MODELLING AWARENESS OF DIABETES MELLITUS: CASE STUDY AT TWO PUBLIC HEALTH CENTRES

HUMAIRA' BINTI ABDUL LATIF

DOCTOR OF PHILOSOPHY

UNIVERSITI MALAYSIA PAHANG

UNIVERSITI MALAYSIA PAHANG

DECLARATION OF THESIS AND COPYRIGHT

Author's Full Name : HUMAIRA' BINTI ABDUL LATIF

Date of Birth : 24 / 07 / 1987

Title : MODELLING AWARENESS OF DIABETES MELLITUS: CASE STUDY AT TWO PUBLIC HEALTH CENTRES

Academic Session : SEM 1 2019 / 2020

I declare that this thesis is classified as:

☐	CONFIDENTIAL	(Contains confidential information under the Official Secret Act 1997)*
☐	RESTRICTED	(Contains restricted information as specified by the organization where research was done)*
☑	OPEN ACCESS	I agree that my thesis to be published as online open access (Full Text)

I acknowledge that Universiti Malaysia Pahang reserves the following rights:

1. The Thesis is the Property of Universiti Malaysia Pahang
2. The Library of Universiti Malaysia Pahang has the right to make copies of the thesis for the purpose of research only.
3. The Library has the right to make copies of the thesis for academic exchange.

Certified by:

_____	_____
(Student's Signature)	(Supervisor's Signature)
870724-06-5408	Associate Professor Dr. Mohd Rashid bin Ab Hamid
New IC/Passport Number	Name of Supervisor
Date:	Date:

NOTE : * If the thesis is CONFIDENTIAL or RESTRICTED, please attach a thesis declaration letter.

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Doctor of Philosophy.

_____

(Supervisor's Signature)

Full Name : DR. MOHD RASHID BIN AB HAMID

Position : ASSOCIATE PROFESSOR

Date :

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

_____

(Student's Signature)

Full Name : HUMAIRA' BINTI ABDUL LATIF

ID Number : PSS14002

Date :

MODELLING AWARENESS OF DIABETES MELLITUS: CASE STUDY AT TWO PUBLIC HEALTH CENTRES

HUMAIRA' BINTI ABDUL LATIF

Thesis submitted in fulfillment of the requirements
for the award of the degree of
Doctor of Philosophy

Centre for Mathematical Sciences
UNIVERSITI MALAYSIA PAHANG

NOVEMBER 2019

ACKNOWLEDGEMENTS

Bismillahirrahmanirrahim,

Alhamdulillah, first of all, I am utterly grateful to Allah S.W.T. The Almighty for His grace and blessing which have given me the courage and the will to complete the writing up of this thesis entitled, "Modelling Awareness of Diabetes Mellitus: Case Study at Two Public Health Centres" in time.

I would like to express my appreciation to my supervisor, Associate Professor Dr. Mohd Rashid bin Ab Hamid, for his unfailing ideas, guidance, encouragement, enthusiasm, and motivation throughout this doctoral journey. Only Allah can reward his kind deeds. May Allah bestow His blessings upon him and his family. Thank you once again.

I would also like to express my sincere appreciation to my father, Abdul Latif bin Jusoh, and my mother, Zalma binti Abdul Hamid, who have always encouraged and supported me from the very beginning since I first started this study until the final touches of this thesis as well as for the constant prayers to ensure the successful completion of my PhD at UMP.

I am also indebted to the Ministry of Higher Education Malaysia for the financial assistance provided through MyPhD and Universiti Malaysia Pahang (UMP) for awarding the research grant Vote No. RDU130612.

Finally, thanks to all those involved who have helped me either directly or indirectly throughout my doctoral study. Their kindness and support will always be remembered.

ABSTRACT

Diabetes is an increasingly growing health concern in Malaysia and the increase in the number of diabetics is worrying. Diabetes is a chronic disease in which the human body is unable to produce or utilize insulin. Insulin is a type of hormone needed to convert sugar, starches and other food into energy needed for daily life. The true cause of diabetes is still unknown, though genetics and the environment play an important role. Every year, the Ministry of Health launches a campaign to create awareness about the effects of diabetes. However, the prevalence of diabetes in Malaysia, especially Type 2, has increased to the epidemic. Therefore, this study proposes a conceptual model to study factors that may create awareness among the public in order to avoid the disease. This model was tested using an exploration approach through statistical modelling techniques to validate the hypothesised model which involved latent constructs such as knowledge about diabetes, attitude towards the disease, the environment surrounding it, symptoms and awareness of diabetes itself. A total of ten hypotheses were put forward to examine the relationships between the five constructs in the hypothesised model. A cross-sectional survey was used in this study, and it was carried out at two health clinics of the Ministry of Health Malaysia (MoH) in Pahang. A total of 441 adults were involved while attending the outpatient department at Klinik Kesihatan Paya Besar and Klinik Kesihatan Padang Rumbia. The sampling used convenience sampling that was conducted from 1 September 2015 to 15 October 2015. Partial Least Squares-Structural Equation Modelling (PLS-SEM) technique was used to test the hypothesised model and examine the relationships between the constructs in the Diabetes Mellitus Awareness Model (DMAM). The results showed that the knowledge had a significant impact on the environment, attitude, and awareness. Meanwhile, environment significantly influenced the attitude whereas attitude had a significant relationship with awareness. However, the findings also indicated that the environment had no significant relationship with awareness and the environment did not have any significant effect on symptoms of diabetes mellitus. The causal relationship between attitude with symptoms, and the relationship between symptom and awareness were also not significant. In general, this study concludes with the relationships that are both statistically significant and insignificant, therefore, due care should be paid and given a due attention by the authorities in order to jumpstart in raising awareness of diabetes mellitus among public. Although the sampling in limited to population in Kuantan Pahang only, but the results of the study could be beneficial for most relevant authorities especially the Ministry of Healths to take further actions for improving the level of awareness among Malaysians.

ABSTRAK

Diabetes merupakan masalah perubatan yang semakin berleluasa di Malaysia dan peningkatan pesakit kencing manis di Malaysia adalah membimbangkan. Kencing manis adalah penyakit kronik di mana badan tidak dapat menghasilkan atau menggunakan insulin dengan sempurna. Insulin adalah satu jenis hormon yang diperlukan untuk menukar gula, kanji dan makanan lain kepada tenaga yang diperlukan untuk kehidupan harian. Punca sebenar diabetes masih tidak diketahui, walaupun genetik dan persekitaran memainkan peranan yang penting. Setiap tahun, Kementerian Kesihatan melancarkan kempen untuk mewujudkan kesedaran mengenai kesan diabetes. Namun, kelaziman penyakit kencing manis di Malaysia, terutamanya yang Jenis 2, telah meningkat kepada wabak. Oleh itu, kajian ini mencadangkan model konseptual untuk mengkaji faktor-faktor yang boleh mewujudkan kesedaran di kalangan orang ramai di Malaysia untuk mengelakkan dari penyakit itu. Model ini diuji menggunakan pendekatan penerokaan melalui teknik pemodelan statistik bagi mengesahkan model hipotesis yang terdiri daripada beberapa faktor terpendam, iaitu pengetahuan tentang diabetes, sikap terhadap penyakit, persekitaran, gejala dan kesedaran terhadap penyakit kencing manis. Sebanyak sepuluh hipotesis telah dicadangkan untuk menguji hubungan di antara lima indikator di dalam model hipotesis. Kaedah tinjauan keratan rentas digunakan dalam kajian ini dan ia telah dijalankan di dua buah klinik kesihatan Kementerian Kesihatan Malaysia (KKM) di Pahang. Sebanyak 441 sampel mudah orang dewasa yang menghadiri jabatan pesakit luar di Klinik Kesihatan Paya Besar dan Klinik Kesihatan Padang Rumbia. Sampel yang digunakan ialah persampelan kemudahan yang dijalankan dari 1 September 2015 hingga 15 Oktober 2015. Teknik kuasa dua terkecil pemodelan persamaan struktur (PLS-SEM) telah dijalankan untuk menguji model hipotesis dan mengkaji hubungan antara konstruk dalam Model Kesedaran Diabetes Mellitus (DMAM). Dapatan kajian menunjukkan bahawa pengetahuan memberi kesan yang signifikan kepada persekitaran, sikap dan kesedaran. Begitu juga, persekitaran mempengaruhi secara signifikan terhadap sikap, dan seterusnya, sikap mempunyai hubungan yang signifikan kepada kesedaran. Namun begitu, keputusan kajian juga mendapati bahawa terdapat hubungan yang tidak signifikan antara persekitaran terhadap kesedaran dan persekitaran terhadap gejala penyakit kencing manis. Juga, hubungan bersebab antara sikap dengan gejala penyakit kencing manis dan hubungan antara gejala penyakit kencing manis terhadap kesedaran turut tidak signifikan. Secara keseluruhannya, kajian ini menyimpulkan kedua-dua perkaitan-perkaitan yang statistik secara signifikan dan tidak signifikan. Oleh itu, hal yang sedemikian harus diambil perhatian yang sewajarnya oleh pihak yang berkuasa agar dapat meningkatkan kesedaran penyakit kencing manis di kalangan orang ramai. Walaupun pensampelan yang terhad kepada populasi di Kuantan Pahang sahaja, tetapi hasil kajian itu boleh memberi manfaat kepada pihak berkuasa yang berkaitan terutamanya Kementerian Kesihatan untuk mengambil tindakan selanjutnya untuk meningkatkan tahap kesedaran di kalangan rakyat Malaysia.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

DM	Diabetes mellitus
GDM	Gestational diabetes mellitus
NCD	Non-communicable disease
IDDM	Insulin-dependent diabetes mellitus
NIDDM	Non-insulin dependent diabetes mellitus
WHO	World Health Organization
NHMS	National Health and Morbidity Survey
MOH	Ministry of Health
DMAM	Diabetics Mellitus Awareness Model
SEM	Structural equation modelling
PLS-SEM	Partial least squares structural equation modelling
KAP	Knowledge, Attitudes, and Practice
SCT	Social Cognitive Theory
EDA	Exploratory data analysis
CMV	Common method variance
AVE	Average variance extracted
CR	Composite reliability
CFA	Confirmatory factor analysis
HTMT	Heterotrait-monotrait
VIF	Variance inflation factor
SPSS	Statistical Package for Social Science
SBPWM	Simple Boost Pulse Width Modulation
ZSI	Z source inverter

CHAPTER 1

INTRODUCTION

1.1 Introduction

Diabetes mellitus (DM) is a primary disease that has increasingly become the major health concern among members of the public all over the world. Its prevalence leads to chronic morbidity, disability, loss of productivity and premature death (Gunay et al., 2006; Yun et al., 2007; Mustaffa Embong, 1990). Recently, as stated in the global estimation by the World Health Organization (WHO), there would be 300 million diabetics by the year 2025 (Gunay et al., 2006). This is worrisome as it was found that in the developing countries, the corresponding increase would be greater. Additionally, the 2012 Malaysia National Health and Morbidity survey (Institute for Public Health, 2012) showed a rapid increases in the figure of diabetic patients in Malaysia and among its victims are the young generations (Teck-Hong & Suhaimi, 2014).

Malaysians have been less healthy continuously from time to time (DM Newsletter, 2014). It is unfortunate that with our impressive development of the economy and our health indices are matching closely to those developed countries; the waistlines of the Malaysia citizen are also growing at a shocking rate. Day by day, the situations are turning to be less physically active and keep spoiling with unhealthy foods and improper eating habits that leads to an unhealthy lifestyle. This unhealthy lifestyle can increase the risk of getting diabetes, hypertension, heart attacks, strokes and many other serious diseases and health conditions. Diabetes is included as one of the non-communicable disease (NCDs), which is the primary cause of premature deaths among adults in Malaysia (Teck-Hong & Suhaimi, 2014; Geraldine, 2013). This exasperate disease can be considered as the main causal of hospital admissions, disabilities, and premature deaths and is occurring amongst the economically productive members of our

population (DM Newsletter, 2014; Geraldine, 2013). The figure is predicted to upsurge if there is no immediate action taken to solve the problem and no exposition to improve the people's awareness. The purpose of this chapter is to present the research background, problem statement, research objectives, research questions, research scope, significance of the research and definition of terms.

1.2 Background of the Study

DM commonly known as diabetes is a specific name for the disease in which the human body system is unable to convert food to produce enough energy required for the routine basis. Consequently, a situation occurs when there exists an abnormal blood sugar (glucose) level (American Diabetes Association, 2012). For a normal healthy individual, the blood sugar level is restrained by a body hormone called insulin that is induced in the body by the pancreas to convert foods into energy (Stahl & Johansson, 2009). However, for a diabetic patient, the pancreas is either incapable to provide insulin, produces insufficient insulin, or the patient's body does not use insulin properly to convert the food intake into energy (Beaser and Hill, 1995). Diabetes is also a disease that can be attributed to the chronic hyperglycaemia, in which the existence of excess glucose in the blood caused by environmental factors and genetic/hereditary (Lim & Liong, 2010). A diabetics will also experience hypoglycaemia when the blood sugar level decreases if there is inordinate amount of insulin produced in the body (Teck-Hong & Suhaimi, 2014).

Among the factors that contribute to the increase in diabetes among Malaysians include genetics, unhealthy lifestyle, diet, alcohol, and smoking (Bernama, 2012). According to Geraldine (2013), obesity is one of the current health problems with 8.5 million of Malaysians or one in three of the population, suffering from the weight problems. It was added that this was caused by unhealthy dietary consumption and minimal physical activities among Malaysians. Being overweight also contributes to a riskier possibility of acquiring diabetes-related complications, for example, heart attack and stroke. It was added that excessive levels of blood cholesterol would result in greater risk of getting heart attack. Sixty five percent of the deaths among people with diabetes is caused by a heart attack or stroke (Live-well Nutraceuticals, 2013). The impact of disease management and the factors that cause sugar content in blood to rise

differs from one individual to another, such as with the consumption of excessive carbohydrates. Besides having a mother and father who have a history of diabetes, plus a habit of taking soft drinks are among the factors that cause diabetes (Ahmad, 2012).

DM can lead to a chronic kidney disorder, which consequently can cause damage to the heart resulting in death (Hamid, 2012). Also, it could result in the amputation of a limb if the disease is not carefully treated due to the spreading of the disease possibly will cause gangrene. Currently, more than 1.3 million of the estimated 5.6 million Malaysians are at risk of being amputated. However, amputation is not the solution because it is more important that the patient must monitor and take care of their bodies, especially by preventing cuts and bruises at their feet to avoid amputation. Also, patients should always check that the blood sugar is at a safe level to help reduce the pressure on the blood vessels; high blood sugar will slow down the flow in the blood vessels, thus weakening the antibody, causing gangrene (Hamid, 2012).

People who develop DM would suffer from a lot of complications such as kidney problems, cardiovascular diseases, losing sight, and lower-extremity amputations. Mostly, the typical consequence of diabetes is complications related with the lower level of the body such as the leg (Chern et al., 2002; Herpburn et al., 1994). Thus, DM is significantly contributing to death, morbidity, disability, and costly hospital treatment (Mustaffa Embong, 1990). Unfortunately, a person may not know that he is suffering from diabetes, even though the complications of diabetes are numerous (Dunst & Trivette, 2009), but the most basic action that can be taken in preventing the complications would be self-management of foot-care.

Also, diabetes is a disease that can affect the vision of a diabetic person in which the power of the glasses that one wear can often vary with the fluctuations in the level of health of the patient; also feeling uncomfortable in the mornings and evenings (Ahmad, 2012). Nerve damage, known as diabetic neuropathy, could also occur in the toes, feet, legs, hands, and arms, which show the symptoms include a feeling of numbness and burning, and loss of sensation or pain in the fingertips, while some sufferers do not show any signs of diabetic neuropathy. Nerve damage is an unexpected failure that might take place in any organ internally such as the heart or digestive tract. Some individual who are suffering from diabetic neuropathy are normally those who are having problems and difficulty in controlling their glucose levels in the blood,

cholesterol level, blood pressure and body weight (Live-well Nutraceuticals, 2013). The adverse emotional response in diabetic patients includes the loss of self-confidence, depression, dissatisfaction, fear and demoralisation (Fenwick et al., 2012). It is due to the fact that stress that results from diabetes poses a negative emotional response to patients as most diabetic patients also need to consider the glycaemic control together with the long-term complications (Wang et al., 2011).

The high blood sugar level in a diabetic produces symptoms like frequent urination particularly during night time, feeling extremely thirsty, abrupt loss of weight, fatigue, dizziness, blurred vision, rapid breathing and also increased hunger (Fezeu et al., 2010). The best prevention method is to practice healthy eating habit, exercise at least twice a week, undergo a regular health screening, and people with diabetes must get proper treatment and care, such as a monitoring the blood sugar levels, getting treatment for high blood pressure, and take care of the legs and eyes (Bernama, 2012).

Mainly, once diabetes is diagnosed and confirmed, the patients need to realize that it is crucial that immediate and effective treatment is essential for them. Diet, exercise, medication, and education are the four major components in the management of DM. An important regime in diabetics is diet control as it is practically nearly impossible to control the disease without it (Mustaffa Embong, 1990).

Diabetics who need to take insulin need to observe a disciplined diet. Individuals who have symptoms of pre-diabetes and those at high risk of developing Type 2 diabetes need to change their lifestyles immediately to prevent the disease from becoming chronic. Active lifestyle and discipline in food intake have shown that it is one of the effective ways of slowing and avoiding the spread of diabetes disease from becoming worst. As diabetes is deemed to be related to lifestyle, the target of diet control is to maintain normal blood glucose level. Individuals suffering from both the first type and the second type of diabetes who are taking insulin or oral medications need to match their food calories intake with the medication or insulin in addition to regular exercises to control the glucose level. In addition to well-planned diet discipline, monitoring and testing of glucose levels are essential. Having a low level of blood sugar (hypoglycaemia) together with high blood sugar (hyperglycaemia) are two conditions that must need to be monitored in diabetics who are taking insulin. Diabetic diet

discipline also includes weighing and measuring of food to get the right amount of calories (Berita Harian, 2012).

Diabetics cannot have the attitude of eliminating food intake, especially those who are taking insulin. Leaving food can disrupt the balance between food intake and insulin that can cause low blood sugar, but on the other hand, weight gain will occur if the patients overindulge. Generally, people with diabetes need to eat three meals a day according to the rules set, and snacks are also important when required (Berita Harian, 2012). Patients are given a diary to record their blood glucose level using a glucometer, in which the goal is to achieve the equal level similar to a non-diabetic. The readings are taken twice a week two hours after each meal; however, the blood glucose level should be taken immediately if the patients feel dizziness. The problem of hyperglycaemia is not as worrisome as that of hypoglycaemia because the latter is far more dangerous. The obvious symptoms of hypoglycaemia are sweating, cold, hunger, headaches, loss of concentration, blurred vision, and feeling to faint; these symptoms should be alert by the patients, spouses, family members, and friends. Also, a diabetic should always carry a supply of carbohydrates such as sweet carbohydrate-based food and sweetened drinks, so the patient can immediately drink or eat the food when hypoglycaemia occurs.

Diabetic who intends to fast need to perceive some guidelines. If the patient feels unwell, he should immediately check his blood sugar level using a glucometer, which can be kept at home without thus avoiding them to go to a clinic frequently. Also, suitable medication control should be administered to those patients who are suffering from hyperglycaemia and hypoglycaemia. The medications need to be taken continuously even when the patient fasts, but the administration is reversed or changed, such as the dose that is usually taken in the morning, including tablets and insulin injections, is taken at night as the patient usually eat a lot during the breaking of fast.

During fasting, patients need to check their sugar level hourly, and they must break the fast if they have these symptoms such as dizziness, loss of focus, starving, shivering and sweating, and the next dose of the medication should be reduced. In terms of nutrition, the practice of pre-dawn meal *(sahur)* is required because of the prolonged effects of the drug, thus *sahur* should not be missed. The food that should be taken during a pre-dawn meal should consist of carbohydrates (rice, bread, noodles, and pasta) and protein (fish, chicken, seafood dairy) as it can provide energy during the day, and

drink plenty of water during *sahur* and *iftar* breaking of fast). While two to three dates are allowed, however, diabetics should refrain from taking food that contains saturated fat and avoid drinking sweetened drinks, such as cordials and carbonated drinks.

1.3 Problem Statement

DM has become a primary public health problem around the globe (Berita Harian, 2013; Van Eijk 2012; Wan Muhamad, 2012; Berita Harian, 2012; Kwach et al., 2011; Omondi 2010; Lim & Liong 2010; Stahl & Johansson 2009; Mashige et al., 2008; King et al., 1998; Diabetes Research and Training Center, 1998). It is one of the most life-threatening complications in the world of medicine in this century (Hasan, 2012) and there were more than 170 million DM patients worldwide in 2000 and it has been predicted that this number would be doubled by 2030 (Robby, 2012; Wild et al., 2004). It was estimated in 2011 by the International Diabetes Federation (IDF) that 366 million of diabetic patients in the world were adults between the age of 20 and 79 and by 2030, this figure has been predicted to increase to 552 millions (David et al., 2011).

The rise in the number of diabetes cases around the world has been primarily linked with factors such as population aging, growth and the commonly known risk factors of diabetes (Wild et al., 2004; Wing et al., 2001; Mokdad et al., 2003). Researchers have predicted an increase in the occurrence of diabetes and will cause the real number of diabetes patients to surge to 52 million by 2025 due to the age structure, population growth rate, unfavourably adjustment in diets and lifestyles, urbanization, financial factors and other health-related issues happening in the country (Ramachandran et al., 2004).

Based on the Second National Health and Morbidity Survey (2010), 3.4 million of Malaysians were estimated as diabetes patients during that year. In addition, National Health and Morbidity Survey indicated the results that showed a dramatic rise of 80%, from 8.3% in 1996 to 14.9% in 2006 in the number of diabetic patients among Malaysian adults who were 30 years old and above. Approximately, 36% of diabetes patients have not been diagnosed and therefore are undetected. Previously, the Second National Health and Morbidity Survey had indicated 2.5% of the cases for the undiagnosed diabetes (NHMS, 1996). The Ministry of Health (2012) also predicted the trends and projections in Malaysia by 2020 for the occurrence of diabetes cases among

adults aged 18 years and above (see Figure 1.1). Prevalence projection in 2011 estimated that almost 4.5 million Malaysians would be diabetes sufferers in 2020, while the projection in 2006 estimated that almost 3 million Malaysians would be diabetes suffer in 2020.

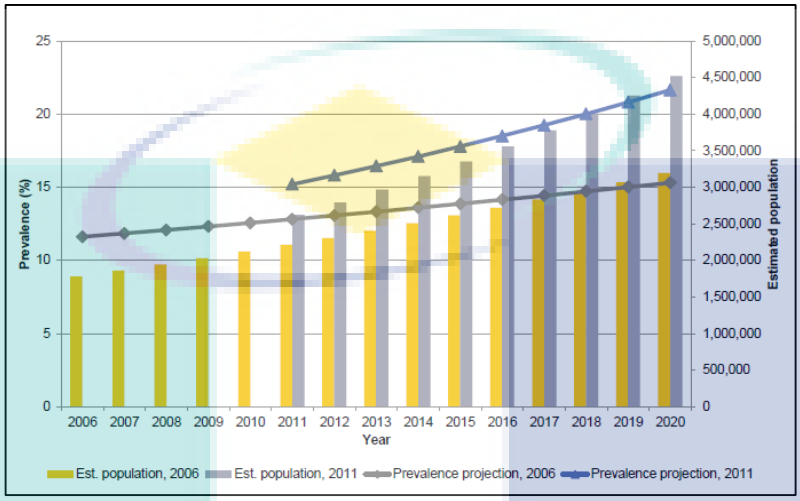


Figure 1.1 Trends and projections of the burden of diabetes in Malaysia by 2020

In a local newspaper, it was reported by The New Straits Time (2012) that Malaysia had the highest diabetes rate as compared to others in the region. According to the survey conducted by the Second National Health and Morbidity, more than 3.4 million Malaysian citizens were diagnosed with diabetes in 2010, and the sad truth is that roughly around 11.8% of the Malaysia's total population in this figure is expected and forecasted to reach 4.5 million by 2020 (Zakaria, 2013). Also, the survey demonstrated that the prevalence of obesity among Malaysians adults aged 18 years and above had increased to 14.0% in 2006 from only 4.4% in 1996 which was over 200% increase in 10 years (Ministry of Health, 2012). This shows that Malaysia ranked the highest among obese and overweight people in Asia. This is worrying because obesity is the primary cause of diabetes as more than 50% of the Malaysian adults are either overweight or obese compared to less than 25% in the last decade. Excessive and uncontrolled consumption of sugar (which is another cause of obesity) has been identified as one of the antecedents of a rising number of diabetics among Malaysians. Therefore, this issue is also being given serious attention by the government in the budget for the year 2013 by imposing a higher price for sugar related commodities (Bajet 2013, 2012).

Additionally, the Malaysian Endocrine and Metabolic Society (MEMS) president has confirmed that the prevalence of diabetes among Malaysian adults is skyrocketing because of the growing rate of obesity among the citizens (Lai et al., 2012). Furthermore, the public healthcare system has severe consequences on the rising number of diabetics as the cost of treatment for diabetics accounts for about 16% of the national healthcare budget i.e., RM 2.4 billion (Edwards, 2013).

Awareness among the citizens is the primary factor during early diagnosis, suitable treatment, and prevention towards complications due to diabetes (Poornima et al., 2012). The poor public awareness of diabetes, restricted availability and access to appropriate preventive and curative care, and a low priority in national health policy and plans have been recognized as the significant issues related to the disease (Ooyub et al., 2004). Increased commonness of diabetes and obesity together with high number of conditions which have gone undiagnosed points towards the requirement for quick implementation of educational programmes along with other interventions as prevention which monitors and keep diabetes under control in Malaysia. With the implementation, those who may encounter complications of the disease ahead of times may be detected at the time of their clinical diagnosis (Baptiste-Roberts et al., 2007; American Diabetes Association, 2004).

Proper knowledge, education and awareness among the youth could be a great help in the early diagnosis and appropriate treatment (Soyed et al., 2005). The estimation of the direct cost of outpatient treatment for approximately 60,000 diabetics that are registered with the Malaysia‘s Ministry of Health was around RM14.5 million per year (equivalent to USD4.14 million) (Sadat et al., 2003). It is crucial to spread the DM awareness towards the community so that the preparation of health promotion and prevention interventions to create a healthier community can be made as it is still a better solution and lower cost is needed comparing to having spent extravagant money on the treatment of the diabetics. This is because prevention of diabetics is better than curing it.

Malaysia has to bear the high costs of health and economic costs due to the lack of awareness among Malaysians about health care and rising NCD-related death rates. Most of the NCD burden can be avoided and the economic loss can be mitigated if there are systematic precautions in its early stages of development. Changing healthy

behaviours and ways of eating well among Malaysians is fundamental to the socio-economic impact of the country and can help reduce the burden of the Malaysian government on high spending on this matter. This has led to the fact that Malaysia will suffer from high economic costs every year due to the lack of awareness of Malaysian health care. The government spends RM2.716 billion a year on the cost of diabetes, heart and cancer treatment, which are the three major diseases facing the country. Of these, diabetes recorded the highest amount of RM2.04 billion followed by coronary heart disease treatment, RM544 million and lung cancer of RM132 million, per year (Gusti Hassan, 2019).

Although there are various diabetes awareness programs conducted in Malaysia such as the 'Blue Walk' program (Nizar, 2017), the level of awareness of these diseases is still low and the number of diabetic patients is increasing every year (Mohamed, 2019). Currently, there are few publications regarding the factors that influence the awareness on DM among Malaysian public. Thus, the present study aimed to explore the relationship between factors influencing DM awareness in Malaysia among the public who had attended primary healthcare centres; 75% of the diabetic patients sought treatment at government health care facilities (Ministry of Health, 2012).

1.4 Research Questions

It has been estimated that 75% to 80% or approximately 700,000 of diabetes patients seek treatment at the Ministry of Health (MOH) healthcare facilities such as government hospitals and health clinics (Ministry of Health, 2012). Statistics have also shown that one over five Malaysians in their 30s has diabetes (Geraldine, 2013). Thus, the government is committed to provide better quality of healthcare in Malaysia. Throughout the country, there are 3,000 health facilities which include 106 mother and child clinics, 919 health clinics, 1,831 rural clinics and 2,361 Malaysia clinics. In addition, the government has emphasized on the involvement of the community to help improve the health status of members in the community by establishing Health Clinic Advisory Panels. The objective of the establishment of these panels is to raise the level of awareness of diseases in the community. With 10,606 members in 778 health clinics, it is envisaged that the members of the advisory panel can assist in communicating

health information to the people with guidance from the clinic personnel (Geraldine, 2013).

Therefore, in the present study, the research questions were as follows:

1. How the variables under study are related to each other?
2. Does knowledge on diabetes directly affect the attitude, environment, symptoms and awareness of diabetes mellitus?
3. Does attitude directly affect the relationship between symptoms on diabetes and the awareness of diabetes mellitus?
4. Does the environment directly affect the relationship between attitude, symptoms on diabetes and the awareness of diabetes mellitus?
5. Do the symptoms directly affect diabetes mellitus awareness?

1.5 Objectives of the Study

The present research mainly aimed to study the factors influencing DM awareness among members of the public in Malaysia by testing a hypothesised model that described the perception of the factors on Diabetics Mellitus Awareness Model (DMAM) using the exploratory modelling methodology. In principle, it is very important to measure the awareness of this disease. Thus, the objectives of this study were as follows:

1. To assess the factors influencing diabetes mellitus awareness among members of the public.
2. To develop Diabetics Mellitus Awareness Model (DMAM).
3. To test the hypothesised relationships among the latent constructs in Diabetics Mellitus Awareness Model (DMAM) using the partial least squares structural equation modelling (PLS-SEM) technique.

1.6 Significance of the Study

Despite the concerted efforts undertaken by the MOH over the years, there has been an upward trend in the number of diabetes patients which is increasing rapidly with more than 2 million cases have been diagnosed to be positive in Malaysia whose

victims are young adults (Institute for Public Health, 2011). Statistics from the NHMS 2011 (Institute for Public Health, 2011) have shown that the number of diabetes patients among adults at the age of 18 years and above in Malaysia rose to 31% in just five years, compared to 11.6% in 2006 (Bernama, 2012).

Managing diabetes incurs a huge cost in the long term, which poses a burden to the diabetics and the nation's health care system as more patients need treatment. This is indeed a global concern from the perspectives of the well-being of the patients and also the financial aspect of providing treatment for the disease and its complications (Yun et al., 2007). In 2010, 16% of the budget on health was allocated to manage the complications of diabetes, placing it in the top 10 list for the money spent to control the disease (Farush Khan, 2014). In 2010, the burden of diabetes-related health care accounted for about 16 per cent of the national healthcare expenditure of RM2.4 billion, thus threatening the overall management of the disease (Satibi, 2017). According to Mohd Ali (2016), about 3.5 million people have diabetes nationwide and the government has to bear the cost of treatment of RM2,684.24 per patient. The country is not only burdened with the costs of the healthcare system but also in terms of economic losses due to the loss of productivity and well-being of the patients. According to DM Newsletter (2014), the increasing medical cost in the treatment and management of diabetes-related complications to patients with NCD such as diabetes is a serious concern to the government. The disease also gives a negative impact on the productivity and economic growth of Malaysia. It is hoped that with the growing knowledge and awareness of this disease, more people will choose the healthier food options, which would consequently influence marketing trends. Generally, Malaysia needs to become a healthy nation by reversing the increasing trend of obesity by prioritising health in all aspects of life instead; not only in terms of physical and mental health but together with spiritual well-being. Meanwhile, according to the President of Malaysian Diabetes Association, diabetes should be considered as social and economic issues rather than a health issue, and that the medical practitioners and all parties concerned should continue to promote awareness of diabetes in order to reduce the number of diabetics in Malaysia (Bernama, 2012).

Diabetic complications, comorbidities, and cost of treatment affect the quality of life (QoL) of an individual. According to Trikkalinou et al. (2017) diabetic's QoL

becomes worse when complications start to develop or comorbidities coexist and García et al. (2019) stated that people with high symptom burden had significantly lower QoL. Majority of the diabetic patients had the QoL score between 50 and 70. Patients without complication had a better QoL. As the number of complications increased, there was a decrease in the QoL. The overall QoL in diabetic patients is reduced (Prajapati et al., 2018).

Many clinical studies have found that healthy living behaviours could prevent or delay Type 2 diabetes (Tuomilehto et al., 2001; Knowler et al., 2002; Kosaka et al., 2005; Zinman et al., 2006; Ramachandran et al., 2006). Preventive measures are those that save money and can be achieved by reducing the progression of the disease and its complications. Therefore, this issue was given serious attention by the Malaysian government in the budget for the year 2013, whereby the government imposed higher prices for sugar-related products (EPU, 2012, 2013). More importantly, the situation has provided a strong justification for the need to investigate the factors influencing DM awareness among members of the public in Malaysia. In the National Strategic Plan for NCDs, non-governmental organizations (NGOs), civil societies and the private sector were urged to assist MOH by promoting healthy lifestyle campaign (Bernama, 2012). Besides, the Malaysian public and the private health sector have been urged to participate in diabetes awareness and self-management programs to promote healthy living among diabetic patients and the members of the public who are healthy.

In Malaysia, comprehensive studies on diabetics, especially the ones concentrating on the medical aspect of diabetes had undoubtedly been conducted. Nevertheless, the focus of the present study was more on the exploratory approach of the predictors contributing towards diabetic mellitus awareness. The present research applied exploratory statistical modelling methodology to empirically validate the hypothesised model in understanding the relationships of knowledge, attitude, environment, and symptom of the public towards DM awareness. It has been anticipated that the findings obtained from the present research would improve the understanding of the medical practitioners on how to educate the public in taking care of the health status effectively. With this awareness, one can know whether one is suffering from this disease as prevention is better than cure.

In other parts of the world, for example, in Jordan, Cameroon and Saudi Arabia, numerous studies have been conducted to study significant factors influencing diabetes awareness. However, such research that involves members of the public in Malaysia has been scarcely carried out despite the rising number of diabetics in Malaysia (Mustaffa Embong, 1990; Ding et al., 2006; Yun et al., 2007; Ju et al., 2010; Ng et al., 2012; Minhat & Hamedon, 2014; Mohd Najib et al., 2014). Thus, this research was carried out to study the diabetes awareness and its determinants that could have important implications towards the health care of the Malaysian public. This is because the health outcome of the people can be enhanced by understanding the phenomena of the awareness of diabetes.

1.7 The Scope of the Study and Its Limitations

The present study focused on the awareness of all types of the DM disease among members of the public who were using the MOH healthcare facilities. The study was cross-sectional and sample was drawn from the population which comprised patients who were seeking treatment at the two MOH healthcare facilities in the state of Pahang in the east coast of Peninsular Malaysia, namely, the outpatients' departments at Klinik Kesihatan Paya Besar and Klinik Kesihatan Padang Rumbia. Patients who were 18 years and above and demonstrated the ability to fill out the questionnaires were included in the sample. Participating respondents were limited to those who could speak and read the Malay language.

