it was 3.91 ± 0.84. Among study participants 60 years and younger, the mean score was 3.92 ± 0.70 while for those older than 60 years old the mean score was 3.77 ± 0.70. The mean self-care score among the Malays, Chinese and Indians were 3.82 ± 0.90, 3.92 ± 0.67 and 3.94 ± 0.68 respectively. The mean self-care score among those with primary, secondary and tertiary education level was 3.78 ± 0.74, 3.98 ± 0.85 and 3.90 ± 1.00 respectively. The self-care scores were similar between age group, sex, ethnicities, and education level, with the p-values being 0.071, 0.181, 0.392 and 0.080 respectively. However, there was a statistically significant difference in the proportion of people with good and poor self-care practices between education levels, p=0.019. Those with higher education level appear to have a higher prevalence of good self-care practice. The proportion of those with good and poor self-care practices were similar between sex, age group, and race (p>0.05).

Table 4.12 : Self-care practices by sex, age, ethnicity, and education

Variables	Self-care score		Self-care practice		
	S (Mean ± SD)	p-value	Good, n (%)	Poor, n (%)	p-value
Sex					
Female	3.91 ± 0.84	0.181	113 (49.1%)	117 (50.9%)	0.102
Male	3.79 ± 0.77		57 (40.4%)	84 (59.6%)	
Age group					
≤ 60 years	3.92 ± 0.70	0.071	123 (48.2%)	132 (51.8%)	0.167
> 60 years	3.77 ± 0.70		47 (40.5%)	69 (59.5%)	
Ethnicity					
Malay	3.82 ± 0.90	0.392	98 (45.6%)	117 (54.4%)	0.520
Indian	3.94 ± 0.68		54 (49.1%)	56 (50.9%)	
Chinese	3.92 ± 0.67		18 (39.1%)	28 (60.9%)	
Education level					
Primary	3.78 ± 0.74	0.080	74 (39.2%)	115 (60.8%)	0.019
Secondary	3.98 ± 0.85		76 (51.0%)	73 (49.0%)	
Tertiary	3.90 ± 1.00		20 (60.6%)	13 (39.4%)	

Total participants = 371

Table 4.13 refers to the association between individual self-care practices by sex, age, ethnicity, education level and insulin use.

The diet mean score among the males was 4.50 ± 1.53 while among the females it was 4.82 ± 1.57. Among study participants 60 years and younger, the diet mean score was 3.74 ± 1.62 while for those older than 60 years old the diet mean score was 4.62 ± 1.43. The mean diet score among the Malays, Chinese and Indians were 3.82 ± 0.90, 3.92 ± 0.67 and 3.94 ± 0.68 respectively. The mean self-care score among those with primary, secondary and tertiary education level was 4.84 ± 1.60, 4.78 ± 1.39 and 4.39 ± 1.51 respectively. The mean diet score among those on insulin and not on insulin was 4.82 ± 1.59 and 4.65 ± 1.55 respectively. The mean diet scores were similar between sex, age group, education level and insulin use with the p-values being 0.051, 0.497, 0.508 and 0.350 respectively. However, there was a statistically significant difference in diet scores between ethnicities, p=0.049. The Malays had better diet practice than the Indians.

The exercise mean score among the males was 2.75 ± 1.77 while among the females it was 2.78 ± 1.79. Among study participants 60 years and younger, the exercise mean score was 2.90 ± 1.79 while for those older than 60 years old the exercise mean score was 2.47 ± 1.73. The mean exercise score among the Malays, Chinese and Indians were 2.69 ± 1.84, 2.65 ± 1.89 and 2.95 ± 1.60 respectively. The mean exercise score among those with primary, secondary and tertiary education level was 2.44 ± 1.71, 3.11 ± 1.76 and 3.02 ± 1.99 respectively. The mean exercise score among those on insulin and not on insulin was 2.91 ± 1.74 and 2.71 ± 1.80 respectively. The mean exercise scores were similar between sex, ethnicity and insulin use with the p-values being 0.884, 0.412 and 0.325 respectively. However, there was a statistically significant difference in exercise scores between sex, p=0.034 and education level, p=0.002. Those in the younger age group exercised more and those with primary education exercised lesser than those with secondary education.

The medication adherence mean score among the males was 6.07 ± 1.81 while among the females it was 5.98 ± 1.88. Among study participants 60 years and younger, the medication adherence mean score was 6.06 ± 1.82 while for those older than 60 years old the diet mean score was 5.92 ± 1.92. The mean medication adherence score among the Malays, Chinese and Indians were 5.74 ± 2.02, 6.42 ± 1.45 and 6.37 ± 1.54 respectively. The mean medication adherence score among those with primary, secondary and tertiary education level 5.92 ± 1.94, 6.15 ± 1.74 and 5.90 ± 1.83 respectively. The mean medication adherence score among those on insulin and not on insulin was 5.98 ± 1.83 and 6.03 ± 1.86 respectively. The mean medication adherence scores were similar between sex, age group, education level and insulin use with the p-values being 0.648, 0.497, 0.508 and 0.801 respectively. However, there was a statistically significant difference in medication adherence scores between ethnicities, p=0.004. The Malays had poorer medication adherence practice than the Indians.

The SMBG mean score among the males was 1.29 ± 1.47 while among the females it was 1.43 ± 1.66. Among study participants 60 years and younger, the SMBG mean score was 1.33 ± 1.54 while for those older than 60 years old the SMBG mean score was 1.47 ± 1.69. The mean SMBG score among the Malays, Chinese and Indians were 1.57 ± 1.76, 1.22 ± 1.26, and 1.06 ± 1.29 respectively. The mean SMBG score among those with primary, secondary and tertiary education level was 1.31 ± 1.54, 1.40 ± 1.60 and 1.68 ± 1.83 respectively. The mean SMBG score among those on insulin and not on insulin was 1.68 ± 1.90 and 1.26 ± 1.44 respectively. The mean SMBG scores were similar between sex, age group and education level with the p-values being 0.400, 0.444 and 0.450

respectively. However, there was a statistically significant difference in SMBG scores between ethnicities, p=0.020 and insulin use, p=0.020. The Malays had better SMBG practice than the Indians and those on insulin performed more SMBG.

The foot care mean score among the males was 5.59 ± 2.05 while among the females it was 5.65 ± 1.94. Among study participants 60 years and younger, the foot care mean score was 5.74 ± 1.89 while for those older than 60 years old the foot care mean score was 5.38 ± 2.15. The mean foot care score among the Malays, Chinese and Indians were 5.14 ± 2.22, 6.10 ± 1.61 and 6.39 ± 1.20 respectively. The mean foot care score among those with primary, secondary and tertiary education level was 5.65 ± 1.85, 5.74 ± 2.01 and 5.02 ± 2.46 respectively. The mean foot care score among those on insulin and not on insulin was 5.52 ± 1.97 and 5.67 ± 1.97 respectively. The mean foot care scores were similar between sex, age group, education level and insulin use with the p-values being 0.757, 0.101, 0.161 and 0.527 respectively. However, there was a statistically significant difference in foot care scores between ethnicities, p<0.001. The Malays had poorer foot care practice than the Indians and Chinese.

Table 4.13 : Diet, exercise, medication adherence, SMBG and foot care practices by sex, age, ethnicity, education level and insulin use.

Characteristic	Mean score of diabetes self-care practices									
	Diet		Exercise		Medication adherence		SMBG		Foot care	
	Mean ± SD	p-value	Mean ± SD	p-value	Mean ± SD	p-value	Mean ± SD	p-value	Mean ± SD	p-value
Sex										
Male	4.50 ± 1.53	0.051	2.75 ± 1.77	0.884	6.07 ± 1.81	0.648	1.29 ± 1.47	0.400	5.59 ± 2.05	0.757
Female	4.82 ± 1.57		2.78 ± 1.79		5.98 ± 1.88		1.43 ± 1.66		5.65 ± 1.94	
Age										
≤60	4.74 ± 1.62	0.497	2.90 ± 1.79	0.034	6.06 ± 1.82	0.497	1.33 ± 1.54	0.444	5.74 ± 1.89	0.101
>60	4.62 ± 1.43		2.47 ± 1.73		5.92 ± 1.92		1.47 ± 1.69		5.38 ± 2.15	
Ethnicity										
Malay	4.84 ± 1.60	0.049[a]	2.69 ± 1.84	0.412	5.74 ± 2.02	0.004[b]	1.57 ± 1.76	0.020[c]	5.14 ± 2.22	<0.001[d]
Chinese	4.78 ± 1.39		2.65 ± 1.89		6.42 ± 1.45		1.22 ± 1.26		6.10 ± 1.61	
Indian	4.39 ± 1.51		2.95 ± 1.60		6.37 ± 1.54		1.06 ± 1.29		6.39 ± 1.20	
Education level										
Primary	4.61 ± 1.50	0.508	2.44 ± 1.71	0.002[e]	5.92 ± 1.94	0.508	1.31 ± 1.54	0.450	5.65 ± 1.85	0.161
Secondary	4.79 ± 1.60		3.11 ± 1.76		6.15 ± 1.74		1.40 ± 1.60		5.74 ± 2.01	
Tertiary	4.82 ± 1.68		3.02 ± 1.99		5.90 ± 1.83		1.68 ± 1.83		5.02 ± 2.46	
Insulin										
Yes	4.82 ± 1.59	0.350	2.91 ± 1.74	0.325	5.98 ± 1.83	0.801	1.68 ± 1.90	0.020	5.52 ± 1.97	0.527
No	4.65 ± 1.55		2.71 ± 1.80		6.03 ± 1.86		1.26 ± 1.44		5.67 ± 1.97	

[a] Malay – Indian =0.444, [b] Malay – Indian = -0.628, [c] Malay – Indian = 0.504, [d] Malay – Indian = -1.24, Malay – Chinese = -0.960, [e] Primary – secondary = -0.673

Total participants = 371

4.6.2 Association between self-care practices and diabetes control

Table 4.13 refers to the self-care practice and the corresponding HbA1c level. The mean HbA1c among those practicing good foot care was 8.9 ± 2.3% while among those with poor care it was 8.3 ± 2.0%. Those performing better foot care had significantly higher HbA1c (p=0.026). The mean HbA1c value among those with good and poor overall self-care practices was 9.2 ± 2.1% and 8.6 ± 2.3% respectively. Those with good diet practice had a mean HbA1c of 8.8 ± 2.3% while those with poor diet practice had a mean HbA1c of 8.8 ± 2.2%. Those with good and those with poor exercise practice had a mean HbA1c of 8.9 ± 2.3% and 8.8 ± 2.3% respectively. Those practicing good medication adherence had a mean HbA1c of 8.7 ± 2.3% while those with poor medication adherence had a mean HbA1c of 9.0 ± 2.3%. Those practicing good SMBG and those with poor SMBG had a mean HbA1c of 8.7 ± 2.0 % and 8.8 ± 2.3% respectively. The mean HbA1c was not influenced by the overall self-care practice, diet practice, exercise, medication adherence or SMBG practice (p>0.05).

Table 4.14 : Good self-care practice and HbA1c (%)

Characteristic	HbA1c% (Mean ± SD)		p-value
	Good practice	Poor practice	
Overall self-care	9.2 ± 2.1	8.6 ± 2.3	0.070
Diet	8.8 ± 2.3	8.8 ± 2.2	0.808
Exercise	8.9 ± 2.3	8.8 ± 2.3	0.683
Medication adherence	8.7 ± 2.3	9.0 ± 2.3	0.338
SMBG	8.7 ± 2.0	8.8 ± 2.3	0.773
Foot care	8.9 ± 2.3	8.3 ± 2.0	0.026

SMBG (Self-monitoring of blood glucose).
Total participants = 371

Table 4.14 shows the correlation and regression analysis between self-care practice and HbA1c level. Overall self-care, dietary care, exercise, medication adherence and SMBG were not correlated with HbA1c. Only foot care had a significant positive correlation with HbA1c (r=0.11, p=0.037). In the crude and adjusted regression models, overall self-care, diet, exercise, medication adherence and SMBG were not associated with HbA1c. Only foot care was significantly associated with HbA1c (crude B=0.12 p=0.037, adjusted B=0.17, p=0.007).

Table 4.15 shows the crude and adjusted logistic regression between self-care practice and glycaemic control. In the crude and adjusted logistic regression models, overall self-care, diet, exercise, medication adherence, SMBG and foot care were not associated with glycaemic control status.

Table 4.15 : The association between self-care practices and it's subdomains with Hba1c (%).

Characteristic	HbA1C (%)				
	Correlation,	Crude		Adjusted	
	r (p-value)	B (95% CI)	p-value	B (95% CI)	p-value
Self-care	0.06 (0.233)	0.17 (-0.11, 0.46)	0.233	0.05 (-0.22, 0.32)	0.714
Diet	-0.02 (0.762)	-0.02 (-0.17, 0.13)	0.762	-0.01 (-0.15, 0.14)	0.918
Exercise	0.06 (0.246)	0.08 (-0.05, 0.21)	0.246	0.02 (-0.11, 0.14)	0.816
Medication adherence	-0.07 (0.213)	-0.08 (-0.20, 0.05)	0.213	-0.08 (-0.21, 0.05)	0.207
SMBG	0.02 (0.763)	0.02 (-0.12, 0.17)	0.763	-0.05 (-0.20, 0.10)	0.648
Foot care	0.11 (0.037)	0.12 (0.01, 0.24)	0.037	0.17 (0.05, 0.30)	0.007

*Adjusted for sex, race, age, duration, education, insulin use and clinic location.
Total participants = 371

Table 4.16 : The association between self-care practices and it's subdomains with good diabetes control.

Characteristic	Good diabetes control			
	Crude		Adjusted	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Self-care	0.97 (0.70, 1.34)	0.836	1.08 (0.76, 1.54)	0.666
Diet	1.09 (0.92, 1.30)	0.321	1.10 (0.91, 1.33)	0.331
Exercise	1.01 (0.87, 1.17)	0.897	1.05 (0.90, 1.23)	0.525
Medication adherence	1.02 (0.88, 1.18)	0.798	1.02 (0.87, 1.20)	0.829
SMBG	0.98 (0.82, 1.16)	0.786	0.99 (0.81, 1.22)	0.950
Foot care	0.92 (0.81, 1.04)	0.204	0.93 (0.80, 1.08)	0.366

*Adjusted for sex, race, age, duration, education, insulin use and clinic location
Total participants = 371

4.6.3 Summary of results

The mean self-care score was 3.87 ± 0.82 with only 45.8% (170) practicing good self-care. The most practiced self-care was medication adherence, and the least was SMBG. Prevalence of good self-care appears to increase with education level. In both crude and adjusted models, when HbA1c was measured as a continuous outcome, better foot care practice was associated with a higher HbA1c. However, when HbA1c was measured as a categorical outcome, foot care was not associated with glycaemic control. In both crude and adjusted models, for both continuous and categorical HbA1c measurement as outcomes, there was no association between overall self-care, diet practices, exercise practices, medication adherence and SMBG practices with glycaemic control.