1.8 Definition of Terms

a) In general, knowledge is the comprehension of something such as skills, descriptions, information or facts, which are obtained through experience or education by learning, discovering or perceiving (Yun et al., 2007). At the same time, it also be defined as a practical or theoretical understanding of any subject. It can be implicit (as with practical skill or expertise) or explicit (as with the theoretical understanding of a subject); it can be more or less formal or systematic (Ding et al., 2006).

b) An attitude is an expression toward a person or reflected in a person's behaviour, which can be formed either from a person's past or present. Apart from that, it is also a measurable and changeable thing which can influence the person's emotion and behaviour (Ng et al., 2012). An attitude refers to a way of feeling or acting toward someone, something or situation, a manner of acting, feeling, or thinking.

c) Human health that focuses on the interrelationship between people and their environment can affect the public health (Pasala et al., 2010). Assessing and controlling factors according to the theory and practice in the environment can possibly influence the health.

d) Once patients have acknowledged the presence of disease or abnormality, it shows that they have noticed the "symptom is a departure from normal function or feeling". A sign would objectively be observable whereas "a symptom is subjective, observed by the patient and cannot be measured directly" (Spitznagel et al., 2006).

e) Sagaran and Srinivasan (2014) have indicated that the "state or ability to perceive, feel or be conscious of" sensory patterns, "objects" or events always explains what awareness is all about. "An observer may confirm any sense data without necessarily implying its understanding" in this level of consciousness. Mostly, it shows "the state or quality of being aware of something. Awareness is defined as a human's perception and cognitive reaction to a condition or event" in biological psychology (Murugesan et al., 2007).

1.9 Structure of the Thesis

The contents of the thesis are organized in five chapters. Chapter 1 provides an overview of the current study and its background. The chapter presents the justification for the study and the statement of the research problem. It also formulates the research questions addressed and the objectives of the study to be achieved in this study. This is followed by the significance of the study as well as the scope of the study and its

limitations. The definitions of key terms are also given in order to explain their true meaning within the context of this study for clearer understanding.

Chapter 2 discusses the literature review concerning critical diseases in Malaysia and trends among diabetics in Malaysia. This chapter also imparts the knowledge towards diabetes, attitude towards DM, environment towards DM, symptoms and DM awareness. Also, in this chapter, it presents the conceptual framework and the development of relevant hypotheses. This chapter explains the conceptualization of the key constructs. Past studies are reviewed which consequently result in five variables used in this study, namely, knowledge, attitude, environment, symptom, and awareness.

Chapter 3 describes the research methodology that illustrates how the present study was implemented which includes methods of data collection and analysis. The questionnaire used and the rationale for the selection of samples are also discussed in this chapter. In this study, the multivariate statistical analysis that was used to analyse the data is partial least squares (PLS) estimation in the form of structural equation modelling (SEM).

In Chapter 4, the results of the testing of the proposed hypotheses and the research findings on Diabetics Mellitus Awareness Model (DMAM) using multivariate analysis technique as predictive modelling technique are presented and discussed.

Finally, Chapter 5 summarizes the study and discusses the relevance of the findings of the present study with those of the previous studies. In addition, the contributions made by the present study in terms of validation of the theory and its application as well as its implications, particularly towards the Malaysian population are discussed. The final chapter of this thesis also highlights the limitations of the study before the conclusion is drawn. Some recommendations and implications for further study are also proposed.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature related to diabetes mellitus awareness and the factors that influence the awareness. The review consists of seven sections as follows: (1) critical diseases in Malaysia, (2) trends of diabetes in Malaysia, (3) knowledge about diabetes, (4) attitude towards diabetes mellitus, (5) environment surrounding diabetes mellitus, (6) symptoms of diabetes mellitus, and, (7) diabetes mellitus awareness. The hypothesis developments that link all the variables in this study ends the second chapter of this thesis.

2.2 Critical Diseases in Malaysia

Diabetes mellitus (DM) has continuously and seriously become a major concern for the public health (Hjelm et al., 2003; Abegunde et al., 2007). Aging population, unhealthy eating habits and inactive lifestyles increase the susceptibility of a person towards obesity and contribute to the global rise in the prevalence of diabetes (Fezeu et al., 2010; Al-Dahan et al., 2013). Abundance of evidence has shown that it is possible to avoid and impede diabetes by adopting active and healthy lifestyles (Zinman et al., 2006; Chiasson, 2007). Increasing or promoting more physical activities, weight reduction, and pharmacological interventions may significantly lower down the probability of being diagnosed with diabetes and suffer its complications, even in among high-risk groups (Fezeu et al., 2010). Implementing severe lifestyle changes, such as a healthy diet which focuses on the reduction of sugar intake, would be crucial

for the impediment and management of incident DM (Zinman et al., 2006; Chiasson, 2007).

One of the four people in the country suffers from diabetes, making Malaysia one of the world's highest diabetes patients (Abu Bakar, 2018). The rate is alarming and is expected to increase. In fact, the National Morbidity Survey Statistics 2015 shows that diabetics aged 18 and over totalled 3.5 million people, while the youngest patients were two months old. Therefore, Malaysians need to be aware of the dangers of diabetes, although many are already aware of it but still do not work or take any action to reduce the number of sufferers. With the increasing number of diabetic population in Malaysia, the present research sought to study and determine the level of awareness on diabetes in Malaysia. This study also aimed to examine whether or not the symptoms of diabetes would influence the awareness and attitude of individuals with DM. Understanding these factors will offer the basis for developing effective interventions to improve DM awareness in public with diabetes.

Diabetes is a condition in which improper or uncontrolled food intake might produce cerebrovascular diseases and lifelong complications of diabetes (Al-Khawaldeh & Al-Jaradeen, 2013). This *diabetes epidemic* is increasing and as the population growth increases, aging, urbanisation and accelerates prevalence of obesity and dormant lifestyle which will persist at the same time, increase the global prevalence of the disease. Therefore, as noted by Ding et al. (2006), DM is a seriously growing public health concern with a massive community and economic burden in Malaysia and worldwide. To overcome the rising prevalence of diabetes, further and continuous endeavour should be spread towards the vital or primary determent and promoting health through counselling and through education dissemination (Yun et al., 2007).

There are three categories of diabetes. The two main categories are Type 1 diabetes and Type 2 diabetes while the third type is diabetes which only occurs during pregnancy, namely, gestational diabetes mellitus (GDM) (Minhat & Hamedon, 2014; Hashmi et al., 2008). According to Stahl and Johansson (2009), Type 1 diabetes is an autoimmune disease–the body is incapable of providing any insulin or hardly produce any insulin, the hormone that is essential for regulating blood sugar level. This condition mostly occurs among children and young adults. Type 1 diabetes is also known as insulin-dependent diabetes mellitus (IDDM). It is also caused by the fault in

the cells in the pancreas, an organ which is responsible for the insulin production (Teck-Hong & Suhaimi, 2014). Consequently, the destruction leads to absolute insulin deficiency, and to overcome this deficiency, Type 1 diabetes patients will need to receive 4-6 daily injections of insulin to stabilise their glucose level in the blood (Stahl & Johansson, 2009; Hart et al., 2003). Byrne et al. (2012) claimed that in an effort to avoid any complications, Type 1 diabetics are necessitate to regularly monitoring their blood glucose level in order to sustain good glycaemic control.

By contrast, the second type of diabetes is closely related to insulin resistance which is an unsafe condition where the cells unable to properly reacted to insulin (Minhat & Hamedon, 2014). It is a metabolic disorder resulting from the inability of organ in the body to produce sufficient insulin or inability to use insulin successfully to maintain a normal blood sugar level (Teck-Hong & Suhaimi, 2014), and it is also the most typical form of diabetes (Nadia, 2012; Suzan, 2012; Mingguan, 2012; Metro Ahad, 2012; Tan et al., 2011; Edith Schober, 2011; Yong Yang, 2012). Additionally, the second type of diabetes is sometimes referred to as non-insulin dependent diabetes mellitus (NIDDM). Teck-Hong and Suhaimi, (2014) stated that the complication of genetic and environmental can be considered as the factors of it (American Diabetes Association, 2012). Even though any person is potentially being identified with diabetes, the risk is greater and higher for the person whose lifestyle is associated with obesity, lack of exercise as well as having a very poor diet; this is because the major causes for the second type of diabetes is usually related to overweight and lack of exercise (Eckert, 2012). There are two types of medication that can be used in order to treat the second type of diabetes, namely, either by consuming insulin or without consuming insulin. This type of diabetes can be treated by using insulin and medicines to regulate sugar level in the blood and can decrease the blood sugar level. Surgeries for weight loss among those who are obese are among effective measures for Type 2 diabetics.

The third type of diabetes, namely, GDM is often occurs during pregnancy. GDM patients are pregnant women who never had diabetes but the level of their blood glucose suddenly become high (DM Newsletter, 2014). GDM is a risk that is suffered by pregnant woman especially for the first time pregnancy, woman who already have a family history with diabetes, obesity during pregnancy, suffered GDM during previous

pregnancies and experience sudden weight gain during pregnancy. After the woman has been diagnosed with GDM, she will be asked to refer to a more senior healthcare provider with better facilities for follow-ups and further treatment and labelled as a high-risk category. They are given knowledge and education on how to live a healthy lifestyle, improved healthcare, better self-care and early prevention of their illness (Shriraam et al., 2013). Normally, they are required to practice a healthful diet, exercise regularly, and even take insulin injections. GDM usually disappears after childbirth, but a woman who had experience GDM face the possibility of getting Type 2 diabetes after delivery, and GDM may lead to a life threatning risk to the unborn child if it is not treated with care (Shriraam et al., 2013).

Past studies conducted by Omobuwa and Alebiosu (2014), Al-Khawaldeh and Al-Jaradeen (2013) and Fezeu et al. (2010) on DM awareness had concentrated on individual factors. However, the larger environmental context that influences awareness and attitude of an individual had not been widely discussed in the literature. This is important because, in these challenging times, lifestyle or environment plays a very crucial part in contributing to the culture of healthy lifestyle in order to ensure more productive survival. If the larger context of environment is neglected, the level of awareness on diabetes would most likely be declining and this would arguably contribute to a rise in the total of number of diabetes cases in the country. Even studies had been conducted on diabetes patients with regard to the environment, which has an effect on the attitude of an individual, these studies had often disregarded the contexts of the circumstances that involved family members, the community and the health care system.

In Malaysia, MOH has continuously organized numerous campaigns or programs on healthy lifestyle (Ding et al., 2006). The prevention and control programmes of non-communicable diseases (NCD) in Malaysia had been implemented since the 1980s and the government continues to strengthen the programmes in the new millennium. Despite every effort, the number of cases of diabetes has been on the rise. Closer cooperation between sectors to organize awareness campaigns are needed to reach the public effectively. With the unhealthy lifestyle adapted from a young age, NCD like diabetes can cause a variety of illnesses and other effects. Currently, NCDs are the main cause of premature death among adults in Malaysia, which has resulted in

the loss of the productive population, thus giving enormous strain on the health care system. Therefore, there should be a strategy that should create an environment that is focused on health food, good eating habits and regular physical activity (Harian Metro, 2012).

2.3 Trends of Diabetes in Malaysia

Currently, diabetes is known as an ordinary health problem among the Malaysians citizen where the statistics shows many diabetic patients in the population are also coming from this country (Najib et al., 2014). More than 3 million Malaysians were diagnosed with DM in 2010 (Ng et al., 2012). The upward trend in the number of DM patients has been associated with the lack of exposure on DM among the general population (Letchuman et al., 2010). Acceptable caused for the blooming in this issues among the Asians are due to "poor lifestyle, rapid westernization, lack of knowledge, unsatisfactory attitude and practices towards DM among the general population and diabetic patients" (Ng et al., 2012).

The prevalence of diabetes in Malaysia has shown a worryingly increasing trend because in 2006, 11.6% of adults in this country who were 18 years or above had diabetes (Farush Khan, 2014). Coupled with obesity, this would increase the risk of Type 2 diabetes. Farush Khan (2014) has discovered that as many as 72% of the people in this country think that their body weight was ideal, and even think they are too skinny; this indicates that most of the people have a high risk of getting diabetes or rejecting the fact that their weight may be excessive. A study on diabetes awareness conducted in Malaysia by Novo Nordisk has found that the average Body Mass Index (BMI) of the population is 24, which is regarded as overweight, while Indonesia and Vietnam, the average BMI is 23 and 22, respectively (Farush Khan, 2014). Geraldine (2013) has also noted that obesity is an alarming health issue in Malaysia with 8.5 million people who are overweight which means that one out of three people is afflicted with obesity in Malaysia. This may be caused by unhealthy eating habits and the lack of physical activities among Malaysians. The figure is likely to rise if no endeavour or preventive measure is taken to overcome the exasperating issues and also to create awareness that is still lacking among the Malaysian people (Geraldine, 2013).

2.4 Diabetes Mellitus Awareness

Prevention, management and control the disease, self and public awareness on distinct aspects of DM are of vital importance. However, DM awareness among the general population is still relatively low (Foma et al., 2013). Therefore, as noted by Ng et al. (2012), enhancing the "knowledge, attitude and practice (KAP)" with consideration to improve and monitor DM would require the implementation of awareness programme. It has also been observed that members of the public are unconsciously ignorant to the need to have knowledge about DM in various aspects (Gunay et al., 2006; Murugesan et al., 2007). The acknowledgment of a family history with diabetes and exposure from any relatives or acquaintances who have been diagnosed with diabetes also seem to be influencing a person's level of knowledge and the perceptions regarding the disease. In other words, those who have positive history of the DM would normally create an awareness among the family members and spread the knowledge about the disease (Murugesan et al., 2007).

Indeed, awareness is the main and vital factor in the early diagnosis as the patient may obtain ample treatment and avoid further complications of the disease (Poornima et al., 2012). Members of the public should therefore be educated on the risk factors of diabetes as this can increase awareness on the essential factors that could prevent diabetes (Al-Khawaldeh & Al-Jaradeen, 2013).

However, early diagnosis is sometimes not possible. Among the circumstances which lead to the failure of early diagnosis are insufficient knowledge, improper infrastructure for diabetic screening, ignorance public on the diabetes symptoms, complication and its prevention and high-risk group identification. Consequently, a lot of young diabetics are developing diseases and suffering from chronic morbidities when they become older as a result of living unhealty lifestyles (Raheja et al., 2001).

Meanwhile, the number of diabetics in this country is increasing and the situation has not been contained. It has continued to put high-risk groups in serious condition. Therefore, awareness and education are the most important aspects that need to be addressed immediately to make a difference to help the public live healthier and more meaningfully. For people with diabetes, this fact cannot be denied as it has been

statistically shown that more Malaysians are at risk due to low awareness in making the necessary changes in lifestyles (Farush Khan, 2014).

In a nutshell, simple information about the disease can be spread through newspapers, social media and television to increase the public awareness. This is because the usage of the mass media would be very efficient in spreading and create awareness on the dangers of untreated diabetes among the public (Mustaffa Embong, 1990).

2.5 Previous Studies on Diabetes Mellitus Awareness

According to Omobuwa and Alebiosu (2014) conducted studies related to awareness of diabetes amongst undergraduates in a Nigerian University, South West Nigeria. This study set out to examine the level of awareness, knowledge, and some risk factors for developing DM among students of the Osun State University, Nigeria. A self-administered semi-structured questionnaire was used to obtain information on respondents' socio-demographics, awareness, knowledge and perception of DM and lifestyle characteristics such as dietary habits, physical activity, use of alcohol, and tobacco smoking. This study showed high awareness level of DM among participants but the knowledge and attitude toward DM was relatively poor.

Next, Rathod et al. (2014) conduct a study of knowledge, attitude and practice of general population of Waghodia towards diabetes mellitus. The result shows that the respondents had good knowledge but poor attitude and practice towards diabetes. Repeated reinforcement and motivation along with health education will definitely bring about a positive change in practices.

Furthermore, study by Foma et al. (2013) evaluates awareness of diabetes mellitus among diabetic patients in the Gambia. A tool containing questions on patient's demographic characteristics and awareness of various aspects of DM including general knowledge on DM, causes, complications, management and prevention. Level of education, duration of illness and knowledge of a family member with diabetes were important predictors of knowledge in this study. This study shows that the majority of patients attending the Medical Out-Patient Department (MOPD) have poor knowledge on several aspects of DM. Hence, there is need for conscious efforts towards improving

the level of awareness through health education and promotion, not limited to the hospital but also within the general population, as part of strategies to prevent, manage and control DM.

On the other hand, Shriraam et al. (2013) conduct a study of awareness of gestational diabetes mellitus among antenatal women in a primary health center in South India. Awareness of the condition among antenatal women will translate into prevention and early diagnosis of the disease. The result shows that only a small proportion of rural antenatal women had good knowledge about GDM. The awareness that untreated GDM may pose a risk to the unborn child was high among the studied women. Health care workers have to play a greater role in bringing about awareness about GDM among antenatal women.

Poornima et al. (2012) in her study to assess the awareness and knowledge regarding diabetes mellitus among degree college students of Mandya city, Karnataka, India. A cross-sectional study was undertaken with 648 degree college students of Mandya City. The students were administered a 36 items, pre-tested, semi structured questionnaire assessing general and specific knowledge of diabetes like symptoms, causation, risk factors, complication, treatment, attitudes towards people with diabetes. The result showed that 59.94% students had knowledge about genetic factors in diabetes. Only 28.70% study participants were aware of diabetes as a rising problem. As much as 62.8% and 35.02% subjects stated that blood and urine tests are done for diagnosing diabetic persons. Common complications not identified by the study subjects were impotence (82.25%), ulcer on foot (70.83%), loss of sensation (69.91%), repeated skin infections (62.80%) and stroke (61.42%). According to them 50.46% diabetics can live normal life; 39.27% can start insulin and eat everything and 27.62% can take herbal medicine and get cured. Conclusion is specific Knowledge about diabetes is poor among the degree college students, hence appropriate activities to increase awareness about diabetes is the need of the hour.

Besides that, Mashige et al. (2008) make an assessment of the level of diabetic patients' knowledge of diabetes mellitus, its complications and management amongst diabetic patients in Durban, South Africa. A questionnaire was provided to a total of 106 diabetic patients attending the Tongaat Community Clinic in Chatsworth. The questionnaire consisted of questions relating to the patients' knowledge of the disease,

its ocular complications and its management. The participants in this study had a significant knowledge of DM and its management. These results highlight the need for educational programmes aimed at improving the knowledge of the effects of DM on the eyes including the need for regular eye examinations.

In a study conducted by Yun et al. (2007) make a comparison of knowledge of diabetes mellitus between patients with diabetes and healthy adults volunteers in Penang, Malaysia. Each participant was required to answer a total of 30 questions concerning knowledge about diabetes mellitus. The results showed that patients with diabetes mellitus were significantly more knowledgeable than the healthy volunteers about risk factors, symptoms, chronic complications, treatment and self-management, and monitoring parameters. Educational level was the best predictive factor for diabetes mellitus and public awareness. The conclusion is knowledge about diabetes mellitus should be improved among the general population.

Murugesan et al. (2007) in their study, focus on investigating the levels of awareness on diabetes and its complications in the general and diabetic population in a city in southern India and to identify factors that influenced the awareness. Details regarding awareness about diabetes in relation with physical activity, healthy and unhealthy diet, causes, symptoms, prevention, complications and measures to improve health were collected using a questionnaire. The result shows that higher education and professional or executive jobs were significantly associated with better awareness. Knowledge regarding causes of diabetes, its prevention and the methods to improve health was significantly low among the general population. Diabetic subjects had better knowledge about symptoms of diabetes and the preventive aspects. The study highlights the urgent need for strategies to spread awareness about diabetes in the general population. Diabetic subjects also required better education on many aspects.

Study by Soltanian et al. (2007) to determine the level of population awareness about diabetes disease and its complications in Bushehr port inhabitants (Iran), based on the available education programs. The cross-sectional study was assessed upon 719 subjects aged over 18 years old, without diabetes and inhabitant in Bushehr port in 2005. The questionnaire included 39 questions: demographics indices, fundamentals about diabetes, its presenting signs and symptoms, the early and late complications, means of management as well as looked into the source of the information. The results

indicate that studies population awareness about fundamental diabetes disease, primary symptoms, early complications, delay complications, diet awareness was low and this implied that the people need more education about diabetes.

Based on the study of Ding et al. (2006) which evaluated the knowledge of diabetes mellitus among diabetic and non-diabetic patients in Klinik Kesihatan Seremban. A 41-item self-administered questionnaire tested the respondents' knowledge on the general aspects of diabetes (8 questions), risk factors (4 questions), symptoms and complications (12 questions), treatment (13 questions), and monitoring of diabetes (4 questions). The result shows that knowledge on diabetes mellitus among patients with diabetes was significantly better than patients without diabetes in Klinik Kesihatan Seremban. Diabetic mellitus health education should put greater emphasis on prevention of diabetes mellitus among the healthy adults as well.

2.6 Knowledge about Diabetes

The knowledge about the disease itself is essential and plays an important role which needs to be taken into consideration to prevent and control it from spreading (Omobuwa & Alebiosu, 2014). Appropriate knowledge about diabetes would show an effective outcome for good diabetes control (Gunay et al., 2006). If the diabetic persons are knowledgeable about the disease they had, it can be anticipated that their health would be in better condition (Ayyagari et al., 2011). Furthermore, knowledge about DM is crucial in order to lessen the incidence and rate of DM (Baradaran & Jones, 2004). Nevertheless, there is a paucity of research on the level of knowledge related to DM within the population and this has remained as a major issue. In a city in southern India, it has been found that education about the causes of diabetes, proper precaution and guide to better and healthy lifestyles was rather poor in the population and among the diabetes patients (Murugesan et al., 2007).

Knowledge and awareness about the possible consequences of diabetes are vital. Nonetheless, enlightenment about the peril of DM should not be limited to those who are already suffering from DM (Minhat & Hamedon, 2014). There could be a higher possibility of being diagnosed with the disease because of the diabetic history among relatives of the person themselves; thus, proper education is necessary for them to detect the symptoms once they have appeared and to avoid risky lifestyles (Van Der Sande et

al., 2001). Patients would be able to plan further necessary actions to seek medical attention promptly if they have adequate knowledge about the symptoms and complications. In addition, they could alert and assist their diabetic next of kin or friends to observe with follow-ups and treatments for a healthy lifestyles. Thus, it shall lessen the medical and financial onuses of the disease and its related issues (Wee et al., 2002).

Numerous research studies have revealed a gap between knowledge and attitude in connection with the increase in the number of diabetics. Most respondents in past studies had general knowledge about diabetes. They were able to understand the symptoms and the possibility of being diagnosed with diabetes. In addition, they also knew that being overweight and unhealthy lifestyles could contribute to the problem. In fact, most of them were aware that the disease could be delayed or hindered by leading a healthy lifestyle such as eating healthy food and exercising. However, adequate knowledge about the disease does not mean that the individual can adopt a healthy lifestyle. Adopting a healthy lifestyle falls on the lowest priority, especially among the high-risk groups. Therefore, all parties should continue to share the view to promote a change in attitudes, especially among the diabetes patients and those with high probability of developing it (Farush Khan, 2014).

The campaign or programme to change public perceptions about diabetes has been designed to improve the individual's knowledge on DM. The knowledge one has about the disease is directly proportional to the duration one has suffered from the disease (Via & Salyer, 1999; Lukoschek, Fazzari & Marantz, 2003). In the Diabetes Care Data Collection Project (DCDCP), it was found by that socioeconomic factors, jobs, profession and level of education were connected to the level of diabetes control which were related (Mustaffa, 1999). Various factors could lead to the poor understanding and education of the community on DM, which could be related to the individual factors or the health promotion programmes conducted which is ineffective (Minhat & Hamedon, 2014).

2.7 Attitude towards Diabetes Mellitus

Many people think lightly, or even take for granted, when it comes to DM, only having an awareness to start living a healthier life after they have detected signs or

symptoms of the disease in them (Live-well nutraceuticals, 2013). It was reported that a study conducted on 1,012 men and women at the aged of 18 and above in Malaysia had shown that there was a gap between knowledge about the disease and attitude towards the disease (Farush Khan, 2014). The study also indicated that 57% of the respondents who were at high-risk did not have their daily 30-minute exercise while 17% of them did not do any physical activity because they *had no time*, making them more vulnerable to the disease (Farush Khan, 2014). The same study also revealed that some of the respondents who were in the high-risk groups never took the necessary tests to detect whether or not they had diabetes. The respondents had not been informed of the possible complications due to diabetes while approximately 58% opined that diabetes could be easily controlled and treated as if it was not as serious as other diseases. This assumption is incorrect as high blood sugar level affects one's health in the long term, including kidney failure, blindness, restricted mobility due to amputation, and suffer from cardiovascular diseases especially heart attack and stroke or even death. In addition, the study showed that many people with diabetes preferred taking the tablets rather than the insulin injection even though the insulin injection would be more effective to avoid or minimize the complications of the disease, and with assistance of the latest technology, needles would be easier to use and would not cause much pain (Farush Khan, 2014).

In a study done by Mohd Najib (2014) showed that although majority of the public (66%) had good attitudes toward diabetes, 33.30% of the respondents reported that they never check their blood glucose for diabetes screening due to busy with work. Even though, in Malaysia, diabetes screening is not a routine, it is possible for the healthcare authorities to look into feasibility of implementing continuous routine screening of high risk individuals as a preventive step. In fact, this is very alarming to the country as the government has undertaken various campaigns on healthy lifestyle and on diabetes awareness over the years (Mustaffa, 2004). Other reasons that contribute to the failure for diabetes screening includes ignorance about the disease (25.5%), transportation problem (2.0%) and low level of trust (13.7%).

The study done by Tanjia et al. (2016) showed that most of the patients (about 62.38%) never perform self-blood sugar test because either they do not know how to interpret the result or they feel this is not really needed. However, individuals should be

encouraged to undergo health check-up to determine if they are in the risk group or suffering from diabetes. They need to be proactive, especially if there are any family members that are suffering from diabetes, high blood pressure or high cholesterol. Physicians should play a role in educating the patients on the different types of treatment available so they can make better decisions on how to effectively manage diabetes. Therefore, all parties should continue to share views to encourage changes in attitude, particularly among people with diabetes and those in the high-risk group (Farush Khan, 2014).

2.8 Environment Surrounding Diabetes Mellitus

The built environment has mainly influenced development of the disease. Among the main contributing factors towards diabetes are the sleep cycle and the physical activities affected by stress (Pasala et al., 2010). In developed countries, it has been evident that modification of the environment and lifestyle in the human life has shown that it is a factor that can prevent diabetes (Pasala et al., 2010). Some exploration of the effect of environmental or external context on DM awareness together with the impact of individual factors on DM has been made in which causes for both types of diabetes have been found to be possibly due to the genetic factor and the surrounding or environmental factor (American Diabetes Association, 2012). The environment in the context of the diabetic patients includes providing information as well as other forms of tangible support (Goz et al., 2007; Mlynarczyk, 2013). In this regard, Helgeson (2003) has found that the higher the environment is accepted and embraced by the individual, the better it is for the individual's quality of life. It has been evident that the environment has become the most significant factor in relation to the individual's quality of life. The environment encompasses family, friends or even healthcare professionals as diabetic patients generally require better environment from the people around them. In fact, Debona and Cachia (2007) have asserted that social relationships and the diabetic patients' quality of life are extremely related.

The environment has a beneficial effect on diabetes awareness; hence, the support and the encouragement would aid individuals to become familiar with a healthy lifestyle. The encouragement or supportive behaviour would not only matter to the person is being supportive, but how the receiver of the support would act towards the

support given. Family members are the most valuable support to the health management of diabetic patients. Additionally, colleagues and friends should be highly encouraged to assist the diabetics by providing the emotional support, mainly among patients at the early age. As noted by Ashraff et al. (2013), help and support from members of the family and also from friends would be vital in developing management of self and adjustments to diabetes which may eventually result in high quality of living. This shows that the surrounding or the environment is crucial in shaping the attitude in a person in order to avoid diabetes.

2.9 Symptoms of Diabetes Mellitus

Diabetes is a disease that does not give effects that are too obvious to some individuals. This is why some people are not too concerned about the perils of the disease and may cause symptoms that do not bring awareness to the patients. More worrisome is the situation when patients are diagnosed with diabetes, they do not take medications as recommended by the health officials, while some patients prefer to take traditional medicines. However, when the disease becomes worse, the patients would return to consult the health officials.

According to Soltanian et al. (2007), one out of two people who have Type 2 diabetes mellitus is undiagnosed; this remains oblivious to them that they are affected by the disease. Sudden complications and other consequences may arise due to ignorance and lack of awareness. Hence, early diagnosis of diabetes is effective care that should be taken into consideration. However, some patients are not willing to undergo the treatment or simply unaware that they have diabetes because they do not feel like having any minimal symptoms (Mustaffa Embong, 1990). Currently, the diagnosis of DM is easy as it requires approximately two minutes to specify or obtain the glucose concentration in the blood. Patients may seek medical assistance from their doctor, either in the public sector or the private sector who would have the expertise to run tests in order to determine the glucose levels in blood and detect diabetes at early stage (Mustaffa Embong, 1990).

Unfortunately, diabetes develops and effects is silence. Patients may not even realise or they may not be aware of the disease until complications begin to appear and become life-threatening. To conclude, it is necessary to have an awareness on diabetes

particularly with regard to the usual signs and symptoms of the disease such as "constantly feeling tired, increase thirst, frequent urination especially at night, sudden weight loss, blurred vision, skin infections, time-consuming for healing of cuts and wounds, and numbness or burning sensations in the limbs" (Najib et al., 2014).

The signs and symptoms of diabetes are disregarded by many because of the chronic progression of the disease (Ramachandran, 2014). People do not consider this as a serious problem because unlike many other diseases the consequences of hyperglycaemia are not manifested immediately. People are not aware that damage can start several years before symptoms become noticeable. This is unfortunate because recognition of early symptoms can help to get the disease under control immediately and to prevent vascular complications.

2.10 Underpinning Theories for Conceptual Framework

This part discusses further the theories which affiliated with the constructs of this study. These theories are elaborated to provide the support for the conceptual framework of the present study. From this framework, a model was hypothesised and developed for this study.

2.10.1 Knowledge, Attitudes and Practice (KAP) Theory

The Knowledge, Attitudes and Practice (KAP) theory was developed for the first time in the 1950s. A decade later, this theory was used extensively for family planning practice in many countries all over the world. In general, KAP surveys are apparently the most cost-efficient and conserve less resources as compared to other methodologies as the KAP survey is objective-focused and its scope remains restricted (Eckman & Walker, 2008). Each letter represents its own criteria, namely, *K* "for knowledge of the problem or disease", *A* "for attitude towards the problem or disease", and *P* "for practice or preventive behaviour to protect against the problem or disease". In the field of health education, this research framework has been mainly used in the process of spreading awareness on family planning and in the provision of guidelines in understanding the health education's method for patient behavioural changes and patient health outcome (Jaccard, Dittus, & Gordon, 1996). This theory is used to measure the individual knowledge about the disease or health problem. It has been used

widely as a methodology to study the human behaviour affected by a problem or disease. Evaluation toward feelings and beliefs of the participants is mostly done by applying the attitude instruments. Nevertheless, the instrument also capable of reaching for details regarding the preventive behaviours and the practice measures that a person has to follow in order to avoid a problem or a disease. Practices refer to behaviours or actions that can impede or delay the development of a disease. In this regard, knowledge, attitude and practice are related with each other while knowledge and attitude are directly having an influence on preventive practice.

2.10.2 Social Cognitive Theory (SCT)

The social cognitive theory (SCT) is another theory employed as a model for health promotion programmes across a wide range of behaviours (Glanz, Lewis, & Rimer, 1997). This theory has been used as the basis for the diabetes mellitus awareness model (DMAM). SCT, which was developed by Albert Bandura (1986), is a learning theory that embraces the agentic perspective of the capability of humans that affect changes in their behaviours to accomplish variations and accomplishments in life. The fundamental of SCT lies in the communications among these three main areas of influences, namely, the behavioural, the personal, and the environmental factors. The behavioural factors encompass the individual's behavioural capability in relying on precise knowledge and skills required in order to perform the activities that are desired. Meanwhile, the personal factors comprise "cognitive, affective, and biological characteristics of the individual" whereas the environmental factors involve "the perceived social and physical environment as well as situations". Environmental factors include physical and social environment, where social support may also have a positive effect. According to Bandura (1997), the environment includes the physical surroundings in addition to situations that individual's encounter, which concerns more of the perception of the surroundings including others with which interaction takes place. This construct is interrelated with social support since most of our perception seems to rely on those around us.

There are many previous studies conducting using these two theories such as study done by Bagherniya et al. (2018), Rav-Marathe et al. (2016) and Alzghoul and Chew Abdullah (2015).

2.11 Conceptual Framework

The proposed conceptual framework for diabetes mellitus awareness model (DMAM) considered all important aspects in determining the factors influencing diabetes mellitus awareness among the public, which included knowledge, attitude, environment and symptoms. For each of the aspects considered in this model, all criteria were measured using indicators or items of the constructs. Generally, there is a distinct linkage between knowledge and diabetic mellitus awareness. Figure 3.1 shows the relationship between each factor in DMAM which would be assessed according to the consolidated constructs.

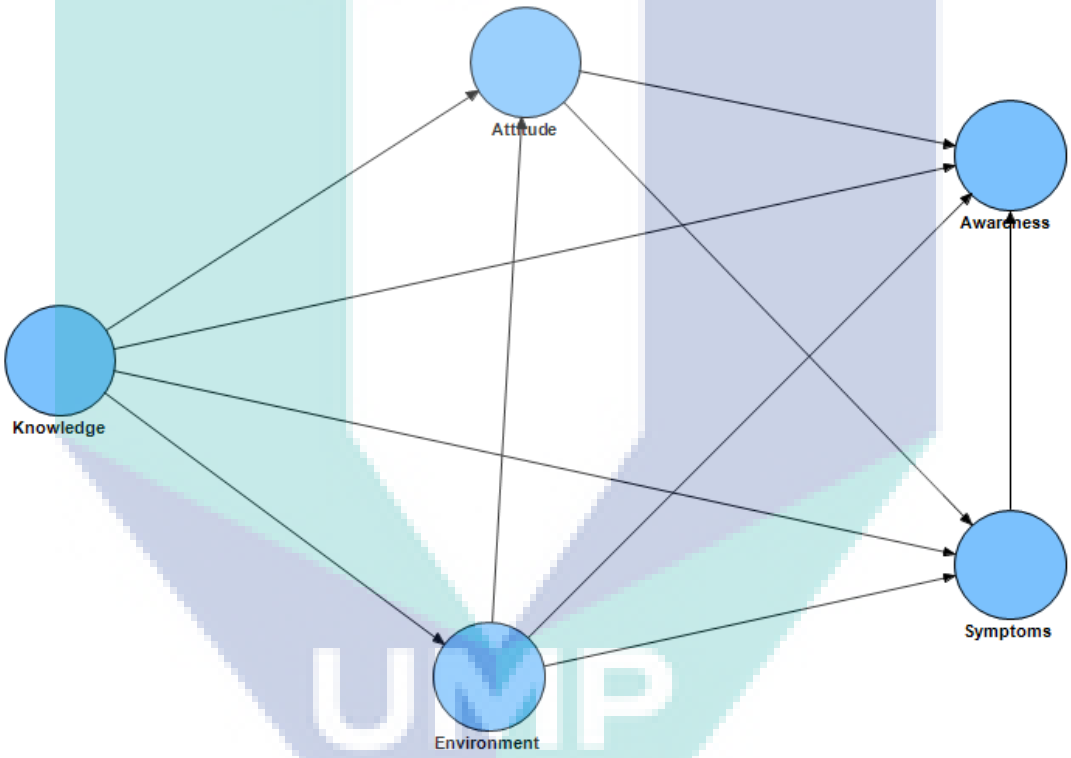


Figure 2.1 Conceptual Framework for Diabetics Mellitus Awareness Model

The following statements (a–j) are hypothetical constructions which described the relationships tested between knowledge, attitude, environment, symptoms and diabetes mellitus awareness in the conceptual framework of DMAM as shown in Figure 2.1. Therefore, the following statements (a–j) show the relationships between the constructs studied with diabetes mellitus awareness.

a. There is a significant relationship between knowledge and attitude;
b. There is a significant relationship between knowledge and environment;
c. There is a significant relationship between knowledge and DM symptoms;
d. There is a significant relationship between knowledge and DM awareness;
e. There is a significant relationship between attitude and DM symptoms;
f. There is a significant relationship between attitude and DM awareness;
g. There is a significant relationship between environment and attitude;
h. There is a significant relationship between environment and DM symptoms;
i. There is a significant relationship between environment and DM awareness; and,
j. There is a significant relationship between DM symptoms and DM awareness.