4.7 Knowledge with diabetes self-care practices and diabetes control.

4.7.1 Distribution of the knowledge scores

Figure 4.1 shows the histogram and distribution of the knowledge score. The Malaysian version of the MDKT consists of 14 questions. For every correct answer, a score of 1 was given. No score was deducted for wrong answers. The maximum possible score was 14 while the minimum was 0. A score of above 11 was considered high, between 7 to 11 considered moderate and below 6 was considered low. The mean score for the Malaysian version of the MDKT was 6.78 ± 2.07, ranging from 1 to 12. Among the 371 participants, 1.0% (4) obtained high scores, 55.3% (205) obtained moderate scores while the remaining 43.7% (162) obtained low scores.

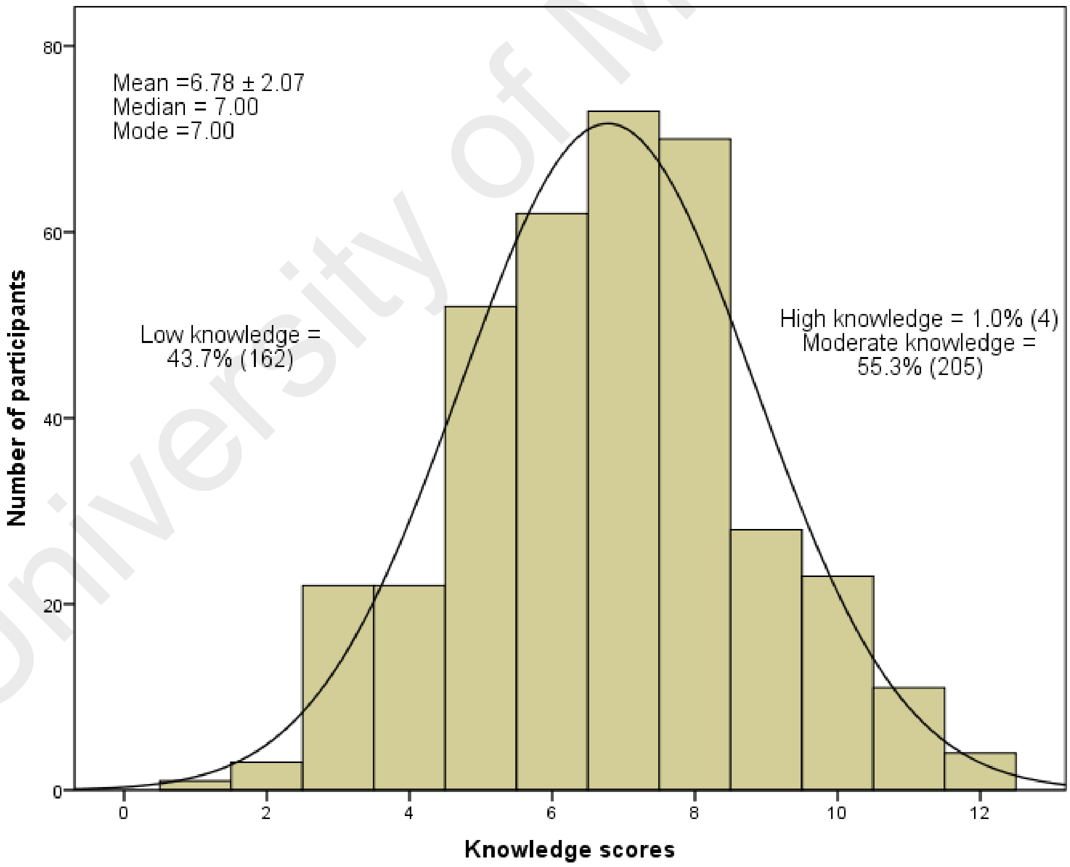


Figure 4.1 : Distribution of the knowledge scores

4.7.2 The association between sex, age group, ethnicity, education level and knowledge scores.

Table 4.16 describes the knowledge scores according to sex, age group, ethnicity, and education level. The mean knowledge score among study participants 60 years and younger was 6.99 ± 1.99 while for those older than 60 years old the mean knowledge score was 6.32 ± 2.16. The younger age group had a significantly higher knowledge score (p=0.004). The males and females had a mean knowledge score of 6.72 ± 2.02 and 6.81 ± 2.10 respectively. The mean knowledge score among the Malays, Chinese and Indians were 6.86 ± 2.08, 6.96 ± 2.28 and 6.55 ± 1.94 respectively. The mean knowledge score among those with primary, secondary and tertiary education level was 6.57 ± 2.01, 6.76 ± 1.90 and 8.06 ± 2.61 respectively. The knowledge score was significantly highest among those with tertiary education. The proportion of those who were categorized as having low knowledge level and high and moderate knowledge level significantly differed between age group and education level. The score and level of knowledge were similar between sex and race.

Table 4.17 : Knowledge scores according to sex, age group, ethnicity, and education level.

Characteristics, n (%)	Knowledge				
	Score (mean ± SD)	**p-value**	**High and moderate, n (%)**	**Low, n (%)**	**(p-value)**
Sex					
Female	6.81 ± 2.10	0.691	135 (58.7%)	95 (41.3%)	0.241
Male	6.72 ± 2.02		74 (52.5%)	67 (47.5%)	
Age group					
≤ 60 years	6.99 ± 1.99	0.004	155 (60.8%)	100 (39.2%)	0.010
> 60 years	6.32 ± 2.16		54 (46.6%)	62 (53.4%)	
Race					
Malay	6.86 ± 2.08	0.354	128 (59.5%)	87 (40.5%)	0.319
Indian	6.55 ± 1.94		56 (50.9%)	54 (49.1%)	
Chinese	6.96 ± 2.28		25 (54.3%)	21 (45.7%)	
Education level					
Primary education	6.57 ± 2.01	0.001	98 (51.9%)	91 (48.1%)	0.035
Secondary education	6.76 ± 1.90		86 (57.7%)	63 (42.3%)	
Tertiary education	8.06 ± 2.61		25 (75.8%)	8 (24.2%)	

Total participants = 371

4.7.3 The association between knowledge and self-care.

Table 4.17 shows that knowledge had a significant positive correlation with self-care score (r=0.19, p<0.001). In the crude and adjusted regression models, knowledge score had a significant positive association with self-care score (crude B=0.08 p<0.001, adjusted B=0.08, p=0.001).

Table 4.18 : The association between knowledge score with self-care score

Characteristic	Self-care score				
	Correlation, r (p-value)	Crude		Adjusted	
		B (95% CI)	p-value	B (95% CI)	p-value
Knowledge score	0.19 (<0.001)	0.08(0.04, 0.12)	<0.001	0.08(0.04, 0.12)	<0.001

*Adjusted for sex, race, age, duration, education, insulin use and clinic location
Total participants = 371

Referring to Table 4.18, in the crude and adjusted logistic regression models, better knowledge score was associated with higher odds of good self-care practice (crude OR=1.25 p<0.001, adjusted OR=1.27 p<0.001). In the crude and adjusted logistic regression models, when compared to those with low knowledge, those with moderate/high knowledge have higher odds of good self-care practice (crude OR=1.25 p<0.001, adjusted OR=1.23 p<0.001).

Table 4.19 : The association between knowledge score with the odds of good self-care.

Characteristics	Odds of good self-care			
	Crude		Adjusted	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Knowledge				
Scores	1.25 (1.13, 1.40)	<0.001	1.27 (1.13, 1.42)	<0.001
Categories				
Low	1.00 (reference)		1.00 (reference)	
Moderate/High	1.25 (1.13, 1.40)	<0.001	1.23 (1.10, 1.38)	<0.001

Adjusted for sex, race, age, duration, education, insulin use and clinic location
Total participants = 371

4.7.4 The association between knowledge and diabetes control

Table 4.19 shows that there was no correlation between knowledge score with HbA1c (r=0.08, p=0.135). In the crude and adjusted regression models, knowledge score was not associated with HbA1c (crude B=0.09 p=0.135, adjusted B=0.07, p=0.183).

Table 4.20 : Association between knowledge score with HbA1c (%).

Characteristic	HbA1c (%)				
	Correlation, r (p-value)	Crude		Adjusted	
		B (95% CI)	p-value	B (95% CI)	p-value
Knowledge score	0.08 (0.135)	0.09 (-0.03, 0.20)	0.135	0.08 (-0.03, 0.19)	0.157

Adjusted for sex, race, age, duration, education, insulin use and clinic location
Total participants = 371

Referring to Table 4.20, in the crude and adjusted logistic regression models, knowledge score was not associated with diabetes control (crude OR=0.97 p=0.685, adjusted OR=0.98 p=0.758). In the crude and adjusted logistic regression models, knowledge level was not associated with diabetes control (crude OR=0.98 p=0.944, adjusted OR=0.89 p=0.676).

Table 4.21 : The association between knowledge score with the odds of good self-care.

Characteristics	Odds of good diabetes control			
	Crude		Adjusted	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Knowledge				
Scores	0.97 (0.86, 1.12)	0.685	0.98 (0.85, 1.13)	0.758
Categories				
Low	1.00 (reference)		1.00 (reference)	
Moderate/High	0.98 (0.58, 1.67)	0.944	0.89 (0.49, 1.59)	0.676

Adjusted for sex, race, age, duration, education, insulin use and clinic location
Total participants = 371

4.7.5 Summary of results

The mean knowledge score was 6.78 ± 2.07, with 1.0% (4) obtaining high scores, 55.3% (205) obtaining moderate scores and the 43.7% (162) obtaining low scores. Higher education level was associated with knowledge score. In both crude and adjusted models, for both continuous and categorical self-care measurement as outcomes, higher knowledge was associated with better diabetes self-care. In both crude and adjusted models, for both continuous and categorical HbA1c measurement as outcomes, there was no association between knowledge with glycaemic control.

4.8 Psychosocial factors and diabetes self-care practices

4.8.1 Psychosocial factors distribution and the association with age, sex, ethnicity, and education level.

Table 4.21 describes the distribution of psychosocial factors which were measured in this study and the association with age, sex, ethnicity, and education level. Support was measured using the CIRS questionnaire. The mean support score was 2.55 ± 0.66. The mean support score was similar between age group, sex, and ethnicity ($p>0.05$). The mean support score was significantly different between education level ($p=0.008$). The mean support score among those with primary, secondary and tertiary education level was 2.47 ± 0.67, 2.60 ± 0.62 and 2.81 ± 0.65 respectively. Tertiary education had higher support scores compared to primary education ($p=0.013$). Empowerment was measured using the DES questionnaire. The overall empowerment mean score was 3.97 ± 0.48. The empowerment scores were similar between sex, age group, ethnicity, and education level ($p>0.05$).

Self-efficacy was measured using the DMSE questionnaire. The mean self-efficacy score was 104.08 ± 23.20. The self-efficacy scores were similar between age group, sex, and ethnicity ($p>0.05$). The mean self-efficacy score was significantly different between education level ($p=0.026$). The mean self-efficacy score among those with primary, secondary and tertiary education level were 101.46 ± 23.53, 108.05 ± 21.09 and 101.18 ± 28.06 respectively. The self-efficacy score was significantly higher among those with secondary education level when compared to those with primary education ($p=0.028$).

Distress was measured using the DDS questionnaire. The mean distress score was 1.54 ± 0.66. The distress scores were similar between sex and age group ($p>0.05$). There was a significant difference in distress scores between ethnicity and education level. The mean distress score among the Malays, Chinese and Indians were 1.63 ± 0.73, 1.47 ± 0.68 and 1.39 ± 0.47 respectively. The distress score was significantly higher among the Malays when compared to the Indians (p=0.008). The mean distress score among those with primary, secondary and tertiary education level were 1.49 ± 0.62, 1.53 ± 0.65 and 1.88 ± 0.84 respectively. The distress score was significantly higher among those with tertiary education when compared to primary education (p=0.006) and secondary education (p=0.018). Depression was measured using the PHQ questionnaire. The mean depression score was 4.58 ± 2.57. The depression scores were similar between sex, age group, ethnicity, and education level (p>0.05).

Table 4.22 : Psychosocial factor scores according to age, sex, ethnicity and education level.

Characteristics	Psychosocial factors score, Mean ± SD				
	Support	**Empowerment**	**Self-efficacy**	**Distress**	**Depression**
Tools	CIRS	DES	DMSE	DDS	PHQ-9
Number of items	18	7	14	17	9
Possible score range	1 - 5	1 - 5	0 - 140	1 - 6	0 - 27
Total core	2.57 ± 0.65	3.97 ± 0.48	104.08 ± 23.20	1.54 ± 0.66	4.58 ± 2.57
Sex					
Female	2.49 ± 0.66	3.94 ± 0.53	103.81 ± 24.30	1.50 ± 0.63	4.63 ± 2.60
Male	2.52 ± 0.64	4.01 ± 0.46	104.52 ± 21.34	1.61 ± 0.72	4.50 ± 2.54
p-value	0.661	0.173	0.777	0.105	0.645
Age group					
≤ 60 years	2.51 ± 0.64	3.99 ± 0.49	105.25 ± 22.75	1.54 ± 0.66	4.61 ± 2.62
> 60 years	2.48 ± 0.69	3.91 ± 0.55	101.51 ± 24.05	1.55 ± 0.67	4.46 ± 2.44
p-value	0.632	0.150	0.150	0.871	0.645
Race					
Malay	2.44 ± 0.63	3.96 ± 0.51	103.55 ± 25.30	1.63 ± 0.73	4.67 ± 2.85
Indian	2.58 ± 0.68	4.00 ± 0.51	105.70 ± 19.22	1.39 ± 0.47	4.50 ± 2.12
Chinese	2.57 ± 0.72	3.92 ± 0.67	101.22 ± 21.70	1.47 ± 0.68	4.35 ± 2.16
p-value	0.220	0.581	0.535	0.007	0.681
Education level					
Primary	2.47 ± 0.67	3.94 ± 0.51	101.46 ± 23.53	1.49 ± 0.62	4.74 ± 2.70
Secondary	2.60 ± 0.62	4.02 ± 0.46	108.05 ± 21.09	1.53 ± 0.65	4.32 ± 2.29
Tertiary	2.81 ± 0.65	3.89 ± 0.51	101.18 ± 28.06	1.88 ± 0.84	4.91 ± 2.98
p-value	0.008	0.220	0.026	0.008	0.245

* CIRS (Chronic Illness Resources Support), DES (Diabetes empowerment Scale), DMSE (Diabetes Management Self-Efficacy), DDS (Diabetes Distress Scale), PHQ (Patient Health Questionnaire). Total participants = 371

4.8.2 Association between psychosocial factors and diabetes self-care

Referring to Table 4.22, self-efficacy (r=0.46 p<0.001), support (r=0.48 p<0.001) and empowerment (r=0.28 p<0.001) had significant positive correlations with self-care whereas distress (r=-0.24 p<0.001) and depression (r=-0.14 p=0.009) had significant negative correlations with self-care. In the crude and adjusted regression models, self-efficacy (crude B=0.02 p <0.001, adjusted B=0.02, <0.001), support (crude B=0.60 p<0.001, adjusted B=0.60, p<0.001) and empowerment (crude B=0.47 p<0.001, adjusted B=0.48 p<0.001) had significant positive association with self-care. Distress (crude B=-0.30 p<0.001, adjusted B=-0.34 p<0.001) had significant negative association with self-care. Depression (crude B=-0.04 p=0.009, adjusted B=-0.05 p=0.008) was not associated with self-care.

Table 4.23 : The association between psychosocial factors with self-care score

Characteristic	**Self-care score**				
	Correlation, r (p-value)	**Crude**		**Adjusted**	
		B (95% CI)	**p-value**	**B (95% CI)**	**p-value**
Self-efficacy	0.46 (<0.001)	0.02 (0.01, 0.02)	<0.001	0.02 (0.01, 0.02)	<0.001
Support	0.48 (<0.001)	0.60 (0.49, 0.71)	<0.001	0.60 (0.49, 0.72)	<0.001
Empowerment	0.28 (<0.001)	0.47 (0.30, 0.63)	<0.001	0.48 (0.31, 0.65)	<0.001
Distress	-0.24 (<0.001)	-0.30 (-0.42, -0.18)	<0.001	-0.34 (-0.47, -0.21)	<0.001
Depression	-0.14 (0.009)	-0.04 (-0.08, -0.01)	0.009	-0.05 (-0.08, -0.01)	0.008

*Adjusted for sex, race, age, duration, education, insulin use and clinic location
Total participants = 371

Referring to Table 4.23, in the crude and adjusted logistic regression models, higher levels of self-efficacy (crude OR=1.03 p<0.001, adjusted OR=1.03 p<0.001), support (crude OR=3.95 p<0.01, adjusted OR=4.09 p<0.001) and empowerment (crude OR=1.87 p=0.008, adjusted OR=1.99 p=0.006) were associated with higher odds of good self-care. Higher levels of distress (crude OR=0.72 p=0.049, adjusted OR=0.61 p=0.010) was associated with poorer odds of good self-care. Depression (crude OR=0.95 p=0.210, adjusted OR=0.93 p=0.123) was not associated with self-care.

Table 4.24 : The association between psychosocial factors with the odds good self-care.

Psychosocial factors	Odds of good self-care			
	Crude		Adjusted	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Self-efficacy	1.03 (1.02, 1.04)	<0.001	1.03 (1.02, 1.04)	<0.001
Support	3.95 (2.68, 5.83)	<0.001	4.09 (2.68, 6.24)	<0.001
Empowerment	1.87 (1.18, 2.97)	0.008	1.99 (1.21, 3.26)	0.006
Distress	0.72 (0.52, 0.99)	0.049	0.61 (0.42, 0.89)	0.010
Depression	0.95 (0.88, 1.03)	0.210	0.93 (0.86, 1.02)	0.123

*Adjusted for sex, race, age, duration, education, insulin use, and clinic location.
Total participants = 371

4.8.3 Summary of results

The mean support score was 2.57 ± 0.65 from a possible score of 1-5. Highest support score was observed among those with higher education level. The mean empowerment score was 3.97 ± 0.48 from a possible score of 1-5, and it was similar across age group, sex, ethnicity, and education level. The mean self-efficacy score was 104.08 ± 23.20 from a possible score of 0-140. Higher support score was observed among those with secondary education level than those with primary education level only. The mean distress score was 1.54 ± 0.66 and prevalence of diabetes distress was 5.7%. The mean depression score was 4.58 ± 2.57and prevalence of diabetes distress was 4.3%. In both crude and adjusted models, for both continuous and categorical self-care measurement as outcomes, higher levels of support, empowerment, and self-efficacy were associated with better diabetes self-care. In both crude and adjusted models, for both continuous and categorical self-care measurement as outcomes higher level of distress was associated with poorer diabetes self-care. In both crude and adjusted models, when self-care was measured as a continuous outcome, depression was associated with poorer self-care. However, when self-care was measured as a categorical outcome, there was no association between depressions with self-care.

4.9 Path coefficient analysis between age, sex, education level, diabetes duration, knowledge, psychosocial factors and diabetes self-care practice.

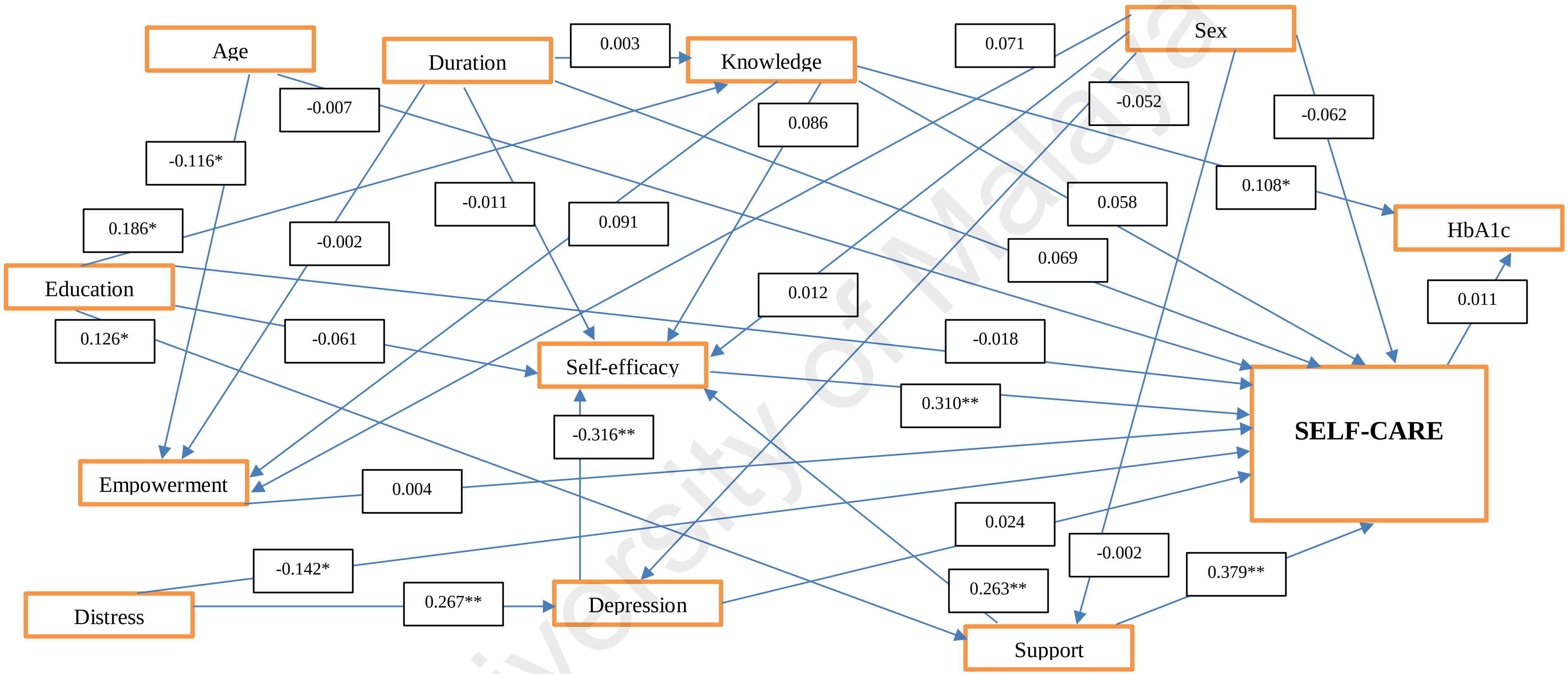
4.9.1 Full model analysis

The conceptual model was assessed using structural equation modeling to identify the path coefficient between age, sex, education level, diabetes duration, knowledge, psychosocial factors, and diabetes self-care practices. Structural equation modeling was performed using the SmartPLS3 software. Figure 4.2 shows the association between the variables and their respective path coefficients. Table 4.24 summarizes the direct effect tested and the corresponding path coefficients and respective p-values. There were significant associations between self-efficacy and self-care (path coefficient= -0.310, p<0.001), between support and self-care (path coefficient= 0.379, p<0.001), between diabetes distress and self-care (path coefficient= -0.142, p=0.011), between age and empowerment (path coefficient= -0.07, p=0.068), between education and knowledge (path coefficient= 0.186, p=0.006), between education and support (path coefficient= 0.126, p=0.008), between depression and self-efficacy (path coefficient= -0.316, p<0.001), between diabetes distress and depression (path coefficient= 0.267, p<0.001), and between support and self-efficacy (path coefficient= 0.263, p<0.001).

There were significant positive direct effects from self-efficacy to diabetes self-care, from support to self-care, from distress to depression, from support to self-efficacy, from education to knowledge, and from education to support. Thus, we can conclude that as the level of self-efficacy support increases, diabetes self-care improve. Those with higher education level were more knowledgeable and enjoyed more support. Those with higher levels of support have higher levels of self-efficacy. Diabetics who were experiencing diabetes distress were more likely to be depressed.

There were significant negative direct effects from diabetes distress to diabetes self-care, from age to diabetes empowerment, and from depression to diabetes self-efficacy. We can conclude that as the level of diabetes distress increases, diabetes self-care practices worsen. As a person with diabetes gets older; they feel less empowered. Diabetics with higher levels of depressive symptoms have lower levels of self-efficacy.

There was no association between age and self-care, between sex and self-care, between education and self-care, between duration and self-care, between knowledge and self-care, between empowerment and self-care, between depression and self-care, between sex and support, between sex and empowerment, between sex and self-efficacy, between sex and depression, between education and self-efficacy, between duration and empowerment, between duration and self-efficacy, between duration and knowledge, between knowledge and empowerment, between knowledge and self-efficacy, and between support and depression, $p>0.05$ respectively.



***p<0.05, **p<0.001**

Figure 4.2 : Path statistics of the association between age, sex, education, diabetes duration, knowledge, psychosocial factors and diabetes self-care.

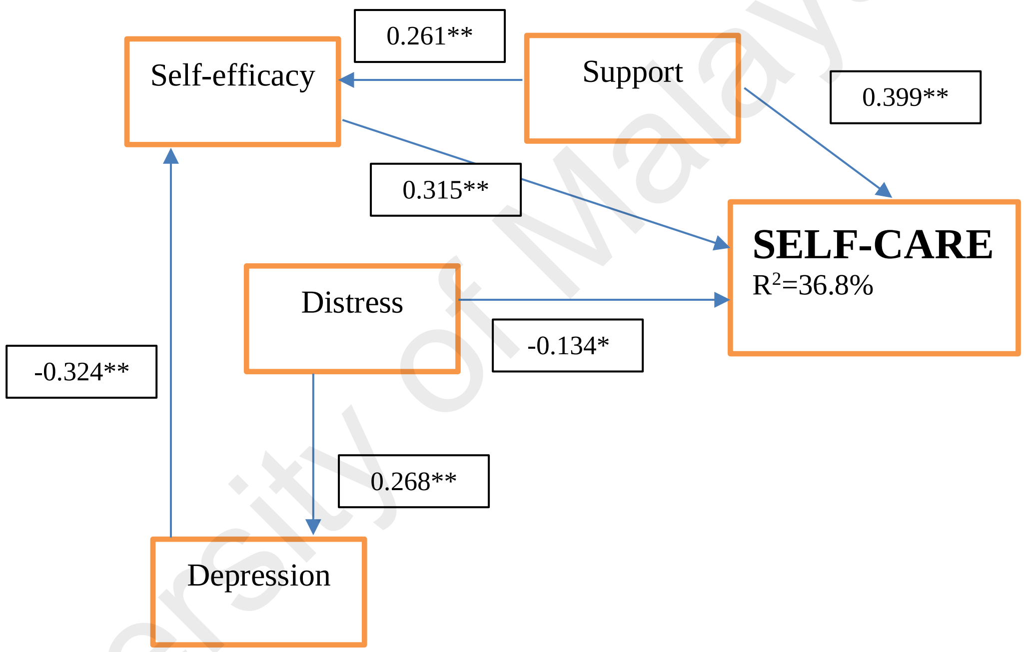
Table 4.25 : Direct effect and path coefficient statistics for conceptual model

Direct effect	Path coefficient (95% CI)	p-value
age → self-care	-0.070 (-0.153 , 0.012)	0.058
sex → self-care	-0.062 (-0.145 , 0.015)	0.134
education → self-care	-0.018 (-0.116 , 0.079)	0.721
duration → self-care	0.069 (-0.004 , 0.141)	0.064
knowledge →self-care	0.058 (-0.029 , 0.146)	0.204
empowerment →self-care	0.004 (-0.107 , 0.112)	0.952
self-efficacy →self-care	0.310 (0.190 , 0.424)	<0.001
support →self-care	0.379 (0.294 , 0.459)	<0.001
depression →self-care	0.024 (-0.072 , 0.110)	0.684
diabetes distress →self-care	-0.142 (-0.25 , -0.034)	0.011
age → empowerment	-0.116 (-0.219 , -0.013)	0.028
sex → support	-0.002 (-0.106 , 0.105)	0.974
sex → empowerment	0.071 (-0.027 , 0.162)	0.144
sex → self-efficacy	0.012 (-0.080 , 0.093)	0.785
sex → depression	-0.052 (-0.149 , 0.049)	0.317
education → knowledge	0.186 (0.049 , 0.313)	0.006
education → self-efficacy	-0.061 (-0.151 , 0.029)	0.194
education → support	0.126 (0.030 , 0.213)	0.008
duration → empowerment	-0.002 (-0.134 , 0.121)	0.961
duration → self-efficacy	-0.011 (-0.107 , 0.078)	0.802
duration → knowledge	0.003 (-0.098 , 0.105)	0.966
knowledge → empowerment	0.091 (-0.033 , 0.208)	0.130
knowledge → self-efficacy	0.086 (-0.015, 0.187)	0.100
depression → self-efficacy	-0.316 (-0.434 , -0.193)	<0.001
diabetes distress → depression	0.267 (0.149 , 0.378)	<0.001
support → depression	-0.032 (-0.131 , 0.07)	0.520
support → self-efficacy	0.263 (0.134 , 0.383)	<0.001

Total participants = 371

4.9.2 Parsimonious model analysis

After obtaining the statistically significant path coefficients, the model was reanalyzed while retaining significant variables associated with self-care. Figure 4.3 shows the parsimonious final model with the significant variables retained and the respective path coefficients. Table 4.25 summarizes the association tested and the corresponding path coefficients and respective p-values. The parsimonious model explained 36.8% of variation in self-care. There was a significant direct positive effect from self-efficacy (path coefficient=0.315, p<0.001) and social support (path coefficient=0.399, p<0.001) to diabetes self-care. There was a significant direct negative effect from diabetes distress to self-care (path coefficient=-0.134, p=0.007) and from depression to self-efficacy (path coefficient=-0.324, p<0.001). There was a significant direct positive effect from diabetes distress to depression (path coefficient=-0.268, p=0.007) and from support to self-efficacy (path coefficient=-0.261, p<0.001).