2.11.1 Hypothesis Development

It can be summarised from past studies that the association between knowledge and attitude is very strong (Ng et al., 2012; Bradley et al., 1999), while increased knowledge is a precondition for changing attitudes (Arcury, 1990). To lessen the prevalence and morbidity that are associated with DM, knowledge related to DM, appropriate attitude and practices are necessary (Baradaran & Jones, 2004; Binhemd, 1992). By observing the relationship between knowledge and attitude, it was found that majority of the respondents in past studies had knowledge; however, their attitudes and practices were not in parallel in terms of the knowledge they had (Ng et al., 2012). Although patient education has been identified as the most important component in diabetes treatment, it is not solely intended to spread the information or knowledge but also to execute changes in one's behaviour or attitude (Gunay et al., 2006).

Knowledge is a critical component of behavioial change in an individual (Omobuwa & Alebiosu, 2014), and is very important in changing the attitude of an individual towards diabetes. According to Rathod et al. (2014), knowledge has a positive correlation with good behaviour or attitude. Ranjini et al. (2003) has noted that the treatment of this disease would mostly depend on the knowledge about the disease among the diabetic patients. However, having good knowledge does not necessarily lead to changes in behaviour or practice of a person (Ahmad Makinuddin & Ali, 2000). Thus, from this viewpoint, the following hypotheses were developed.

H_1: There is a significant relationship between knowledge and attitude.

Appropriate knowledge promotes environmental literacy among members of the public who possess the proper suitable behaviour and attitude (Moseley, 2000). Knowledge disseminated to a community can give a positive impact, affecting an environment that is positive towards diabetes, such as a healthy lifestyle, which can prevent diabetes from worsening. Knowledge related to DM among the general population should be improved as it would be good for diabetes control in the population or the community because having appropriate knowledge about the disease can produce more effective results. For this reason, the following statement was hypothesized:

H_2: There is a significant relationship between knowledge and environment.

Knowledge can help an individual detect the symptoms of a disease, particularly diabetes. Decent knowledge comprehension on diabetes could culminate in early diagnosis and improved management towards DM (Fezeu et al., 2010). Knowledge of managing a healthy lifestyle or balanced diet is essential in preventing diabetes from worsening and can help to reduce the budget for these problems. The findings of past studies have indicated that proper education and free access to the medical or health services are of great importance for the determent of chronic diseases such as diabetes and its complexities (Reed & Tu, 2002; Middelkoop & Wal, 2004).

Knowledge of diabetes among the family with diabetics is also vitally crucial because of the higher contingency of being diagnosed with the same disease. Therefore, proper apprehension is extremely essential in noticing the early symptoms and signs when the disease is appearing and also to avert risky lifestyles (van der Sande et al., 2001). Hence, another hypothesis was proposed as follows:

H_3: There is a significant relationship between knowledge and DM symptoms.

Knowledge disseminated among the public can expand the individual's general awareness regarding a disease (Arcury, 1990). Level of awareness is determined by the level of knowledge. When the level of knowledge increases, the level of awareness is also relatively high (Amin et al., 2012). Knowledge is the basis of establishing DM awareness as the increase in knowledge about diabetes among the population in general would certainly boost the public awareness and also develop proper detection and management of the disease (Gunay et al., 2006).

Nevertheless, the level of knowledge of DM complications has been low (Al-Dahan et al., 2013). This could essential be the main reason contributing to the lack of awareness on how severe DM is, which might compromise the attitude toward the preventive measures (Al-Dahan et al., 2013). Therefore, the hypothesis was proposed to be tested:

H_4: There is a significant relationship between knowledge and DM awareness.

Positive attitudes can reduce the symptom of diabetes. According to Moritz et al. (2014), positive attitudes are associated with having positive symptoms. Numerous studies have claimed that lack of physical activity, having an unfit body and being overweight are factors that have mainly induced insulin resistance development, metabolic syndrome and Type 2 diabetes (Laaksonen et al., 2005). Several researchers have also suggested and are in favour of excercises or physical activities which may also minimize the probability and development of several types of cancers (World Cancer Research Fund, 2007; Irwin & Mayne, 2008). In addition, the impact of proper diet has also been highlighted on the probably of being infected by the disease and its potential prevention (Hu et al., 2001; Tuomilehto et al., 2001). According to Cooper (2006), there is a link between eating habits and symptoms of depression by having young male student as respondent. Thus, hypothesis generated from this issue:

H_5: There is a significant relationship between attitude and DM symptoms.

A positive attitude indicates a high awareness. According to Arcury (1990), positive public attitudes can increase the public's awareness, and other studies have found that individuals' attitude are positively correlated with the type 2 diabetes prevention (Al-Naggar et al., 2013). In general, a family with a positive diabetes history will eventually have a higher awareness towards it. Perceived risk is the primary motivation which makes a presumption that the greater the perceived risk related to the condition, the greater adjustment can be made by an individual on their behaviour in reducing the risk (Baranowski et al., 2003). The factors that are influencing the perceptions on family history could be diverse between individuals and also between diseases. The perceived risk would be vital in motivating "preventative health behaviours and control of disease" (Walter et al., 2004). Family members that are actively taking care of welfare of their siblings with chronic conditions for the disease will surely build up and boost their knowledge, awareness and physical activities regarding diabetes. Hence, the hypothesis that would be tested was:

H_6: There is a significant relationship between attitude and DM awareness.

All in all, environment can affect an individual's attitude. Environmental support or relationships can be described as an empathy or encouragement provided to one's attitude (Saeeet al., 2012). Such support can be divided into giving emotional and informational aid, understanding and other forms of tangible support (Goz et al., 2007; Mlynarczyk, 2013). Helgeson (2003) has found that the correlation between individual's attitude and environment support is linear, which indicates that extra environment supports an individual receives, the better the individual's attitude towards diabetes.

It has been clearly evident that environmental support has shown to have the strongest relationship with an individual's attitude. The environmental support received would become more effective when it comes from their own family, friends or healthcare professionals. Diabetic patients generally require environmental support from the society around them. Debona and Cachia (2007) have observed that there is a strong linkage between the diabetic patients' environment and their attitudes. In addition, other studies have found that environment support has helped patients to become accustomed to their new way of life and the medicinal life (Goz et al., 2012; Saaed et al., 2012).

Supportive behaviour towards individual does not only function to give encouragement, but also in the way the encouragement or the support is being offered by the surrounding community and how it is being comprehended by the receiver of the support. In other words, a connection exists between the support given by people and how the support is recognised (Mlynaczyk, 2013). Debono and Cachia (2007) have also noted that diabetic patients usually feel desolated, ignored and believe that nobody around them could empathise with how it feels to confront with diabetes.

Family members are the most valuable form of support to the attitude of diabetic patients. Additionally, peers and friends are also essential in providing emotional support to the diabetics, especially those in the adolescent stage. Ashraff et al. (2013) has illustrated how encouragement from family members and friends is significantly correlated with a better attitude.

Apart from family members and friends, nurses in hospital have also been identified to have played a huge task in administering support to diabetic patients. The Cross-National Diabetes Attitudes and Wishes and Needs (DAWN) study has indicated that nurses would be able to offer the best care and support possible for their patients (Donohue-Porter, 2012). In addition, Connell et al. (1994) have found that the low level of depression among diabetic patients has also been significantly connected with the social support given or relationships. Thus, the hypothesis that would be tested was:

H_7: There is a significant relationship between environment and attitude.

According to O'Brien et al. (2006), positive "association between environment and symptoms of risk for onset psychosis", and positive family involvement can decrease the symptoms of the disease at an early stage. Family and friends could be used as a potential intervention at a very early stage of DM since the surrounding or environment in a family is the crucial part in the evolution of symptoms of the disease, which would contribute to the reduction of the symptoms and enhanced functional outcomes. Thus, the present study hypothesised that environment from family members or friends could be associated with symptoms of DM. Therefore, the hypothesized relationship that would be tested was:

H_8: There is a significant relationship between the environment and DM symptoms.

Environment affects awareness among the public. Having family history or acquaintances with the disease is linked with better awareness or greater precaution to avoid the risk factors of diabetes (Baptiste-Roberts et al., 2007). In addition, less preference is given in national health policy and plans, and also limitation to the availability of relevant preventive measures and curatives has been distinguished as the main factor as the lack of awareness of the disease still exists in the society, among decision-makers, and also among health professionals (Ooyub et al., 2004). Therefore, the hypothesized relationship that would be tested was:

H_9: There is a significant relationship between environment and DM awareness; and,

There is a relationship between symptoms and awareness as symptoms is positively associated with the relationship between depressive symptoms and awareness

of the deficits in a disease (Spitznagel et al., 2006). Hence, the following hypotheses were proposed to be tested:

H_{10}: There is a significant relationship between DM symptoms and DM awareness.

2.12 Summary

Diabetes mellitus (DM) is a major health problem worldwide. To prevent diabetes from worsening and to optimize the health outcome among Malaysians, individuals must adopt healthy lifestyle and embrace self-care. To develop effective intervention programmes in order to promote awareness of diabetes, the factors influencing diabetes awareness must be identified.

In this study, both the knowledge, attitudes and practice (KAP) theory and the social cognitive theory (SCT) are the two theories that have been identified to be related with the constructs tested in the present research and these theories were therefore used to develop the conceptual framework for the model that would be tested. Construct for knowledge and attitudes were taken from KAP theory, meanwhile construct awareness are modification from practice variable in KAP theory. Also, construct environment is taken from SCT theory. Based on the conceptual framework and the model developed, 10 hypotheses were proposed to be tested.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter describes the research methodology of the present study. It provides the descriptions of the specific research plan involved, the target population identified, the data collection which include the sampling technique, ethical considerations of the participants' rights, the instrument used, the pre-test conducted and the actual study. In addition, data analysis procedures such as the partial least squares structural equation modelling (PLS-SEM) technique, were also described.

3.2 Types of Research

The present study was an applied research in nature. It investigated factors influencing the awareness of diabetes mellitus among Malaysians. The aim of this research was to examine the relationships among the latent constructs in Diabetes Mellitus Awareness Model (DMAM) and to test the hypotheses which had been proposed. The latent constructs and their indicators developed would serve as guidelines and provide the basis to understand and measure the perceptions of knowledge, attitude towards, environment surrounding, symptoms, and awareness of diabetes mellitus among Malaysians. This study adopted a cross-sectional design to ensure representative sampling and to minimize the response bias (Dabholkar et al., 2000). The cross-sectional data collection method would be more than sufficient to be used in this type of study; moreover, it has also been typically used by other past and current researchers (Mostafa, 2005).

In the present study, the survey method with a structured questionnaire was used to obtain specific information from respondents who were sampled from the population (Malhotra, 2009). The method has been used by many researchers to collect data in quantitative studies. Accordingly, survey research is the most popular way of collecting primary data for causal analysis; the survey data are used to assess whether one construct would affect another (De Vaus, 2005). Thus, the quantitative data collection method was used for this study as it was considered adequate to investigate the perceptions of the public towards diabetes mellitus and to examine the relationship among the constructs. To minimize any response bias in this study, the respondents should have clear and proper comprehension of the questions asked in the questionnaire; hence, the questionnaire was translated to Malay.

3.3 Sampling and Population

Sampling is a procedure of gathering sufficient number of subjects or participants in a study population (Sekaran, 2006). Hence, it is very crucial to acquire a suitable sample to represent the study population. It is necessary for the sampling technique to be clearly employed in order to estimate the value of the parameters from the population through statistical analysis of the sample (Sekaran, 2006). The sampling method that has been carried out scientifically can ensure that the statistical value of the sample is approaching the population parameter (Sekaran, 2006).

Data in this study were collected from adult Malaysians who were attending the Outpatients' Department at two health clinics in Pahang from 1st September 2015 to 15th October 2015. In order to participate in this study, the respondents had to meet the following inclusion criteria: 1) adult Malaysians of various ethnic groups (e.g., Malay, Chinese, Indian etc.); 2) aged 18 years and above; 3) able to read and understand the Malay language; and, 4) willing to participate in the study.

A total of 550 respondents were sampled in the present study by utilizing the convenience sampling technique. Convenience sampling is a specific type of non-probability sampling method that relies on data collection from population members. The rule of thumb for PLS-SEM in establishing a minimum sample size is equivalent to ten times the greater of the number of indicators comprising the most complex

formative construct or the largest number of exogenous construct leading to an endogenous construct (Hair et al., 2011). In this study, the largest group of exogenous construct that lead to an endogenous construct was four. Thus, indicating that the minimum sample requirement for statistical analysis was 40 usable responses. Based on regression analysis requirement, Field (2005) has suggested that 15 samples for each exogenous construct in the regression. In view of the expectation, this study used four exogenous construct, therefore 60 samples are considered appropriate. However, this sample size of 550 were targeted in this study also fulfilled the requirement that would be suitable to perform multivariate statistical analysis and was also in line with the recommendations made by Sekaran (2006) in terms of representativeness of the population study while also complying with the sampling simulation as suggested by Krejcie and Morgan (1970).

3.4 Research Instrument Process

A comprehensive survey instrument was developed to measure the constructs in the research model. An instrument is a set of questions employed to collect data from the respondents to obtain information about the constructs in a study (Sekaran, 2006). This research involved the development of a questionnaire to measure the perceptions towards factors that influence awareness on diabetic mellitus among the public in Malaysia.

The instrument developed in this research was partially adapted from the previous studies, which were also taken as the basis and guidelines in constructing the items in the questionnaire. As discussed in Chapter 2, five constructs of DMAM that have been determined (knowledge, attitude, environment, symptom and awareness) were studied in the present research based on expert opinions and literature review. Generally, the construction and adaptation of a questionnaire were made through discussion to arrive at the proper operational definitions of the constructs. In addition, scholars in the fields of medical and social sciences were referred to in order to confirm face and content validity. In this cross-sectional study, each participant was given a self-administered questionnaire. The participants were asked to complete a structured questionnaire, which provided sociodemographic details in six parts, Part A–Part F.

Data collection was conducted within two months (from September until October 2015). The returned questionnaires were analysed using IBM Statistical Package for Social Sciences (SPSS) version 20 and modelling analysis was done through exploratory statistical modelling methodology, namely, partial least squares (PLS) estimation using SmartPLS version 3.0. Figure 3.1 illustrates the flow chart which describes the research process of the present study.

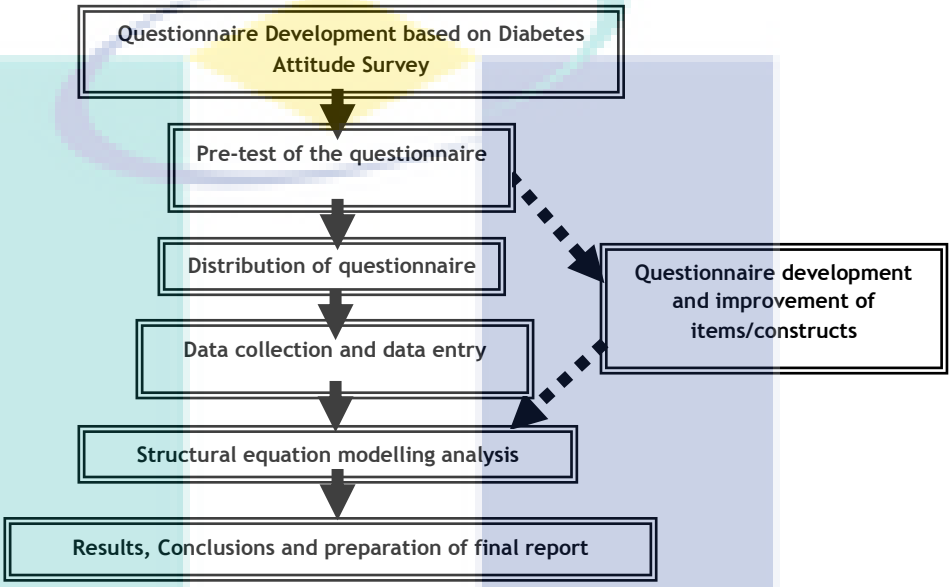


Figure 3.1 Research Process

3.4.1 Scale Rating

In this study, the Likert scale was used to measure the feedback or perceptions of the respondents on DMAM questionnaire. Likert scale is among the most common, popular and suitable technique to understand, explain and predict the perception of the respondents (Weijters et al., 2010). However, the scale response used in the survey items may significantly influence the findings of the survey. The range of the Likert scale is to provide opportunities or freedom to the respondents to give a point or score on their perception of each statement listed. This would yield various responses from the respondents, and this variation is vital in statistical methods (Sekaran 2006). In this study, five-point Likert scale was deemed to be suitable and appropriate to use as suggested by Weijters et al. (2010). In similar vein, the findings of Preston and Colman (2000), who examined the response categories based on ease of rating, the time required to select an answer together with respondents' satisfaction and their ability to express

their feelings, which found that a scale with 5 response categories would be adequate for most studies. Variations in responses between the respondents would be expected; however, as shown in Figure 3.2, the variations can be controlled by the indicators used along with the Likert scale (Sekaran 2006). The different indicators that were used in the study are for common method variance (CMV).

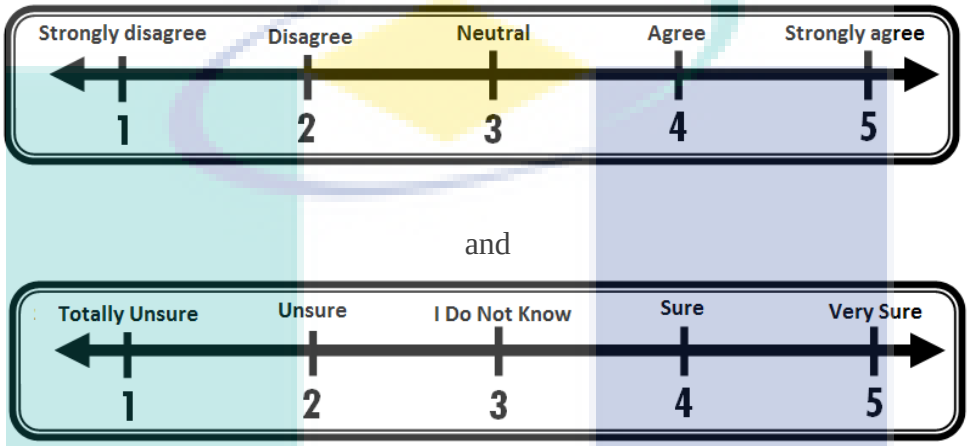


Figure 3.2 Two indications of Likert scales used in the present study

The labelled-indicator Likert scale can guide the respondents by providing more accurate answers compared to the one using indicators that are not labelled. The assessment used a scale of 1-5 as follows: *1 = Strongly disagree/ Totally unsure*; *2 = Disagree/ Unsure*; *3 = Neutral/ I do not know*; *4 = Agree/ Sure*; and, *5 = Strongly agree/Very sure*. Consequently, it would be easier for the respondents to make a proper assessment reflecting their actual perceptions. Based on the literature review, there were various sizes of the Likert scale used by researchers; each would depend on the purpose of the study. For instance, Byrne (2010) has suggested that if the number of categories of data and the answer are much closer to a normal distribution, either ordinal or scale data can be used. Furthermore, a wide range of categories can improve the reliability of the items in the questionnaire (Kanji 1998) and enable the respondents to make better discrimination (Turkyilmaz & Ozkan, 2007, Fornell et al., 1996).

3.4.2 Measurement based on Diabetes Mellitus Awareness Model (DMAM)

Data were collected using a self-reported questionnaire that measured five constructs and demographic information. The questionnaire was designed to measure the factors influencing awareness of diabetes mellitus among Malaysians. The

respondents were required to provide answers for all items measuring each construct. The feedback provided was used only for scientific research. Generally, being abstract, the questions of the factor influencing awareness could not be measured directly.

All the examined criteria in this study formed the latent factors (latent variables). The factors were knowledge of diabetes, attitude towards the disease, the environment surrounding diabetes, symptoms of diabetes and awareness of the disease. Each of these variables were measured. In short, the items in the questionnaire were indicators representing the latent constructs (Byrne, 2010).

The questionnaire had two main sections. Section 1 referred to demographic information of respondents such as age, gender, race, educational level, marital status, employment status, and personal and family history of diabetes. Section 2 was related to the responses from the respondents to obtain data in the study and is further divided into five sub-sections, Part B–Part F (see Table 3.1).

Table 3.1 Diabetes Mellitus Awareness Model (DMAM) Questionnaire

	Part	Item	No. of Items
Section 1	Part A Demographic Information	Gender	1
		Age Group	1
		Race	1
		Education Level	1
		Occupational Level	1
		Income	1
		Marital Status	1
		BMI	1
		Having DM	1
		Knowing DM	1
		Relative Having DM	1
Section 2	Part B-F Respondents' Perceptions	Part B – Knowledge	40
		Part C – Attitude	12
		Part D – Environment	9
		Part E – Symptoms	9
		Part F – Awareness	12

In Part A, respondents were asked to provide demographic information about themselves (11 items). In part B, respondents were requested to respond to an assessment of their knowledge about diabetes mellitus (40 items). Part C assessed the respondents' perceptions on attitude towards diabetes mellitus (12 items) whereas Part D assessed the environment surrounding the disease (9 items). Meanwhile, Part E

examined the symptoms of diabetes mellitus (9 items) and Part F examined respondents' awareness of the disease (12 items). Tables 3.2 to 3.6 show the items in the questionnaire of DMAM. The full questionnaire is provided in Appendix A of this thesis.

Table 3.2(a) Items measuring the construct of DM Knowledge: general knowledge.

Construct	Item Label	Item
General Knowledge of Diabetes Mellitus	GK1	a. Diabetes is a condition of the high level of sugar in the blood.
	GK2	b. Diabetes is a condition of insufficient insulin production.
	GK3	c. Diabetes is a condition of the body not responding to insulin.
	GK4	d. Diabetes is non-contagious.
	GK5	e. Diabetes is incurable.
	GK6	f. Insulin is a hormone in the body that is produced by the pancreas.
	GK7	g. Insulin can decrease blood sugar level.
	GK8	h. Insulin is required for some diabetic patients.
	GK9	i. Diabetic patients should not donate blood.
	GK10	j. Pregnant women are at high risk of GDM (gestational diabetes mellitus) during the first pregnancy.
	GK11	k. GDM disappears after childbirth.
	GK12	l. Women who have had GDM are at risk of developing Type 2 diabetes in the future.
	GK13	m. Untreated GDM can pose a risk to the child in the womb.

Table 3.2(b) Items measuring the construct of DM Knowledge: risk factor.

Construct	Item Label	Item
Risk Factor of Diabetes Mellitus	KR1	a. Diabetes can occur when consuming food with high-sugar content.
	KR2	b. Diabetes can occur when consuming food with high-carbohydrate content.
	KR3	c. Diabetes can occur when consuming food with high-fat content.
	KR4	d. Diabetes can occur due to lack of consistent physical activity.
	KR5	e. Diabetes is a high risk when having a family history of diabetes.
	KR6	f. Obesity can lead to diabetes.
	KR7	g. Diabetes can occur due to excessive alcohol consumption.
	KR8	h. Smoking can contribute to diabetes.
	KR9	i. Pregnant women are at high risk of developing diabetes.

Table 3.2(c) Items measuring the construct of DM Knowledge: prevention.

Construct	Item Label	Item
Prevention of Diabetes Mellitus	KP1	a. Diabetes prevention can be done through regular exercise/physical activity.
	KP2	b. Diabetes prevention can be done by reducing/weight control.
	KP3	c. Diabetes prevention can be done by adopting a balanced diet.
	KP4	d. Diabetes prevention can be done by stop smoking.

Table 3.2(d) Items measuring the construct of DM knowledge: complication.

Construct	Item Label	Item
Complications of Diabetes Mellitus	KC1	a. Diabetes can lead to blindness.
	KC2	b. Diabetes can lead to eye problem.
	KC3	c. Diabetes can lead to kidney failure.
	KC4	d. Diabetes can lead to heart attack.
	KC5	e. Diabetes can lead to sense of sensation/numbness in arms and legs.
	KC6	f. Diabetes can lead to amputation of limbs.
	KC7	g. Diabetes can lead to hypertension.
	KC8	h. Diabetes can lead to stroke.
	KC9	i. Diabetes can lead to sexual impotence.

Table 3.2(e) Items measuring the construct of DM Knowledge: treatment.

Construct	Item Label	Item
Treatment of Diabetes Mellitus	KT1	a. Diet is a treatment of diabetes.
		b. Exercise/physical activity is a treatment of diabetes.
	KT2	c. Diabetes can be treated with oral antidiabetic drugs .
	KT3	d. Insulin injections are also used for treatment of diabetes.
		e. Monitoring of blood glucose level is important in treatment of diabetes

Table 3.3 Items measuring the construct of Attitude

Construct	Item Label	Item
Attitude towards Diabetes Mellitus	A1	I always maintain an ideal weight/BMI.
	A2	I measure my weight periodically.
	A3	I am willing to have an ideal weight/BMI.
	A4	I practice a balanced diet.
	A5	I can easily change my diet to a healthy diet.
	A6	I exercise at least three times a week.
	A7	I am willing to exercise at least three times a week.
	A8	I lead a healthy lifestyle.
	A9	I do not smoke.
	A10	I enjoy taking fizzy drinks.
	A11	I prefer to take fast food.
	A12	I spend more of my time every day in front of the TV/monitor.

Table 3.4 Items measuring the construct of Environment

Construct	Item Label	Item
Environment Surrounding Diabetes Meliitus	E1	I found my relatives, or my friends have a family history of diabetes.
	E2	I found myself surrounded by those who are obese/overweight.
	E3	I am surrounded by people who are smoking.
	E4	I have friends or relatives who excessively consume alcohol.
	E5	My environment is surrounded by those who practise healthy diet.
	E6	I found myself surrounded by people who often do exercise at least once a week.
	E7	I am surrounded by people who frequently eat fast food.
	E8	I am surrounded by people who regularly consume soft/sweetened drinks.
	E9	I am surrounded by people who regularly perform physical activity.

Table 3.5 Items measuring the construct of DM Symptoms

Construct	Item Label	Item
Symptom of Diabetes Mellitus	S1	I frequently feels thirsty.
	S2	I urinate frequently.
	S3	I experience weight loss despite normal appetite.
	S4	I am often tired or weak.
	S5	I often feels dizzy.
	S6	I experienced a blurriness of vision.
	S7	I experience rapid breathing.
	S8	I often feels hungry.
	S9	My wound heals slowly.

Table 3.6 Items measuring the construct of DM Awareness

Construct	Item Label	Item
Awareness of Diabetes Mellitus	AW1	I realize that diabetes is worsening.
	AW2	I have a family history related with diabetes.
	AW3	Diabetes can be prevented by leading a healthy lifestyle by adopting a balanced diet.
	AW4	Diabetes can be prevented by leading a healthy lifestyle by exercising regularly.
	AW5	Long-term complications of diabetes can be prevented.
	AW6	Diabetes can be treated.
	AW7	Diabetes is recognized as a chronic disease.
	AW8	I realize the need to control my weight regularly.
	AW9	I always monitor my blood glucose level.
	AW10	Diabetes can occur during the first pregnancy.
	AW11	There are three types of diabetes.
	AW12	Diabetes can affect both children and adults.

Assessment of the items (Table 3.2–Table 3.6) was based on the levels of knowledge, attitude, environment, symptoms and awareness of diabetes mellitus in Part B–Part F. Respondents were required to choose one answer for each question from a scale based on the statement on their perception. Respondents were also provided with general guidance in answering the questionnaire by reminding them to give an honest answer in evaluating each statement in the questionnaire and not to rush in providing their responses to the items.

3.5 Pre-Test

After the development of the questionnaire, a pre-test should be conducted, which is generally a small-scale study before making the actual study (Anderson, 1998). In addition, the pre-test also aimed to assess the reliability and validity of the questionnaire. After the reliability and the validity of the questionnaire had been assessed, the questionnaire was modified from the original format. The pre-test was also used to estimate the time required for the participants to complete the questionnaire and to examine the process of choosing the participants.

Therefore, a pre-test was conducted to evaluate or validate the instrument, in which a cross-sectional research design was used. This pre-test aimed to identify the

instructions and items that were not clear to the respondents so that in the actual study, the items in the questionnaire administered could be fully understood. Anderson (1998) suggested that the number of participants in the pre-test should be within the range of 6–12 people, which should be effective for early feedback that should be considered before the actual study.

A total of 27 respondents were involved in the pre-test. The findings of this pre-test would also be fundamental to the process of improving the questionnaire of DMAM. The average time taken by the respondents to complete the questionnaires in the pre-test was approximately 25-30 minutes. Respondents who were unclear about any statement or item in the questionnaire were given the opportunity to ask the present researcher for further clarification. All significant matters that had arisen during the pre-test were taken into consideration towards the refinement process of the items in the questionnaire to be used in the actual study.

3.5.1 Content Validity

A crucial aspect of a research is the validity of the instrument used (Hair et al., 2010; Sidek, 2002; Sidek & Wan Marzuki, 2007). Generally, the validity of the instrument measures what is to be measured by the researcher (Bollen, 1989). Hair et al. (2010) have stated that the validity of a measure could represent the concepts studied, and to ensure the validity of an instrument, a deep understanding of the measurement is required so that the measure is right. In this regard, Sekaran (2006) has asserted that a sufficient measure is one that can be represented by a number of items to explain a concept which acts as a function of the measure construct outlined.

There are several types of validity in research that involves the usage of an instrument or questionnaire to obtain the data. In the present study, the content validity was evaluated by the experts in the field. Questionnaire in this study was adapted from the questionnaire that had been administered in the previous studies (see Shriraam et al., 2013; Al-Sarayra & Khalidi, 2012; Sagaran & Srinivasan, 2014) and has been enhanced by several researchers. In addition, the questionnaire was referred to two experts, a medical officer and Head of Quality Assurance, Centre for Educational Development, Universiti Kebangsaan Malaysia (UKM). Comments and recommendations made by the

experts were considered in the process of improving the items in the instrument before the actual research. Therefore, the questionnaire used had gone through assessment of face validity and content validity. Although Hair et al. (2010) have suggested that there is no difference between the face validity and content validity, Sekaran (2006) has argued that the content validity would be more important than the face validity. Hence, both types of validity were assessed in the present study.

Bollen (1989) suggested that construct validity can be assessed empirically from the confirmatory factor analysis (CFA), which can be done by looking at whether there are items that are also an indicator of other constructs. If this case occurs, then the construct validity is low. This also means that the validity of the constructs can be measured through the items that were used. Furthermore, convergent validity is related to construct validity. The factor loading which is regressed to the latent constructs that exceeds the value of 0.70 implies that the items of the factor are involved in these constructs. In order to verify that any latent constructs would be different from each other, the discriminant validity must also be tested empirically (Bollen, 1989).

3.5.2 Reliability

The analysis may also provide information about the reliability of the instrument. Reliability can be defined as the consistency in measurement (Anderson 1998; Hair et al., 2010; Sidek, 2002; Sidek & Wan Marzuki, 2007). Meanwhile, Sekaran (2006) has defined reliability as a measure without error that guarantees consistent measurement over time in the instrument and noted reliability as a measure of the stability of the measurement device. Additionally, the Cronbach alpha coefficient which is the most widely used reliability coefficient by most researchers (Hair et al., 2010; Sekaran, 2006), is used to determine the internal consistency of the assessment (Hair et al., 2010). The aim is to ensure that the questionnaire has good reliability coefficients before distributing it to the respondents.

The reliability coefficients were within the range of 0 to 1. There are various cut-off values of the coefficient that would be acceptable in a study. Nunnaly (1978) has stated that reliability coefficient as low as 0.50 could still be acceptable; however, Sekaran (2006) has recommended higher value as better or more reliable while Hair et

al. (2010) have suggested that coefficients with values of 0.70 and higher would generally be acceptable.

3.6 Data Collection

The sample population involved in this study comprised of Malaysian adults who were attending the Outpatients' Department at Klinik Kesihatan Paya Besar dan Klinik Kesihatan Padang Rumbia in Pahang from 1st September 2015 to 15th October 2015. The participants in the actual study were those who fulfilled the inclusion criteria and were not the same respondents in the pre-test. The purpose of this study had first been explained to the participants and they had also been informed of their rights to refuse to participate or withdraw from the study should they decide to discontinue participating in the study. The completed questionnaires were returned directly to the present researcher. Some of respondents were unable to read the questionnaire by themselves as they did not bring their reading glasses with them; hence, the present researcher provided assistance to them in answering the questionnaire during the survey.

3.7 Statistical Analysis Techniques

The preliminary statistical techniques used in data analysis are the exploratory data analysis (EDA) and descriptive analysis.

3.7.1 Exploratory Data Analysis (EDA)

The first step carried out after the completion of data collection was to screen all the characteristics that are included in the instrument. Data screening and preliminary analysis were done through EDA, in which the data were partitioned for some features such as outliers, common method variance (bias) normality and correlation analysis.

3.7.1.1 Outliers

The data outlier analysis was conducted in order to identify the possibility of the presence of outliers. The outliers refer to data that have unique values which are totally different from other data. In addition, an outlier is also an extreme response to a

particular question or extreme responses to all questions (Hair et al., 2014). Therefore, it is essential to identify outliers to obtain high-quality output, which is to find the data whose values might be biased to the model (Field, 2009). In the present study, the presence of outliers was detected using Mahalanobis distance (Filzmoser, 2005) which referred to outliers that showed Mahalanobis distance values greater than the critical value of chi-square (x^2 = 82.72, df = 47, p < 0.001) which are removed from the data set.

3.7.1.2 Common Method Variance

Several studies have noted that common method variance (CMV) is also a potential issue in behavioural research because of the main source of measurement error (Podsakoff et al., 2003). CMV is a potential source that can be used to identify the error in the quantitative study (Podsakoff et al., 2003). There are a variety of techniques that can be used to detect and control any possible CMV; the commonly used method is the post-hoc Harman's single-factor test as recommended by Chang et al. (2010). Therefore, Harman's single-factor test was employed in this study. The Harman's single-factor test is among the most broadly used methods to check whether there is a single factor in the data that is largely attributed to only a variance (Chang et al., 2010). CMV occurs when a construct is describing most of the covariance among all constructs (Podsakoff et al., 2003). In addition, high correlations (r > 0.90) among the latent constructs are the indication of common method variance in the data (Bagozzi et al., 1991).