***p<0.05, **p<0.001**

Figure 4.3 : Final parsimonious model analysis of significant pathways influencing diabetes self-care practices.

Table 4.26 : Direct effect and path coefficient statistics for parsimonious model

Direct effect	Path coefficient (95% CI)	p- value
self-efficacy→ self-care	0.315 (0.201 , 0.422)	<0.001
support → diabetes self-care	0.399 (0.319 , 0.477)	<0.001
diabetes distress → diabetes self-care	-0.134 (-0.235 , -0.042)	0.007
depression → self-efficacy	-0.324 (-0.435 , -0.201)	<0.001
diabetes distress → depression	0.268 (0.150 , 0.377)	<0.001
support → self-efficacy	0.261 (0.132 , 0.381)	<0.001

4.9.3 Direct and Indirect effects

Based on the parsimonious model, the indirect effect of support on self-care via self-efficacy and the indirect effect of depression on self-care via self-efficacy were investigated. Table 4.26 and Table 4.27 summarize the direct and direct effect of support and depression on self-care. Social support had a direct positive effect (path coefficient=0.399, p<0.001) and indirect effect via self-efficacy (path coefficient=0.078, p=0.001) on self-care. The total effect of support on self-care was 0.477.

Though depression had no direct effect on self-care (path coefficient=0.024, p=0.684), there was an indirect negative effect via self-efficacy (path coefficient= -0.098, p=0.001). The total effect of support on self-care was -0.074.

Table 4.27 : Total effect, direct and indirect effect of social support (via self-efficacy) on self-care practices

Variables	Path coefficient (95% CI)	p-value
Path coefficient for direct effect	0.399 (0.319 , 0.477)	<0.001
Path coefficient for indirect effect	0.078 (0.035 , 0.125)	0.001
Total effect	0.477	

Total participants = 371

Table 4.28 : Direct and indirect effect of depression (via self-efficacy) on self-care practices

Variables	Path coefficient (95% CI)	p-value
Path coefficient for direct effect	0.024 (-0.072 , 0.110)	0.684
Path coefficient for indirect effect	-0.098 (-0.165 , -0.050)	0.001

Total participants = 371

4.9.4 Summary of results

Having higher social support, higher levels of self-efficacy and a lower level of diabetes distress leads to better diabetes self-care practices. Higher level of social support was also associated with better self-efficacy and eventually better self-care. Depression had no direct effect on self-care but was indirectly associated via poorer self-efficacy. Depression was associated with poorer self-efficacy.

CHAPTER 5: DISCUSSION

5.1 Chapter overview

This chapter begins by reviewing the background, aim and the objectives of the study. This is followed by an overview of the results obtained in the study. The findings of this study are then interpreted and discussed according to the respective objectives, results, and are compared and contrasted with previous studies presented in the systematic review.

5.2 Introduction

In Malaysia, the prevalence of type 2 diabetes is high and increasing in trend. Within the span of 25 years (from 1985 to 2011), the prevalence of diabetes among those 30 years old and older have increased from 6.3% to 20.8% (Abdul Rashid et al., 2016; Letchuman et al., 2010; Tahir A & Ani Noor, 2011). National audits in Malaysia showed that diabetes was poorly controlled, with only 12.9% to 18.0% of people with diabetes achieving optimal diabetes control (Mafauzy et al., 2011; Mastura I, 2011).

Little is known about diabetes self-care practices among Malaysian diabetic patients. This study aimed to address issues regarding diabetes self-care among Malaysian with type 2 diabetes. This study was of cross-sectional design, involving 371 type 2 diabetics recruited from 6 government primary health clinics from the district of Hulu Selangor.

5.3 Participant's demography, clinical characteristics and self-care practice.

In this study, 371 participants were recruited. Sixty two percent were females. There were 58% Malays, 12.4% Chinese and 29.6% Indians. In this study, the mean age of the patients was 54.71 ± 9.78 years, with 68.7% being ≤60 years old. The mean duration of diabetes was 6.12 ± 4.58 year, with 55.4% having diabetes of less than 5 years. These patient characteristics were almost similar to Malaysia's diabetes population attending primary care clinics.

According to the data from Malaysia's National Diabetes Registry involving 654,862 type 2 diabetics recruited from 644 primary care clinics nationwide, in 2012, 58% of diabetics were females, the mean age of patients with diabetes was 59.7 years and 55% were younger than 55 years. It was reported that the mean diabetes duration in Malaysia in 2012 was 6 years (Ministry of Health Malaysia, 2013). The racial composition in this study however did not reflect the national distribution which was 58.9% Malays, 21.4% Chinese and 15.3% Indians.

Among the participants of this study, slightly over 18% attained a HbA1c level of <6.5%. According to Malaysia's National Diabetes Registry (n=653,326) in 2012, about 23.8% attained HbA1c <6.5% (Ministry of Health Malaysia, 2013). The trend of hypoglycemic agents used in this study was comparable to the data from Malaysia's National Diabetes Registry. In this study, 91.4% of the study participants were on biguanide, the recommended first line oral hypoglycemic agents among type 2 diabetics if not contraindicated. In 2012, at the national level, about 82.5% of diabetics were prescribed this medication. The use of sulphonyureas, acarbose and insulin among the participants of this study was 67.7%, 4,9% and 27.8% respectively while in 2012 at the national level the use was 56.9%, 4.7% and 21.4% respectively. In this study, the use of single hypoglycemic agent, two or more agents and the combination of oral agents and insulin was 24.5%, 75.5% and 22.8% while in 2012 at the national level the use was 27.0%, 45.7% and 16.5% respectively.

In this study, those in the older age group and with primary education exercised lesser. Those on insulin practiced more SMBG. When compared to the Indians, the Malays practiced better diet and more SMBG but, were less adherent to medication. Among the

3 ethnicities, the Malays practiced the least foot care. There appeared to be differences in self-care practices according to sociodemographic factors.

Age influences diabetes self-care in many ways. Shigaki et al. (2010) reported older diabetic exercised lesser due to difficulty in performing such task due to the associated medical comorbidities. The aging process tends to reduce muscle mass, reduce physical fitness (strength, endurance, agility, and flexibility), and results in difficulties in daily life activities and normal functioning of the elderly (Milanović et al., 2013). Previous studies have reported better exercise practice among those with higher education (Mier et al., 2017; Tamirat, Abebe, & Kirose, 2014). Individuals with higher level of education are more receptive of new information, able to acquire and understand new knowledge and are able to synthesize this new knowledge into actions. Compared to diabetics with higher education attainment, those with lower education level and poor literacy skills, they are more likely to have difficulty reading and understanding basic health care information, thus leading to lesser knowledge and subsequently poorer diabetes self-care practices (Braveman, Cubbin, Egerter, Williams, & Pamuk, 2010). In this study, most of them with lower education were the elderly patients, which may also contribute the finding. The better SMBG practice among insulin users was similar to previous meta-analysis findings (Zhu, Zhu, & Leung, 2016a). Diabetics on insulin are recommended to perform SMBG, while this recommendation has not been proven to benefit diabetics not on insulin (American Diabetes Association, 2017a). Many studies have found that health practices differ between ethnicities. Generally, ethnic minorities has been associated with having poorer self-care. In many studies, ethnic minorities has been associated with the lesser income group (Pamela Jo Johnson, Neha Ghildayal, Todd Rockwood, & Susan A. Everson-Rose, 2014; J. K. Kirk et al., 2006; Mark Peyrot et al., 2018). In this study, the medication and health care services were provided for almost free. The difference in self-care practices between ethnicities in this study indicate that social, traditional and cultural factors may influence self-care practice. Malaysia’s National Health and Morbidity Survey (NHMS) in 2011 involving 18184 adults reported that self-rated health differed between ethnicities (Y. Y. Chan et al., 2015). Another study in Malaysia by Teh, Tey, and Ng (2014) involving 3406 adults aged above 50 years reported that perceived heath status differed between ethnicities. Varying illness perception between patients of from different ethnicity and background leads to the difference in self-care practices (Bean, Cundy, & Petrie, 2007).

5.4 The association between self-care and diabetes control

This study found that the diabetes control was poor, with on 18.1% study participants achieving the recommended HbA1c target of <6.5%. The overall diabetes self-care was unsatisfactory, with only 45.8% categorized as good. A total of 81.7 % practiced good medication adherence, 78.2% practiced good foot care, 71.7% practices good diet care, 30.2% practiced good diet care and only 8.6% practiced good SMBG. In the correlation analysis, linear regression analysis and logistics regression analysis, the overall self-care, exercise domain, medication adherence domain, diet domain and SMBG domain were not associated with glycaemic control (p>0.05). However, the foot care domain was associated with diabetes control in the correlation (r=0.11, p=0.037) and linear regression (crude B=0.12, p=0.037, adjusted B=0.17, p=0.007) analysis. In the logistic regression analysis, after categorizing the HbA1c values into good and poor control, foot care was not associated with diabetes control (crude OR=0.92, p=0.204, adjusted OR=0.93, p=0.366).

Medication adherence was the most practiced self-care, and this was most likely because the medication was provided for free by the healthcare provider and unlike diet practices and exercise which requires lifestyle changes, it was easier to perform (O'Reilly, 2011). Furthermore, the immediate effect or derangement of health outcome if medication prescription was not followed may increase their compliance rate (Rifkin et al., 2010). Medication adherence was the best-practiced self-care but was not associated with diabetes control. Despite only 18.1% of the study participants achieving recommended HbA1c values of <6.5%, 81.1% were prescribed 1 or 2 hypoglycemic agents with the remaining 18.9% prescribed 3 hypoglycemic agents. Non-optimal pharmacological treatment may have contributed to this finding. A cohort study in the UK involving over 81,000 people with type 2 diabetes found that for those on a single oral hypoglycemic agent, the median time before an oral agent was added or insulin intensification was done were 2.9 years and 7.2 years respectively (Khunti, Wolden, Thorsted, Andersen, & Davies, 2013). In the United States, Fu and Sheehan (2017) reported that among 11525 people with type 2 diabetes, those with timely pharmacotherapy intensification had a reduction of 0.33% in HbA1c within 1 year of follow up.

SMBG being the least practiced self-care in this study was comparable to the findings of others (Gillani et al., 2013; M. Y. Tan & J. Magarey, 2008). Unlike medications which are provided for free, glucose testing machines and their test strips are not provided by the health clinics, and patients are required to purchase it themselves. Having to finance the cost for self-monitoring of blood glucose personally may limit the practice (Gillani et al., 2013; Zgibor & Simmons, 2002). In a qualitative study involving 15 people with type 2 diabetes, Ong, Chua, and Ng (2014) reported that the reasons for poor SMBG practice include frustration related to high blood glucose reading; perception that SMBG was only for insulin titration; stigma; fear of needles and pain; cost of test strips and needles;

inconvenience; unconducive workplace; and lack of motivation, knowledge, and self-efficacy. In this study, the prevalence of good SMBG was low and not associated with diabetes control. The non-association could have been due to the small proportion. Furthermore, among those who practiced SMBG, no information was available regarding the action taken after acquiring the blood glucose levels. In a study involving 7320 patients with type 2 diabetes in California, (Grant et al., 2015) reported that nearly 1 in 6 patients with type 2 diabetes practiced SMBG without either the patient or physician using the results.

In this study, both diet and exercise were not associated with diabetes control. This finding was similar to a Malaysian study conducted by S. L. Tan et al. (2011) who found no association between the intake of sugar; eating fatty food; eating more fruits and vegetables with HbA1c control. In another Malaysian study, Hasimah, Tahir, Rashidah, and Lim (2014) reported no association between dietary practice with Hba1c level. In this study, the dietary practice of the patients was a non-experiment cross-sectional assessment. The patients were most likely not to have undergone a specific dietary intervention as there was no dedicated diabetic team in the health clinics in Hulu Selangor (Hussein et al., 2015). A systematic review of 16 studies involving countries such as Europe, Australia, Middle East and the US by Nowlin, Hammer, and D'Eramo Melkus (2012) found non-consistent finding between dietary practice with HbA1c level. Experimental studies involving a varied diet or a diet practice change following an interventional program were more likely to be associated with a change in HbA1c level when compared to non-experimental studies.

In this study, exercise was not associated with HbA1c levels. This was in agreement with observational cross-sectional studies in Saudi, Jordan, and Myanmar which reported no association between exercise and glycemic control (Al-Khawaldeh, Al-Hassan, & Froelicher, 2012; Saad et al., 2017; Wynn Nyunt, Howteerakul, Suwannapong, & Rajatanun, 2010). In this study, the participants were not involved in any prescribed physical activities. Thus, the type, duration, intensity, and combination of physical activity might not be optimal in reducing the HbA1c level. In a systematic review of 28 studies investigating the effect of exercise on diabetes control, Oliveira, Simoes, Carvalho, and Ribeiro (2012) reported that prescribed, structured physical activity with the appropriate volume and intensity significantly reduced the HbA1c level.

Though foot care score had a significant positive association with HbA1c value in the correlation and linear regression analysis, the association did not exist in the logistic regression analysis. Thus, foot care practice was unable to predict diabetes control. Active foot infection or foot ulcer will lead to poor glycaemic control (Weledji & Fokam, 2014). In this study, no study participants were diagnosed with an active foot infection or foot ulcer. This situation may have influenced the finding of this study. The initial apparent higher HbA1c levels among those with better foot care scores may have been due to more frequent foot care among those with higher HbA1c value as they are more at risk of developing foot pathologies (Mishra, Chhatbar, Kashikar, & Mehndiratta, 2017).

5.5 The association between diabetes knowledge with self-care and diabetes control.

5.5.1 Overview of results

This study found that the diabetes control was poor, with on 18.1% achieving recommended HbA1c target. The knowledge level was fairly poor among the participants of this study, with only 1.1% categorized as having high knowledge. Better diabetes knowledge was seen among those with higher education. Higher diabetes knowledge was associated with better self-care practices but was not associated with diabetes control.

5.5.2 Discussion

Diabetes knowledge was measured using the 14 item, Malay version of the MDKT (Michigan Diabetes Knowledge Test) questionnaire. A score of 1 was given for each correct item. No scores were awarded or deducted for wrong answers. The scoring for the MDKT was based on the total score of all 14 items, with a possible score of between 0 to 14. The mean MDKT score in this study was 6.78 ± 2.07. No study participant managed to obtain a full score. Only 1% of the study participants obtained a high score, while about 55% had a moderate score with the remaining obtaining low score. The level of knowledge among the participants of this study was similar to previously reported studies in Malaysia. In a study utilizing the Malay version of the MDKT to assess the level of knowledge among 400 Malaysian diabetics, Al-Qazaz et al. (2011) reported almost similar results with a mean score of 7.

In the correlation analysis ($r=0.19$, $p<0.001$), linear regression analysis (crude $B=0.08$, $p<0.00$, adjusted $B=0.08$, $p<0.001$) and logistics regression analysis (crude $OR=1.25$, $p<0.001$ adjusted $OR=1.27$, $p<0.001$) more knowledge was associated with better self-care practices. This finding was in agreement with previous studies by (Chavan et al., 2015; Saleh et al., 2012; Shengnan Yang et al., 2016).

Diabetes knowledge is closely associated with education level (X. Zhong et al., 2011). In this study, those with higher education had higher knowledge scores. People with higher education can seek and understand information better, thus increasing their knowledge and allowing them to navigate the healthcare services and practice better self-care (Braveman et al., 2010; Zimmerman et al., 2015). Knowledge about the illness is likely to inform patients about specific actions in the diabetes management process. Thus, the more knowledge patients have about their illness, the more likely they are to comprehend their illness and take up self-care behaviors such as diet, exercise, and blood sugar testing among others (Kugbey, Oppong Asante, & Adulai, 2017). In this study, the participants had generally higher knowledge scores for the complications of diabetes. This showed that the awareness regarding the complications of diabetes is high among them. According to Taksande, Thote, and Jajoo (2017), higher awareness of diabetes which can be evaluated via the knowledge level predicts better self-care practices.

In the correlation analysis (r=0.08, p=0.135), linear regression analysis (crude B=0.09, p=0.135, adjusted B=0.08, p=0.157) and logistics regression analysis (crude OR=0.97, p=0.685 adjusted OR=0.98, p=0.758) no association was found between knowledge and Hba1c level.

Among the participants of this study, better knowledge led to better self-management practices, but this was not reflected in blood sugar levels. Previous studies have reported non-consistent finding between knowledge level with glycemic control. Studies by Santos, Bernardo, Gabbay, Dib, and Sigulem (2013) involving 90 Brazilians and Islam et al. (2015) involving 515 Bangladeshi patients with diabetes found no association between knowledge with glycemic control. Meanwhile, studies by Ozcelik et al. (2010) involving 164 Turkish patients and Gomes et al. (2018) involving 1190 patients with diabetes found more knowledge was associated with better glycemic control. In this study, the overall knowledge score was low. Furthermore, the knowledge score for diabetes management was generally lower than the score for diabetes complications. This shows that though the awareness may be high about diabetes, there is lack of knowledge on how to manage diabetes appropriately. Knowledge is an essential aspect of health literacy. People who are adequately health literate can obtain, process, understand and communicate about health-related information needed to make informed health decisions (Sørensen et al., 2012). However, the relevant knowledge must be acquired to improve one's health literacy (von Wagner, Steptoe, Wolf, & Wardle, 2009). In this study, the lower knowledge scores pertaining to diabetes management may indicate that there is inadequacy in terms of health literacy (van der Heide et al., 2014).Previous studies have shown that questionnaires alone are not the best method to measure one's knowledge and even health literacy. Questionnaires generally does not incorporate, encourage, or evaluate higher-level cognitive processes and skills (McAllister & Guidice, 2012).

Due to the lack of a dedicated diabetic team in the district of Hulu Selangor, the participants of this study may not be able to gain or use the knowledge they have for appropriate diabetes care. A study by Shengnan Yang et al. (2016) showed that diabetics who received proper diabetes education from a dedicated diabetic team demonstrated significantly better diabetes self-management behaviour and had lower HbA1c levels than those who did not. Furthermore, the difference in diabetes knowledge scores between education levels among the participants of this study showed that health promotion, education and awareness services were still non-satisfactory (Muhammad-Lutfi et al., 2014).

The relationship between patients' knowledge and glycemic control could be confounded if knowledgeable patients have more difficulty achieving treatment goals. Furthermore, patients may have gained knowledge in the process of self-care instead of knowledge leading to self-care (Persell et al., 2004). Niroomand et al. (2016) reported that patient's knowledge and practices increases as diabetes worsens.

5.6 Association between psychosocial factors and diabetes self-care practices.

5.6.1 Overview of results

The psychosocial factors investigated in this study were social support, empowerment, self-efficacy, diabetes distress and depression. Better social support was associated with higher education level. The level of diabetes empowerment was similar between sex, race, age group and education level. Self-efficacy was lesser among those with lower education. The prevalence of diabetes distress was 5.7%, with the Malays and those with higher education experiencing more distress. The prevalence of depression was 4.7%, with depressive levels being similar between sex, race, age group and education level. More social support, higher level of empowerment and self-efficacy, and lesser distress and depressive symptoms were associated with better overall diabetes self-care.

5.6.2 Discussion

Social support was measured using the 18 items, CIRS (Chronic Illness Resources Survey) questionnaire which was translated and validated in this study. Each item was scored between 1 to 5, and the CIRS scoring was based on the average score of all items. Similar as in other studies, support was measured, but there was no classification for the level of support (Gleeson-Kreig, Bernal, & Woolley, 2002; Hunt et al., 2012; King et al., 2010). The mean CIRS score among the participants of this study was 2.57 ± 0.65, out of a possible score of 1 to 5. The correlation analysis ($r=0.48$, $p<0.001$), linear regression analysis (crude $B=0.60$, $p<0.001$, adjusted $B=0.60$, $p<0.001$) and logistics regression analysis (crude $OR=3.95$, $p<0.001$ adjusted $OR=4.09$, $p<0.001$) found that higher level of support was associated with better self-care practice. This finding was in agreement with many previous studies (Darawad et al., 2017; Fortmann et al., 2011; Gao et al., 2013; Koetsenruijter et al., 2016; Mayberry & Osborn, 2014; Tang et al., 2008). A chronic disease like diabetes requires extensive behavioral changes and adherence to a complex medical plan. Social support is considered as one of the influential and important factors for performing self-care, and for adherence to the treatment and glycemic control (Rad et al., 2013). In a meta-analysis of 122 studies, DiMatteo (2004) reported that adherence was 27% higher when patients had practical support available to them. Support acts as an encouragement to engage in health behaviors. Conversely, the lack of support becomes a barrier to health behavior (Reblin & Uchino, 2008). Social support benefits a patient by buffering stress, changing affective states, increasing self-efficacy, and influencing change in adverse health behaviors (Miller & DiMatteo, 2013). People with good support have better psychological adjustment, improved efficacy and better coping mechanism (Ozbay et al., 2007).

Diabetes empowerment level was measured using the 6 item, Malay version of the DES (Diabetes Empowerment Scale) questionnaire which was translated and validated in this study. Each item was scored from 1 to 5, and the average of all items was calculated as the DES score. Higher score meant better empowerment. The mean score of the DES was 3.96 ± 0.51, from a possible of 1 to 5. The correlation analysis ($r=0.28$, $p<0.001$), linear regression analysis (crude $B=0.47$, $p<0.001$, adjusted $B=0.48$, $p<0.001$) and logistics regression analysis (crude $OR=1.87$, $p<0.008$ adjusted $OR=1.99$, $p<0.006$) found that higher level of empowerment was associated with better self-care practices. This finding was consistent with a study in Turkey which reported that among 220 patients with diabetes, empowerment was a predictor of good self-care (Arda Surucu, Buyukkaya Besen, & Erbil, 2017). Similarly, in a multicenter study in China involving 885 patients with diabetes, S. Yang, Hsue, and Lou (2015) found that empowerment was a strong predictor of self-care after controlling for age, gender, marital status, educational level, and diabetes duration. Empowered patients, especially those equipped with the correct information will have the confidence to perform the appropriate diabetes self-care.

Having the information or knowledge alone without empowerment is a waste of resources. This is because a person's actual ability to contribute to self-care and health protection is not used as one does not think one can do much (Eyuboglu & Schulz, 2016). Empowered individuals believe that their actions in performing self-care practices will result in the improvement of their health, thus making them motivated (M. Fitzgerald, O'Tuathaigh, & Moran, 2015). For empowerment to benefit diabetes self-care, a patient must be knowledgeable, and the relevant tools, techniques, and support must be made available to enable them to make good use of their available knowledge (Chatzimarkakis, 2010).

Diabetes self-efficacy level was measured using the previously translated and validated 14 item, Malay version of the Diabetes Management Self Efficacy Scale (DMSE). Each item was scored from 0 to 10, with the total score for all 14 items being calculated to measure self-efficacy. The mean total score of the DMSE was 104.08 ± 23.20, from a possible score of 0 to 140. The correlation analysis ($r=0.46$, $p<0.001$), linear regression analysis (crude $B=0.02$, $p<0.001$, adjusted $B=0.02$, $p<0.001$) and logistics regression analysis (crude $OR=1.03$, $p<0.008$ adjusted $OR=1.03$, $p<0.006$) found that higher level of self- efficacy was associated with better self-care practice. This finding was consistent with a systematic review of 26 studies which found that self-efficacy was a strong predictor of diabetes self-care (Mohebi et al., 2013). In Taiwan Y. J. Lee et al. (2016) reported that among 295 people with diabetes, instead of health literacy, self-efficacy was a strong predictor of self-care practice. In Indonesia, Kurnia, Amatayakul, and Karuncharernpanit (2017) studied the impact of self-efficacy, social support, distress, knowledge and sociodemographic factors on diabetes self-care and reported that better self-efficacy was the best predictor of diabetes self-care. In Turkey, using structural equation modeling, Cosansu and Erdogan (2014) reported that support, education, and interference in daily life had no direct effect on diabetes self-care but self-efficacy had a strong direct effect on self-care. Self-efficacy beliefs have a strong effect on the degree to which a patient will actively perform the appropriate diabetes self-care practices. Diabetics with higher self-efficacy are more persistent at a task, resilient and are willing to take the extra effort to carry out diabetes self-care practices despite the obstacles (Keefer, Kiebles, & Taft, 2011). Patients with high self-efficacy are more likely to overcome their physical, psychological and social challenges to achieve the appropriate behavioral change. People with high levels of self-efficacy trust their capabilities, and this is a pre-requisite to behavioral change (Mohebi et al., 2013).

Diabetes distress was measured using the 17 item, Malay version of the Diabetes Distress Scale (DDS) which was translated and validated in this study. Each item was scored from 1 to 6 on the Likert scale. Diabetes distress was measured by calculating the average of all 17 items, with a score of 3 and more considered positive for the presence of diabetes distress. The mean distress score was 1.54 ± 0.66, from a possible score of 1 to 6. Approximately 5.7% of the study participants had diabetes distress. In a systematic review of 55 studies worldwide, the prevalence of diabetes distress was estimated to be at 36% among those with type 2 diabetes (Perrin, Davies, Robertson, Snoek, & Khunti, 2017). In this study, the participants were recruited from primary care centers. Patients treated in primary care centers generally have lower level of distress when compared to those being treated in secondary care centers (Stoop et al., 2014). The correlation analysis ($r=-0.24$, $p<0.001$), linear regression analysis (crude $B=-0.30$, $p<0.001$, adjusted $B=-0.34$, $p<0.001$) and logistics regression analysis (crude $OR=0.72$, $p=0.049$ adjusted $OR=0.61$, $p=0.010$) found that higher levels of distress was associated with poorer self-care practice. This finding was consistent with many recent studies. In the United States, D. M. Hessler et al. (2017) reported that elevated diabetes distress level was associated with missing medications. In India, N. Kumar et al. (2017) reported that diabetics with low distress levels were more adherent to self-care practices. In a cross-sectional and longitudinal study involving 392 diabetics in the United States, D. Hessler et al. (2014) reported that higher distress at the beginning of the study was associated with poorer self-care. After a year of follow-up, reduction in diabetes distress was associated with improvement in self-care practice. Diabetes distress can result from the diagnosis itself, or from the strict treatment protocol and self-care activity the patient needs to follow. It can originate at the point of diagnosis, or when the patient contemplates the nature of his condition and complex challenges ahead of endless lifestyle modifications and self-care activities which needs to be carried out on a daily basis, along with the fear of complications (Beeney, 2015).The inability of the patient to cope with diabetes affects the psychological state of mind which in turn leads to poorer healthcare practices (N. Kumar et al., 2017).