3.7.1.3 Normality

Examining the assumption of data normality is a requirement by most statistical methods, and this can be achieved by using parametric statistical analysis to assess the assumption of data normality. If the assumption of normality is violated as stressed by Henseler et al. (2009), the interpretation and inference may not be valid and reliable for the parametric test (Razali & Wah, 2011). The most common methods for normality testing in statistical software are Kolmogorov-Smirnov (KS), Shapiro-Wilk (SW), Anderson-Darling (AD) Test, and Lilliefors (LF) test (Razali & Wah, 2011). In the present study, KS and SW statistical analyses were employed to determine the data normality.

3.7.1.4 Correlation Analysis

Correlation is the covariance standards that indicate the strength and direction of the relationship between two random variables (Hair et al., 2010). Pearson correlation coefficient is typically used to measure the degree of correlation, and its value is in the range from -1 to +1. Generally, the items in the same construct should correlate at least in the range ±0.35 (Karuthan, 2009). If this does not happen, the item may be removed from the construct. In addition, if the correlation between items or between latent constructs is more than 0.90, this means that there is repetition within the meaning of item or its latent construct and it does not provide discrimination towards the meaning of the item or its latent construct. This condition is known as multicollinearity. Therefore, items or their latent constructs can be checked or removed in a subsequent analysis. If a researcher maintains the item or latent constructs parallel to the underlying theory, the interpretation of the causal relationship in the modelling analysis should be made carefully to avoid misinterpretation in assessing the causal relationship.

3.7.2 Descriptive Analysis

Before further data analysis is made, the data should be checked by descriptive analysis regarding the central tendency measures and dispersion measures (Sekaran, 2006; Suhr, 2002). It is important to get an early description of how the respondents answered the items in the questionnaire (Sekaran, 2006). Researchers can use either the summative scores or the mean scores for each of the construct that has been studied. For example, in the present study, the researcher used the mean scores to represent five parts of the knowledge construct. The five parts of knowledge construct are general knowledge of diabetes mellitus, the risk factor of diabetes mellitus, prevention of diabetes mellitus, complications of diabetes mellitus and treatment of diabetes mellitus. The descriptive analysis could be done because each set of indicators was used to represent a construct act collectively in defining the respective latent constructs (Hair et al., 2010).

3.8 Structural Equation Modelling (SEM)

In the present study, an advanced statistical modelling technique known as the structural equation modelling (SEM) was employed to examine the interconnectedness

between knowledge, attitude, environmental and symptoms factors and DM awareness in the form of causal relationships. In the past, the types of analysis commonly employed to examine the relationships between diabetes awareness and its determinants had mostly been on correlation analysis and multiple regression analysis. These two types of analysis have some weaknesses. For instance, the former merely provides evidence of an association between two variables; however, it cannot determine nor verify whether the relationship is causal. Meanwhile, although the latter may be able to possibly explain causal relationships among several variables, the causal effects cannot be established directly and indirectly. In this regard, SEM is superior compared to these two analyses because it is able to simultaneously estimate and test both direct and indirect causal effects. Therefore, SEM provides a better alternative to understand and explain the mechanism of the effects of multiple factors on DM awareness.

Structural equation modelling (SEM) was applied in order to answer the research questions in this study. SEM enables researchers to find the direct or indirect estimation between one or more independent and dependent variables (Ullman, 2001). In addition, SEM is also known a statistical methodology to analyse a structural theory bearing on some phenomenon through confirmatory (hypothesis-testing) approach (Byrne, 2009). It is a multivariate statistical analysis technique that takes a 'validation' in hypotheses testing in a built theory in research (Buhi et al., 2007; Byrne, 2010; Tolbert & Stephenson, 2002; Suhr, 2002). It is also a collection of statistical models that describe the relationships between several variables (Hair et al., 2010; Shah and Goldstein, 2006) by allowing researchers to hypothesise the relationships and taking into account the measurement error in the estimation (Bollen, 1989; Byrne, 2010). In other words, SEM is a multivariate method for researching the cause-effect relationship between the variables studied (Chua, 2009; Schumaker & Lomax, 2004). Other than that, SEM is also a mixture between two techniques of multivariate factor analysis and multiple regression analysis involving both latent constructs and variables observed in an analysis (Hair et al., 2010).

Latent variables cannot be measured directly from the respondent but may be delegated by several indicators or statements, known as observed variables, in the questionnaire that are used to represent a concept or construct. These latent constructs can be measured indirectly by looking at the consistency between the various

observable variables; the use of which can improve better theoretical concepts to reduce measurement error and improve the statistical estimation of the relationship between latent variables with regards to measurement error (Hair et al., 2010).

In SEM, each of the indicators' contribution in latent constructs can be determined. This is closely linked to the validity and reliability evaluation of the construct understudied. After a preliminary analysis such as construct validity and reliability are met, the discussion regarding the relationship between each of the constructs in the model can be done. Moreover, the dependent variable, also known as endogenous variable, is a latent construct that is asscociated with specific constructs. Meanwhile, the independent variables, also known as exogenous variables, are not associated with any other latent constructs in the model, unlike the endogenous variable(s).

There exist two types of the measurement scale in SEM that are known as formative and reflective. The indicators that cause the latent variables and are not interchangeable among them are called the formative measurement scale. Generally, this type of indicators could have a positive, negative or having no correlation at all among them (Haenlein & Kaplan, 2004; Petter et al., 2007). Thus, it will be meaningless to report the outer loadings, square root of average variance extracted (AVE) and composite reliability for a latent variable as it is made up of completely different and uncorrelated measurement if a formative measurement scale is used. Furthermore, for formative model, some of the analyses such as internal consistency, indicator loading and discriminant validity seem to be unreliable.

By contrast, the reflective measurement scale is used if the indicators studied are showing a high correlation and are interchangeably with each other; hence, it is compulsory to thoroughly examine their reliability and validity (Hair et al., 2014). Henceforth, their outer loadings, composite reliability, AVE and its square root should be examined and reported.

3.8.1 Confirmatory Factor Analysis (CFA)

A confirmatory factor analysis (CFA) was carried out to measure the construct validity of the instrument that measured the knowledge on diabetes, attitude towards the

disease, environment surrounding diabetes, symptoms of the disease and awareness of diabetes. However, to use CFA, a researcher needs to have a strong background theory on the latent variables structure (Byrne, 2010; Siti Aishah & Kaseh, 2008), which means that the scale of measurement used by researchers in past studies would need to be carefully understood (Green & Pearson, 2004; Peng et al., 2008).

CFA is a technique in which the focus is on the relationship between the factors and the items in questionnaire (Byrne, 2010; Hair et al., 2014). It evaluates how the items measure the construct that has been set (Hair et al., 2014; Hair et al., 2010). This is crucial as it is a part of the construct validity process involving the convergent validity and divergent validity (Courvoisier et al., 2008; Rahim & Magner, 1995; Schmidt et al., 2005).

Schumaker and Lomax (2004) have suggested that exploratory factor analysis (EFA) should be conducted if there is no strong theoretical basis with regard to the measurement model proposed and recommended the 4-step modelling technique. However, in the present study, the 2-step modelling technique was used, in which the testing of the measurement model had been made prior to the testing of the structural model. CFA needs to be conducted in order to assess the construct validity (convergent validity, divergent validity, and discriminant validity). Although the reliability coefficient is important and produces good value, it does not guarantee that a construct is measured precisely (Hair et al., 2010). Hence, it is vital for the assessment of all criteria of construct validity. As asserted by Hair et al. (2010), the combination of CFA and construct validity results would produce a robust model and also provide a better comprehension regarding the quality measures. The measurement model should be in satisfactory level before the study could proceed to the structural model measurement which would measure the significance between the constructs (Fornell & Larcker 1981).

In addition, according to Fornell and Larcker (1981), the value of average variance extracted (AVE) should be greater or higher than the square of the correlation between all the constructs studied for the discriminant validity to be valid. This correlation has also shared the variance with the other latent constructs. As suggested by Fornell and Larcker (1981), the very first step is the calculation of construct reliability or composite reliability (CR) and variance extracted using the following expressions:

$$\text{Composite Reliability, CR} = \frac{\left(\sum_{i=1}^{p} \lambda_i\right)^2}{\left(\sum_{i=1}^{p} \lambda_i\right)^2 + \sum_{i=1}^{p} \varepsilon_i}, \qquad 3.1$$

where,

λ_i = loading standard, ε_i = measurement error

$$\text{Average Variance Extracted, AVE} = \frac{\sum_{i=1}^{p} \lambda_i^2}{\sum_{i=1}^{p} \lambda_i^2 + \sum_{i=1}^{p} \varepsilon_i}, \qquad 3.2$$

with,

λ_i^2 = loading squares, ε_i = measurement error

Therefore, to verify the constructs in this study, the CFA approach was used.

3.8.2 Partial Least Squares Structural Equation Modelling (PLS-SEM)

Partial least squares (PLS) estimation is a technique that can be used to overcome some of the constraints of data distribution such as the normality and the possible multicollinearity between latent constructs. PLS estimation has gained the attention of many researchers (Barclay et al., 1995; Hair et al., 2010; Henseler et al., 2009) and is said not be influenced by the presence of outliers (Habshah & Azmi, 2006). Therefore, the PLS is the technique of multivariate statistical analysis which assesses the outer (measurement) and inner (structural) model simultaneously (Sang et al., 2010). PLS estimation is also more oriented towards estimating application or predictive modelling predictions (Barclay et al., 1995; Kline, 2011) and more suitable if the sample size is small (Kline, 2011). It has also been noted that this modelling technique is more appropriate towards the development of theory rather than an emphasis on the theory in developing a model. The advantages of using SEM can be summarised as follows:

i) Small sample size (Hair et al., 2010).
ii) The normality assumption of the sample data is not required (Fornell et al., 1996).
iii) Can handle reflective constructs and formative constructs despite having only one item.
iv) The analysis is based on the variance that is oriented towards predictive aspects or forecasting model (explanation of variance).
v) PLS technique can manage the multicollinearity issue (Grewal et al., 2004; Inkpen & Birkenshaw, 1994; Manpreet, 1982; Norliza et al., 2006; Westlund et al., 2008) where this technique is distribution-free, which is independent of the distribution assumptions (independence) between each other in the independent variable (Gefen et al., 2000).

There are two stages in measuring PLS models: 1) measurement model (item reliability, internal consistency, convergent validity and divergent validity); 2) assessment of the structural model (the relationship between each variables and its significance are measured) (Barclay et al., 1995). The process of evaluating the measurement model and the structural model in the present study used the method which had been implemented by other researchers in past studies (see Barclay et al., 1995;, Chen & Tsou; 2007; Ismail et al., 2011; Luo et al., 2006; Rouibah et al., 2011; Sang et al., 2010; Sattler et al., 2010; Turkyilmaz & Ozkan, 2007; Volckner et al., 2009). In the present study, SmartPLS version 3.0 was used in data analysis.

3.8.3 Measurement Model (Outer Model) Assessment

The first set of analyses examined the measurement model (outer model). The measurement model assessment was performed to demonstrate how the indicators would load on the theoretically-defined constructs and to evaluate whether the indicators correctly measure the theoretical constructs. Thus, the assessment was conducted to ensure and confirm the reliability and validity of the instrument.

Moreover, this CFA technique was employed to test the measurement model (or outer model) in order to determine how the indicators would fit with the theoretically defined construct or variable (Hair et al., 2014). It was performed to ensure that

questionnaire had been measuring what it was supposed to measure and thus affirm the reliability of the instrument used. Smart PLS version 3.0 was used with the application of bootstrapping, composite reliability (CR) and average variance extracted (AVE) to measure the significance of the factor loadings. Bootstrapping is a method where the samples are being resampled repeatedly by computer-based program following to the omission distance value chosen by drawing the sample again randomly from the population studied (Kline, 2005).

The steps required in the measurement model assessment include the calculation of reliability and validity values. The factor loading would be essential in assessing the measurement model (outer model). The value of the factor loading would show the reliability of the item studied. As suggested by Barclay et al. (1995), the value must be more than 0.707. A model would be considered fit if it passed the composite reliability (CR), convergent validity and divergent validity. For validity model, CR value must be more than 0.70 (Fornell & Larcker, 1981).

Furthermore, the model would fulfil the convergent validity test when the AVE value is equal or more than 0.50. Each of the factor loadings in PLS analysis would have its own factor loading and cross-loading values towards other items or factor loadings. Through this, the cross loading analysis would support divergent validity as each factor loadings should have better or strong values toward its own factor loading (higher value towards itself) compared to its value towards other loadings. In addition, each and every square root of AVE of a latent construct should have higher value than the correlations with all other latent constructs in fulfilling proper discriminant validity. This means that each latent construct should share more variance with its own indicators compared to other indicators.

3.8.3.1 Internal Consistency

Internal consistency is the reliability of the construct. In the present study, the reliability or internal consistency was measured using the Cronbach alpha and CR (Henseler et al., 2009). The values of the Cronbach alpha would determine how good the indicators or items measuring the construct studied (Cronbach, 1951, Gotz et al., 2010) and also measuring the interrelationship reliability of items towards variables (Milone, 2010). It has suggested that the Cronbach alpha value should be 0.60 or higher

for it to be considered as reliable and adequate for further analysis (Nunnally & Berstein, 1994).

However, CR has been outperforming Cronbach Alpha to be better estimation for internal consistency analysis in PLS-SEM (Gotz et al., 2010). Yet, only reflective indicators can be measured through composite reliability in PLS-SEM. Its value range is from 0 to 1. The higher the value of CR, the better the reliability estimation would be. The acceptable and adequate value for CR is 0.70 or higher (Fornell & Larcker, 1981; Hulland, 1999; Hair et al., 2010).

3.8.3.2 Indicator Reliability

Indicator reliability for each item signifies whether the measurement of each indicator is consistent or reliable. The individual reflective indicator reliability is determined through factor loadings to the specified latent constructs. Individual indicator reliability is sufficient when the factor loading is equal to or more than 0.70. This indicates that 50% or more of the variance is being explained by the indicator towards the construct compared to other construct (Gotz et al., 2010; Henseler et al., 2009; Chin, 1998). Therefore, it can basically be explained that the greater the value, the greater the reliability of the indicator (Gerbing & Andeson, 1988). However, weak loadings are observed when newly developed scales are being used (Hulland, 1999). Thus, to establish the significance and the relative importance of the factor loading of each reflective indicator, the present study used the guidelines recommended by Hair et al. (2010). Hence, only indicators with loadings higher than 0.70 would be considered as acceptable in modelling process. Items with indicators reliability below 0.70 would be considered to be removed. In this regard, the removal of the low loading indicators must be done in order to provide better composite reliability (Henseler et al., 2009). In this process, two analyses were carried out by the Smart-PLS software: (1) the assessment of the outer model to determine the indicator factor loadings, (2) the 5000 samples bootstrapping procedure. These were performed in order to generate the standard error and *t*-values for each indicator.

3.8.3.3 Construct Validity

Certain indicators may be specifically examined by checking the corresponding cross loading and factor loading to construct validity the indicators itself. It has been recommended by Hair et al. (2011) that loadings higher than 0.50 or higher are considered as significant.

3.8.3.4 Convergent Validity

Convergent validity is also analysed in the measurement model. According to Henseler et al. (2009), convergent validity is the degree of which the multiple indicators used to measure a variable is in agreement. It has been noted that if all of factor loadings are significant, then the convergent validity has been fulfilled (Anderson & Gerbing, 1988; Gefen & Straub, 2005).

Convergent validity is measured through AVE (Fornell & Larcker, 1981). The AVE calculates the variance captured by the indicators relative to measurement error and the value must be 0.50 or more for AVE to be considered as acceptable and adequate. It indicates that the variable or the latent construct is accountable for 50% of the variance of its own items (Fornell & Larcker, 1981; Henseler et al., 2009; Chin, 2010).

3.8.3.5 Discriminant Validity

Discriminant validity can be defined as the extent that the items would be able to discriminate the constructs or assess and determine distinctively divergent concepts. Hence, discriminant validity is also known as divergent validity. This type of validity assessment is performed by examining the possibly overlapping variables that may have measured the same thing (Fornell & Larcker, 1981) and further verify that the variables are truly measuring different concepts. Hence, the AVE for each of the construct should have greater value compared to the square of the correlation between its own construct or other constructs studied (Christmas, 2005). A good research model that fulfils the discriminant validity test is a model where all of the square roots AVE are indicating greater values than the correlation between constructs (Fornell & Larcker, 1981).

Meawnhile, it has been noted by Henseler et al. (2014) that the use of heterotrait-monotrait ratio of correlations (HTMT) would establish a more robust result of discriminant validity tests. HTMT imposes a more stringent criterion in measuring discriminant validity and it is proven through simulation that it predicts the discriminant validity better than the Fornell and Larcker criterion.

3.8.4 Structural Model (Inner Model) Assessment

The second set of analyses in PLS-SEM assessed the structural model. Assessment of the structural model refers to measuring the relationship between the constructs studied. To analyse the structural model, path coefficients, coefficient of determination (R^2), effect size (f^2) and predictive relevance (Q^2) were determined.

a. Path Coefficients

A model is evaluated in terms of magnitude, sign (i.e., positive or negative), significance (*t*-test) and interpreted in the form of the regression analysis and equivalent to the standardized beta weight (β) (Henseler et al., 2009). The strength and direction of the causal links of the latent constructs in the model are explained by the path coefficients. The path coefficients that do not correlate with the theory studied means that they do not support the hypotheses.

In the present study, bootstrap sampling procedure was applied to determine the significance of the path coefficients by using *t*-statistic. Bootstrapping is an approach to determine and measure the precision of path coefficient or the PLS-SEM estimation. The data was run with 5000 bootstrapping samples in this study with the same number of cases as the original sample provided earlier.

In addition, SEM is used in order to measure the relation between some of the equations in the model through the structural model by showing a causal relationship between the variables or constructs. This includes path coefficient approximation that shows the strength of the hypothesised relationship of exogenous variables towards endogenous variables and the value of R^2 that determines the power of predictive models. In other words, the variance of an exogenous variable is explaining the endogenous variables. In PLS, the variance explains the importance of the R^2 value and

path coefficients, and its significance of each correlation between the constructs is an indicator of fit or suitable model (Barclay et al., 1995; Gefen et al., 2000; Hansmann & Ringle, 2005). In this case, the path coefficient is crucial in assessing the inner model. To assess the significance of path coefficients, bootstrapping methods are used, in which the process is done through a sampling of the sample used. Then, the *t*-values are used to determine the level of significance of each correlation between the latent variables in the research model.

3.8.4.1 The Coefficient of Determination (R^2)

The Coefficient of Determination (R^2) is commonly employed in assessing and predicting the structural model accurately. This coefficient is expressed as the squared correlation among the predicted latent constructs and the actual values (Hair et al., 2013, 2011). The R^2 values range from 0 to1 with higher R^2 values as better and more accurate predictive indicators of the endogenous variables (Hair et al., 2013). According to Hair et al. (2013), the strength of the R^2 value can be divided into three categories: "substantial (R^2 = 0.75), moderate (R^2 = 0.50) and weak (R^2 = 0.25)" whereas Henseler et al. (2009) have suggested that 0.67 for high, 0.33 for moderate, and 0.19 for weak R^2 values, respectively. Meanwhile, Cohen (1988) has recommended that R^2 values for substantial (R^2 = 0.26), moderate (R^2 = 0.13) or weak (R^2 = 0.02) for endogenous latent variables as a general rule of thumb.

3.8.4.2 Effect Size (f^2)

Another crucial aspect in model assessment is the effect size (f^2) analysis, which is conducted to determine the changes in R^2. This is done to identify and determine if any of the latent constructs would have a practical impact on the study that is conducted (see Cohen, 1988). The effect size, f^2, is calculated by omitting specific exogenous variable and in order to determine whether the construct omitted has any impact on the endogenous construct or R^2 changes. Cohen (1998) has recommended that the effect size can be considered large if the f^2 is 0.35, medium if f^2 is 0.15 and small if the f^2 is 0.03. According Vinzi (2010), the formula to calculate the effect size is as follows:

$$R^2 = \frac{R^2 included - R^2 excluded}{1 - R^2 included} \qquad 3.3$$

Where R^2 included and R^2 excluded are the R-squares provided on the dependent latent variables when the predictor latent variable is used or omitted in the structural equation, respectively.

3.9 Summary

This chapter has described the methodology of the present study. The theoretical model was evaluated using quantitative approach by distributing questionnaire in a survey in order to test the proposed hyphotheses in DMAM. This chapter has also outlined the procedures of data collection and the sampling design described which used convenient sampling. In addition, the instrument and its measurements have also been discussed. The instrument was adapted from multiple sources to measure latent constructs representing five constructs in the DMAM. The description also included the techniques and statistical analyses used in this study comprising descriptive statistics, EFA, CFA, SEM and PLS estimation. Data analysis is presented in Chapter 4.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the analysis of latent constructs used in the questionnaire for Diabetes Mellitus Awareness Model (DMAM) and discusses the results. The preceding chapters have identified five latent constructs of DMAM that are supported from the literature reviews and based on the views of experts on diabetes mellitus in Malaysia. This chapter presents the findings beginning with the descriptive analysis of each construct. This is then followed by the construct reliability analysis and structural equation modelling (SEM), which involves the relationship between the constructs as expressed in the objectives and the framework of the study.

4.2 Profile of Respondents: Demographic Data Analysis

The study was held at two Ministry of Health (MOH) health clinics, namely, Klinik Kesihatan Paya Besar in the district of Kuantan and Klinik Kesihatan Padang Rumbia in the district of Pekan, Pahang. The results were analysed using Partial Least Squares-Structural Equation Modelling (PLS-SEM) technique. This approach focuses on modelling predictions (predictive modelling) and provides added value to the analysis. These questionnaires had first gone through a cleaning process that involved incomplete questionnaires or questionnaires that had missing details of demographic data such as age, weight, and height.

From the total number of 550 questionnaires distributed, 523 (95.1%) were returned by the participants to the present researcher and this response rate was considered as very satisfactory. However, only 441 valid questionnaires were used for

the analysis stage as described previously. Of the 441 respondents, 172 (39.0%) were male and 269 (61.0%) were female. Regarding age group, the age range of 18-30 is the class mode for this study. In addition, 131 participants were in the 31-40 age group, 73 in the 41-50 age group, 35 in the 51-60 age group, and 13 were above 60 years of age. A huge majority of the respondents were Malays (426, 96.6%). The remaining were of Chinese, Indian and other ethnic compositions (15, 3.4%). The participants' level of education ranged from primary level (15 participants), secondary level (230 participants), tertiary level (165 participants) and vocational/technical level (31 participants). More than half of the respondents were either employed or self-employed (270, 61.22%) while nearly a quarter of them were either housewives or students (121, 27.44%). A small fraction of the respondents were either unemployed or retired (31, 7.03%). Meanwhile, less than five percent (19, 4.31%) of them indicated that fell into the category of others.

As for the income, more than half of the respondents (274, 62.13%) earned less than RM2000 per month. Nearly one-third of them (138, 31.29%) had monthly income in the range of RM2001-RM5000. Meanwhile, those who earned more than RM5000 per month accounted for less than 10% of the total number of respondents with 5.90% (26) in the range of RM5001-RM10000, and 0.68% (3) more than RM10000 per month, respectively. Regarding marital status, 297 (67.35%) of the participants were married, 127 (28.80%) were single, and 17 (3.85%) were widower/widow. As for BMI, 202 (45.8%) of the participants had an ideal/normal BMI, 131 (29.71%) were overweight, and 108 (24.49%) were obese.

From the total of 441 respondents, a large majority of them (412, 93.4%) claimed that they did not have diabetes while the remaining 29 (6.6%) admitted that they were suffering from the disease. In addition, more than three quarters of the respondents (375, 85.0%) had knowledge about diabetes mellitus whereas the remaining 66 (15.0%) revealed that they did not have knowledge about the disease. Meanwhile, approximately slightly more than half of them (228, 51.7%) did not have relatives who had diabetes and the other nearly half of them (213, 48.3%) knew their relatives who had diabetes. Table 4.1 shows details of the profile of the respondents by gender, age, race, education level, occupational level, income, marital status, BMI, health status, knowledge about diabetes and information about relative(s) having DM.

Table 4.1 Respondent Profile (n = 441)

	Category	Frequency	Percentage
Gender	Male	172	39.00
	Female	269	61.00
Age Groups	18-30	189	42.86
(year)	31-40	131	29.71
	41-50	73	16.55
	51-60	35	7.94
	> 60	13	2.95
Race	Malay	426	96.60
	Chinese	3	0.68
	Indian	3	0.68
	Others	9	2.04
Education	Primary	15	3.40
Level	Secondary	230	52.15
	Tertiary	165	37.41
	Vocational / Technical	31	7.03
Occupational	Employed/Self Employed	270	61.22
Level	Unemployed/Retired	31	7.03
	Housewives/Students	121	27.44
	Others	19	4.31
Income	<RM2001	274	62.13
	RM2001-RM5000	138	31.29
	RM5001-RM10000	26	5.90
	>RM10000	3	0.68
Marital Status	Single	127	28.80
	Married	297	67.35
	Widower/Widow	17	3.85
BMI	Normal (<25)	202	45.80
	Overweight (25-29.9)	131	29.71
	Obese (>=30)	108	24.49
Having DM	Yes	29	6.6
	No	412	93.4
Knowing DM	Yes	375	85.0
	No	66	15.0
Relative(s)	Yes	213	48.3
Having DM	No	228	51.7

It was found that 23% of the participants obtained the information from health centers as their first level health professional contact in the community. Additionally, 19% of them obtained the information from TV/radio, which suggests that television programs must have portrayed the disease in an accurate and positive light. Another important finding is that 14% of the respondents obtained the information through poster/sticker/leaflets and 12% from their friends/relatives. Furthermore, 11% of them acquired the information from a newspaper/website, 7% from schools, 2% from attending mosques/churches, and 1% from other sources. Figure 5.1 illustrates the percentage of the sources from where the respondents obtained the information on diabetes mellitus.

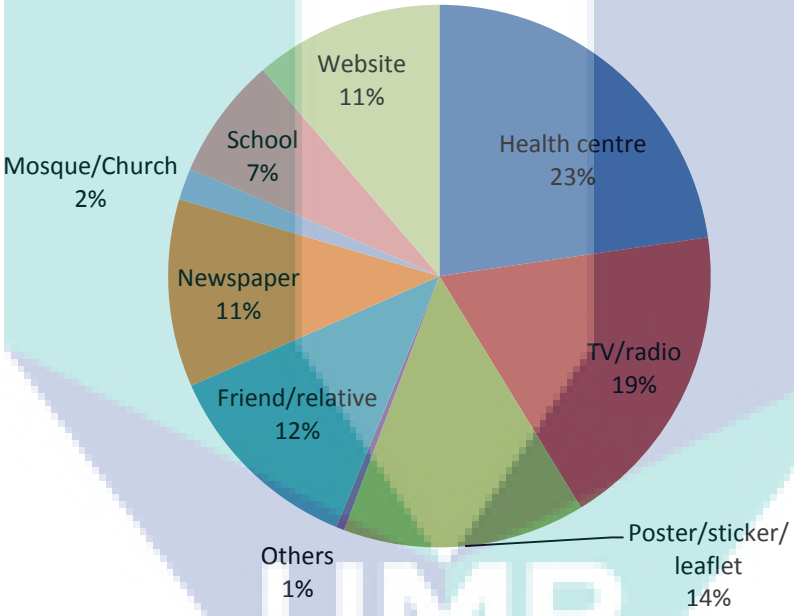


Figure 4.1 Source of Information on Diabetes Mellitus

4.3 Exploratory Data Analysis (EDA)

Exploratory data analysis is conducted on the raw dataset in the process of analysing the data, such as the examination of common method bias, identification of outliers, checking the reliability coefficient and the normality of data distribution. The first process that had been carried out before data analysis began was data screening. This was done to meet the psychometric assumptions that may have influence on the use of data analysis techniques. All the processes were carried out using IBM Statistical Package for Social Science (SPSS) Statistics software version 20.

4.3.1 Outliers Analysis

The analysis of data outlier was conducted to identify the presence of outliers or in other words, data with unique values that were very distinct from the others (Hair et al., 2014). It is crucial to investigate an outlier as it might become an issue (i.e., distort the statistical test) in the next analysis if it happened to be a problematic outlier (Hair et al., 2010).

Data from a total of 523 questionnaires received were entered into IBM SPSS Statistics 20. However, after removing all the data that were missing, only the full dataset from 441 questionnaires are to be considered for the analysis process to enhance the study validity (Rahim & Magner, 1995; Sekaran, 2006). As the statistical approach was a causal analysis, only questionnaires that had been completely answered were considered for the analysis (Hansmann & Ringle, 2005). Next, multivariate outliers were detected using Mahalanobis distance (Filzmoser, 2005). Outliers with Mahalanobis distance greater than the critical value of chi-square (x^2 = 82.72, df = 47, p < 0.001) were removed from the dataset. Finally, after the removal of the outliers, a clean dataset of 378 responses was analysed. Despite the removal of the outliers which caused the total number of valid responses for further analysis to become smaller, the number of sample was still adequate to meet the general criteria for minimum sample size of at least 200 respondents as adopted by most researchers in the practice of SEM analysis. Furthermore, Schumaker and Lomax (2004) have also suggested that the minimum number of sample as low as 150 would be sufficient to conduct SEM analysis.

4.3.2 Common Method Variance

Usually, data that have been collected using a questionnaire are examined using the common method variance (CMV). To avoid bias in the collected data, the respondents are guaranteed that the answers they have given would remain confidential and only be used for research purposes (Barua et al., 2004). However, the data that have been collected from the same group of respondents might be influenced by the social desirability (Podsakoff & Organ, 1986). To overcome this problem, in the present study, the Harman's single factor test was used (Podsakoff & Organ, 1986; Barua et al., 2004).

All the items were pooled together in the exploratory factor analysis (EFA) as shown in Table 4.2.

Table 4.2 Common Method Variance

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.196	19.566	19.566	9.196	19.566	19.566
2	5.180	11.021	30.588	5.180	11.021	30.588
3	3.906	8.312	38.899	3.906	8.312	38.899
4	2.800	5.958	44.858	2.800	5.958	44.858
5	1.934	4.114	48.972	1.934	4.114	48.972
6	1.743	3.709	52.681	1.743	3.709	52.681
7	1.602	3.407	56.089	1.602	3.407	56.089
8	1.265	2.692	58.781	1.265	2.692	58.781
9	1.233	2.623	61.403	1.233	2.623	61.403
10	1.106	2.354	63.757	1.106	2.354	63.757
11	1.011	2.152	65.909	1.011	2.152	65.909
12	1.002	2.132	68.042	1.002	2.132	68.042
13	.866	1.843	69.885			
14	.799	1.699	71.584			
15	.763	1.624	73.208			
16	.742	1.580	74.788			
17	.708	1.505	76.293			
18	.695	1.480	77.773			
19	.653	1.388	79.161			
20	.610	1.297	80.459			
21	.585	1.245	81.703			
22	.560	1.191	82.895			
.	.	.	.			
.	.	.	.			
.	.	.	.			
43	.190	.404	98.739			
44	.172	.366	99.105			
45	.164	.350	99.455			
46	.136	.290	99.745			
47	.120	.255	100.000			

Extraction Method: Principal Component Analysis.

The EFA revealed the unrotated factor solutions of the items in the survey questionnaire. The first factor explained 19.57% of the variance and all others explained less than 11.02%. This indicated that no single factor emerged, and no factor accounted for more than 50% of the variances. Since the unrotated factor solutions did not generate a general factor; therefore, common method variance was not an issue in this study.

4.3.3 Data Normality

Certain multivariate data analysis techniques including regression analysis and SEM would require assessment of data normality. If the normality assumption is not fulfilled, a different technique of data analysis should be employed (Henseler et al., 2009). The present research employed the Kolmogorov-Smirnov and the Shapiro-Wilk

statistical analyses for the data normality test. The Kolmogorov-Smirnov test and Shapiro-Wilk test are designed to test normality by comparing the data to a normal distribution with the same mean and standard deviation as in the sample (Mooi & Sarstedt, 2011). The results of the test of normality are presented in Table 4.3.

Table 4.3 Normality tests

Construct	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig
Knowledge	.034	378	.200*	.990	378	.010
Attitude	.047	378	.047	.994	378	.141
Environment	.089	378	.000	.980	378	.000
Symptoms	.070	378	.000	.980	378	.000
Awareness	.083	378	.000	.988	378	.004

This deviation of the data from normality assumption is a strong reason for using PLS path modelling in this study (Henseler et al., 2009). The significant *p* values were < 0.05. As shown in Table 4.3, the data were not normally distributed as the univariate normality is shows mixed results of non-normality, those for multivariate normality is also not possible. Hence, PLS-SEM analysis was found to be relevant to be adopted.

4.3.4 Multicollinearity

The strong correlation between independent variables is called multicollinearity. The two independent (exogenous) variables are multicollinear if any of the following conditions occur: (1) the correlation value is equal to or greater than 0.90 (Pallant, 2011); (2) the tolerance value is less than 0.20 (Field, 2009); or, (3) the variance inflation factor (VIF) value is equal to or greater than 5 (Hair et al., 2014). Multicollinearity can cause problems in regression analysis when there are two or more independent variables that are measuring the same attribute (Pallant, 2011).

In the current study, the multicollinearity was verified to be non-existent by using IBM SPSS Statistics 20. Table 4.4 shows that the correlations among the independent variables were less than the threshold value of 0.90.

.

Table 4.4 Correlation among Construct

Latent Constructs	Knowledge	Attitude	Environment	Symptoms	Awareness
Knowledge	1				
Attitude	0.291	1			
Environment	-0.013	0.377	1		
Symptoms	0.015	-0.168	-0.172	1	
Awareness	0.585	0.373	0.033	0.050	1

The tolerance and variance inflation factor (VIF) were determined through regression analysis. Table 4.5 presents the tolerance values which were found to be greater than the threshold value of 0.20, and the VIF for each independent variable was less than the threshold value of 5.

Table 4.5 Variance Inflation Factor

Independent variable	Collinearity Statistics	
	Tolerance	VIF
Knowledge	0.895	1.117
Attitude	0.758	1.318
Environment	0.831	1.203
Symptoms	0.956	1.046

Note: Dependent variable: Awareness

The results suggested that no multicollinearity problem existed among the independent variables. Thus, the remaining data analysis could proceed to the next level.