Depression was measured using the previously translated and validated Malay version of the Patient Health Questionnaire (PHQ-9). This scale has 9 items, with each item having an option of 4 answers, each scored as 0, 1, 2 and 3. For scoring purposes, the total score of all 9 items were calculated. An individual was categorized as depressed if the score was 10 or more. The mean total score for the PHQ-9 was 4.54 ± 2.53. Approximately 4.3% of the study population were categorized as being depressed. The prevalence of depression among the participants of this study was lower than previously published studies involving Malaysian with diabetes. Previous studies in Malaysia have estimated the prevalence of depression to be between 11.5% to 22% among those with diabetes (Kaur, Tee, Ariaratnam, Krishnapillai, & China, 2013; Khai, 2010). The correlation analysis (r=-0.14, p=0.009) and linear regression analysis (crude B=-0.04, p=0.009, adjusted B=-0.05, p=0.008) found that higher depression score was associated with poorer self-care practices. However, when self-care was categorized, the effect of depression was attenuated and became non-significant (crude OR=0.95, p=0.210 adjusted OR=0.93, p=0.123). These findings show that depressive severity is a better predictor of self-care intensity instead of self-care category. Previous studies have reported that higher level of depression was associated with poorer self-care. In a systematic review of 21 cross-sectional studies, 19 studies reported that depression was associated with poorer self-care (Sumlin et al., 2014). According to a meta-analysis of 47 studies by J. S. Gonzalez, M. Peyrot, et al. (2008), depressive severity was associated with poorer adherence to medication, diet, exercise, SMBG and poorer medical appointment attendance. Similar as in this study, the effect of depressive symptoms were stronger in studies evaluating self-care as a continuous variable rather than a categorical variable. Depressed individuals suffer from mood problems, disturbed emotions, poorer cognition, have poor concentration, psychomotor retardation, sleep changes and/or even suicidal thoughts (Bădescu et al., 2016). Depression influences how an individual feels, think, act and leads to a variety of emotional and physical problems, resulting in a decrease in ability to function (Parekh, 2017).

5.7 Direct and indirect pathways between age, sex, education, diabetes duration, knowledge and psychosocial factors with diabetes self-care practices.

5.7.1 Overview of results

Diabetes self-care was influenced by social support, self-efficacy, diabetes distress and depression. More social support, a higher level of self-efficacy and a lower level of diabetes distress led to better diabetes self-care practices. The effect of social support was also mediated by self-efficacy. Depression had no direct effect on self-care but influenced self-care via self-efficacy. Age, duration of diabetes, knowledge, and empowerment had no influence on diabetes self-care.

5.7.2 Discussion

In this study, age was not associated with diabetes self-care (path coefficient = -0.07, p=0.058). This finding was in agreement with Al Johani et al. (2015), Freitas et al. (2014), Primožič et al. (2012) and Y. Song et al. (2012). The absence of an association between age with self-care in this study was best explained by the age of the participants. In this study, the mean age of the participants was 55.33 ± 10.09 years old, with 68.7% of them being 60 years old and younger. Studies involving younger diabetics (Primožič et al., 2012; Y. Song et al., 2012) or with unequal distribution of age (Al Johani et al., 2015; Freitas et al., 2014) does not allow much of the variability in self-care to be observed. Diabetes self-care is complex and is influenced by age-related factors such as cognitive dysfunction and diabetes complications (Powers et al., 2015). In this study, the prevalence of diabetes-related complications such as ischemic heart disease that limits self-care practices such as exercise was low, at only 5.8%. Musculoskeletal problem and cardiac problem which limits practices are more common among those older than 65 years old while cognitive impairment is more common among those older than 75 years old (Kirkman et al., 2012). In this study, those deemed to have cognitive impairment were not included. Thus, the relatively younger age group in this study did not allow much heterogeneity in their answer regarding self-care.

This study found no association between education level and self-care practices (path coefficient =- 0.018, p = 0.712). The association between education level and self-care has been inconsistent. Al Johani et al. (2015), Primožič et al. (2012) and Bains and Egede (2011) reported no association between education level with self-care practices. However, Y. Song et al. (2012), Walker, Gebregziabher, et al. (2014), Y. Xu et al. (2010) and Feil et al. (2012) reported higher education level was associated with better self-care practices while Ahmad Sharoni et al. (2015) and Freitas et al. (2014) have reported otherwise. The lower education level among the participants of this study may have contributed to the finding. The proportion of participants with tertiary education was 8.9% in this study. Studies reporting no association or a negative association between education level and self-care involved participants with lower education levels, with those attaining tertiary education ranging from 0 to 31.8%. In studies reporting a positive association between education level with self-care practices, the proportion of those with tertiary education ranged from between 30.6% to 58.8%. People with higher education have higher awareness and greater intellectual and cognitive abilities, enabling them to better understand the principles and potential of self-care (Rhee et al., 2005; Tadele, Tefera, Endalew, & Negalign, 2014).

This study found no association between sex and self-care (path coefficient = -0.062, p = 0.155). This finding was in agreement with studies by Y. Xu et al. (2010) and Ahmad Sharoni et al. (2015). However, the association between sex and self-care practices has not been consistent. While Al Johani et al. (2015) and Y. Song et al. (2012) found that females had better overall diabetes self-care, Feil et al. (2012) reported that males practiced more exercise than females. Previous research have attributed the disparities in diabetes self-care and health behavior between male and female to the local and traditional sociocultural gender role and gender power inequality (S. E. Choi, 2009).The lack of access to healthcare has also been reported to be a reason for health behavior disparities between male and female (Ravindran, 2012). In this study, the social gender roles were not explored. However, the almost free health service provided by the government may reduce the health behavior discrepancies among the participants of this study. Furthermore, the social and cultural norm of the study participants regarding gender roles may have also contributed to the current finding Hirschman (2016).

This study found that higher education was associated with more social support (path coefficient =0.126, p = 0.015). This finding was in agreement with Y. Song et al. (2012). Gao et al. (2013) and Y. Xu et al. (2008) however reported no association between education level and social support. The measurement and classification of education level in the studies by Y. Song et al. (2012), Gao et al. (2013) and Y. Xu et al. (2008) varied and thus non-comparable. Those with higher education enjoy more social support than those with lower education level (Cosansu & Erdogan, 2014; Ranchor, Bouma, & Sanderman, 1996). Apart from poorer social support, those with lower education level have lesser emotional support and have a higher level of negative interaction (Mickelson & Kubzansky, 2003). Individuals with higher education level can utilize resources around them better (Chien et al., 2013). Furthermore, a formal education setting encourages the development of friendships and interpersonal skills, and people with more education and related social advantages may also have more time and resources to maintain relationships and support friends emotionally and financially (Egerter, Sadegh-Nobari, Grossman-Kahn, & Dekker, 2009).

This study found no association between education level and self-efficacy (path coefficient = -0.061, p = 0.206). This was not in agreement with Y. Song et al. (2012), Y. Xu et al. (2008) and Sharoni and Wu (2012) which reported higher self-efficacy among those with higher education level. In the studies by with Y. Song et al. (2012), Y. Xu et al. (2008) and Sharoni and Wu (2012), at least 29% of the study participants had tertiary education. In this study, only 8.9% had tertiary education. Higher education level has been reported to be the main contributor to better diabetes self-efficacy (Robert, Manon, & William, 2014). Individuals with a higher level of education are more receptive to new information and can acquire and synthesize it into actions (Braveman et al., 2010).

This study found that higher education was associated with better diabetes knowledge (path coefficient = 0.126, p = 0.015). This finding was consistent with studies by X. Zhong et al. (2011) and Y. Xu et al. (2008). Individuals with a higher level of education are more receptive to new information, able to acquire and understand new knowledge and can synthesize this new knowledge into actions. Compared to diabetics with higher education attainment, those with lower education level and poor literacy skills are more likely to have difficulty reading and understanding basic health care information, thus leading to lesser knowledge (Braveman et al., 2010).

In this study, sex was not associated with social support (path coefficient = -0.002, p = 0.974). This finding was in agreement with Gao et al. (2013) which reported no association between sex and social support. Y. Song et al. (2012) however reported that males enjoy more social support while females had more unmet support needs. This has been attributed to the social gender roles among Korean females in which they are expected to exhibit "competence without complaint". Furthermore, as the primary nurturer of the well-being of their families, they are supposed to prioritize the needs of other family members over their own. Previous studies exploring the association between sex and social support has attributed the discrepancies due to the social gender roles (Mansyur, Rustveld, Nash, & Jibaja-Weiss, 2015). Caetano, Silva, and Vettore (2013) reported that males enjoy better social support. However, this did not necessarily translate into social participation. In another study, Chemaitelly et al. (2013) reported that despite having similar levels of social support, females respond differently by having more positive outlook compared to males. In this study, though the social gender roles were not investigated, previous studies by Noor (1999) and Hirschman (2016) have reported that social gender roles among Malaysian did not influence the support received nor the participation in socioeconomic activities.

This study found no association between sex and self-efficacy scores (path coefficient = 0.012, p = 0.790). This finding was in agreement with Y. Song et al. (2012), Sharoni and Wu (2012) and Gao et al. (2013). Sex is closely associated with social gender role which is usually determined by socioeconomic status and traditional and cultural norms (Vlassoff, 2007). In Malaysia, Hirschman (2016) has reported that historically there has been gender equality among Malaysians as evident by the involvement of females in agricultural production and trade, and the occasional participation of males in domestic roles. This finding may also be true for the participants in this study. When controlled for social gender role and sociodemographic factors, self-efficacy does not differ between sex (Adebayo & Olonisakin, 2014; K. Venkataraman et al., 2012).

This study found no association between sex and empowerment scores (path coefficient = 0.071, p = 0.144). The association between sex and empowerment has been inconsistently reported in previous studies. While A. Tol, Shojaeezadeh, Sharifirad, Alhani, and Tehrani (2012) and Antonio et al. (2013) have reported that female diabetics were more empowered than males, M. Fitzgerald et al. (2015) and Naccashian (2014) have reported no association between sex and diabetes empowerment. Previous studies have reported that the differences in empowerment between male and female were associated with the sociodemographic background, gender and cultural role, and individual's belief and perception (Hara, Hisatomi, et al., 2014; Stubbs, 2007). Gender equality has been historically reported in Malaysia, especially in socioeconomic areas Hirschman (2016). This finding may also be true for the participants in this study.

This study found no association between sex and depression scores (path coefficient = - 0.052, p = 0.317). This finding was not in agreement with Ronny A. Bell et al. (2010) which used the CES-D, a 20-item self-report depression symptom scale developed by the Center for Epidemiologic Studies to assess depression, and found that the prevalence of depression was 15.8% and it was associated with female sex. Findings from cross sectional studies in Malaysia, China, Bangladesh, and Palestine with varying instruments to measure depression (e.g. Beck Depression Inventory (BDI-II), Patient Health Questionairre-9 (PHQ-9), Depression, Anxiety and Stress Scale (DASS) 21, and Taiwan Depression Questionnaire (TDQ)) reported the prevalence of depression among people with diabetes ranged from 11.5% to 40.2% with being female as a predictor of depressive symptoms. (H. L. Chan, Lin, Chau, & Chang, 2012; Kaur et al., 2013; Roy, Lloyd, Parvin, Mohiuddin, & Rahman, 2012; Sweileh, Abu-Hadeed, Al-Jabi, & Zyoud, 2014). Females are more prone to emotional trauma, and due to their gender roles, they are burdened with chronic strains that might contribute directly or indirectly to depression. Biologically, compared to males, females are more prone to hypothalamic dysregulation when faced with stress (Weiss, Longhurst, & Mazure, 1999). Furthermore, the self-concept of females with regards to interpersonal relationship forces them to accommodate the need of others first, and the tendency to keep problems to themselves further make them prone to depression more than males (Nolen-Hoeksema, 2001). The non-significant association between sex and depression in this study could have been due to the much lower prevalence of depression (4.3%), the difference in the study population and the type of survey instrument used.

This study found no association between duration of diabetes with self-care practices (path coefficient = 0.069, p = 0.064). This finding was not in agreement with Feil et al. (2012), Y. Song et al. (2012), Y. Xu et al. (2010) and Y. Xu et al. (2008) which reported that longer duration of diabetes was associated with better self-care. In these studies, the mean duration of diabetes among the study participants ranged from 8.8 years to 15 years. In an intervention study involving 1665 diabetics which were divided into control and intervention group, who were then followed up for an average of 5 years duration, Trief et al. (2013) reported that longer duration of diabetes was associated with better diabetes self-care practices. In their study, the mean age of study participants was between 70 to 71 years old with a mean duration of diabetes between 10 to 12 years. Alrahbi (2014) reported that individuals with at least 6 years of diabetes have better problem-solving skills as they have adapted to living with diabetes. In this study, the absence of an association between duration of diabetes with self-care practices could be explained by the relatively shorter duration of diabetes, with a mean duration of about 6 years only.

Among the participants of this study, diabetic knowledge was not related to diabetes self-care (path coefficient = 0.058, p = 0.204). This finding was in agreement with Y. Xu et al. (2008) but not X. Zhong et al. (2011). The difference in study findings may have been due to the questionnaire used to assess knowledge. In this study, the prevalence of good diabetes knowledge was poor. Only 1.1% of the study participants were considered to have good diabetes knowledge. This was in contrast to the study by X. Zhong et al.

(2011) which reported that up to 45.6% of study participants being considered as having good diabetes knowledge. Furthermore, the participants in this study did have a better knowledge on common diabetes complication but had poorer knowledge about managing diabetes.

Among the participants of this study, empowerment level was not related to diabetes self-care (path coefficient = 0.004, $p = 0.952$). This finding was in agreement with Y. J. Lee et al. (2016). However, Hernandez-Tejada et al. (2012) reported that higher level of empowerment was associated with better diabetes self-care. In this study, the empowerment level was similar between age group, sex, race, and education level. Out a possible score of 1 to 5, over 80% of the study participants scored 4 or more on the DES (Diabetes Empowerment Scale). The high levels of empowerment score among the participants of this study did not leave much variability in the overall empowerment level score. Previous studies have reported that socio-cultural norms influence one's perception of disease. Studies have shown that Asians and Caucasians perceive disease differently (Grewal, Stewart, & Grace, 2010; Skinner, Tantam, Purchon, & John, 2002). This study involved Asians, which was similar to that of Y. J. Lee et al. (2016). Thus, the socio-cultural background of study the participants may have contributed to the finding.