4.4 Descriptive Analysis

In this section, the mean scores of each of the items according to the variables or constructs of DMAM are presented and discussed. These constructs were knowledge, attitude, environment, symptom, and awareness. Generally, based on the indicators in the questionnaire, the value of the mean scores would be indicative of the level of agreement, in which a high value of mean scores would indicate that the respondents agreed to the items. Furthermore, the standard deviations (*SD*) are also reported to identify whether the respondents were in agreement with the items being asked (Norzaidi & Intan Salwani, 2009; Rouibah et al., 2011). Therefore, the descriptive analysis was conducted to obtain a clear indication of the items before proceeding to the modelling process in the next level.

a. Descriptive Analysis of Knowledge

Descriptive analysis showed that the mean score of general knowledge of diabetes mellitus was 3.587 with a standard deviation of 0.526. In descending order, the score of the indicators are as follows: "Diabetes is a condition of high level of sugar in the blood" (4.259); "Diabetes is non-contagious" (4.116); "Insulin is required for some diabetic patients" (3.871); "Insulin can decrease blood sugar level" (3.692); "Pregnant woman at high risk of gestational diabetes mellitus (GDM) during the first pregnancy" (3.664); "Untreated GDM can pose a risk to the child in the womb" (3.649); "Diabetes is a condition of insufficient insulin production" (3.610); "Diabetic patients should not donate blood" (3.469); "Insulin is a hormone in the body that is produced by the pancreas" (3.435); "Diabetes is a condition of the body not responding to insulin" (3.342); "GDM disappears after childbirth" (3.077); "Women who have had GDM are at risk of type 2 diabetes in the future" (3.054); and "Diabetes is incurable" (2.683). Table 4.6(a) presents the descriptive statistics of indicators representing the latent construct of knowledge for general knowledge of DM.

Table 4.6(a) Descriptive Statistics for Knowledge: General Knowledge of DM

Construct	Item Label	Item	Mean	Std. Deviation
General Knowledge of Diabetes Mellitus	GK1	a. Diabetes is a condition of high level of sugar in the blood.	4.259	0.903
	GK2	b. Diabetes is a condition of insufficient insulin production.	3.610	1.061
	GK3	c. Diabetes is a condition of the body not responding to insulin.	3.342	1.052
	GK4	d. Diabetes is non-contagious.	4.116	1.090
	GK5	e. Diabetes is incurable.	2.683	1.185
	GK6	f. Insulin is a hormone in the body that is produced by the pancreas.	3.434	1.075
	GK7	g. Insulin can decrease blood sugar level.	3.692	1.007
	GK8	h. Insulin is required for some diabetic patients.	3.871	0.977
	GK9	i. Diabetic patients should not donate blood.	3.469	1.164
	GK10	j. Pregnant woman at high risk of gestational diabetes mellitus (GDM) during the first pregnancy.	3.664	1.064
	GK11	k. GDM disappears after childbirth.	3.077	1.046
	GK12	l. Women who have had GDM are at risk of type 2 diabetes in the future.	3.054	0.966
	GK13	m. Untreated GDM can pose a risk to the child in the womb.	3.649	1.079

Table 4.6(b) presents the descriptive analysis of the risk factors of diabetes mellitus. The mean score was 3.678 with a standard deviation of 0.597. In descending order, the score of the indicators are as follows: "Diabetes can occur when consuming food with high-sugar content" (4.347); "Obesity can lead to diabetes" (4.043); "Diabetes is a high risk when having a family history of diabetes" (4.009); "Diabetes can occur when consuming food with high-carbohydrate content" (3.766); "Diabetes can occur due to lack of consistent physical activity" (3.757); "Pregnant women are at high risk of developing diabetes" (3.467); "Diabetes can occur when consuming food with high-fat content" (3.322); "Diabetes can occur due to excessive alcohol consumption" (3.268); and "Smoking can contribute to diabetes" (2.989).

Table 4.6(b) Descriptive Statistics for Knowledge: Risk Factors of DM

Construct	Item Label	Item	Mean	Std. Deviation
Risk Factors of Diabetes Mellitus	KR1	a. Diabetes can occur when consuming food with high-sugar content.	4.347	0.809
	KR2	b. Diabetes can occur when consuming food with high-carbohydrate content.	3.766	1.090
	KR3	c. Diabetes can occur when consuming food with high-fat content.	3.322	1.128
	KR4	d. Diabetes can occur due to lack of consistent physical activity.	3.757	0.994
	KR5	e. Diabetes is a high risk when having a family history of diabetes.	4.009	0.937
	KR6	f. Obesity can lead to diabetes.	4.043	0.922
	KR7	g. Diabetes can occur due to excessive		
	KR8	alcohol consumption.	3.268	1.073
	KR9	h. Smoking can contribute to diabetes.	2.989	1.015
		i. Pregnant women are at high risk of developing diabetes.	3.467	1.031

Table 4.6(c) presents the descriptive analysis of the prevention of diabetes mellitus. The mean score was 3.878 with a standard deviation of 0.713. In descending order, the score of the indicators are as follows: "Diabetes prevention can be done by adopting a balanced diet" (4.218); "Diabetes prevention can be done by reducing/weight control" (4.020); "Diabetes prevention can be done through regular exercise/physical activity" (3.923); and "Diabetes prevention can be done by stop smoking" (3.308).

Table 4.6(c) Descriptive Statistics for Knowledge: Prevention of DM

Construct	Item Label	Item	Mean	Std. Deviation
Prevention of Diabetes Mellitus	KP1	a. Diabetes prevention can be done through regular exercise/physical activity.	3.923	0.960
	KP2	b. Diabetes prevention can be done by reducing/weight control.	4.020	0.925
	KP3	c. Diabetes prevention can be done by adopting a balanced diet.	4.218	0.791
	KP4	d. Diabetes prevention can be done by stop smoking.	3.308	1.081

Table 4.6(d) presents the descriptive analysis of the complications of diabetes mellitus. The mean score was 3.800 with a standard deviation of 0.716. In descending order, the score of the indicators are as follows: "Diabetes can lead to amputation of limbs" (4.322); "Diabetes can lead to sense of sensation/numbness in arms and legs" (3.989), "Diabetes can lead to kidney failure" (3.898); "Diabetes can lead to eye problem" (3.771); "Diabetes can lead to hypertension" (3.732); "Diabetes can lead to stroke" (3.712); "Diabetes can lead to heart attack" (3.662); "Diabetes can lead to blindness" (3.542); and "Diabetes can lead to sexual impotence" (3.510).

Table 4.6(d) Descriptive Statistics for Knowledge: Complications of DM

Construct	Item Label	Item	Mean	Std. Deviation
Complications of Diabetes Mellitus	KC1	a. Diabetes can lead to blindness.	3.542	1.146
	KC2	b. Diabetes can lead to eye problem.	3.771	1.097
	KC3	c. Diabetes can lead to kidney failure.	3.898	0.977
	KC4	d. Diabetes can lead to heart attack.	3.662	1.034
	KC5	e. Diabetes can lead to sense of sensation/numbness in arms and legs.	3.989	0.950
	KC6	f. Diabetes can lead to amputation of limbs.	4.322	0.798
	KC7	g. Diabetes can lead to hypertension.	3.732	1.064
	KC8	h. Diabetes can lead to stroke.	3.712	1.069
	KC9	i. Diabetes can lead to sexual impotence.	3.510	1.122

Table 4.6(e) presents the descriptive analysis of the analysis of the treatment of diabetes mellitus. The mean score was 3.3.881 with a standard deviation of 0.680. In the analysis of the treatment of diabetes mellitus, the mean values of the indicators lie in between 3.336 and 4.109. In descending order, the score of the indicators are as follows:

"Monitoring of blood glucose level is important in the treatment of diabetes" (4.109); "Exercise/physical activity is a treatment of diabetes" (3.967); "Diet is a treatment of diabetes" (3.959); "Insulin injections are also used for treatment of diabetes" (3.943); and "Diabetes can be treated with oral antidiabetic drugs" (3.336).

Table 4.6(e) Descriptive Statistics for Knowledge: Analysis of the Treatment of DM

Construct	Item Label	Item	Mean	Std. Deviation
Treatment of Diabetes Mellitus	KT1	a. Diet is a treatment of diabetes.	3.959	0.960
		b. Exercise/physical activity is a treatment of diabetes.	3.968	0.919
	KT2	c. Diabetes can be treated with oral antidiabetic drugs.	3.336	1.018
	KT3	d. Insulin injections are also used for Treatment of diabetes.	3.943	0.929
		e. Monitoring of blood glucose level is important in the treatment of diabetes	4.109	0.854

To measure the construct of knowledge, five indicators representing the mean scores for all 40 items of knowledge were used in the study as shown in Table 4.6(f). It was found that the mean score for the knowledge was 3.753 with a standard deviation of 0.127. In the descriptive analysis of knowledge, the mean values of the respective indicators were between 3.587 and 3.881. In descending order, the score of the indicators are as follows: treatment (3.881); prevention (3.878); complication (3.800) risk factor (3.678) and general knowledge (3.587).

Table 4.6(f) Mean Scores of Indicators Measuring Knowledge

Construct	Item	Mean	Std. Deviation
Knowledge	General Knowledge	3.587	0.526
	Risks Factor	3.678	0.597
	Prevention	3.878	0.713
	Complication	3.800	0.716
	Treatment	3.881	0.680

b. Descriptive Analysis of Attitude

Table 4.7 presents the mean scores and standard deviations for the 12 indicators of the latent construct of attitude.

Table 4.7 Descriptive Statistics for Attitude

	Item	Mean	Std. Deviation
A1	I always maintain ideal body weight/BMI.	3.817	0.774
A2	I often weigh periodically	3.767	0.819
A3	I am willing to have an ideal weight/BMI.	3.831	0.782
A4	I practice a balanced diet with intake of carbohydrates, fat and sugar in a small quantity.	3.765	0.810
A5	I can change my diet for a healthy diet with easily.	3.844	0.783
A6	I often exercise/do physical activity for 20 to 30 minutes at least three times a week.	3.661	0.814
A7	I am willing to exercise/do physical activity 20 to 30 minutes at least three times a week.	3.712	0.829
A8	I lead a healthy and active lifestyle.	3.881	0.796
A9	I do not smoke.	4.098	1.247
A10	I enjoy taking carbonated drinks.	3.677	1.082
A11	I prefer to take fast food.	3.508	1.037
A12	Every day, I spent a lot of my time in front of the monitor.	3.540	1.134

It was found that the mean score for the analysis of attitude was 3.737 with a standard deviation of 0.157. In the analysis of attitude, the range of the mean values of the indicators was between 3.540 and 4.098. In descending order, the score of the indicators are as follows: "I do not smoke" (4.098); "I lead a healthy and active lifestyle" (3.881); "I can change my diet for a healthy diet with easily" (3.844); "I am willing to have an ideal weight/BMI" (3.831); "I always maintain ideal body weight/BMI" (3.817); "I often weigh periodically" (3.767); "I practice a balanced diet with intake of carbohydrates, fat and sugar in a small quantity" (3.765); "I am willing to exercise/do physical activity for 20 to 30 minutes at least three times a week." (3.712); "I enjoy taking carbonated drinks" (3.677); "I often exercise/do physical activity for 20 to 30 minutes at least three times a week" (3.661); "Every day, more of my time is I spent in front of the monitor" (3.54); and "I prefer to take fast food" (3.508). The standard deviation scores which ranged between 0.774 and 1.247 indicated that most of the participants responded to the scale nearest to the mean score, which were 2 and 3 in the 5-point Likert scale.

c. Descriptive Analysis of Environment

The nine indicators of environment that had been identified were assessed by the respondents in the survey. Their descriptive statistics are as shown in Table 4.8.

Table 4.8 Descriptive Statistics for Environment

	Item	Mean	Std. Deviation
E1	I found my relatives and my friends had a family history of diabetes.	2.347	1.031
E2	I am surrounded by those who are obese/overweight.	2.984	1.005
E3	I am surrounded by people who smoke.	2.63	1.026
E4	I have an acquaintance who consumes alcohol excessively.	4.108	0.993
E5	My environment is surrounded by those who consume healthy diet.	3.439	0.834
E6	I am surrounded by people who often do exercise at least three times a week.	3.415	0.863
E7	I am surrounded by people who frequently eat fast food.	3.013	0.941
E8	I am surrounded by people who regularly drink soft drinks/sweet.	3.085	0.996
E9	I am surrounded by people who regularly do a physical activity/active life.	3.606	0.849

It was noted that the mean score for the environment was 3.164 with a standard deviation of 0.517. In descending order, the score of the indicators are as follows: "I have an acquaintance who consumes alcohol excessively" got the highest score (4.108); "I am surrounded by people who regularly do physical activity/active life" (3.606); "My environment that surrounded by those who consume a healthy diet" (3.439); "I find myself surrounded by people who often do exercise at least three times a week" (3.415); "I am surrounded by people who regularly drink soft drinks/sweet" (3.085); "I am surrounded by people who frequently eat fast food" (3.013); "I am surrounded by those who are obese/overweight" (2.984); "I am surrounded by people who smoke" (2.63); and "I found my relatives and my friends had a family history of diabetes" (2.347). The range of the standard deviation scores was between 0.834 and 1.031. This showed that most of the participants responded to scale nearest to the mean score, which were 2 and 3 in the 5-point Likert scale.

d. Descriptive Analysis of Symptom

Table 4.9 presents the descriptive statistics for indicators of symptoms of diabetes mellitus.

Table 4.9 Descriptive Statistics for Symptoms of DM

	Item	Mean	Std. Deviation
S1	I often feel thirsty.	3.249	0.895
S2	I urinate frequently.	3.148	0.869
S3	I lost weight despite having normal appetite.	2.556	0.978
S4	I am often feel tired or weak.	2.894	0.942
S5	I have dizziness.	3.024	0.949
S6	I suffer from blurred vision.	2.854	1.078
S7	I experienced rapid breathing.	2.529	0.92
S8	I often feel hungry.	2.759	1.015
S9	I suffer from wounds that heal slowly.	2.415	1.015

It was noted that the mean score for diabetes symptoms was 2.834 with a standard deviation of 0.300. In descending order, the score of the indicators are as follows: “I often feel thirsty” (3.249); “I frequently urinate” (3.148); “I have dizziness” (3:024); “I often feel tired or weak” (2.894); “I suffer from blurred vision” (2.854); “I often feel hungry” (2.759); “I lost weight despite having normal appetite” (2:556); “I experienced rapid breathing” (2.529); and “I suffer from slow healing of wounds” (2.415). The range of the standard deviation scores was between 0.869 and 1.078. This indicated that there was consistency among the respondents in answering the questionnaire as most of them responded to the scale nearest to the mean score, which were 2 and 3 in the 5-point Likert scale.

e. Descriptive Analysis of Awareness

Table 4.10 shows the descriptive analysis of indicators representing the latent construct of awareness.

Table 4.10 Descriptive Statistics for Awareness

	Item	Mean	Std. Deviation
AW1	I realize that diabetes is increasing among the people in this country.	4.299	0.669
AW2	I have a family history of diabetes.	3.325	1.273
AW3	Diabetes can be prevented by living a healthy lifestyle that is by adopting a balanced diet.	4.357	0.676
AW4	Diabetes can be prevented by living a healthy lifestyle that is by exercising consistently.	4.325	0.673
AW5	Long-term complications of diabetes can be prevented.	4.156	0.72
AW6	Diabetes can be treated.	4.122	0.728
AW7	Diabetes mellitus is classified as a chronic disease.	3.897	0.844
AW8	I realize I need to control my weight regularly.	4.222	0.693
AW9	I always monitor my blood glucose levels.	3.685	0.89
AW10	Diabetes can occur during the first pregnancy.	3.608	0.917
AW11	I know that there are three types of diabetes.	3.172	0.894
AW12	Diabetes can happen to anyone regardless of their age.	4.323	0.691

It was found that the mean score of awareness was 3.933 with a standard deviation of 0.441. In descending order, the score of the indicators are as follows: "Diabetes can be prevented by living a healthy lifestyle that is by adopting a balanced diet" (4.357); "Diabetes can be prevented by living a healthy lifestyle that is by exercising consistently" (4.325); "Diabetes can happen to anyone regardless of their age level" (4.323); "I realize that diabetes is increasing among the people in this country" (4.299); "I realize I need to control my weight regularly" (4.222); "Long-term complications of diabetes can be prevented" (4.156); "Diabetes can be treated" (4.122); "Diabetes mellitus is classified as a chronic disease" (3.897); "I always monitor my blood glucose levels" (3.685); "Diabetes can occur during the first pregnancy" (3.608); "I have a family history of diabetes" (3.325); and "I know that there are three types of diabetes" (3.172). The range of the standard deviation scores was between 0.669 and 1.273. This indicated that there was consistency among the respondents in answering the questionnaire as most of them responded to the scale nearest to the mean score, which were 2 and 3 in the 5-point Likert scale.

4.5 Partial Least Squares - Structural Equation Modelling (PLS-SEM)

A confirmatory factor analysis (CFA) was performed to examine the properties of the latent construct in the hypothesised model to determine the impact of exogenous latent variables, namely, knowledge, attitude, environment, and symptoms on awareness. The CFA performed in this study was PLS-SEM. This technique consists of two components: (1) an outer model or the measurement model that is concerned with the loadings of the indicators; and, (2) the inner model or the structural model that relates to the path coefficients. This section presents the analysis of both the outer model and the inner model using PLS-SEM.

Table 4.11 presents the results of the reliability analysis for each construct in DMAM. It was noted that the reliability coefficients for each of the constructs studied exceeded the value of 0.70 recommended by Hair et al. (2010), with the exception of the construct of symptoms. This is because the construct of symptoms is formative measure.

Table 4.11 Indices for Construct Reliability

Construct	α Cronbach
Knowledge	0.893
Attitude	0.894
Environment	0.853
Awareness	0.891

Therefore, it can be said that each construct in this study was highly reliable because each construct had a good coefficient value. The coefficients of reliability in the actual survey were also found to be greater than those of the pre-test after the quality of items in the questionnaire had been improved as suggested by the experts. The issue of unidimensionality was also addressed when the values of Cronbach alpha were found to be greater than 0.70 (Tenenhaus et al., 2005).

4.5.1 Assessment of the Outer Model

Table 4.12 presents the acceptable values of four latent variables (not including the formative latent variable) with 22 factor loadings and weights obtained from the model. All of the 22 items had factor loadings greater than 0.70. This showed good loadings on the specified latent constructs. The loadings and cross-loadings examination for this study are also shown in Table 4.12.

Table 4.12 Loadings and Cross Loadings Examination

Construct	Item	Attitude	Awareness	Environment	Knowledge
Attitude	A1	**0.718**	0.202	0.314	0.225
	A2	**0.706**	0.311	0.306	0.302
	A3	**0.746**	0.291	0.303	0.278
	A4	**0.774**	0.250	0.395	0.229
	A5	**0.755**	0.390	0.319	0.310
	A6	**0.766**	0.202	0.493	0.143
	A7	**0.779**	0.263	0.436	0.207
	A8	**0.820**	0.258	0.471	0.207
Awareness	AW1	0.253	**0.772**	0.185	0.483
	AW12	0.300	**0.777**	0.233	0.466
	AW3	0.258	**0.792**	0.149	0.414
	AW4	0.310	**0.846**	0.205	0.452
	AW5	0.332	**0.811**	0.279	0.506
	AW6	0.234	**0.671**	0.216	0.367
	AW7	0.167	**0.627**	0.113	0.383
	AW8	0.290	**0.72**	0.171	0.447
Environment	E5	0.464	0.244	**0.868**	0.222
	E6	0.446	0.213	**0.902**	0.170
	E9	0.416	0.230	**0.866**	0.177
Knowledge	General	0.186	0.451	0.137	**0.772**
	Prevention	0.270	0.459	0.116	**0.790**
	Risks	0.262	0.464	0.216	**0.845**

From Table 4.12, it could be observed that all of the items loadings that measured their respective constructs were higher than 0.70 and also higher compared to the other latent constructs. The differences between the values of the loadings and the other values in the other constructs were found to be more than 0.10, which indicated that the items achieved a good divergent validity. This indicated that each of the items had good reliability and was measuring what it was intended to measure. This indirectly contributed to convergent validity. The analysis was done at the significant level of

0.05. Moreover, the model also fulfilled the divergent validity test as there were no items studied that cross-loaded on other constructs. In another words, the items only loaded on their own constructs and explained more on their own constructs rather than cross-loaded on others.

4.5.2 Indicator Reliability

Table 4.13 presents the loadings of the indicators. The results of the analysis showed that each of the 22 indicators had a factor loading greater than the value recommended which is 0.70 (Gotz et al., 2010; Henseler et al., 2009; Chin, 1998).

Table 4.13 Outer Model Assessment

Construct	Items	Factor Loading	CR	AVE
Attitude	A1	0.718	0.915	0.576
	A2	0.706		
	A3	0.746		
	A4	0.774		
	A5	0.755		
	A6	0.766		
	A7	0.779		
	A8	0.820		
Awareness	AW1	0.772	0.913	0.570
	AW12	0.777		
	AW3	0.792		
	AW4	0.846		
	AW5	0.811		
	AW8	0.671		
Knowledge	Complication	0.627	0.921	0.773
	General	0.720		
	Prevention	0.868		
	Risks	0.902		
	Treatment	0.866		
Environment	E5	0.772	0.911	0.701
	E6	0.790		
	E9	0.845		

a. Average variance extracted (AVE) = (summation of the square of the factor loading)/{(summation of the square of factor loadings) + (summation of the error variances)}.

b. Composite reliability (CR) = (square of the summation of the factor loading)/{(square of the summation of the factor loadings) + (square of the summation of the error variances)}.

However, in the first modelling analysis, many indicators had a loading below than the threshold value of 0.70; hence, these low loading indicators had been removed to increase the measures of average variance extracted for each latent construct. This deletion process had to be done so that the items in the final model could give admissible results towards the assessment of the outer model and the inner model in the next step. Although many items had been deleted, PLS estimation employed an exploratory approach that justified this process. Furthermore, the survey instrument used was a considerably newly-established questionnaire that would require a thorough examination of the items used for the analysis.

4.5.3 Construct Validity

From Table 4.13, it can also be concluded that the items and indicators values loaded more than 0.50 on their own respective constructs and also loaded less than 0.50 on other constructs. Therefore, this confirmed the construct validity of the present study.

4.5.4 Convergent Validity

Convergent validity can be defined as the degree to which the multiple items of the construct that are measuring the same thing are in agreement. It can be seen from Table 4.13 that CR values ranged from 0.911 to 0.921 and exceeded the recommended value of 0.70 (Hair et al., 2011). In addition, AVE would be the last measurement that needed to be measured as it would be accountable for the "complete amount of variance in the observed variable accounted by the latent variable relative to the measurement error" (Hair et al., 2011). As shown in Table 4.13, the AVE values ranged between 0.570 and 0.773 and exceeded the minimum recommended value of 0.50 (Barclay et al., 1995).

Generally, the results obtained from the analyses showed that all values of the five constructs (knowledge, attitude, environment, symptoms, and awareness) were valid in terms of their respective constructs according to their parameter estimates and statistical significance. The model was further assessed for discriminant validity testing by applying the Fornell and Larcker criterion (1981) and Heterotrait-monotrait (HTMT) ratio of correlations.

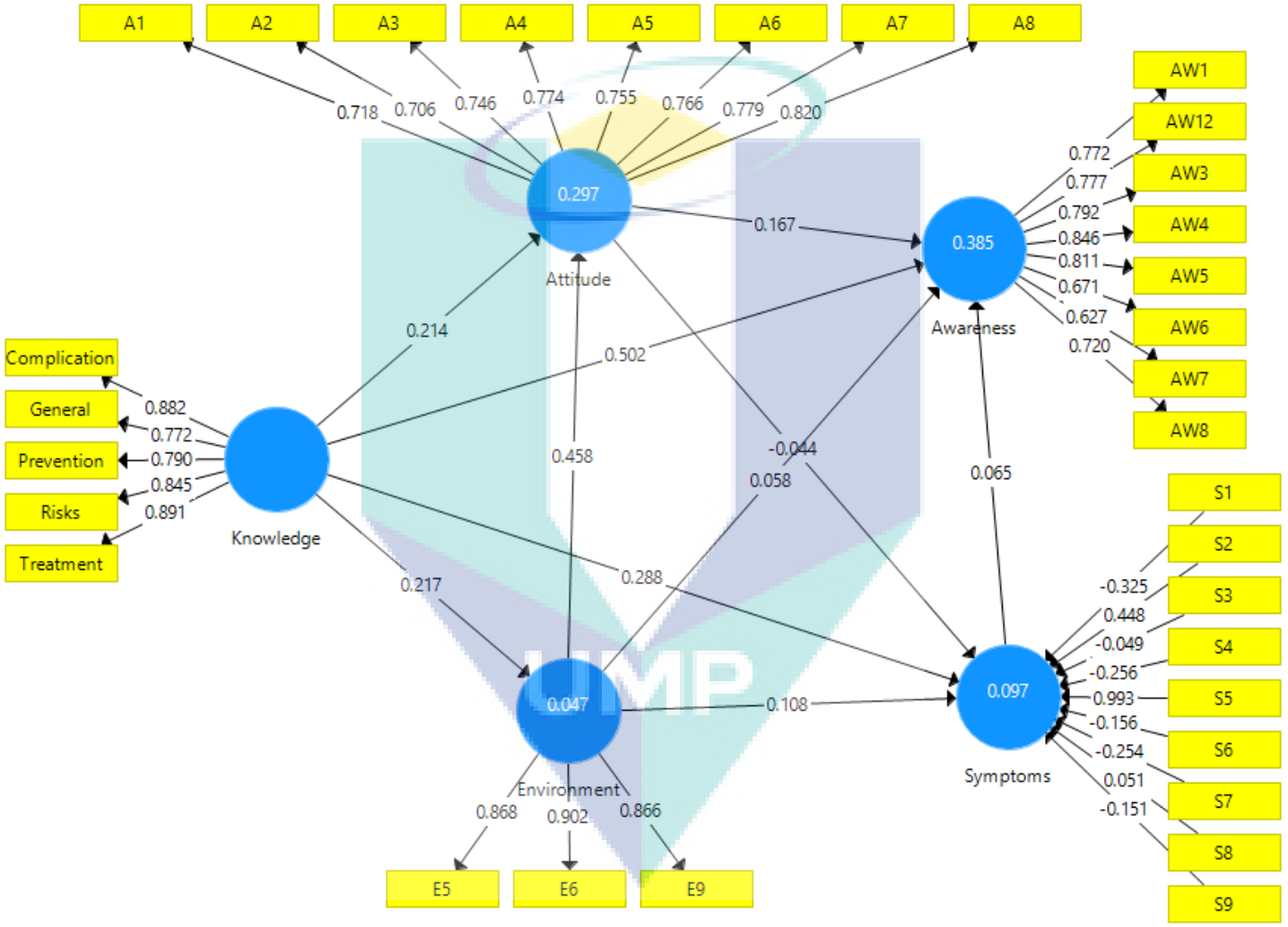


Figure 4.2**:** Assessment of Outer Model

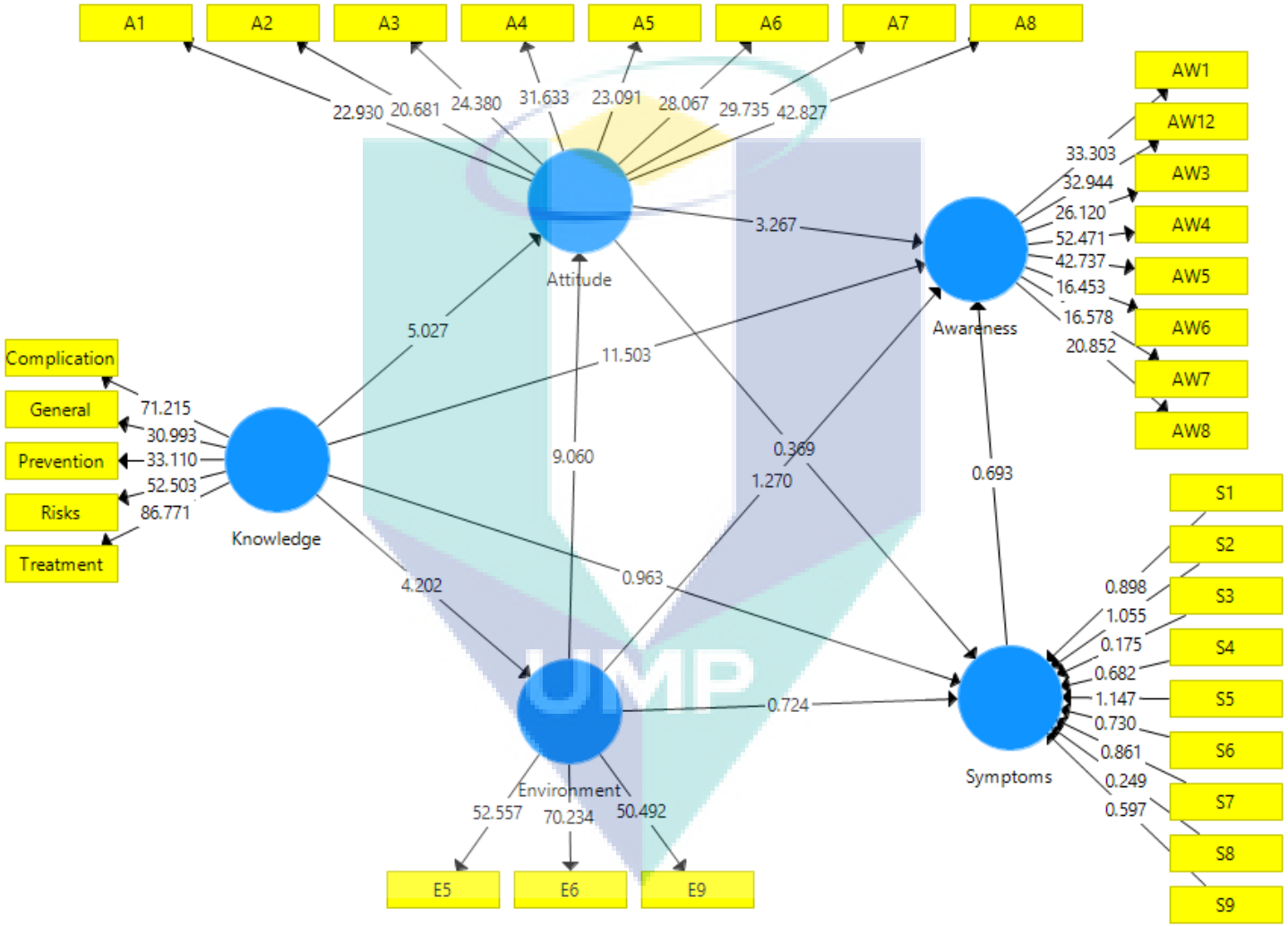


Figure 4.3: Bootstrapping Result

4.5.5 Discriminant Validity Assessment

a) Fornell and Larcker Criterion

Table 4.14 showed that all the AVE values were higher than the recommended value, and the correlations for each of the latent variables was less than the square root of its AVE (shown in bold on the diagonal value). Therefore, it can be said that discriminant validity requirement was fulfilled (Ramayah et al., 2013).

Table 4.14 Discriminant Validity

	Attitude	Awareness	Environment	Knowledge
Attitude	**0.759**			
Awareness	0.360	**0.755**		
Environment	0.504	0.261	**0.879**	
Knowledge	0.313	0.586	0.217	**0.837**

Note: Diagonal represents the square root of the AVE, while the off-diagonals represent the correlations among the variables.

b) Heterotrait-monotrait (HTMT)

The heterotrait-monotrait criterion is also used to determine discriminant validity. In this assessment, HTMT ratio of correlations would be obtained based on the formula as recommended by Henseler et al. (2014). The ratio values for all of the constructs are presented Table 4.15.

Table 4.15 HTMT Results

	Attitude	Awareness	Environment	Knowledge
Attitude	-			
Awareness	0.396	-		
Environment	0.572	0.295	-	
Knowledge	0.349	0.653	0.244	-

The HTMT results indicated that discriminant validity problem had not existed. These results also showed that the construct validity was valid and admissible. In other words, the latent constructs truly discriminated each other. Therefore, the modelling analysis proceeded to the inner model evaluation (i.e., the structural model).

4.5.6 Assessment of the Inner Model/ the Structural Model

4.5.6.1 Hypotheses Testing

The ten hypothesised relationships in the SEM was analysed using PLS estimation technique. The results of the modelling analysis, as shown in Table 4.16, represented the path coefficients (β) and significance of the inner model, from which it was noted that some relationships were significant, while others were not significant. The significant paths suggested that the associated hypotheses were supported, while the non-significant paths indicated that the related hypotheses were not supported.

Table 4.16 Hypotheses Testing

Hypothesis	Relationship	Standard Beta	Standard Error	T Statistics	Decision
H1	Knowledge -> Attitude	0.214	0.042	5.027**	Supported
H2	Knowledge -> Environment	0.217	0.052	4.202**	Supported
H3	Knowledge -> Symptoms	0.288	0.299	0.963	Not Supported
H4	Knowledge -> Awareness	0.502	0.044	11.503**	Supported
H5	Attitude -> Symptoms	-0.044	0.119	0.369	Not Supported
H6	Attitude -> Awareness	0.167	0.051	3.267**	Supported
H7	Environment -> Attitude	0.458	0.051	9.06**	Supported
H8	Environment -> Symptoms	0.108	0.149	0.724	Not Supported
H9	Environment -> Awareness	0.058	0.046	1.270	Not Supported
H10	Symptoms -> Awareness	0.065	0.094	0.693	Not Supported

**$p < 0.01$, *$p < 0.05$, two-tailed

Hypothesis 1 postulated that there would be a significant effect of knowledge on attitude. The results supported the relationship as the standardised regression weight of 0.214, *t*-value = 5.027 at 0.01 significance level, two-tailed. This indicated that whenever knowledge increased in one standard deviation, attitude would also increase by 0.214.

Hypothesis 2 proposed that there would be a significant impact of knowledge on the environment. The results showed that there was a significant impact with standardised regression weight of 0.217, *t*-value = 4.202 at 0.01 significance level, two-tailed. This can be interpreted as an increase in one standard deviation of knowledge would contribute to an increase in the environment by 0.217.

Hypothesis 4 predicted a significant impact of knowledge on awareness. The results revealed a significant relationship with standardised regression weight of 0.502 at 0.01 significance level at the two-tailed test with *t*-value = 11.503. This means that when knowledge increased in one standard deviation, there would also be an increase in awareness by 0.502 unit.

Hypothesis 6 predicted another significant impact on awareness which would be caused by attitude. It was revealed that this was significant with a standardised β values of 0.167 at 0.01 significance level at the two-tailed test with *t*-value = 3.267. This showed that there was a positive relationship between attitude and awareness among the respondents.

Hypothesis 7 examined the structural impact of the environment on attitude. Results showed that there was a significant impact at 0.01 significance level, *t*-value = 9.06 with standardised regression weight of 0.458. In other words, if there was an increase in environment by one standard deviation, there would also be an increase in attitude by 0.458.

Meanwhile, Hypothesis 3, Hypothesis 5, and Hypothesis 8 posited that there would be significant influence of knowledge, attitude, and environment on symptoms, respectively. Additionally, Hypothesis 9 and Hypothesis 10 posited that there would be significant influence of environment and symptoms on awareness. Nevertheless, there were no empirical evidence found to support these five hypotheses.

4.5.6.2 The Coefficient of Determination (R^2)

Generally, the hypothesised model would describe the significant amount of variance for each construct. It can be seen in Figure 4.4 that the R^2 value of awareness was 0.385, which implied that 38.5% of awareness was predicted by knowledge, attitude, environment, and symptoms.

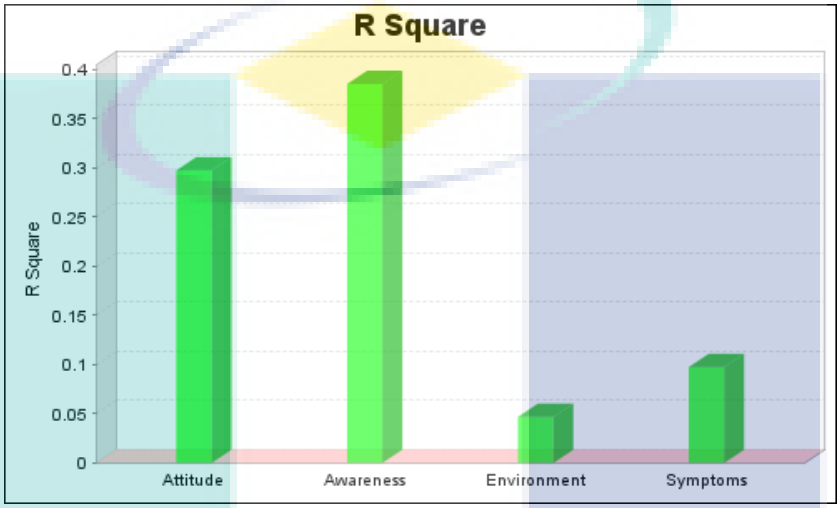


Figure 4.4 Quality Criteria of R Square

In addition, the R^2 value for attitude was 0.297. In other words, 29.7% of this construct was explained by the latent constructs of knowledge and environment. Furthermore, 4.7% of the environment was explained by knowledge and 9.7% of symptoms was explained by attitude and environment. Overall, the proportion of variance explained by each endogenous construct from exogenous constructs was found acceptable.

4.5.6.3 Effects Size

Table 4.17 shows the effect size (f^2) of exogenous antecedent constructs on the endogenous construct of attitude. The results showed that the antecedent constructs of environment and knowledge contributed to the explanation of the attitude were 0.2703 and 0.0555 respectively, which were considered medium and small effect sizes. Additionally, this indicated that the impact of the construct for the environment was considerably high for attitude and can be interpreted as negligible for knowledge.

Table 4.17 Effect Size (f^2) of Knowledge and Environment on Attitude

	f^2	Interpretation
Knowledge	0.0555	Small
Environment	0.2703	Medium

Table 4.18 shows the effect size of exogenous antecedent constructs on the endogenous construct of the symptoms of diabetes mellitus. The results showed that the antecedent constructs of knowledge, attitude, and environment contributed to the explanation of the symptom were 0.0377, 0.00 and 0.0078, respectively. This indicated that the impact of knowledge on symptoms was acceptable while the environment had a very small. By contrast, attitude had no effect at all on symptoms.

Table 4.18 Effect Size (f^2) on Symptoms

	f^2	Interpretation
Knowledge	0.0377	Small
Attitude	0.000	None
Environment	0.0078	None

Table 4.19 indicates that knowledge had a large effect on awareness whereas the others exogenous antecedent constructs had no effect at all on awareness. Table 5.18 shows the effect size of the exogenous antecedent constructs on the endogenous construct of awareness. The results showed that the antecedent constructs of knowledge contributed to the explanation of the awareness, which was 0.3789 and considered a large effect size, indicating that the impact of the construct of knowledge was acceptable for awareness. However, the other antecedent constructs of attitude, environment, and symptoms were merely 0.0309, 0.00 and 0.0065, respectively. Hence, each of the effect size for attitude, environment, and symptom on the endogenous construct of awareness could be considered negligible.

Table 4.19 Effect Size (f^2) for Awareness

	f^2	Interpretation
Knowledge	0.3789	Large
Attitude	0.0309	None
Environment	0.0000	None
Symptom	0.0065	None

In conclusion, knowledge is of utmost important in creating awareness among the public.

4.6 Summary

This chapter presents the results of the assessment of the research model through empirical validation of the outer model and the inner model. This was done by testing the hypotheses and measuring the structural impacts of the hypothesised relationships that had been posited based on review of literature. The PLS-SEM modelling technique was applied in this model evaluation. From the modelling analysis, several items had also been excluded before the final version of the validated model was established. Overall, the hypothesised model was found to be valid and admissible.

CHAPTER 5

CONCLUSION

5.1 Introduction

The present research aimed to empirically examine the structural model of the Diabetes Mellitus Awareness Model (DMAM). This was done by testing the hypothesised relationships between each of the constructs using the structural equation modelling (SEM) technique. In this study, each of the constructs, namely, knowledge, attitude, environment, symptoms, and awareness were measured and analysed. Convenient sampling was used which managed to obtain responses from 523 participants from the Outpatients' Department of two selected health clinics in the state of Pahang (i.e., one situated in the District of Kuantan, and the other in the District of Pekan). Results showed that DMAM was statistically acceptable. Hence, this awareness model can be suggested to be adopted by the Ministry of Health, Malaysia (MOH). Furthermore, the present study has found the relationships between knowledge, attitude, environment an awareness to be significant. In addition, it was found that the relationship between attitude and awareness, as well as that of between environment and attitude, was significant. Moreover, empirical evidence indicated that knowledge, attitude and environment had no significant effects on symptoms, respectively. Similarly, it was also empirically evident that environment and symptoms had no direct effects on awareness, respectively.

5.2 Discussion of Findings

This section discusses the findings of each of the tested hypothesised relationships that have been presented in Chapter 5 using partial least squares (PLS)

estimation technique in order to answer the research questions that have been put forward in chapter 1.

5.2.1 The Relationships between Knowledge with Attitude, Environment, Symptoms on Awareness

The analysis of the responses in the survey indicated that knowledge affected attitude toward diabetes. This significant relationship implied that knowledge clearly influenced the attitude, especially in the context of the present study through observable items. In other words, knowledge formed positive perceptions of the awareness of diabetes. Therefore, the MOH Malaysia needs to enhance awareness campaigns so that they become an impetus to healthy living. The findings of the present study have been consistent with those of the study conducted by Ng et al. (2012) in an urban diabetes care centre who had investigated the effect of knowledge on the attitude toward diabetes and found a strong relationship between knowledge with attitude. This has led to an understanding of the impact and the influence of knowledge on attitude in diabetes awareness in the context of Malaysia. Earlier, Arcury (1990), who conducted a study among residents in Kentucky, had also found that attitude would be influenced by knowledge. More recent findings by Omobuwa and Alebiosu (2014) have further reinforced that knowledge associated with attitude could generate high level of awareness. Similarly, Rathod et al. (2014) have also discovered a positive correlation between knowledge and good attitude.

Furthermore, the present study also found a significant relationship between knowledge and the environment. In similar vein, a study conducted by Bradley et al. (1999) had discovered that there was a significantly positive relationship that existed between environmental attitude and environmental knowledge among high school students. Meanwhile, Moseley (2000) has noted that the appropriate knowledge would promote environmental literacy among members of the public who possess the appropriate attitude and behaviour.

On the one hand, the present study found that knowledge did not influence the symptoms of diabetes. Therefore, it can be deduced that there was no significant relationship between knowledge and symptoms of diabetes. The third hypothesis proposed that the symptoms could be detected in the presence of knowledge. They may

have knowledge but still miss out on healthy eating, inconsistent diet. Nevertheless, results showed that the knowledge gained could not make someone become aware of the symptoms encountered. They also treat the symptoms as normal, which may not happen in themselves. This may be due to the insufficiency of the knowledge gained. These findings have been consistent with those of a study conducted by Hoëbes and Matenguthere (2014) which had discovered that there was no significant association between the knowledge of HIV/AIDS and menopausal symptoms. However, by contrast, Patel et al. (2014) have noted an important relationship between the knowledge of women concerning menopausal symptoms and its management.

On the other hand, the results of the present study have revealed that there was a significant relationship between knowledge and awareness. In other words, there were both direct and indirect relationship between knowledge and awareness through the variable under study. This had been emphasised by Arcury (1990) who argued that knowledge would expand an individual's general awareness. Amin et al. (2012) who conducted a course on Environment and Health among students in a university in Malaysia also found that the course had enhanced the students' level of awareness and knowledge on environmental health matters. In addition, Gunay et al. (2006) who had conducted a study on the population of Narlidere Health District in Izmir, Turkey found that knowledge would affect the level of awareness of the population. In addition, Aminrad et al. (2013) have also noted that there was, albeit not strong, a significant relationship between knowledge and awareness. In other words, knowledge could enhance the awareness of diabetes.

5.2.2 The Relationship between Attitude on Symptoms and Awareness

The present study has also discovered that attitude did not affect the symptoms. In other words, Hypothesis 5 was not supported, indicating that there was a poor relationship between attitude and symptoms. These findings have been coherent with those of the research conducted by Altun and Keser (2017) who had found no significant relationship between the eating attitude and obsessive-compulsive symptoms. Furthermore, Park et al. (2016) noted that there were no significant correlations between any parenting attitudes and depressive symptoms among male adolescents. Similarly, according to Givshad et al. (2015), no significant correlation

could be found between the severity of PMS symptoms and the attitude towards menstruation. This finding was in contrast with the views expressed by Moritz et al. (2014) who discovered a certain positive relationship between attitude and psychotic symptoms. Additionally, these findings also contradicted the findings of Cooper (2006) who discovered that in a student sample of young men, a relationship between eating attitudes and depressive symptoms had been observed.

Last but not least, the present study has discovered that there was a significantly direct relationship between attitude and awareness, indicating that attitude affected awareness. Similarly, Arcury (1990) had found that positive attitudes among members of the public would increase their awareness. In addition, Al-Naggar et al. (2013) who had conducted a study among Malaysian university students found that an individual's attitude would positively be related with the awareness of diabetes. This has suggested that attitude would have a significant relationship with diabetes awareness; in other words, attitude could increase awareness of diabetes.

5.2.3 The Relationship between Environment on Attitude, Symptoms, and Awareness

The present study has also found that the environment affected positive attitude. According to Helgeson (2003), the more one receives environmental support, the better the individual's attitude towards diabetes would be. This is evident when someone is surrounded by a positive environment, positive attitude toward diabetes will also increase. Debona and Cachia (2007) have noted that a strong relationship would exist between environment relationships and attitude of diabetic patients. Meanwhile, Ashraff et al. (2013) have suggested that better attitudes have been significantly linked with the support from both family and friends.

The World Health Organization (WHO) describes environmental health as "those aspects of the human health, including quality of life, that are determined by physical, biological, social and psychosocial factors in the environment" (Landon, 2006). Landon (2006) has explained that "the WHO definition of environmental health highlights the connection between the state of the environment and the health experiences of individuals and communities" and "the relationship between human activities and the environment has the potential to either impair or improve health". He

has further suggested that education is one of the ways that can help in alleviating the adverse effects from human and environment relationship. In similar vein, Roth (1992) has suggested the promotion of environmental literacy to be the primary goal of environmental education and proposed for environmental literacy to be incorporated into general education curriculum; hence, environmental literacy would develop from awareness to knowledge and action.

The current study has also discovered no significant relationship between the environment surrounding diabetes and the symptoms of the disease. By contrast, O'Brien et al. (2006) had found that positive family involvement could decrease the symptoms of the disease at an early stage. In addition, Oliveira et al. (2014) had also found that there was a significant correlation between family functioning and depressive symptoms. This may be caused by the environment of the family and friends who would be less knowledgeable about diabetes, who could not indirectly give support to an individual about the symptoms of diabetes.

Furthermore, the current study has found that the environment did not affect the awareness of diabetes. In other words, the associated hypotheses were not supported. Therefore, it can be assumed that there was no significant relationship between the environment surrounding diabetes and the awareness of the disease. These findings also contradicted with those of Baptiste-Roberts et al. (2007) whose study had found that individuals with a family history of diabetes or acquaintances would be more aware of the diabetes risk factors. This may be due to the insensitivity of the individual against the illness of a family member or friend etc, which would cause a lack of awareness of diabetes suffered by family members or people surround them.

5.2.4 The Relationship between Symptoms and Awareness

In the present study, the results of the analysis showed that the symptoms of diabetes did not affect awareness of the disease. This was in contrast to what was reported by Spitznagel et al. (2006) who had found a positive relationship between depressive symptoms and awareness of deficits in dementia. This may be due to a lack of knowledge about the symptoms suffered and did not create an awareness of diabetes. Even though they had the symptoms of diabetes, members of the public who were not diagnosed with diabetes did not know that they had the disease either because of their

lack of knowledge or because they did not take care of their health or because they simply refused to go to the clinic to identify what disease or diseases they had.

5.3 Diabetes Mellitus Awareness Model (DMAM) in Malaysia

Overall, it has been evident from the DMAM that awareness of diabetes would be dependent on knowledge and attitude. It has provided an important overview to consider the causal effect studied. It can be said that the environment would have an indirect impact on the awareness of diabetes through attitude due to the insignificant consequence of environment on the awareness of diabetes. In addition, awareness of diabetes can be estimated by the attitude of the individual through the environment. Meanwhile, the role of knowledge would be important in the contribution towards the overall awareness of diabetes. Knowledge of diabetes can create a better attitude towards a healthier life, which would eventually affect a healthier lifestyle.

The findings from the current study have shown that most of the respondents lacked the awareness that one of the causes of diabetes is the deficiency of insulin. They also thought that diabetes could be cured and they were not aware of the blood sugar normal range. As a result, the general public might be less careful in taking preventive measures due these misconceptions. The participants in the present study were also incapable of recognising that physical inactivity and obesity would be the risk factors. However, the present researcher holds the view that the sample surveyed comprehended that high consumption of dietary sugar would be a risk factor in developing diabetes. Although the persons with diabetes would very likely have significantly greater knowledge of diabetes risk factors, the healthy population should also be more aware of such risks, health promotion activities and disease prevention.

The results of the present study have highlighted the necessity for a well-structured educational and awareness programme, which can be delivered through mass media publicity and distribution of educational literature. The programs should be planned as a primary prevention for healthy individuals at risk, and a programme for secondary and tertiary prevention for patients with diabetes. In addition, the need for prevention and reduction of obesity should be emphasized during the programme by promoting a healthy diet and increasing physical activity. As noted by Yun et al. (2007), this can be conducted at various levels, including schools, universities, workplaces and

the general public. The public health policy should relate to the issues of screening the public to distinguish individuals who are at pre-diabetes stage from those who have undiagnosed diabetes. Meanwhile, Al-Khawaldeh and Al-Jaradeen (2013) have also suggested that awareness on the importance of diabetes can be raised by focusing on diabetes risk factors during the public education.

In addition, educational strategies for the prevention of diabetes comprise activities which should aim at preventing susceptible individuals from suffering diabetes by promoting healthy lifestyle as well as by encouraging individuals, family and community members to become aware of their responsibilities. The target population should involve individuals who are at high risks of developing diabetes (e.g., obesity, above 40 years, family history of diabetes) or a community-wide approach to lower the overall levels of risk factors (Yun et al., 2007).

In conclusion, a greater emphasis should be placed on primary prevention, health promotion, and lifestyle modification to contend with the increasing number of diabetics through counseling and education. The current study has produced empirical evidence that might picture a substantial number of the Malaysian population lacked sufficient level of awareness and knowledge required in preventing and coping with the increasing number of diabetics in Malaysia. Therefore, based on the findings of the present study, healthy lifestyle and comprehensive health education programme at general public level would highly be recommended and should be organised often in order to reduce the risk of developing Type 2 diabetes. Additionally, the health professionals from the public and private sectors can also help in communicating the information about the risks of diabetes by actively engaging with patients as well as designing population-based programs to increase the awareness of the risks of diabetes.

By conveying and educating healthy subjects about diabetes risk factors, there is high expectation that high-risk individuals would be encouraged to adopt healthy lifestyle, undergo routine medical check-ups and be actively involved in the prevention of diabetes. Awareness of diabetes risk factors and implementation of healthy lifestyle behaviours in healthy subjects who have no diabetes are often connected (Okosun et al., 2012). Moreover, when adults are told that they are at the stage of pre-diabetes and have increased risk of developing diabetes, they would make the effort to lose or control their

weight, reduce the intake of dietary fat or calories, increase physical activities or exercises, and engage in all of the three kinds of activities (Rolka et al., 2008).

The findings of the present study have also indicated a need for community groups, organizations concerned with health education, educators, parents and the media to actively play their role in helping the younger generation to develop healthy lifestyles which would eventually lead to healthy adulthood. As for the health education advisory group, decision-makers and planners, strategies that could lead to an improvement in the school health programmes should be explored and implemented in the formal and informal ways for the younger generation.

With adequate knowledge of symptoms and complications, people who are healthy, as well as those who are suffering from diabetes, would probably take the fundamental actions or seek medical attention promptly. Furthermore, educating the population about healthy living is very useful as this can help in guiding their relatives or friends with diabetes to comply with follow-up and treatment. Internet-based programmes could also be implemented to supplement the formal health care support system and disseminate the necessary information, especially to young adults as they are generally computer-savvy (Yun et al., 2007).

The result from the study showed that symptoms cannot predict awareness. Also, knowledge, attitude and environment cannot predict symptoms. In this model, both the knowledge, attitude and practice (KAP) theory and social cognitive theory (SCT) are two theories that have been identified to be related with the construct tested in the present research. The construct practice in the KAP model has been changed to the construct awaereness in this model. This is because our awareness is depends on our practices. The construct symptoms are being pulled out from the model because based on the results that have been obtained. So, the contribution of this study by suggesting the construct of environment in the model. This construct of environment has been extracted from SCT theory that has been used to support the theorical construction of the model.

5.4 Implications and Contributions of Study

The results of the current study can be implemented as guidelines for those who are concerned with and interested in implementing programmes and activities to improve health awareness, as well as for those who are providing assistance and support for the family, school and community involvement in health education among young people. The findings of the present study can also be used to investigate the level of knowledge on the health of primary schools' students as a first step in the prevention of early diabetes through strategies to improve health. Family, school, and community play an important role in shaping young people to live a healthy lifestyle, which would eventually lead to healthy adulthood.

The first and key step in achieving a healthy lifestyle among young people is to educate young people about the concepts of basic health at an early age. Education health awareness can also be guided by the counselling unit in all schools under the Ministry of Education with the aim of making the schools as an agency to improve the general health awareness among students.

The present study has contributed to the planning of the next steps that would be needed to raise diabetes awareness among the public through the community, government or private health-related organizations, educators, parents and the media. To ensure the survival of our society, the task of nurturing and developing awareness of the environment should be fostered at all levels in the education system, from school through to the higher learning institutions (Roth, 1992). A variety of strategies and methods should be used to provide sufficient education and development of problem-solving skills in the various aspects of diabetes awareness, and the education programmes should target diabetics, relatives of the diabetics and the general population (Gunay et al., 2006).

The current study has made a huge significance on the design of an educational programme for diabetics and a health promotion programme as these programmes are the primary prevention measure for the healthy population in general, and especially for those at high risk. In addition, the results of the present study could be beneficial in designing future studies for evaluating the knowledge of patients and the general public

on diabetes mellitus as fundamental prevention and lifestyle modification can have a notable impact in reducing the effects of diabetes.

Education on diabetes should be provided not only to the diabetics but also to those who are close to the diabetics and the population in general, especially to non-diabetics who do not have awareness of diabetes and lack of the knowledge of managing the disease. The focus of the programme for such non-diabetics should be on leading healthy lifestyle, which includes information about risk factors, diet, exercise, and screening. The proposed model used in the present study can serve as the core element of a community-based and a hospital-based programme to control and prevent the increase in the number of diabetics as combined efforts from various parties would be required to educate the Malaysian population on preventable and modifiable risk factors. Those who are non-diabetics would likely become more aware and informed of the disease prevention and health promotion activities, particularly if they have relatives or friends who are suffering from diabetes.

The American Diabetes Association (2012) recommended that implementing routine screening of high-risk individuals by healthcare units as a crucial preventive measure. Other than that, the units can implement diabetes prevention target strategies related to obesity prevention in adults and children, as well as changes to increase opportunities for health-promoting food and physical activity choices. It has been evident that in preventing diabetes among high-risk groups, consistent lifestyle modification would be very effective method (Murugesan et al., 2007). Furthermore, the complications occurred from diabetes could be reduced by improving lifestyle behaviours of the patients such as regular physical activity and healthy diet (Steyn et al., 2004; Ard & Svetkey, 2005).

Last but not least, a considerable effort should be made to promote the adoption of healthy lifestyle that includes regular exercise and prevention of obesity to reduce the incidence of diabetes. Early diagnosis is mandatory so that prompt and effective treatment for diabetes and its complications can be undertaken. Additionally, the medical profession plays a preeminent role in controlling and preventing diabetes mellitus. Even though education is most important, apparently it is presently the most neglected aspect (Mustaffa Embong, 1990).

5.5 Recommendation

Apart from diabetes mellitus, the model used in this study can be extended to other non-communicable diseases (NCDs). It can be developed to create awareness of cancer for generalization and add value to the results of the study. In addition, the replication model needs to be made in different sectors besides the health sector for the suitability and durability of the model as a guideline for the practitioner of this model. Furthermore, future studies could also consider the involvement of school students or those with diabetes to see their perception of the proposed awareness model.

Due to constraints in obtaining the sampling frame because of a large number of Malaysians throughout the entire population, future studies could consider increasing the numbers of health clinics. The sampling of diabetic patients can be done by appointing research assistants to distribute questionnaires within the framework of the population in the clinics. The answers to the questionnaires could be analysed by using a probability sampling procedure according to statistical theory. It is essential that the survey be carried out by the researchers in cooperation with the health clinics and in collaboration with the MOH as the findings from the study can be used to raise the awareness of diabetes in Malaysia.

Items in the present study may be used as backups and as a guide in the process of improving the items that can be used in future surveys such as providing more details and depth to the items. In addition, future research may focus on the effects of the intermediate variables between each awareness construct with SEM analysis using both maximum likelihood (ML) and PLS estimator. In addition, the invariance analysis can be done to the demographic factors of the respondents, which include gender, age group, and educational level, to determine the effect of moderating variables on the model structure. The effects of these simplification variables can also be carried out to test the integrity of psychometric properties of the questionnaire during the stage of factor validation analysis.

Furthermore, the modelling analysis can be performed using the Bayesian approach as a supplementary analysis to perform cross-validation. Bayesian analysis is concerned with the prior distribution in its analysis; hence, the findings of the present study can be used as a basis for the initial distribution in future studies.

Finally, as proposed by Gudergan et al. (2008), future research can focus on confirmatory tetrad analysis for the measurement model in SEM path modelling, in addition to factor validation analysis used in the SEM modelling.

5.6 Limitations of the Study

The results of this study would only be related to the chosen target sample, which was conducted at two health clinics. Moreover, the data collected were unable to provide information on the perceptions of most people with diabetes. The findings of those with diabetes that would also be important in the evaluation of the awareness of diabetes; however, this was not possible due to time constraints. Furthermore, because data were collected using a self-reported questionnaire, participants may have underestimated or overestimated their perceptions, which might have affected the findings.

5.7 Conclusions

The findings of the present study can be used to develop knowledge on the measurement system of diabetes awareness, which involves intangible aspects of Malaysian participants. Results have provided the support for the adequacy of the measurement of diabetes awareness in terms of the five criteria in DMAM. The items used were found suitable to be used as a measurement of the awareness construct. The results of the present study have not only supported the goodness of DMAM studied but have also been in similar vein with the findings of several previous studies related to the attitude towards and environment surrounding diabetes awareness. Therefore, the proposed awareness model can be used as the foundation of the assessment of diabetes awareness in Malaysia.

This study has provided additional support in terms of evidence that individual attitude and environmental factors, would directly and indirectly, affect diabetes awareness. The final model fit lends validity to the importance of those factors for DMAM in Malaysian participants. Replication of this study with other populations would be required to validate the results. In order to promote diabetes awareness, more comprehensive interventions involving both individual attitude and environmental factors beyond enhancing diabetes knowledge would be needed. Nevertheless, the differences between the subgroups may need to be addressed in the intervention programmes.

REFERENCES

Abegunde, D.O., Mathers, C.D., Adam, T., Ortegon, M. & Strong, K. (2007). The burden and costs of chronic diseases in low-income and middle-income countries. *Lancet*. 370(9603): 1929–38.

Abu Bakar, M. (2018). Melayu paling ramai tidak peduli penyakit diabetes. *Utusan*. 29 Oktober: 4.

Ahmad Makinuddin, A. & Ali, O. (2000). Pengetahuan, Sikap dan Amalan Tentang Kanser Serviks di Kalangan Bidan, Jururawat Desa dan Jururawat Masyarakat. *Akademika*, 56(Januari), 107-119.

Ahmad, S. (2012). Disiplin Diet. *Berita Harian*. 22 January: 1-4.

Al-Dahan, S. M., Albaik, M., Alomran, Y., Aldahan, F. & Albaik, S. (2013). Awareness and Knowledge of Diabetes among Al-Wazarat Family Medicine Health Center Attendants. *American Journal of Research Communication*. 1(12): 104-130.

Al-Khawaldeh, O.A. & Al-Jaradeen, N. (2013). Diabetes awareness and diabetes risk reduction behaviors among attendance of primary healthcare centers. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*. 7: 172–178.

Al-Naggar, R.A., Bobryshev, Y.V. & Mohd Noor, N.A. (2013). Lifestyle Practice among Malaysian University Students. *Asian Pacific Journal of Cancer Prevention*. 14(3): 1895-1903.

Al-Sarayra, L. & Khalidi, R.S. (2012). Awareness and Knowledge about Diabetes Mellitus among Students at Al-Balqa' Applied University. *Pakistan Journal of Nutrition*. 11(11): 1023-1028.

Altun, H.K. & Keser, L. (2017). Assessment of Eating Attitude Behaviours and Obsessive-Compulsive Symptoms of a Group of University Students: A Pilot Study from Turkey. *Journal of Nutritional Medicine and Diet Care*. 3(1): 1-5.

Alzghoul, B.I. & Chew Abdullah, N.A. (2015). Psychosocial Theories and Pain Management Practices: A Review of Empirical Research. *Mediterranean Journal of Social Sciences*. 6(6): 60-67.

American Diabetes Association. (2012). Standards of medical care in diabetes. *Diabetes Care*. 35(1): S11–63.

American Diabetes Association. (2004). Screening for type 2 diabetes. *Diabetes Care*. 27(suppl 1): S11–S14.

Amin, L., Mahadi, Z., Ibrahim, R., Yaacob, M. & Nasir, Z. (2012). The effectiveness of the 'environment & health' course in increasing students' awareness & knowledge on environmental health issues. *Procedia - Social and Behavioral Sciences*. 59: 77 – 84.

Aminrad, Z., Sayed Zakariya, S.Z., Hadi, A.S. & Sakari, M. (2013). Relationship Between Awareness, Knowledge and Attitudes Towards Environmental Education Among Secondary School Students in Malaysia. *World Applied Sciences Journal*. 22(9): 1326-1333.

Anderson, G. (1998). *Fundamentals of Educational Research*. London: Falmer Press.

Arcury, A.T. (1990). Environmental Attitude and Environmental Knowledge. &man Organization. 49(4): 300-304.

Ard, J.D. & Svetkey, L.P. (2005). Diet and blood pressure: applying the evidence to clinical practice. *American Heart Journal*. 149: 804–12.

Ashraff, S., M Siddiqui & T. Carline, (2013). The Psychosocial Impact of Diabetes in Adolescents: A Review. *Oman Medical Journal*. 28(3): 159-162.

Ayyagari, P., Grossman, D. & Sloan, F. (2011). Education and health: evidence on adults with diabetes. *Int J Health Care Finance Econ*. 11: 35–54.

Bagherniya, M., Taghipour, A., Sharma, M., Sahebkar, A., Contento, I.R., Keshavarz, S.A., Darani, F.M. & Safarian, M. (2018). Obesity intervention programs among adolescents using social cognitive theory: a systematic literature review. *Health Education Research*. 33(1): 26-39.

Bagozzi, R. P., Yi, Y. & Phillips, L. W. (1991). Assessing construct validity in organizational research. *Administrative Science Quarterly*. p. 421–458.

Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Social and Clinical Psychology*. 4(3): 359-373.

Bandura, A. (1997). Self-efficacy: The exercise of control. New York: W.H. Freeman.

Baptiste-Roberts, K.B., Gary, T.L., Beckles, G.L.A, Gregg, E.W., Owens, M., Porterfield, D. & Engelgau, M.M. (2007). Family History of Diabetes, Awareness of Risk Factors, and Health Behaviors Among African Americans. *American Journal of Public Health*. 97(5): 907-912.

Baradaran, H. & Jones, K. (2004). Assessing the knowledge, attitude and understanding of type 2 diabetes amongst ethnic groups in Glasgow, Scotland. *Practical Diabetes International*. 21(4): 143-148.

Baranowski, T., Cullen, K.W., Nicklas, T., Thompson, D. & Baranowski, J. (2003). Are current health behavioral change models helpful in guiding prevention of weight gain efforts? *Obes Res*. 11:23S–43S.

Barclay D., Higgins C. & Thompson R. (1995). The partial least squares (PLS) approach to causal modeling: Personal computer adoption and use as an illustration. *Technology Studies* 2(2): 285-309.

Barua, A., Konana, P., Whinston, A.B. & Yin, F. (2004). An empirical investigation of net-enabled business value. *MIS Quarterly* 28(4): 585-620.

Baumgartner, H. & Homburg, C. (1996) Applications of structural equation modeling in marketing and consumer research: A review. *International Journal of Research in Marketing* 13(1): 139–161.

Beaser, R.S. & J.V.C. Hill, (1995). The Joslin Guide to Diabetes: A Program for Managing Your Treatment. Simon and Schuster, New York.

Bergkvist, L. & Rossiter, J.R. (2007) The predictive validity of multiple-item versus single-item measures of the same constructs. *Journal of Marketing Research* 44(2): 175–184.

Berita Harian. (2012). Peningkatan penghidap diabetes membimbangkan. 22 Jun 2012.

Berita Harian. (2013). Hakikat kemanisan hidup. Ruangan sihat. Ms 14-15. 6 Jan 2013.

Bernama. 2012. Peningkatan penghidap diabetes membimbangkan. *Berita Harian*. 22 June: 1-2.

Binhemd, T.A. (1992). Diabetes mellitus: knowledge, attitude, practice and their relation to diabetes control in female diabetics. *Ann Saudi Med*. 12(3):247-251.

Bollen, K.A. (1989). *Structural Equations with Latent Variables*. New York: John Wiley & Sons.

Bradley, J.C., Waliczek, T.M. & Zajicek, J.M. (1999). Relationship Between Environmental Knowledge and Environmental Attitude of High School Students. *The Journal of Environmental Education*. 30(3): 17-21.

Byrne, B.M. (2010). *Structural Equation Modeling with AMOS*. Edisi ke-2. New York: Taylor & Francis Group.

Byrne, B. M. (2009). *Structural equation modelling with AMOS: Basic concepts, applications, and programming*. Routledge.

Byrne, M., J. Newell, N. Coffey, M.C.O. Hara, D. Cooke & S.F. Dinneen, (2012). Predictors of Quality of Life Gains among People with Type 2 Diabetes Participating in the Dose Adjustment for Normal Eating (DAFNE) Structured Education Programme. *Diabetes Research and Clinical Practice*. 98(2): 243-248.

Casey, T. & Wilson-Evered, E. (2012). Predicting uptake of tehnology innovations in online family dispute resolution services: An application and extension of the UTAUT. *Computers in Human Behavior*. 28: 2034-2045.

Cohen J. (1988). *Statistical power analysis for the behavioral sciences*. Mahwah, NJ: Lawrence Erlbaum.

Cohen J. (1992). A power primer. *Psychological Bulletin* 112: 155-159.

Cooper, M.J. (2006). Beliefs and their relationship to eating attitudes and depressive symptoms in men. *Eating Behaviors*. 7: 423–426.

Chang, S.-J., Van Witteloostuijn, A. & Eden, L. (2010). From the editors: common method variance in international business research. *Journal of International Business Studies*. 41(2): 178–184.

Chen, J.S. & Tsou, H.T. (2007). Information technology adoption for service innovation practices and competitive advantage: The case of financial firms. *Information Research* 12(3): paper 314.

Chern J.Y., Wan T.T.H. & Begun J.W. (2002). A Structural Equation Modeling Approach to Examining the Predictive Power of Determinants of Individuals' Health Expenditures. *Journal of Medical Systems*. 26(4): 323-336.

Chiasson, J.L. (2007). Prevention of Type 2 diabetes: fact or fiction? *Expert Opin Pharmacother*. 8(18): 3147–58.

Chin, W.W. (1998). Issues and opinion on structural equation modeling. *Management Information System Quarterly* 22(1): 7-16.

Chin, W.W. (2010). How to write up and report PLS analyses. In *Handbook of Partial Least square: Concept, Methods and Applications in Marketing and Related Fields*. Vincenzo Esposito Vinzi, Wynne W. Chin, Jorg Henseler, and Huiwen Wang, eds., Berlin: Springer, 655-690.

Chin, W. W., Gopal, A. & Salisbury, W. D. (1997). Advancing the theory of adaptive structuration: The development of a scale to measure faithfulness of appropriation. *Information Systems Research*. 8(4): 342–367.

Christmas, T. H. (2005). Using partial least squares approach to predict factors that contribute to the impact of E-Folios on Pre-Service teachers' learning. Ph.D. Thesis. Louisiana State University. USA.

Chua, Y.P. (2009). *Statistik Penyelidikan Lanjutan*. Kuala Lumpur: McGraw Hill Malaysia.

Courvoisier, D.S., Nussbeck, F.W., Eid, M., Geiser, C. & Cole, D.A. (2008). Analyzing the convergent and discriminant validity of states and traits: Development and applications of multimethod latent state-trait models. *Psychological Assessment* 20(3): 270-280.

Dabholkar, P.A., Shepherd, C.D. & Thorpe, D.I. (2000). A comprehensive framework for service quality: an investigation of critical conceptual and measurement issues through a longitudinal study. *Journal of Retailing*. 76(2): 139-173.

David R, Whiting D, Guariguata L, Weil C & Shaw J. (2011). IDF Diabetes Atlas: global estimates of the prevalence of diabetes for 2011 and 2030. *Diabetes Research and Clinical Practice*. 94(3):311–21.

De Vaus, D. (2005). *Services in social research.* 5ft Edition. London: Routledge-Taylor & Francis Group.

Debono, M. & E. Cachia. (2007). The Impact of Diabetes on Psychological Well Being and Quality of Life. The Role of Patient Education. *Psychology, Health & Medicine*. 12(50): 545-555.

Diabetes Prevention Program Research Group. (2002). Reduction in the incidence of type 2 diabetes with life-style intervention or metformin. *New England Journal of Medicine* 346: 393-403.

Diabetes Research and Training Center. (1998). University of Michigan.

Ding, C.H., Teng, C.L. & Koh, C.N. (2006). Knowledge of Diabetes Mellitus among Diabetic and Non-Diabetic Patients in Klinik Kesihatan Seremban. *Med J Malaysia* 61(4): 399-404.

DM Newsletter. (2014). *Berita KONTROL*. Selangor Darul Ehsan. Diabetes Malaysia.

Dunst C.J. & Trivette C.M. (2009). Meta-Analytic Structural Equation Modeling of the Influences of Family-Centered Care on Parent and Child Psychological Health. International Journal of Pediatrics. DOI:10.1155/2009/576840.