In this study, those with higher levels of self-efficacy practiced better diabetes self-care (path coefficient = 0.31, $p = <0.001$). This was consistent with majority of the studies (Gao et al., 2013; Y. J. Lee et al., 2016; Sharoni & Wu, 2012; Walker et al., 2015; Walker, Smalls, et al., 2014; Wu et al., 2007; Y. Xu et al., 2008; X. Zhong et al., 2011). Diabetics with higher levels of self-efficacy have better self-regulation autonomy, more confidence, more initiative and more persistence in dealing with the daily needs to care for diabetes (Senecal, Nouwen, & White, 2000). Self-efficacy ensures the continuity of appropriate diabetes self-care practices. Thus, many studies have utilized the concept of enhancing self-efficacy to foster and maintain good diabetes self-care practices (Nazlı et al., 2008).

In this study, those reporting higher levels of social support perform better diabetes self-care (path coefficient = 0.379, p = <0.001). This finding was in agreement with majority of other studies such as those by Brittany L. Smalls et al. (2014), Walker et al. (2015), Mayberry and Osborn (2014), Tang et al. (2008), Gao et al. (2013), Fortmann et al. (2011) and Y. Xu et al. (2008). Support has been categorized differently by many authors and usually is related to the concept of measurement used in their respective studies. Support can be categorized as social support which consists of emotional support, esteem support, tangible support and informational support (Scott, 2016). Support can also be classified based on the source of support such a family and friends support, neighborhood support, community support, healthcare provider support or policy support (Shaw, Gallant, Riley-Jacome, & Spokane, 2006). Diabetics perceiving good family support find that there are fewer barriers when performing diabetes self-care practices. Those having good family support are more adherent to better diet practices since family members can help in food preparation (Wen, Parchman, & Shepherd, 2004). Social support may also offer coping strategies and structure in daily routines enabling the individual to cope with daily diabetes care with lesser stress and better adherence (Kadirvelu et al., 2012).

Self-reported depressive symptoms were not associated with diabetes self-care (path coefficient = 0.024, p = 0.684). This finding was not in agreement with studies by Primožič et al. (2012), J. S. Gonzalez, L. M. Delahanty, et al. (2008), Walker, Gebregziabher, et al. (2014), R. A. Bell et al. (2010) and Feil et al. (2012) which reported that depressed diabetics performed poorer diabetes self-care. The studies which reported an association between depression with diabetes self-care had a prevalence of depression between 13.7% to 25% and were conducted in the United States or European countries. In this study, the participants were Malaysians, with a much lower prevalence rate of 4% for depression. Thus, the absence of an association between depression and diabetes self-care practices in this study could have been due to the lower prevalence of depression and the difference in the study population (Wyatt, Ung, Park, Kwon, & Trinh-Shevrin, 2015). Furthermore, the low prevalence of diabetes-related complications and almost free health services among the participants of this study could have served as a protective factor from depression (Dunlop, Song, Lyons, Manheim, & Chang, 2003).

Those reporting higher level of diabetes distress performed poorer diabetes self-care (path coefficient = -0.142, p = 0.011). This finding was not in agreement with Primožič et al. (2012) and J. S. Gonzalez, L. M. Delahanty, et al. (2008) which found no association between diabetes distress and diabetes self-care practices among their study participants. The studies by Primožič et al. (2012) and J. S. Gonzalez, L. M. Delahanty, et al. (2008) Europeans and White Americans. In this study, the participants were Asians. When compared between ethnicity, the Malays appear to experience a higher level of diabetes distress than other ethnicity. It is evident that within the sample population of this study, existed difference of diabetes distress by ethnicity. Previous studies have reported that socio-cultural norms influence one's perception of disease. Studies have shown that Asians and Caucasians perceive disease differently (Grewal et al., 2010; Skinner et al., 2002). It is possible that the difference in the study population may influence the finding of this study.

The duration of diabetes did not influence the empowerment level (path coefficient = -0.002, p = 0.961). This finding was not in agreement with Y. J. Lee et al. (2016) which reported that those with a longer duration of diabetes were more empowered. In their study, the mean duration of diabetes was 9.9 years while in this study, the mean duration of diabetes was much shorter at 6.1 years. Furthermore, the instruments used to measure empowerment differed, and questionnaires are known to influence survey outcomes (Quelhas et al., 2011). As mentioned earlier, the high proportion of those with a high level of empowerment score among the participants of this study does not allow much variability regarding the response, which may have led to the current findings. The complex relationship between duration of diabetes with empowerment level may lead to the inconsistent finding regarding the association between duration of diabetes and empowerment. Longer duration of diabetes allows for the exposure of other factors which may influence empowerment (Hara, Iwashita, et al., 2014). It is probable that years of living with diabetes can affect patients in adopting healthy practices through empowerment. Longer duration of diabetes enables a person with diabetes to have more chances to attend diabetes education and other healthcare services. This coupled with better familiarity with the disease and better relationship with the healthcare providers leads to better levels of empowerment (K. V. S. Kumar, Kumar, Anish, & Pillarisetti, 2014).

This study found no association between duration of diabetes with self-efficacy (path coefficient = -0.011, p = 0.802). This finding was not in agreement with those by Sharoni and Wu (2012), Y. Song et al. (2012) and Y. Xu et al. (2008), which reported that longer duration of diabetes was associated with higher levels of self-efficacy. In their studies, the participants had a mean duration of diabetes between 7.8 years to 15 years, or more than 50% had diabetes for over 10 years. Among the participants of this study, the duration of diabetes was relatively shorter, with a mean duration of 6.12 years only. Duration of diabetes may influence self-efficacy in many ways. Longer duration of diabetes has been associated with patients receiving more or longer duration of care including receiving more diabetes-related education from healthcare providers, and this may indirectly influence diabetes self-efficacy (Bruce et al., 2003). Apart from more opportunities in receiving care, longer duration of diabetes allows an individual to gain the experience of living with diabetes, and this enables them to adapt and find the most appropriate way and confidence to deal with the daily needs of living with diabetes (Odili, Isiboge, & Eregie, 2011).

This study found no association between duration of diabetes with knowledge (path coefficient = 0.003, p = 0.966). This was in agreement with Y. Xu et al. (2008) but not X. Zhong et al. (2011) which found that longer duration of diabetes was associated with better knowledge. In this study, during initials stages of analysis, those with higher education were found to be more knowledgeable. However, the association between education level and knowledge was not tested in the final model. Y. Xu et al. (2008) investigated the association between diabetes duration and knowledge between those with and without insulin and despite both group having a markedly different mean duration of diabetes (7.8 years and 15 years respectively), the education attainment was similar in both groups. Thus, similar to their study, the educational attainment of the participants of this study may have contributed to the finding. Among those with poor educational attainment, longer duration of diabetes may improve one's knowledge via the years of experience and awareness gained by living with diabetes (Odili et al., 2011). In communities with poor socio-demographic background and with the absence of proper health education, longer duration of diabetes will force the individual to learn more about the disease based on personal experience and complications of diabetes (Walid, Rose, Akhtar, Ivan, & Tawfeg, 2013).

In this study, older patients had poorer empowerment scores (path coefficient = -0.116, p = 0.028). This finding was in agreement with Y. J. Lee et al. (2016). The relationship between age and empowerment is complex, as they are many other factors which are associated with aging. Hara, Iwashita, et al. (2014) reported that older diabetics in Japan were more empowered as most of them are retirees and have ample of time to perform the necessary changes needed for their diabetes care. In a study involving 688 people with diabetes in Iran, Azar Tol et al. (2013) reported that older diabetics were less empowered. This was attributed to the longer duration of diabetes among the elderly diabetics rendering them less sensitive to diabetes care, and show less readiness to change the situation.

This study found that knowledge scores were not associated with the empowerment scores (path coefficient = 0.091, p = 0.130). This finding was not in agreement with Hernandez-Tejada et al. (2012) which reported that better knowledge was associated with higher levels of diabetes empowerment. During the initial stages of analysis, having a higher score for the knowledge test was associated with having a tertiary education. Across developed and developing countries, higher education level has been associated with better diabetes knowledge (Al-Adsani, Moussa, Al-Jasem, Abdella, & Al-Hamad, 2009; Bruce et al., 2003; Gunay et al., 2006; G. H. Murata et al., 2003). In the studies finding an association between diabetes knowledge with empowerment level, the proportion of participants with tertiary education were sizeable, ranging from 27.9% to 40.7%, which was similar to the study by Hernandez-Tejada et al. (2012) with a proportion of over 30% (Bhargava, Wartak, Friderici, & Rothberg, 2014; Eyüboğlu & Schulz, 2016). However, in this study, only about 9% had a tertiary education level, with only 1% having good knowledge regarding diabetes. The poor knowledge score in this study which was associated with poor education attainment, coupled with a sizeable proportion of those with a high level of empowerment score does not allow much variability regarding the response, which may have led to the current finding.

This study found no association between knowledge scores with self-efficacy scores (path coefficient = 0.086, p = 0.100). This finding was not in agreement with Y. Xu et al. (2008) which reported that better diabetes knowledge was associated with higher levels of self-efficacy. Comparisons of knowledge and self-efficacy level between studies were not possible as different questionnaires were used. However, as mentioned earlier, the poor knowledge level among the participants of this study may have contributed to the current finding. It is important to note that self-efficacy acts as the link between knowledge and desirable behaviors Due to the chronic nature of diabetes, over time, some individual would have developed an attitude towards their efficacy of self-management. Thus, the knowledge they recently acquire might not influence their self-efficacy (S. H.-M. Guo, Chang, & Lin, 2015)

In this study, higher depressive scores were associated with lower self-efficacy scores (path coefficient = -0.316, p = <0.001). This finding was in agreement with Adam and Folds (2014) and Wu, Huang, et al. (2013). Depression is twice as common among diabetic as compared to the general population. Diabetes may increase the risk of depression because of the sense of threat and loss associated with receiving this diagnosis and the substantial lifestyle changes necessary to avoid developing debilitating complications (Mezuk, Eaton, Albrecht, & Golden, 2008). Depression leads to problems such as apathy, hopelessness, fatigue, memory problems and loss of confidence in performing daily activities which are all required in managing a chronic disease like diabetes (Ludman et al., 2013). Depression affects patient initiated activities and influences their confidence level (E. H. B. Lin et al., 2004).

This study found that those experiencing more distress were more likely to be more depressed (path coefficient = 0.267, $p = <0.001$). This finding was in agreement with J. S. Gonzalez, L. M. Delahanty, et al. (2008). Elsewhere, many other studies reported similar findings. In a cross-sectional study in Massachusetts involving 146 diabetics, Carper et al. (2014) reported that diabetes distress was positively associated with depression. Similar findings were reported by van Bastelaar et al. (2010) in a cross-sectional study involving 627 diabetics in the Netherlands. Schmitt et al. (2015) further reported that among 466 German's with diabetes, depression and diabetes distress was strongly and positively associated. Diabetes distress is caused by the difficulty in coping with diabetes in daily life. A minimal amount of diabetes distress is part of living with diabetes. However, when severe enough, or exacerbated by other environmental or personal factor, diabetes distress may be severe enough to lead to depression and warrants medical pharmacotherapy.

Among the participants of this study, social support was not related to depression (path coefficient = -0.032, $p = 0.520$). This finding was not in favor with the study by Fortmann et al. (2011) which reported that lower social support was associated with higher level of depression. The study population may have contributed to the difference in the outcome. Fortmann et al. (2011) recruited Latinos who were the minority and from the underserved community who had limited access to healthcare. In this study, all the participants had good access to healthcare service, which was provided for almost free of charge. The socio-cultural background of the participants in this study may have played a role as a protective factor against depression as Asians were less likely to experience major depression. Furthermore, Asians tend to be more conservative and find it difficult to express depression (Wu, Young, et al., 2013). The prevalence of depression among the study population by Fortmann et al. (2011) was at 25% whereas it was a mere 4.3% in this study population. The lower prevalence of depression may have also led to the current finding.

This study found that higher level of support was associated with better self-efficacy (path coefficient = 0.264, $p < 0.001$). This finding was consistent with those reported by Y. Song et al. (2012) and Y. Xu et al. (2008). Those who perceived better social support are more willing to ask and find ways on how to do things right (C. H. Yu et al., 2014). Thus, social support has often been used as an intervention to improve diabetes self-efficacy. At the individual level, intervention incorporating social support has increased the self-efficacy levels of diabetics and has prompted them to get the support of others to practice better diabetes self-care (Heisler & Piette, 2005). Similar findings were repeated in community-level intervention studies, utilizing community-based, peer-led programs as an intervention (Klug, Toobert, & Fogerty, 2008). Not only has community support improved the self-efficacy level of diabetic patients, diabetes self-care practices and the severity of depression has been reported to be lower (Lorig, Ritter, Villa, & Armas, 2009).

In this study, depression had no direct effect on self-care (path coefficient = 0.024, $p=0.684$) but had a significant indirect effect via self-efficacy (path coefficient = -0.098, $p=0.001$). Similar associations has been reported by Cherrington, Wallston, and Rothman (2010), Gharaibeh, J Gajewski, Smadi, and Boyle (2016) and Greenberger, Dror, Lev, and Hazoref (2014). One underlying mechanism on how depression leads to poor self-care is that the symptoms of depression (e.g., fatigue, loss of motivation, hopelessness) reduces adherence and ultimately adversely affects health (Sacco et al., 2007). However, it is possible that depression is more intricately tied to the confidence and feelings of mastery of diabetes self-care, which then leads to a poor sense of self-efficacy and subsequently poor self-care (Cherrington et al., 2010). This study found that social support had both direct (path coefficient = 0.399, $p<0.001$) and indirect effects on self-care via self-efficacy (path coefficient = 0.078, $p=0.001$) on diabetes self-care. The indirect effects of social support via self-efficacy is in agreement with previous studies (Maeda, Shen, Schwarz, Farrell, & Mallon, 2013; E. G. Tovar et al., 2015; K. Williams & M. Bond, 2002). Social support is one of the influential and important factors for performing self-care and for adherence to the treatment as it acts as an encouragement to engage in health behaviors (Reblin & Uchino, 2008). Furthermore, the support received by patients may serve as a positive and rewarding experience, which could eventually lead to a sense of self-worth, self-esteem, and eventually higher self-efficacy which is then translated into better diabetes self-care (Nastaran, Hamid, Mohammad Reza, & Mohammad Raze, 2017).