Eckert, K. (2012). Impact of Physical Activity and Bodyweight on Health-Related Quality of Life in People with Type 2 Diabetes. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*. 5 (1): 303-311.

Eckman, K & Walker, R. (2008). Knowledge, Attitudes and Practice (KAP) Survey-summary report for the Duluth Lakeside stormwater reduction project (LSRP). Duluth: Water Resources Center, University of Minnesota.

Edwards, A. (2013). Diabetics Getting Younger, The Star, November. Retrieved from http://www.thestar.com.my/News/Nation/2013/11/14/Diabetics-getting-younger-Disease-to-affect-productivity-and-quality-of-life-in-the-long-run.aspx/

Fadia, Y.A.M. & El-Sayed, M.M. A. (2012). Health Education Intervention Improves Knowledge, Attitude and Practices of Mothers of Insulin Dependent Diabetes Mellitus. *World Applied Sciences Journal*. 17(11): 1398-1404.

Farush Khan, F. F. (2014). Diabetes Kian Membimbangkan. *Harian Metro*. 20 January: 1-4.

Fenwick, E., G. Rees, K. Pesudovs, M. Dirani, Kawasaki, R., Wong, T & Lamoureux, E. (2012). Social and Emotional Impact of Diabetic Retinopathy: A review. *Clinical & Experimental Ophthalmology*. 40(1): 27-38.

Fezeu, L., Fointama, E., Ngufor, G., Mbeh, G. & Mbanya, J.C. (2010). Diabetes awareness in general population in Cameroon. *Diabetes research and clinical practice*. 90: 312–318.

Field, A. (2009). *Discovering Statistics using SPSS for Windows.* Third Edition, London-Thousand Oaks-New Delhi: Sage publications.

Filzmoser, P. (2005). Identification of multivariate outliers: A performance study. *Austrian Journal of Statistics* 34(2): 127-138.

Foma, M. A., Saidu, Y., Omoleke, S. A. & Jafali, J. (2013). Awareness of diabetes mellitus among diabetic patients in the Gambia: a strong case for health education and promotion. *BMC Public Health*. 13(1124): 1-18.

Fornell, C. & Larcker, D.F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research* 18(1): 39-50.

Fornell, C., Johnson, M.D., Anderson, E.W., Jaesung, C. & Bryant, B.E. (1996). The American customer satisfaction index: Nature, purpose and findings. *Journal of Marketing* 60(4): 7-18.

García, A. A., Bose, E., Zuñiga, J. A. & Zhang, W. (2019). Mexican Americans' diabetes symptom prevalence, burden, and clusters. *Applied Nursing Research*. 46: 37–42.

Gefen, D., Straub, D.W. & Boudreau, M. C. (2000). Structural equation modelling and regression: Guidelines for research practice. *Communications of the Association for Information Systems* 4: 1–79.

Geraldine, A. (2013). Dying early from chronic diseases. *New Straits Times*. 27 September: 1-2.

Gerbing, D.W. & Anderson, J.C. (1988). An updated paradigm for scale development incorporating unidimensionality and its assessment. *Journal of Marketing Research*. 25(2): 186-192.

Gholami, R., Sulaiman, A.B., Ramayah, T. & Molla, A. (2013). Senior managers' perception on green information systems (IS) adoption and environmental performance: Results from a field survey. *Information and Management* **50**(7): 431-438.

Givshad, R.D., Saadoldin, S.N. & Esmaily, H. (2015). The Relationship of Perceived Severity of Premenstrual Syndrome with Knowledge, Attitude and Recorded Severity of Syndrom by a Daily Calendar among University Students in Iran. J Midwifery Reprod Health. 4(1): 522-529.

Glanz, K., Lewis, F. M. & Rimer, B. K. (1997). Health behavior and health education: Theory, research, and practice (3rd ed.). San Francisco, CA: Jossey-Bass.

Goldstein, C.M., Josephson, R., Xie, S. & Hughes, J.W. (2012). Current Perspectives on the Use of Meditation to Reduce Blood Pressure. *International Journal of Hypertension* 2012: 1-11.

Goz. F., Karaoz, S., Goz, M., Ekiz, S. & Cetin, I. (2007). Effects of the Diabetic Patients‟ Perceived Environment on their Quality of Life. *Journal of Clinical Nursing*. 16(7): 1353-1360.

Gotz, O., Liehr-Gobbers, K. & Krafft, M. (2010). Evaluation of structural equation models using the partial least square (PLS) approach. In *Handbook of Partial Least Square: Concept, Methods and Applications in Marketing and Related*

Fields. Vincenzo Esposito Vinzi, Wyne W. Chin, Jorg henseler and Huiwen Wang, eds., Berlin: springer, 691-711.

Green, D.T. & Pearson, J.M. (2004). A confirmatory factor analysis of two web site usability instruments. *Proceedings of the Third Annual Workshop on HCI Research in MIS*, hlm. 35 - 39.

Grewal, R., Cote, J.A. & Baumgartner, H. (2004). Multicollinearity and measurement error in structural equation models: Implications for theory testing. *Marketing Science* 23(4): 519-529.

Gudergan, S.P., Ringle, C.M., Wende, S. & Will, A. (2008). Confirmatory tetrad analysis in PLS path modeling. *Journal of Business Research* 61: 1238-1249.

Guidelines Committee. (2003) European Society of Hypertension-European Society guidelines for the management of arterial hypertension. *J Hypertens* 21: 1011–1053.

Gunay, T., Ulusel, B., Velipasaoglu, S., Unal, B., Ucku, R. & Ozgener, N. (2006). Factors affecting adult knowledge of diabetes in Narlidere Health District, Turkey. *Acta Diabetol* 43: 142–147.

Gusti Hassan, N.K. (2019). Kerajaan biaya RM2.7 bilion kos diabetes, jantung, kanser. *Sinar Harian*. 14 April: 6.

Habshah, M. & Azmi, J. (2006). The misuse of statistical techniques in research: An observation and experiences. *Prosiding Seminar Kebangsaan Sains Kuantitatif*.

Hair J.F., Black W.C., Babin B.J. & Anderson R.E. (2010). *Multivariate Data Analysis*. 7th Ed. Upper Saddle River, New Jersey: Prentice Hall.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2014). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Sage Publication: Los Angeles.

Hair, J., Ringle, C. and Sarstedt, M. (2013). Editorial-Partial Least Squares Structural Equation Modelling: Rigorous Applications, Better Results and Higher Acceptance. *Long Range Planning*. 46 (1-2): 1-12.

Hair, J. F., Ringle, C. M. & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *The Journal of Marketing Theory and Practice*. 19(2): 139–152.

Hamid, N. (2012). Kesedaran pesakit penting. *Berita Harian*. 14 Oktober: 14.

Hansmann, K.W. & Ringle, C.M. (2005). Enterprise-networks and strategic success – an empirical analysis. Dlm. Theurl, T. & Meyer, E.C. (pnyt.). *Strategies for Cooperation*, hlm. 133-152. Aachen: Shaker.

Hart, H.E., H.J.G. Bilo, W.K. Redekop, R.P. Stolk, J.H. Assink & B. Meyboom-de Jong. (2003). Quality of Life of Patients with Type I Diabetes Mellitus. *Quality of Life Research*. 12: 1089-1097.

Hasan A.R. (2012). The Future of Diabetes in Malaysia. Keynote Address: Malaysian Diabetes Educators Society Seminar 2012. Ministry of Health Malaysia. Subang Jaya, Selangor.

Hashmi, N.R., Manzoor, I. & Daud, S. (2008). Diabetes Mellitus; Awareness among Individuals Attending Out Patient Department of Ghurki Trust Teaching Hospital. *Professional Med J Mar*. 15(1): 96-100.

Helgeson, V.S. (2003). Environment and Quality of Life. *Quality of Life Research*. 12(1): 25-31.

Henseler, J., Ringle, C.M. & Sinkovics, R.R. (2009). The use of partial least squares path modeling in international marketing. *Advances in International Marketing* 20: 277–319.

Herpburn D.A., MacLeod K.M., Deary I.J. & Frier B.M. (1994). Structural Equation Modeling of Symptoms, Awareness and Fear of Hypoglycemia, and Personality in Patients With Insulin-Treated Diabetes. *Diabetes Care*. 17(11): 1273-1280.

Hjelm, K., Mufunda, E., Nambozi, G. & Kemp, J. (2003). Preparing nurses to face the pandemic of diabetes mellitus: a literature review. *J Adv Nurs*. 41(5): 424–34.

Hoëbes, K.H. & Matengu, K. (2014). Knowledge and Understanding of Menopause and Menopausal Symptoms: A Namibian Perspective. *International Journal of Health Sciences*. 2(2): 163-183.

Hulland, J. (1999). Use of partial least squares (PLS) in strategic management research: a review of four recent studies. *Strategic Management Journal*. 20(2): 195–204.

Inkpen, A.C. & Birkenshaw, J. (1994). International joint ventures and performance: An interorganizational perspective. *International Business Review* 3(3): 201-217.

Ismail, W.R., Mamat, N.J.Z., Lee, Y.L., Mustafa, Z., Suradi, N.R.M. & Shahabuddin, F.A. (2011). Technology acceptance model for the use of SPIN in UKM. *Proceedings of UMTAS*, hlm. 92-96.

Jaccard, J., Dittus, P. & Gordon, V. (1996). Maternal correlates of adolescent sexual and contraceptive behavior. Family Planning Perspectives. 28: 159–65.

Ju, L.C., Shahar, S., Yahya, H.M., Ching, T.S., Mohd Nor, N.S., Chuo, L.H, Mohd Zaki, M.F., Salehuddin, D. & Mukhsan, N. (2010). Tahap Pengetahuan Pemakanan dan Kesedaran Kesihatan di Kalangan Pesakit Diabetes Mellitus di Klinik Kesihatan, Cheras, Kuala Lumpur, Malaysia. *Sains Malaysiana*. 39(3): 505–511.

Kanji, G.K. (1998). Measurement of business excellence. *Total Quality Management* 9(7): 633-643.

Karuthan, C. (2009). *Structural Equation Modeling using AMOS*. Monograf tidak diterbitkan.

King, H., Aubert, R.E. & Herman, W.H. (1998). Global burden of diabetes, 1995-2025. *Diabetes Care*. 21(9): 1414-1431.

Kline, R. B. (2005). *Principles and practice of structural equation modelling*. New York: Guilford press.

Kline, R.B. (2011). *Principles and Practice of Structural Equation Modeling*. 3rd ed. New York: The Guilford Press.

Knowler, W.C., Barrett-Connor, E., Fowler, S.E., Hamman, R.F., Lachin, J.M. & Walker, E.A. (2002). Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *New England Journal of Medicine*. 346(6): 393–403.

Kosaka, K., Noda, M. & Kuzuya, T. (2005). Prevention of type 2 diabetes by lifestyle intervention: a Japanese trial in IGT males. Diabetes Research and Clinical Practice. 67: 152–62.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement* 30: 607-610.

Kwach B., Ongati O. & Simwa R. (2011). Mathematical Model for Detecting Diabetes in the Blood. Applied Mathematical Sciences. 5(6): 279-286.

Lai, P., S.S. Chua, C.H. Tan & S.P. Chan, (2012). Validation of the Diabetes, Hypertension and Hyperlipidemia (DHL) Knowledge Instrument in Malaysia. BMC Medical Research Methodology, 12(1): 18.

Landon, Megan. (2006). Environment, Health and Sustainable Development. England: Open University Press.

Letchuman, G.R., Wan Nazaimoon, W.M., Wan Mohamad, W.B., Chandran, L.R., Tee, G.H., Jamaiyah, H., Isa, M.R., Zanariah, H., Fatanah I. & Ahmad Faudzi Y. (2010). Prevalence of diabetes in Malaysia National Health Morbidity Survey III 2006. *Med J. Malaysia*. 65(3):180-6.

Lim M.Y. & Liong C.Y. (2010). Analisis terhadap keputusan ujian saringan diabetes menggunakan model regresi logistik. *Prosiding Persidangan Antarabangsa Sains Matematik Kedua (ICMS2010)*. 987-994.

Live-well Nutraceuticals. (2013). Hakikat Kemanisan Hidup. *Berita Harian*. 6 January: 14.

Live-well Nutraceuticals. (2013). Kebal Insulin. *Berita Harian*. 6 January: 15.

Łopatyński J, Mardarowicz G. & Szcześniak G. (2003). A comparative evaluation of waist circumference, waist-to-hip ratio, waist-to-height ratio and body mass index as indicators of impaired glucose tolerance and as risk factors for type-2 diabetes mellitus. *Ann Univ Mariae Curie Sklodowska Med* 58(1): 413–419.

Luo, M.M., Remus, W. & Chea, S. (2006). Technology acceptance of internet-based information services: An integrated model of TAM and U&G theory.

Proceedings of the Twelfth Americas Conference on Information Systems, hlm. 1139-1150.

Ma, H. (2006). Cholesterol and Human Health. *The Journal of American Science* 2(1): 46-50.

Malhotra, N.K. (2009). *Basis Marketing Research: A Decision-Making Approach.* 3rd edition, Perason Education: Uppe Saddle River, New Jersey.

Mashige, K.P., Notshweleka, A., Moodley, S., Rahmtoola, F.H., Sayed, S.B., Singh, S. & Sardiwalla, Z. (2008). An assessment of the level of diabetic patients' knowledge of diabetes mellitus, its complications and management in Durban, South Africa. *The South African Optometrist*. 67(3): 95-105.

Mehdad S., Hamrani A., El Kari K., El Hamdouchi A., Barakat A. & El Mzibri M. (2012). Body mass index, waist circumference, body fat, fasting blood glucose in a sample of Moroccan adolescents aged 11–17 years. *J NutrMetab* 2012: 510458.

Metro Ahad. (2012). Galak kesedaran diabetes. Ruanga sihat, ms F6. 9 Disember 2012.

Middelkoop, B.J.C. & Wal G.V.D. (2004). Culture-specific diabetes care for Surinam South Asians with a low socio-economic position: who benefits. *Patient Educ Couns*. 53:353–358

Milone, G. (2010). A Mutivariate Strategic Perspective for the Evaluation of Customer Satisfaction in Great Distribution. *Journal of Applied Quantitative Methods*. 302.

Minhat, H.S. & Hamedon, T.R. (2014). Understanding Towards Diabetes Mellitus among Rural Adult Community in Malaysia. *World Journal of Medical Sciences*. 11(2): 217-221.

Mingguan Malaysia. (2012). Sengsara akibat diabetes. Ruangan Kesihatan, ms 17. 10 Jun 2012.

Mlynarczyk, S.M. (2013). Adolescents‟ Perspectives of Parental Practices Influence Diabetic Adherence and Quality of Life. *Paediatric Nursing*. 39(4): 181-189.

Mohamad Saleh, S., Azahari, M. H. & Ismail, A. I. (2013). Diabetic Healthcare Awareness in Malaysia: The Role of Poster as a Communication Medium. *Procedia - Social and Behavioral Sciences* 91(2013): 539–544.

Mohamed, I.S. (2019). Tahap kesedaran bahaya NCD rendah. *Berita Harian*. 7 Ogos: 5.

Mohd Ali, A.F. (2016). 3.5 juta rakyat hidap diabetes. *Utusan*. 8 April: 6.

Mohd Najib, M.N., Dali, A.F., Ahmad, A., Sulaiman, S., Hussin, S.N. & Mokhtar, N.A. (2014). Knowledge and Attitude on Diabetes Among Public In Kota Bharu Kelantan, Malaysia. *International Journal of Education and Research*. 2(2): 1-10.

Mokdad AH, Ford ES, Bowman BA, Dietz WH, Vinicor F. & Bales VVS. (2001). Prevalence of obesity, diabetes, and obesity-related health risk-factors. *JAMA The Journal of the American Medical Association*. 289(10):76–9.

Mooi, E.A., & Sarstedt, M. (2011). *A concise guide to market research: The process, data, and methods using IBM SPSS Statistics*. Berlin: Springer.

Moritz, S., Hünsche, A. & Lincoln, T.M. (2014). Nonadherence to antipsychotics: The role of positive ttitudes towards positive symptoms. *European Neuropsychopharmacology*. 24: 1745–1752.

Moseley, M. (2000). Teaching for environmental literacy. *Clearing House*. 74(1): 23-24.

Mostafa, M.M. (2005). An empirical study of patients' expectation and satisfaction in Egyptian hospitals. *International Journal of Health Care Quality Assurance*. 18(7): 516-532.

Mustaffa, B.E. (2004). Diabetes Epidemic in Malaysia. *Medical Journal of Malaysia*. 59(3): 295-296.

Mustaffa B.E. (1999). Diabetes in Malaysia: a challenge to prevention and control. J Asian Fed Endocr Soc. 17:44–7.

Mustaffa Embong. (1990). Diabetes in Malaysia: Problems and challenges. Med. J. Malaysia. 45(l): 1-7.

Murugesan, N., Snehalatha, C., Shobhana, R., Roglic, G. & Ramachandran, A. (2007). Awareness about diabetes and its complications in the general and diabetic population in a city in southern India. Diabetes Research and Clinical Practice. 77: 433–437.

Nadia H. (2012). Berita Harian. Kesedaran pesakit penting. Ruangan sihat. Ms 14-15. 14 Oktober 2012.

National Health and Medical Research Council. (2001). National Evidence Based Guidelines for the Management of Type 2 Diabetes Mellitus. Sydney: Australian Centre for Diabetes Strategies.

Ng, S.H., Chan, K.H., Lian, Z.Y., Chuah, Y.H., Waseem, A.N. & Kadirvelu, A. (2012). Reality vs Illusion: Knowledge, Attitude and Practice among Diabetic Patients. *International Journal of Collaborative Research on Internal Medicine & Public Health*. 4(5): 723-732.

Nisar, N., Ahmad Khan, I., Qadri, M.H. & Sher, S.A. (2008). Knowledge and risk assessment of diabetes mellitus at primary care level: a preventive approach required combating the disease in a developing country. *Pak J Med Sci*. 24(5): 667-72.

Nizar, H. (2017). Program 'Blue Walk' untuk kesedaran penyakit diabetes. *Utusan*. 12 November: 4.

Norliza, A., Maizah Hura,A. & Robiah, A. (2006). A comparative study on some methods for handling multicollinearity problems. *Matematika* 22(2): 109-119.

Norzaidi, M.D. & Intan Salwani, M. (2009). Evaluating technology resistance and technology satisfaction on students performance. *Campus-Wide Information Systems* 26(4): 298-312.

Nunnaly, J.C. (1978). *Pscyhometric Theory*. New York: McGraw-Hill.

O'Brien, M. P., Gordon, J. L., Bearden, C. E., Lopez, S. R., Kopelowicz, A. & Cannon, T. D. (2006). Positive family environment predicts improvement in symptoms and social functioning among adolescents at imminent risk for onset of psychosis. *Schizophrenia Research*. 81 (2006): 269– 275.

Ogden, C., Carroll, M., Curtin, L., McDowel, M. & Flegal, K. (2006). Prevalence of overweight and obesity in the United States, 1999-2008. *JAMA: Journal of the American Medical Association* 295: 1549-1555.

Okosun, I.S., Davis-Smith, M. & Seale, J.P. (2012). Awareness of diabetes risks is associated with healthy lifestyle behavior in diabetes free American adults: evidence from a nationally representative sample. Primary Care Diabetes. http://dx.doi.org/10.1016/j.pcd.2011.12.005.

Oliveira, S.C., Santos, A.A. & Pavarini, S.C.I. (2014). The relationship between depressive symptoms and family functioning in institutionalized elderly. Rev Esc Enferm USP. 48(1): 65-71.

Omobuwa, O. & Alebiosu, O.C. (2014). Awareness of diabetes amongst undergraduates in a Nigerian University, South West Nigeria. *Sahel Medical Journal*. 17(1): 29-33.

Omondi, D.O., Walingo M.K., Mbagaya G.M. & Othuon L.O.A. (2010). Understanding Physical Activity Behavior of Type 2 Diabetics Using the Theory of Planned Behavior and Structural Equation Modeling. *International Journal of Human and Social Sciences*. 5(3): 160-167.

Ooyub, S., Ismail, F. & Daud, N. (2004). Diabetes program in Malaysia—current and future. *NCD Malaysia*. 3: 6–12.

Pallant, J. (2011). *SPSS survival manual: A step by step guide to data analysis using SPSS*. 4th Edition. NSW, Australia: Allen & Unwin.

Park, S., Kim, B. & Park, M. (2016). The relationship between parenting attitudes, negative cognition, and the depressive symptoms according to gender in Korean adolescents. *International Journal of Mental Health Systems*. 10(35): 1-8.

Pasala, S.K., Rao, A.A. & Sridhar. G.R. (2010). Built environment and diabetes. *Int J Diab Dev Ctries*. 30(2): 63-68.

Patel, V., Koshy, S. & Ravindra, H.N. (2014). Effectiveness of structured teaching programme on knowledge regarding menopausal symptoms and its management among women. IOSR J Nurs Health Sci. 3: 22-6.

Peng, D.X., Schroeder, R.G. & Shah, R. (2008). Linking routines to operations capabilities: A new perspective. *Journal of Operations Management* 26: 730-748.

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y. & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology*. 88(5): 879-903.

Podsakoff, P.M. & Organ, D.W. (1986). Self-reports in organizational research: Problems and prospects. *Journal of Management* 12(4): 531-544.

Poornima, S., Ragavendra, L. & Shivakumar, K.M. (2012). Awareness regarding diabetes mellitus among degree college students of Mandya City, Karnataka, India. *Indian J. Prev. Soc. Med*. 43(3):283-287.

Prajapati, V. B., Blake, R., Acharya, L. D. & Seshadri, S. (2018). Assessment of quality of life in type II diabetic patients using the modified diabetes quality of life (MDQoL)-17 questionnaire. *Brazilian Journal of Pharmaceutical Sciences*, 53(4).

Preston, C.C. & Colman, A.M. (2000). Optimal number of response categories in rating scales: Reliability, validity, discriminating power, and respondent preferences. *Acta Psychologia.* 104: 1-15.

Raheja, B.S., Kapur, A., Bhoraskar, A., Sathe, S.R., Jorgensen, L.N. & Moorthi, S.R. (2001). Diab Care Asia-India Study: Diabetes care in India-Current status. J Assoc Physicians India. 49: 717–22.

Rahim, M.A. & Magner, N.R. (1995). Confirmatory factor analysis of the styles of handling interpersonal conflict: First-order factor model and its invariance across groups. *Journal of Applied Psychology* 80(1): 122-132.

Ramachandran, A. (2014). Know the signs and symptoms of diabetes. *Indian J Med Res*. 140(5): 579–581.

Ramachandran, A., Snehalatha, C., Baskar, A.D., Mary, S., Kumar, C..K. & Selvam, S. (2004). Temporal changes in prevalence of diabetes and impaired glucose tolerance associated with lifestyle transition occurring in the rural population in India. Diabetologia. 47: 860–5.

Ramachandran, A., Snehalatha, C., Mary, S., Mukesh, B., Bhaskar, A.D. & Vijay, V. (2006). Indian Diabetes Prevention Programme (IDPP). The Indian Diabetes Prevention Programme shows that lifestyle modification and metformin prevent type 2 diabetes in Asian Indian subjects with impaired glucose tolerance (IDPP-1). *Diabetologi*a. 49(2): 289–97.

Ramayah, T., Lee, J.W.C. & In, J. B.C. (2011). Network collaboration and performance in the tourism sector. *Service Business.* 5(4): 411–428.

Ramayah, T., Yeap, J. A. & Ignatius, J. (2013). An Empirical Inquiry on Knowledge Sharing Among Academicians in Higher Learning Institutions. *Minerva.* 51(2):131–154.

Ranjini, A., Subashini, A. & Ling, H.M. (2003). A Knowledge, attitude and practice (KAP) study of diabetes mellitus among patients attending Klinik Kesihatan Seri Manjung. *NCD Malaysia*. 2(2): 6-16.

Rathod, G.B., Rathod, S., Parmar, P. & Parikh, A. (2014). Study of knowledge, attitude and practice of general population of Waghodia towards diabetes mellitus. *Int J Cur Res Rev*. 6(1): 63-68.

Rav-Marathe, K., Wan, K.T.H. & Marathe, S. (2016). A Systematic Review on The KAP-O Framework For Diabetes Education And Research. *Medical Research Archives*. 4(1): 1-21.

Razali, N.M. & Wah, Y.B. (2011). Power comparisons of shapiro-wilk, kolmogorov-smirnov, lilliefors and Anderson-darling tests. *Journal of Statistical Modeling and Analytics*. 2(1): 21–33.

Reed M.C. & Tu H.T. (2002). Triple jeopardy: low income, chronically ill and uninsured in America. Issue Brief Cent Stud Health Syst Change. 49:14. http://www.hschange.org/CONTENT/411/411.pdf

Ringle, C.M., Wende, S. & Will, A. (2005). SmartPLS 2.0 M3. www.smartpls.de.

Robby K. (2012). Correlation of Selenium and other antioxidants in diabetic patients with and without complications. Free Radicals and Antioxidants Vol. 2, Issue 1.for Diabetic Ketoacidosis. The Journal of Pediatrics, 160, 4.

Rolka, M.S., Burrows, N.R., Li, Y.& Geiss, L.S. (2008). Self-reported prediabetes and riskreduction activities—United States, 2006. MMWR Morbidity and Mortality Weekly Report. 57(44): 1203–5.

Roth, C.E. (1992). Environmental Literacy: Its Roots, Evolution and Directions in the 1990s. Ohio: Clearinghouse for Science, Mathematics and Environmental Education.

Rouibah, K., Ramayah, T. & May, O.S. (2011). Modeling user acceptance of internet banking in Malaysia: A partial least square (PLS) approach. Dlm. Sharma, S.K. (pnyt.). *E-adoption and Socio-Economic Impacts: Emerging Infrastructural Effects*, hlm. 1-23. IGI Global: DOI: 10.4018/978-1-60960-597-1.ch001.

Saadat N., Salehi P., Emami H. & Azizi, F. (2005). The Relationship between Glucose Intolerance and Blood Pressure, Body Mass Index, and Waist to Hip Ratio in Tehran Urban Population: "Tehran Lipid and Glucose Study". *International Journal of Endocrinology and Metabolism* 1: 37-47.

Sadat, N., Siraj, M.D., Omar, Z.A., Samad, M.I., Ismail, F., Daud, N.A., Kamarudin, A.S., Ishak, J., Ramly, R., Roslina, N.M., Jailani, R., Rajalakshimi, K., Usha, M., Arshad, J., Ismail, S., Said, S.H., Nizam, S., Anizah, A. & Lan, H.S. (2003). Direct costs of diabetes in an outpatient setting in Malaysia. *NCD Malaysia*. 2003; 2: 19–27.

Sagaran, R. & Srinivasan, N. (2014). Public awareness of diabetes mellitus in Klang district, Selangor. International Journal of Allied Medical Sciences and Clinical Research (IJAMSCR). 2(3): 186-195.

Sang S.L., Lee J.D. & Lee J. (2010). E-government adoption in Cambodia: A partial least squares approach. *Transforming Government: People, Process and Policy* 4(2): 138-157.

Satibi, Z. (2017). Rawatan murah diabetes. *MyMetro*. 15 January: 8.

Sattler, H., Volckner, F., Riediger, C. & Ringle, C.M. (2010). The impact of brand extension success drivers on brand extension price premiums. *International Journal of Research in Marketing* 27: 319-328.

Schmidt, S., Muhlan, H. & Power, M. (2005). The EUROHIS-QOL 8-item index: Psychometric results of a cross-cultural field study. *European Journal of Public Health* 16(4): 420-428.

Schober, E., Otto, K.P., Dost, P., Jorch N. & Holl, R. (2011). Association of Epilepsy and Type 1 Diabetes Mellitus in Children and Adolescents: Is There an Increased Risk for Diabetic Ketoacidosis. *The Journal of Pediatrics*. 160, 4.

Schumacker, R.E. & Lomax, R.G. (2004). *A Beginner's Guide to Structural Equation Modeling*. New Jersey: Lawrence Erlbaum Associates.

Second national health and morbidity survey. (1996). Malaysia: Institute of Public Health, Ministry of Health; 1996.

Sekaran, U. (2006). *Research Methods for Business*. 4th ed. New York: John Wiley & Sons.

Sekaran, U. & Bougie, R. (2010). *Research Methods for Business: A skill Building Approach*. UK: John Wiley and Sons.

Sepp E., Kolk H., Loivukene K. & Marika M. (2014). Higher blood glucose level associated with body mass index and gut microbiota in elderly people. *Microbial Ecology in Health & Disease* 25: 1-8.

Shah, R. & Goldstein, S.M. (2006). Use of structural equation modeling in operations management research: Looking back and forward. *Journal of Operations Management* 24: 148-169.

Shriraam, V., Rani, M.A., Sathiyasekaran, B.W.C. & Mahadevan, S. (2013). Awareness of gestational diabetes mellitus among antenatal women in a primary health center in South India. *Indian Journal of Endocrinology and Metabolism*. 17(1): 146-148.

Sidek, M.N. (2002). *Rekabentuk Penyelidikan: Falsafah, Teori dan Praktis*. Serdang: Penerbit Universiti Putra Malaysia.

Sidek, M.N & Wan Marzuki, W.J. (2007). Analisis kesahan dan kebolehpercayaan inventori penilaian kaunselor terhadap penyelia (IPKtP). *Jurnal PERKAMA* 13: 1-13.

Siti Aishah, H. & Kaseh, A.B. (2008). Exploratory versus confirmatory factor analysis. *Seminar Penyelidikan dan Pembangunan Sumber Manusia 2008*. Faculty of Educational Studies, UPM.

Skarfors E.T., Selinus K.I. & Lithell H.O. (1991). Risk factors for developing noninsulin dependent diabetes: a 10 year follow up of men in Uppsala. *BMJ* 303: 755-60.

Soltanian, A.R., Bahreini, F. & Mohammad Afkhami-Ardekani, M.A. (2007). People awareness about diabetes disease and its complications among aged 18 years and older in Bushehr port inhabitants (Iran). *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*. (2007)1: 245—249.

Soyed, S.A., Das, S. & Begum, T. (2005). Foot Involvement in diabetes mellitus. *Asian J Diabetology*. 7(1): 15–24.

Spitznagel, M.B., Tremont, G., Brown, L.B. & Gunstad, J. (2006). Cognitive Reserve and the Relationship Between Depressive Symptoms and Awareness of Deficits in Dementia. *J Neuropsychiatry Clin Neurosci*. 18(2): 186-190.

Stahl F. & Johansson R. (2009). Diabetes mellitus modelling and short-term prediction based on blood glucose measurements. *Mathematical Biosciences* 217(2009): 101-117.

Stanford, J., Kaiser, M., Ablah, E., Dong, F., Paull-Forney, B. & Early, J. (2012). The effect of weight loss on fasting blood sugars and hemoglobin A1c in overweight and obese diabetics and non-diabetics. *Journal of Diabetes Mellitus* 2(1): 126-130.

Steyn, N.P., Mann, J., Bennett, P.H., Temple, N., Zimmet, P. & Tuomkhto, J. (2004). Diet, nutrition and the prevention of type 2 diabetes. *Public Health Nutrition*. 7(19): 147–65.

Stone M. (1974). Cross-validator choice and assessment of statistical predictions. *Journal of the Royal Statistical Society* 36(2): 111–147.

Suhr, D. D. (2002). SEM for health, business, and education. *Proceedings from the 27th Annual SAS® Users Group International Conference*. April 14-17, Orlando, Florida.

Suzan, A. (2012). Menangani terapi insulin. Ruangan sihat. *Berita Harian*. Ms 14. 4 Nov 2012.

Tan S.L., Juliana S. & Sakinah H. (2011). Dietary Compliance and its Association with Glycemic Control among Poorly Controlled Type 2 Diabetic Outpatients in Hospital Universiti Sains Malaysia. *Malaysian Journal of Nutrition*. 17(3): 287-299.

Tanjia, N., Fannana, T., Ahmed Naved, M. & Sultana, S. (2016). Assessing the Knowledge, Attitude and Practice of Diabetes Mellitus among Diabetes Patients in Dhaka City, Bangladesh. *J Pharm Chem Biol Sci*. 4(1): 64-75.

Teck-Hong, T. & Suhaimi, F. (2014). Assessing Diabetes Education and Self-Management Program on Quality of Life among Young Diabetic Patients: Case of Klang Valley, Malaysia. *Australian Journal of Basic and Applied Sciences*. 8(7): 352-359.

Tenenhaus, M., Vinzi, V.E., Chatelin, Y.M. & Lauro, C. (2005). PLS path modeling. *Computational Statistics and Data Analysis* 48: 159-205.

Tesfaye S., Chaturvedi N., Eaton S., Ward J., Manes C. & Ionescu-Tirgoviste, C. (2005). Vascular risk factors for diabetic neuropathy. *New England Journal of Medicine* 352: 341-350.

Trikkalinou, A., Papazafiropoulou, A.K. & Melidonis, A. (2017). Type 2 diabetes and quality of life. *World J Diabetes*. 8(4): 120-129.

Tuomilehto, J., Lindstrom, J., Eriksson, J.G., Valle, T.T., Hamalainen, H. & Ilanne-Parikka, P. (2001). Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *New England Journal of Medicine*. 344: 1343–50.

Turkyilmaz, A. & Ozkan, C. (2007). Development of a customer satisfaction index model: An application to the Turkish mobile phone sector. *Industrial Management & Data Systems* 107(5): 672-687.

Ullman, J.B. (2001). Structural equation modeling. In B. G. Tabachnick, & L. S. Lidell (4th Ed.), *Using multivariate statistics* (pp.653-771). Needham Heights, MA: Allyn & Bacon.

Van der Sande, M.A., Walraven, G.E., Milligan, P.J., Banya, W.A., Ceesay, S.M., Nyan, O.A. & McAdam, K.P. (2001). Family history: an opportunity for early interventions and improved control of hypertension, obesity and diabetes. *Bull World Health Organ*. 79: 321–328.

Van Eijk, K.N.D., Bloma, J. Gussekloo, B.C.P. Polak, Y. & Groeneveld. (2012). Diabetic retinopathy screening in patients with diabetes mellitus in primary care: Incentives and barriers to screening attendance. Diabetes Research and Clinical Practice, 96, 10 – 16.

Veghari G., Sedaghat M., Joshaghani H., Banihashem S., Moharloei P., Angizeh A., Tazik E., Moghaddami A., Hajian-Tilaki K. & ZahedPasha, Y. (2014). The association of fasting blood glucose (FBG) and waist circumference in northern adults in Iran: a population based study. *Journal of Diabetes & Metabolic Disorders* 13(2): 1-6.

Vinzi V. E. (2010). *Handbook of partial least squares: Concepts, methods and applications*. Springer.

Volckner, F., Sattler, H., Hennig-Thurau, T. & Ringle, C.M. (2009). The role of parent brand quality for service brand extension success. *Journal of Service Research* DOI: 10.1177/1094670510370054.

Walter, F.M., Emery, J., Braithwaite, D. and Marteau, T.M. (2004). Lay understanding of familial risk of common chronic diseases: a systematic review and synthesis of qualitative research. *Ann Fam Med*. 2(6): 583–94.