These findings suggest that self-efficacy is an important mechanism by which social support and depression may influence self-care. Patients with greater support may have better opportunities to perform self-care while those with depression may have lower self-esteem and may lead to poorer self-care (Maeda et al., 2013).

5.8 Limitation of study

To understand the results and conclusion of this study better, there are some limitations which need to be considered when interpreting the findings.

5.8.1 Confounders

This was an observational cross-sectional study. The best effort has been taken to measure the possible confounders in this study. In this study, age, sex, race, education level, duration of diabetes, insulin use and clinic location were adjusted for in the analysis. However, there are possible confounders which were not measured in this study. Income was not measured in this study. The association between income with self-care has not been consistently reported. Bains and Egede (2011) and Y. Xu et al. (2010) reported no association between income with diabetes self-care while X. Zhong et al. (2011) and Watkins et al. (2013) reported that lower income was associated with poorer self-care practices. Income has always been considered as confidential, and it is difficult to ascertain the accuracy of reported figures in questionnaires. Though other sources such as tax returns or payrolls are more reliable, it is not feasible (Cuc & Griffin, 2007). However, in this study, education level was measured. Education level can be considered as a proxy for income. According to Abellan, Rodriguez-Laso, Pujol, and Barrios (2015) and Araya, Lewis, Rojas, and Fritsch (2003), education level is more important than income level in determining health outcome.

The cognitive function was not measured in this study. Cognitive impairment can range from mild cognitive impairment up to dementia (Julie Hugo & Mary Ganguli, 2014). Cognitive impairment is associated with poorer self-care Compean-Ortiz et al. (2010); Feil et al. (2012); Primožič et al. (2012). The presence of a sizeable proportion of participants with cognitive impairment may confound the finding in this study. However, cognitive impairment usually affects those above 65 years old (Julie Hugo & Mary Ganguli, 2014). In this study, the mean age of the participants was 54.71 ± 9.78 years old.

Medical comorbidities leading to poor self-care was not explored in this study. According to Childs (2007), most diabetics have 1 comorbidity with up to 40% having 3 comorbidities. The number, type, and severity of comorbidities influence diabetes patients' self-management and treatment priorities (Kerr et al., 2007). The impact of type and severity of medical comorbidities which was not explored may be a confounder in this study

5.8.2 Bias

5.8.2.1 Sampling bias

The participants in this study were recruited via systematic random sampling. Though it would be ideal to select the sample from the study population, this was not feasible (Setia, 2016). Every patient with diabetes was seen by the doctor in the health clinic at least once in every 3 months. However, the systematic random sampling of every 10th patient based on the clinic attendant list for the day, spread for about 6 months was more feasible as this ensured all the patients in the clinic had an equal chance of being selected into the study. Thus, this will reduce the chance of a systematic selection bias where patients recruitment were affected by time or date of the appointment (Setia, 2016). In this study, the response rate was 81.5%. The literature does not agree on a minimum acceptable response rate. However, there is a consensus that the response rate should be at least 50% (Draugalis, Coons, & Plaza, 2008). Based from the available sociodemographic and clinical data; the age, sex, duration of diabetes, HbA1c, fasting and random blood glucose, blood pressure, cholesterol and triglyceride levels were similar between responder and non-responder. This similarity in sociodemographic and clinical data showed there was no difference between responder and non-responder, thus may reduce response bias. However, the non-response bias may still exist as it is impossible to predict attitude or behavior based on known demographic and clinical data characteristics (Nulty, 2008).

5.8.2.2 Measurement bias

The questionnaire in this study was interviewer administered. Participants may not have been honest in reporting their actual practices due to social desirability (van de Mortel, 2008). Social desirability is the tendency for participants to present a favorable image of themselves. The presence of an interviewer can affect how a respondent forms an answer to a survey question and whether and how a respondent edits his answer before communicating it (Davis, Couper, Janz, Caldwell, & Resnicow, 2010). Interviewer bias may also influence the way respondents answer the questionnaires. The way the interviewer dressed, talked, body language and personal qualities of the interviewer are key determinants of the outcome of the interview (Salazar, 1990). The participants may also experience recall bias. Recall bias is a classic form of information bias (Eman, 2005). Since recalling the answers depends entirely on memory, unintentional differential recall (and thus reporting) of information may occur leading to information error. However, the interviewer-administered questionnaire does have its advantages. This method of questionnaire administration ensures more item response, higher response rate and has a lower cognitive burden. In this study, the interviewers were briefed and trained on how to carry out the interview, (e.g. non-leading answers, reading the words from questionnaire accurately, and dressing and appearing pleasantly). This was done to reduce interviewer bias (Bowling, 2005).

The questionnaire used in this study was closed-ended. Close-ended questions pose a disadvantage as it allows those without opinion or knowledge to answer as well and the answers are simplified. Closed-ended questions are unable to explore an individual's actual logic, thinking process, creativity and self-expression (Reja, Lozar Manfreda, Hlebec, & Vehovar, 2003). However, the closed-ended questionnaire was suitable for this study as the sample population was large, easier to answer, allows quantitative data to be easily analyzed, respondents are more likely to answer and less articulate participants are not at a disadvantage to answer.

5.8.3 Unconscious (Implicit) Bias and Health Disparities

In this study, the influence of the physicians on the patients was not controlled for. Varying physicians style in treating diabetes has been reported to influence diabetes self-care and glycemic control (Genere et al., 2016). Furthermore, in a chronic diseases such as diabetes, individualization of treatment is needed as each patient will have their own set of goals depending on their clinical status. Thus, the self-care reported by the participants in this study may be influence by the varying patient physicians communication (Heisler et al., 2003).

5.8.4 Financial limitation

There were some financial constraints in this study. For the lipid profile blood test, only the total cholesterol and triglyceride levels were measured for every patient due to financial insufficiency. Thus, we were unable to determine the actual risk factors and lipid control, especially the LDL cholesterol levels which has been associated with worsening macrovascular complications in diabetes.

5.8.5 Study design

This study was of a cross-sectional design. This study design is only a snap shot of the situation and may provide different results if another time frame had been chosen. A causal effect conclusion cannot be made based on a cross-sectional study (Levin, 2006). However, in this study, a cross-sectional design took lesser time and resources to perform, enabled many variables to be assessed simultaneously, and no loss to follow-up. Furthermore, it allows for the prevalence of good self-care to be estimated for a common disease such as diabetes (Goldberg, McManus, & Allison, 2013),

5.9 Generalizability

This study was of cross-sectional design involving patients with type 2 diabetes recruited from government health clinics in the district of Hulu Selangor. The sampling frame was representative of the study population, and the participants were selected via systematic random sampling. Questionnaires in this study were validated. The response rate was 81.5% with no difference in sociodemographic and clinical data between responders and non- responders. Thus, the finding of this study can be generalized to the patients with type 2 diabetes receiving treatment from the government health clinics in the district of Hulu Selangor.

CHAPTER 6: CONCLUSION

6.1 Chapter overview

As outlined in the earlier chapters of this thesis, type 2 diabetes mellitus is a common, worsening, costly, and serious health problem affecting Malaysians. Studies have shown that improving glycaemic control may delay or prevent macrovascular and microvascular complications. In diabetes, over 90% of disease management is performed by the individual (Alzaid, 2014). Diabetes self-care, comprising of at least exercise, diet, medication adherence and self-monitoring of blood glucose is required to manage optimal glycemic control (Sigurdardottir, 2005). The main aim of the study presented in this thesis was to determine and assess factors influencing the diabetes self-care practices among type 2 diabetics in the district of Hulu Selangor. This chapter summarizes the main findings of the study, discusses the public health significance and issues central to the study, limitations of the study and recommendations for future research.

6.2 Summary of finding

In this study, among the 471 study participants, only 18.1% had good glycemic control. A total of 45.8% practiced good diabetes self-care. However, no association was observed between overall self-care with glycemic control. The MDKT (Michigan Diabetes Knowledge Test) was used to assess diabetes knowledge, and only 1.0% had high score while the majority 55.3% had a moderate score and the remaining 43.7% obtained low scores. Higher knowledge score was associated with better self-care practice but was not associated with glycemic control.

Support was measured using the CIRS (Chronic Illness Recourses Survey), with a mean score of 2.57 ± 0.65 (from a possible score of 1 to 5). Self-efficacy and empowerment were assessed using the DMSE (Diabetes Management Self-Efficacy) scale and the DES (Diabetes Empowerment Scale) respectively. The mean DMSE score was 104.08 ± 23.20 (from a possible score of 0 to 140) while the mean DES score was 3.96 ± 0.51 (from a possible score of 1 to 5). Based on the PHQ-9 (Patient Health Questionnaire), the prevalence of depression was 4.3%. Based on the DDS (Diabetes Distress Scale), the prevalence of diabetes distress was 5.7%. Those with lower education level had lesser diabetes knowledge, lesser levels of social support and lesser self-efficacy.

Higher levels of self-efficacy and social support were associated with better self-care. Better social support was also associated with improved self-efficacy, which in turn led to better self-care. Depression, while not having any direct impact on self-care, led to lower self-efficacy. Diabetes distress was associated with poorer self-care and worsening depression.

6.3 Public Health Significance

This study found that the glycemic control and diabetes self-care practices were nonsatisfactory among patients with type 2 diabetes attending government health clinics in the district of Hulu Selangor.

The high prevalence of poorly controlled diabetes is worrying as high levels of HbA1c is associated with macrovascular and microvascular complications (Zoungas et al., 2012). Treating and managing diabetes is expensive. In Malaysia, the treatment of diabetes is provided by the government at almost no cost to the public. Malaysia spent a total of 16% of its healthcare budget on diabetes. In the year 2010, Malaysia spent an estimated RM

2.4 billion on diabetes-related healthcare services (Mustapha, 2014). The increasing prevalence of diabetes associated with a high proportion of poorly controlled diabetes will exert a heavy financial burden on the government health service. The government must be ready to tackle the issue of poorly controlled diabetes now or face a population with high rates of diabetes complication later which will have a higher impact on the health system.

The difference in diabetes self-care practices between ethnicities showed that social, traditional and cultural factors may influence diabetes perception. Future health policies and programmes should be more individualized to reduce the ethnic discrepancies in diabetes self-care.

The fairly poor diabetes knowledge levels and poor diabetes self-care among the participants show that there much more can be done to improve, especially concerning areas of diabetes education (U. S. Jasper et al., 2014). The poor diabetes knowledge is most likely due to the lack of information or education, which leads to poor diabetes care and subsequently diabetes-related complications (Carlowe, 2015). The finding of this study pertaining to the poor knowledge among the diabetics should be seen as an opportunity to provide education and disperse information among people with diabetes. This is best done by well-trained healthcare workers and should be a priority for the healthcare authority and policy makers. It is hoped that in future, more trained and qualified healthcare services such as the availability of diabetes educators will be made available to all healthcare facilities.

In this study, various factors influenced diabetes self-care practices. However, only self-efficacy and social support were identified as strong determinants of diabetes self-care. Previous studies have incorporated both factors as an intervention to improve diabetes self-care. Future intervention should include an emphasis on the development and improvement of the individual's self-efficacy and their diabetes self-care ability (Krichbaum, Aarestad, & Buethe, 2003). Apart from improving self-efficacy, programs and policies aimed at improving diabetes care should be more supportive of the patients. Where applicable, the support provided should preferably be illness specific or regimen specific to enable better diabetes care (Heisler, 2007).

6.4 Recommendations for future research

Based on the insight gained from this study, there are some recommendations worth considering;

1. Study design- Further investigation on the same topic should be done. Instead of a cross-sectional study, a longitudinal study should be performed. Any changes of diabetes self-care over time should be compared with the HbA1c levels. Furthermore, other factors such as the medication titration should be included in the assessment of the bio-clinical markers.
2. Study population – It is important for this study to be conducted involving a bigger sample size from various institution such as recruiting diabetics attending specialized diabetic clinics, hospitals and if possible those from the private sector as well. By involving diabetics from various organizations, the finding of the study is more generalizable.
3. Questionnaire design – The questionnaire regarding diabetes self-care practices was self-reported. Further studies concerning diabetes self-care should be performed with more reliable measures of diabetes self-care. For instance, to assess physical activity, instead of self-reporting, study participants could be

provided with pedometers to quantify their physical activity. To assess the dietary intake, participants may weigh their food and utilize a food frequency questionnaire to calculate the caloric intake accurately. The use of recent modern technologies such as the use of apps designed to support health (especially with diet and exercise) may also be considered in future research to assess self-care as these methods are more user friendly and fairly objective in measurement (Jimoh et al., 2018).

4. Healthcare system - The findings of this study indicated that the diabetes self-care practice and glycemic control were non-satisfactory. The poorest practiced diabetes self-care was self-monitoring of blood glucose. This could have been due to the limited diabetes educator and dietitian services, poor access to see a family physician, the absence of a diabetologist and financial constraints of performing self-monitoring of blood glucose as the cost of the glucometer and strip must be borne by the patient. Hence, future studies may aim to identify factors within the healthcare system which can contribute to the improvement in diabetes self-care. Health policies which are holistic, with sound strategies, plans and resources can improve the life of Malaysian with type 2 diabetes and thereby reduce the burden of this disease in our country.

6.4 Conclusion

This study assessed the health status and metabolic control of diabetics attending government health clinics in the district of Hulu Selangor. Most importantly, this study explored the four cornerstones of diabetes self-care; physical activity, proper diet, medication adherence and self-monitoring of blood glucose.

This study found that only 18.1% of the participants had good glycemic control. The results of this study found that only 45.8% practiced good diabetes self-care. The most practiced diabetes self-care was medication adherence while the least practiced was self-monitoring of blood glucose.

Several common characteristics among the study participants were associated with diabetes self-care. Higher levels of self-efficacy, good social support and not experiencing diabetes distress were associated with better diabetes self-care practices.

This study found that those with lower education had poorer diabetes knowledge and were more vulnerable to psychosocial matters such as lesser social support and lower levels of self-efficacy.

It is hoped that the finding of this study may contribute to the improvement of diabetes self-care and glycemic control, thus preventing the complications associated with poor diabetes control and eventually reducing the morbidity and mortality associated with diabetes in Malaysia.

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LIST OF PUBLICATIONS AND PAPERS PRESENTED

1. Devarajooh C, Chinna K (2017) Depression, distress and self-efficacy: The impact on diabetes self-care practices. PLOS ONE 12(3): e0175096. https://doi.org/10.1371/journal.pone.0175096