Wan Muhamad A. & Norizan M. (2012). Influence of Hypertension and Diabetes Mellitus on Family History of Heart Attack in Male Patients. Applied Mathematical Sciences. 6(66): 3259-3266.

Wang, R., L., Wu & Hsu, H. (2011). A Path Model of Health-Related Quality of Life in Type 2 Diabetic Patients: A Cross-Sectional Study in Taiwan. *Journal of Advanced Nursing*. 67(12): 2658-2667.

Wee, H.L., Ho, H.K. & Li, S.C. (2002). Public awareness of diabetes mellitus in Singapore. *Singapore Med J*. 2002: 128–34.

Weijters, B., Cabooter, E. & Schillwaert, H. (2010). The effect of rating scale format on response styles: The number of responses categories and response category labels. *International Journal of Research in Marketing*. 27: 236-247.

Westlund, A.H., Kallstrom, M. & Parmler, J. (2008). SEM-based customer satisfaction measurement: On multicollinearity and robust PLS estimation. *Total Quality Management and Business Excellence* 19(7-8): 855-869.

Wild, S., Roglic, G., Green, A., Sicree, R. & King, H. (2004). Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. Diabetes Care, 27(5), 1047-1053.

Wing, R., Goldstein, M.G., Acton, K.J., Birch, L.L., Jakicic, J.M. & Sallis, J.F. (2001). Behavioral science research in diabetes: lifestyle changes related to obesity, eating behavior, and physical activity. *Diabetes Care*. 24(1):117–23.

Wong K.K. (2013). Partial Least Squares Structural Equation Modeling (PLS-SEM) Techniques Using SmartPLS. *Marketing Bulletin* 24, Technical Note 1. 1- 32.

Wong T., Klein R. & Islam, F.E. (2006). Diabetic retinopathy in a multi-ethnic cohort in the United States. *American Journal of Ophthalmology* 141: 446.

Yun, L.S., Hassan, Y., Abd. Aziz, N., Awaisu, A. & Ghazali, R. (2007). A comparison of knowledge of diabetes mellitus between patients with diabetes and healthy adults: A survey from north Malaysia. *Patient Education and Counseling*. 69: 47-54.

Zakaria, M.Q. (2013). Segera Ubah Gaya Hidup. *Utusan Malaysia*. 5 November, 9.

Zinman B., Harris S.B., Gerstein H.C., Young T.K., Raboud J.M. & Neuman J. (2006). Preventing type 2 diabetes using combination therapy: design and methods of the Canadian Normoglycaemia Outcomes Evaluation (CANOE) trial. *Diabetes Obesity and Metabolism 2006* 8(5): 531–7.

APPENDIX A

QUESTIONNAIRE

Universiti Malaysia PAHANG

Model Kesedaran Diabetes Mellitus (MKDM)
"Diabetes Mellitus Awareness Model (DMAM)"

Soal selidik ini bertujuan untuk mengkaji tahap kesedaran orang awam terhadap penyakit diabetes mellitus. Diabetes mellitus (DM) atau juga dikenali sebagai diabetes atau kencing manis merupakan salah satu penyakit tidak berjangkit (NCD) yang merupakan punca utama kematian pramatang di kalangan orang dewasa di Malaysia.

Sehubungan itu, kami memohon jasa baik Dato' / Datin / Profesor / Profesor Madya / Dr. / Tuan / Puan untuk melengkapkan borang soal selidik ini bagi tujuan tersebut. Semua maklum balas akan dirahsiakan dan hanya digunakan untuk tujuan penyelidikan sahaja.

Borang soal selidik ini mengandungi dua bahagian:
Bahagian A - Tandakan (√) pada salah SATU petak yang disediakan.
Bahagian B – F - Penilaian adalah menggunakan skala 1 – 5. Anda dikehendaki menanda SATU pernyataan sahaja berdasarkan pengetahuan dan persepsi anda. Sebagai panduan, anda boleh menjadikan skala berikut sebagai penunjuk dalam memberikan maklum balas terhadap item-item tersebut. Contoh:
(Skala 1 - Sangat tidak setuju; Skala 2 - Tidak setuju; Skala 3 - Neutral; Skala 4 - Setuju; Skala 5 - Sangat setuju)

Anda dikehendaki memberikan jawapan yang ikhlas dalam menilai setiap pernyataan tersebut. Penilaian ini mengambil masa kira-kira 15 hingga 20 minit. Kerjasama serta maklum balas anda amat kami hargai. Sebarang kemusykilan, sila hubungi Mohd Rashid bin Ab Hamid. Tel: 0143371786. Alamat: Fakulti Sains & Teknologi Industri, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang, Kuantan, Pahang. emel: rashid@ump.edu.my. Terima kasih.

BAHAGIAN A: MAKLUMAT RESPONDEN

1 Jantina:
☐ Lelaki ☐ Perempuan

2 Kumpulan umur (tahun):
☐ 18–30 ☐ 51–60
☐ 31–40 ☐ 61+
☐ 41–50

BAHAGIAN A: MAKLUMAT RESPONDEN

3 Bangsa:

- ☐ Melayu
- ☐ Cina
- ☐ India
- ☐ Lain-lain

Nyatakan: _____

4 Tahap pendidikan (tertinggi):

- ☐ Rendah
- ☐ Menengah
- ☐ Pengajian Tinggi
- ☐ Vokasional/Teknikal

5 Status pekerjaan:

- ☐ Bekerja/Bekerja sendiri
- ☐ Tidak bekerja/Pesara
- ☐ Suri rumah/Pelajar
- ☐ Lain-lain

6 Pendapatan sebulan (individu @ isi rumah):

- ☐ < RM 2000
- ☐ RM 2001 - RM 5000
- ☐ RM 5001 - RM 10,000
- ☐ > RM 10,001

7 Status perkahwinan:

- ☐ Belum berkahwin
- ☐ Berkahwin
- ☐ Duda/Janda

8 Berat (kg): _____

9 Tinggi (cm): _____

10 Daripada mana anda mendapatkan maklumat tentang Diabetes Mellitus (DM) / Kencing Manis?

- ☐ a. Pusat kesihatan
- ☐ b. TV/radio
- ☐ c. Poster/pelekat/risalah
- ☐ d. Rakan/saudara
- ☐ e. Suratkhabar
- ☐ f. Masjid/Rumah ibadat
- ☐ g. Sekolah
- ☐ h. Laman sesawang
- ☐ i. Lain-lain. Nyatakan: _____.

11 Saya merupakan penghidap Diabetes Mellitus (DM) / Kencing Manis:

- ☐ Ya
- ☐ Tidak

BAHAGIAN A: MAKLUMAT RESPONDEN

12 Adakah anda tahu apa itu Diabetes Mellitus (DM) / Kencing Manis?

- ☐ Ya
- ☐ Tidak

13 Adakah terdapat penghidap DM dalam kalangan ahli keluarga anda?

- ☐ Ya
- ☐ Tidak

14 Bagaimanakah pengetahuan berkaitan DM dapat ditingkatkan? (pada pandangan anda)

_____

_____.

15 Saya gemar:

- ☐ Membaca
- ☐ Melayari internet
- ☐ Memandu
- ☐ Lain-lain: _____.
- ☐ Memasak
- ☐ Melancong
- ☐ Bersukan

16 Jenis pekerjaan:

- ☐ Pejabat – berhawa dingin
- ☐ Di lapangan / kawasan terdedah
- ☐ Menghadap komputer
- ☐ Pasukan beruniform

BAHAGIAN B: PENGETAHUAN

Sila berikan penilaian anda terhadap setiap pernyataan di bawah berdasarkan skala pengukuran berikut. TANDAKAN (√) jawapan anda.

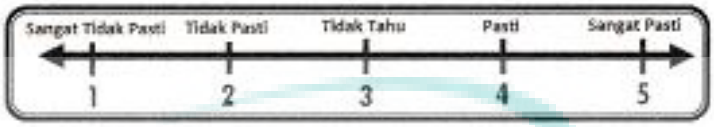
I	Pengetahuan umum Diabetes Mellitus					
	Item	Skala				
		1	2	3	4	5
	a. Diabetes adalah keadaan kadar gula yang tinggi di dalam darah.					
	b. Diabetes adalah keadaan apabila kekurangan penghasilan insulin.					
	c. Diabetes adalah keadaan apabila badan tidak bertindak balas terhadap insulin.					
	d. Diabetes tidak berjangkit.					
	e. Diabetes tidak boleh dirawat.					
	f. Insulin merupakan salah satu hormon yang terhasil di dalam badan.					
	g. Insulin boleh menurunkan tahap gula dalam darah.					
	h. Insulin diperlukan untuk sesetengah pesakit diabetes.					
	i. Pesakit diabetes tidak digalakkan menderma darah.					
	j. Wanita hamil berisiko tinggi menghidap GDM (gestational diabetes mellitus) semasa kehamilan pertama.					
	k. GDM hilang selepas bersalin.					
	l. Wanita yang telah mengalami GDM berisiko menghidap diabetes mellitus jenis 2 pada masa akan datang.					
	m. GDM yang tidak dirawat boleh menimbulkan risiko terhadap anak di dalam kandungan.					

References:

Al-Khawaldeh, O.A. and Al-Jaradeen, N. 2013. Diabetes awareness and diabetes risk reduction behaviors among attendance of primary healthcare centers. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 7: 172–178.

BAHAGIAN B: PENGETAHUAN

Sila berikan penilaian anda terhadap setiap pernyataan di bawah berdasarkan skala pengukuran berikut. TANDAKAN (√) jawapan anda.



2	Faktor risiko Diabetes Mellitus					
	Item	Skala				
		1	2	3	4	5
	a. Diabetes boleh berlaku apabila mengamalkan pengambilan gula yang tinggi.					
	b. Diabetes boleh berlaku apabila mengamalkan pengambilan karbohidrat yang berlebihan.					
	c. Diabetes boleh berlaku apabila mengamalkan pengambilan lemak yang berlebihan.					
	d. Diabetes juga boleh berlaku apabila kurang melakukan aktiviti fizikal secara konsisten.					
	e. Diabetes berisiko tinggi dihadapi apabila mempunyai sejarah keluarga berkaitan diabetes.					
	f. Obesiti/Kegemukan boleh mengakibatkan diabetes.					
	g. Diabetes boleh berlaku disebabkan oleh pengambilan alkohol yang berlebihan.					
	h. Merokok juga boleh menyumbang kepada diabetes mellitus.					
	i. Wanita hamil berisiko tinggi menghidap diabetes mellitus.					
3	Pencegahan Diabetes Mellitus					
	a. Pencegahan diabetes boleh dilakukan dengan melakukan senaman/aktiviti fizikal yang kerap.					
	b. Pencegahan diabetes boleh dilakukan dengan mengurangkan/mengawal berat badan.					
	c. Pencegahan diabetes boleh dilakukan dengan mengamalkan diet seimbang.					
	d. Pencegahan diabetes boleh dilakukan dengan berhenti merokok.					

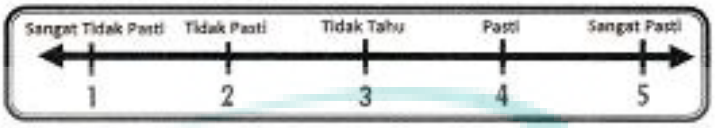
References:

Sagaran, R. and Srinivasan, N. 2014. Public awareness of diabetes mellitus in Klang district, Selangor. International Journal of Allied Medical Sciences and Clinical Research (IJAMSCR). **2**(3): 186-195.

Omobuwa, O. and Christopher Alebiosu.O. 2014. Awareness of diabetes amongst undergraduates in a Nigerian University, South West Nigeria. Sahel Medical Journal. **17**(1): 29-33.

BAHAGIAN B: PENGETAHUAN

Sila berikan penilaian anda terhadap setiap pernyataan di bawah berdasarkan skala pengukuran berikut. TANDAKAN (√) jawapan anda.



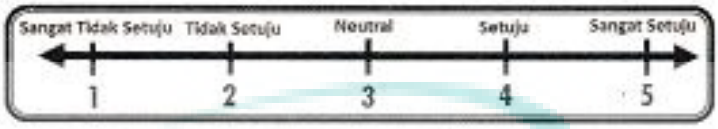
		Skala				
	Item	1	2	3	4	5
4	Komplikasi Diabetes Mellitus					
	a. Diabetes boleh menyebabkan buta.					
	b. Diabetes boleh menyebabkan masalah mata.					
	c. Diabetes boleh menyebabkan kegagalan buah pinggang.					
	d. Diabetes boleh menyebabkan serangan jantung.					
	e. Diabetes boleh menyebabkan hilang deria rasa/kebas pada tangan dan kaki.					
	f. Komplikasi diabetes boleh menyebabkan pemotongan anggota badan.					
	g. Diabetes boleh menyebabkan tekanan darah tinggi.					
	h. Diabetes boleh menyebabkan strok.					
	i. Diabetes boleh menyebabkan mati pucuk.					
5	Rawatan Diabetes Mellitus					
	a. Diet merupakan rawatan terhadap diabetes.					
	b. Senaman/aktiviti fizikal merupakan rawatan terhadap diabetes.					
	c. Salah satu cara rawatan terhadap diabetes adalah dengan pengambilan ubat pil antidiabetik.					
	d. Suntikan insulin juga digunakan semasa rawatan diabetes.					
	e. Pemantauan tahap glukos dalam darah sangat penting bagi rawatan pesakit diabetes.					

References:

Fezeu, L., Fointama, E., Ngufor, G., Mbeh, G. and Mbanya, J.C. Diabetes awareness in general population in Cameroon. Diabetes research and clinical practice. **90**: 312–318.

BAHAGIAN C: SIKAP

Sila berikan penilaian anda terhadap setiap pernyataan di bawah berdasarkan skala pengukuran berikut. TANDAKAN (√) jawapan anda.



No.	Item	Skala				
		1	2	3	4	5
1	Saya sentiasa mengekalkan berat badan/BMI yang ideal.					
2	Saya sering menimbang berat badan secara berkala.					
3	Saya akan mendapatkan berat badan/BMI yang ideal.					
4	Saya mengamalkan diet yang seimbang dengan pengambilan karbohidrat, lemak dan gula dalam kuantiti yang sedikit.					
5	Saya boleh menukar diet saya untuk diet yang sihat dengan mudah.					
6	Saya sering bersenam/melakukan aktiviti fizikal selama 20 minit sehingga 30 minit sekurang-kurangnya tiga kali seminggu.					
7	Saya akan bersenam/melakukan aktiviti fizikal selama 20 minit sehingga 30 sekurang-kurangnya tiga kali seminggu.					
8	Saya mengamalkan gaya hidup sihat dan aktif.					
9	Saya tidak merokok.					
10	Saya gemar mengambil minuman bergas.					
11	Saya gemar mengambil makanan segera.					
12	Setiap hari, masa saya lebih banyak dihabiskan di hadapan monitor.					

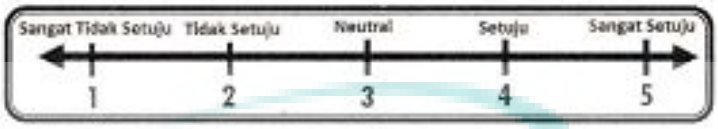
References:

Al-Dahan, S. M., Albaik, M., Alomran, Y., Aldahan, F. and Albaik, S. 2013. Awareness and Knowledge of Diabetes among Al-Wazarat Family Medicine Health Center Attendants. American Journal of Research Communication. **1**(12): 104-130.

Rathod, G.B., Rathod, S., Parmar, P. and Parikh, A. 2014. Study of knowledge, attitude and practice of general population of Waghodia towards diabetes mellitus. Int J Cur Res Rev. **6**(1): 63-68.

BAHAGIAN D: PERSEKITARAN

Sila berikan penilaian anda terhadap setiap pernyataan di bawah berdasarkan skala pengukuran berikut. TANDAKAN (√) jawapan anda.



No.	Item	Skala				
		1	2	3	4	5
1	Saya mendapati saudara mara saya atau rakan-rakan saya mempunyai sejarah keluarga penyakit diabetes.					
2	Saya dikelilingi mereka yang obesiti/kegemukan.					
3	Saya dikelilingi mereka yang merokok.					
4	Saya mempunyai kenalan yang mengambil alkohol secara berlebihan.					
5	Persekitaran saya dikelilingi mereka yang mengamalkan diet yang sihat.					
6	Saya mendapati saya dikelilingi mereka yang sering melakukan senaman sekurang-kurangnya tiga kali seminggu.					
7	Saya dikelilingi mereka yang sering mengambil makanan segera.					
8	Saya dikelilingi mereka yang sering minum minuman bergas/manis.					
9	Saya dikelilingi mereka yang kerap melakukan aktiviti fizikal/kehidupan yang aktif.					

References:

Al-Naggar, R.A., Bobryshev, Y.V. and Mohd Noor, N.A. 2013. Lifestyle Practice among Malaysian University Students. Asian Pacific Journal of Cancer Prevention. **14**(3): 1895-1903.

Foma, M. A., Saidu, Y., Omoleke, S. A. and Jafali, J. 2013. Awareness of diabetes mellitus among diabetic patients in the Gambia: a strong case for health education and promotion. BMC Public Health. **13**(1124): 1-18.

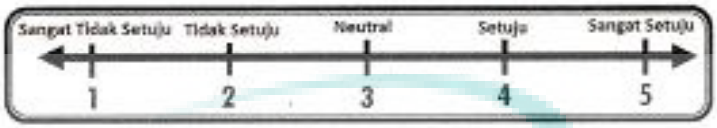
Mohd Najib, M.N., Dali, A.F., Ahmad, A., Sulaiman, S., Hussin, S.N. and Mokhtar, N.A. 2014. Knowledge and Attitude on Diabetes Among Public In Kota Bharu Kelantan, Malaysia. International Journal of Education and Research. 2(2): 1-10.

Al-Sarayra, L. and Khalidi, R.S. 2012. Awareness and Knowledge about Diabetes Mellitus among Students at Al-Balqa' Applied University. Pakistan Journal of Nutrition. **11**(11): 1023-1028.

Minhat, H.S. and Hamedon, T.R. 2014. Understanding Towards Diabetes Mellitus among Rural Adult Community in Malaysia. World Journal of Medical Sciences. **11**(2): 217-221.

BAHAGIAN E: GEJALA DIABETES MELLITUS

Sila berikan penilaian anda terhadap setiap pernyataan di bawah berdasarkan skala pengukuran berikut. TANDAKAN (√) jawapan anda.



No.	Item	Skala				
		1	2	3	4	5
1	Saya kerap dahaga.					
2	Saya sering membuang air kecil.					
3	Saya mengalami penurunan berat badan walaupun selera makan normal.					
4	Saya sering keletihan atau lemah.					
5	Pening merupakan salah satu gejala diabetes mellitus.					
6	Saya mengalami kekaburan penglihatan.					
7	Saya mengalami pernafasan yang pantas.					
8	Saya kerap lapar.					
9	Saya mengalami penyembuhan luka yang perlahan.					

References:

Murugesan, N., Snehalatha, C., Shobhana, R., Roglic, G. and Ramachandran, A. 2007. Awareness about diabetes and its complications in the general and diabetic population in a city in southern India. Diabetes Research and Clinical Practice. 77: 433–437.

Shriraam, V., Rani, M.A., Sathiyasekaran, B.W.C. and Mahadevan, S. 2013. Awareness of gestational diabetes mellitus among antenatal women in a primary health center in South India. Indian Journal of Endocrinology and Metabolism. 17(1): 146-148.

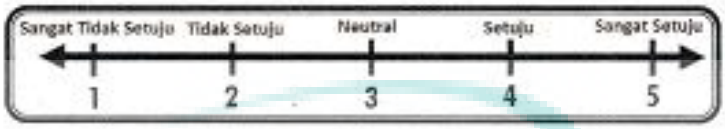
Yun, L.S., Hassan, Y., Abd. Aziz, N., Awaisu, A. and Ghazali, R. 2007. A comparison of knowledge of diabetes mellitus between patients with diabetes and healthy adults: A survey from north Malaysia. Patient Education and Counseling. 69: 47–54.

Poornima, S., Ragavendra, L. and Shivakumar, K.M. 2012. Awareness regarding diabetes mellitus among degree college students of Mandya City, Karnataka, India. Indian J. Prev. Soc. Med. **43**(3):283-287.

Al-Sarayra, L. and Khalidi, R.S. 2012. Awareness and Knowledge about Diabetes Mellitus among Students at Al-Balqa' Applied University. Pakistan Journal of Nutrition. **11**(11): 1023-1028.

BAHAGIAN F: KESEDARAN

Sila berikan penilaian anda terhadap setiap pernyataan di bawah berdasarkan skala pengukuran berikut. TANDAKAN (√) jawapan anda.



No.	Item	Skala				
		1	2	3	4	5
1	Saya sedar penyakit diabetes semakin meningkat di kalangan masyarakat di negara ini..					
2	Saya mempunyai sejarah keluarga berkaitan diabetes.					
3	Diabetes boleh dicegah dengan menjalani gaya hidup sihat iaitu dengan mengamalkan pemakanan yang seimbang.					
4	Diabetes boleh dicegah dengan menjalani gaya hidup sihat iaitu dengan bersenam secara konsisten.					
5	Komplikasi jangka panjang diabetes boleh dicegah.					
6	Diabetes boleh dirawat.					
7	Diabetes mellitus tergolong sebagai penyakit kronik.					
8	Saya sedar saya perlu mengawal berat badan secara berkala.					
9	Saya sering memantau tahap glukosa darah saya.					
10	Diabetes boleh berlaku ketika hamil kali pertama.					
11	Saya sedia maklum/tahu terdapat tiga jenis diabetes.					
12	Diabetes boleh berlaku terhadap sesiapa sahaja tidak mengira tahap umur mereka.					

TERIMA KASIH ATAS KERJASAMA YANG TELAH ANDA BERIKAN DALAM MENJAWAB SOAL SELIDIK INI...

APPENDIX B

Harman's Single Factor Test

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.196	19.566	19.566	9.196	19.566	19.566
2	5.180	11.021	30.588	5.180	11.021	30.588
3	3.906	8.312	38.899	3.906	8.312	38.899
4	2.800	5.958	44.858	2.800	5.958	44.858
5	1.934	4.114	48.972	1.934	4.114	48.972
6	1.743	3.709	52.681	1.743	3.709	52.681
7	1.602	3.407	56.089	1.602	3.407	56.089
8	1.265	2.692	58.781	1.265	2.692	58.781
9	1.233	2.623	61.403	1.233	2.623	61.403
10	1.106	2.354	63.757	1.106	2.354	63.757
11	1.011	2.152	65.909	1.011	2.152	65.909
12	1.002	2.132	68.042	1.002	2.132	68.042
13	.866	1.843	69.885			
14	.799	1.699	71.584			
15	.763	1.624	73.208			
16	.742	1.580	74.788			
17	.708	1.505	76.293			
18	.695	1.480	77.773			
19	.653	1.388	79.161			
20	.610	1.297	80.459			
21	.585	1.245	81.703			
22	.560	1.191	82.895			
23	.558	1.188	84.083			
24	.548	1.165	85.248			
25	.485	1.031	86.279			
26	.468	.996	87.275			
27	.454	.966	88.240			
28	.427	.909	89.149			
29	.409	.870	90.019			
30	.398	.846	90.865			
31	.383	.815	91.679			
32	.361	.768	92.447			
33	.327	.695	93.142			
34	.313	.667	93.808			
35	.312	.663	94.471			
36	.297	.632	95.104			
37	.291	.620	95.724			
38	.284	.604	96.327			
39	.265	.564	96.891			
40	.245	.521	97.412			
41	.232	.494	97.906			
42	.202	.430	98.335			
43	.190	.404	98.739			
44	.172	.366	99.105			
45	.164	.350	99.455			
46	.136	.290	99.745			
47	.120	.255	100.000			

Extraction Method: Principal Component Analysis.

APPENDIX C

Translation Validation Form

Universiti Malaysia PAHANG

BORANG SEMAKAN PENGESAHAN TERJEMAHAN SOAL SELIDIK

Model Kesedaran Diabetes Mellitus (MKDM)

"Diabetes Mellitus Awareness Model (DMAM)"

Soal selidik ini bertujuan untuk mengkaji tahap kesedaran orang awam terhadap penyakit diabetes mellitus. Diabetes mellitus (DM) atau juga dikenali sebagai diabetes atau kencing manis merupakan salah satu penyakit tidak berjangkit (NCD) yang merupakan punca utama kematian pramatang dalam kalangan orang dewasa di Malaysia.

Ulasan keseluruhan:

Translations of items in English version to Malay versions have been very consistent. However, a very few items have slightly been added with term 'mellitus' - to be 'diabetic mellitus' when the English version is the term 'diabetis' only. Most importantly, these do not alter the intended meaning aspired by researcher.

Tandatangan

23 OCT 2019

Nama: Abdullah Adnan bin Mohamed
Senior Lecturer
Center for Modern Languages & Human Sciences
Universiti Malaysia Pahang

Cop Rasmi: Lebuhraya Tun Razak
26300 Gambang, Kuantan, Pahang

Universiti Malaysia PAHANG

BORANG SEMAKAN PENGESAHAN TERJEMAHAN SOAL SELIDIK

Model Kesedaran Diabetes Mellitus (MKDM) / *Diabetes Mellitus Awareness Model (DMAM)*

Pengetahuan umum Diabetes Mellitus		**Comments**
a. Diabetes adalah keadaan kadar gula yang tinggi di dalam darah.	a. Diabetes is a condition of the high level of sugar in the blood.	Exact
b. Diabetes adalah keadaan apabila kekurangan penghasilan insulin.	b. Diabetes is a condition of insufficient insulin production.	Exact
c. Diabetes adalah keadaan apabila badan tidak bertindak balas terhadap insulin.	c. Diabetes is a condition of the body not responding to insulin.	Exact
d. Diabetes tidak berjangkit.	d. Diabetes is non-contagious.	Exact
e. Diabetes tidak boleh dirawat.	e. Diabetes is incurable.	Exact
f. Insulin merupakan salah satu hormon yang terhasil di dalam badan.	f. Insulin is a hormone in the body that is produced by the pancreas.	Exact
g. Insulin boleh menurunkan tahap gula dalam darah.	g. Insulin can decrease blood sugar level.	Exact
h. Insulin diperlukan untuk sesetengah pesakit diabetes.	h. Insulin is required for some diabetic patients.	Exact
i. Pesakit diabetes tidak digalakkan menderma darah.	i. Diabetic patients should not donate blood.	Exact
j. Wanita hamil berisiko tinggi menghidap GDM (gestational diabetes mellitus) semasa kehamilan pertama.	j. Pregnant women are at high risk of GDM (gestational diabetes mellitus) during the first pregnancy.	Exact
k. GDM hilang selepas bersalin.	k. GDM disappears after childbirth.	Exact
l. Wanita yang telah mengalami GDM berisiko menghidap diabetes mellitus jenis 2 pada masa akan datang.	l. Women who have had GDM are at risk of developing Type 2 diabetes in the future.	English version uses term 'diabetes'; Malay version Diabet Mellitu
m. GDM yang tidak dirawat boleh menimbulkan risiko terhadap anak di dalam kandungan.	m. Untreated GDM can pose a risk to the child in the womb.	Exact

BORANG SEMAKAN PENGESAHAN TERJEMAHAN SOAL SELIDIK
Model Kesedaran Diabetes Mellitus (MKDM) / *Diabetes Mellitus Awareness Model (DMAM)*

Faktor risiko Diabetes Mellitus		**Comments**
a. Diabetes boleh berlaku apabila mengamalkan pengambilan gula yang tinggi.	a. Diabetes can occur when consuming food with high-sugar content.	Exact
b. Diabetes boleh berlaku apabila mengamalkan pengambilan karbohidrat yang berlebihan.	b. Diabetes can occur when consuming food with high- carbohydrate content.	Exact
c. Diabetes boleh berlaku apabila mengamalkan pengambilan lemak yang berlebihan.	c. Diabetes can occur when consuming food with high-fat content.	Exact
d. Diabetes juga boleh berlaku apabila kurang melakukan aktiviti fizikal secara konsisten.	d. Diabetes can occur due to lack of consistent physical activity.	Exact
e. Diabetes berisiko tinggi dihidapi apabila mempunyai sejarah keluarga berkaitan diabetes.	e. Diabetes is a high risk when having a family history of diabetes.	Exact
f. Obesiti/Kegemukan boleh mengakibatkan diabetes.	f. Obesity can lead to diabetes.	Exact
g. Diabetes boleh berlaku disebabkan oleh pengambilan alkohol yang berlebihan.	g. Diabetes can occur due to excessive alcohol consumption.	Exact
h. Merokok juga boleh menyumbang kepada diabetes mellitus.	h. Smoking can contribute to diabetes.	English version uses 'diabetic'; Malay version 'Diabetic Mellitus'
i. Wanita hamil berisiko tinggi menghidap diabetes mellitus.	i. Pregnant women are at high risk of developing diabetes.	"
Pencegahan Diabetes Mellitus		**Comments**
a. Pencegahan diabetes boleh dilakukan dengan melakukan senaman/aktiviti fizikal yang kerap.	a. Diabetes prevention can be done through regular exercise/physical activity.	Exact
b. Pencegahan diabetes boleh dilakukan dengan mengurangkan/mengawal berat badan.	b. Diabetes prevention can be done by reducing/weight control.	Exact
c. Pencegahan diabetes boleh dilakukan dengan mengamalkan diet seimbang.	c. Diabetes prevention can be done by adopting a balanced diet.	Exact
d. Pencegahan diabetes boleh dilakukan dengan berhenti merokok.	d. Diabetes prevention can be done by stop smoking.	Exact

Universiti Malaysia PAHANG

BORANG SEMAKAN PENGESAHAN TERJEMAHAN SOAL SELIDIK

Model Kesedaran Diabetes Mellitus (MKDM) / *Diabetes Mellitus Awareness Model (DMAM)*

Komplikasi Diabetes Mellitus		**Comments**
a. Diabetes boleh menyebabkan buta.	a. Diabetes can lead to blindness.	Exact
b. Diabetes boleh menyebabkan masalah mata.	b. Diabetes can lead to eye problem.	Exact
c. Diabetes boleh menyebabkan kegagalan buah pinggang.	c. Diabetes can lead to kidney failure.	Exact
d. Diabetes boleh menyebabkan serangan jantung.	d. Diabetes can lead to heart attack.	Exact
e. Diabetes boleh menyebabkan hilang deria rasa/kebas pada tangan dan kaki.	e. Diabetes can lead to sense of sensation/numbness in arms and legs.	Exact
f. Komplikasi diabetes boleh menyebabkan pemotongan anggota badan.	f. Diabetes can lead to amputation of limbs.	Exact
g. Diabetes boleh menyebabkan tekanan darah tinggi.	g. Diabetes can lead to hypertension.	Exact
h. Diabetes boleh menyebabkan strok.	h. Diabetes can lead to stroke.	Exact
i. Diabetes boleh menyebabkan mati pucuk.	i. Diabetes can lead to sexual impotence.	Exact
Rawatan Diabetes Mellitus		**Comments**
a. Diet merupakan rawatan terhadap diabetes.	a. Diet is a treatment of diabetes.	Exact
b. Senaman/aktiviti fizikal merupakan rawatan terhadap diabetes.	b. Exercise/physical activity is a treatment of diabetes.	Exact
c. Salah satu cara rawatan terhadap diabetes adalah dengan pengambilan ubat pil antidiabetik.	c. Diabetes can be treated with oral antidiabetic drugs .	Exact
d. Suntikan insulin juga digunakan semasa rawatan diabetes.	d. Insulin injections are also used for treatment of diabetes.	Exact
e. Pemantauan tahap glukos dalam darah sangat penting bagi rawatan pesakit diabetes.	e. Monitoring of blood glucose level is important in treatment of diabetes	Exact

Universiti Malaysia PAHANG

BORANG SEMAKAN PENGESAHAN TERJEMAHAN SOAL SELIDIK

Model Kesedaran Diabetes Mellitus (MKDM) / *Diabetes Mellitus Awareness Model (DMAM)*

Sikap			**Comments**
1	Saya sentiasa mengekalkan berat badan/BMI yang ideal.	I always maintain an ideal weight/BMI.	Exact
2	Saya sering menimbang berat badan secara berkala.	I measure my weight periodically.	Exact
3	Saya akan mendapatkan berat badan/BMI yang ideal.	I am willing to have an ideal weight/BMI.	Exact
4	Saya mengamalkan diet yang seimbang dengan pengambilan karbohidrat, lemak dan gula dalam kuantiti yang sedikit.	I practice a balanced diet.	Exact; carry intended meaning to assist readers
5	Saya boleh menukar diet saya untuk diet yang sihat dengan mudah.	I can easily change my diet to a healthy diet.	Exact
6	Saya sering bersenam/melakukan aktiviti fizikal selama 20 minit sehingga 30 minit sekurang-kurangnya tiga kali seminggu.	I exercise at least three times a week.	Exact
7	Saya akan bersenam/melakukan aktiviti fizikal selama 20 minit sehingga 30 sekurang-kurangnya tiga kali seminggu.	I am willing to exercise at least three times a week.	Exact
8	Saya mengamalkan gaya hidup sihat dan aktif.	I lead a healthy lifestyle.	Exact
9	Saya tidak merokok.	I do not smoke.	Exact
10	Saya gemar mengambil minuman bergas.	I enjoy taking fizzy drinks.	Exact
11	Saya gemar mengambil makanan segera.	I prefer to take fast food.	Exact
12	Setiap hari, masa saya lebih banyak dihabiskan di hadapan monitor.	I spend more of my time every day in front of the TV/monitor.	Exact; TV is not stated in Malay translation.

Universiti Malaysia PAHANG

BORANG SEMAKAN PENGESAHAN TERJEMAHAN SOAL SELIDIK
Model Kesedaran Diabetes Mellitus (MKDM) / *Diabetes Mellitus Awareness Model (DMAM)*

Persekitaran			**Comments**
1	Saya mendapati saudara mara saya atau rakan-rakan saya mempunyai sejarah keluarga penyakit diabetes.	I found my relatives, or my friends have a family history of diabetes.	Exact
2	Saya dikelilingi mereka yang obesiti/kegemukan.	I found myself surrounded by those who are obese/overweight.	Exact
3	Saya dikelilingi mereka yang merokok.	I am surrounded by people who are smoking.	Exact
4	Saya mempunyai kenalan yang mengambil alkohol secara berlebihan.	I have friends or relatives who excessively consume alcohol.	Exact
5	Persekitaran saya dikelilingi mereka yang mengamalkan diet yang sihat.	My environment is surrounded by those who practise healthy diet.	Exact
6	Saya mendapati saya dikelilingi mereka yang sering melakukan senaman sekurang-kurangnya tiga kali seminggu.	I found myself surrounded by people who often do exercise at least once a week.	Exact
7	Saya dikelilingi mereka yang sering mengambil makanan segera.	I am surrounded by people who frequently eat fast food.	Exact
8	Saya dikelilingi mereka yang sering minum minuman bergas/manis.	I am surrounded by people who regularly consume soft/sweetened drinks.	Exact
9	Saya dikelilingi mereka yang kerap melakukan aktiviti fizikal/kehidupan yang aktif.	I am surrounded by people who regularly perform physical activity.	Exact

BORANG SEMAKAN PENGESAHAN TERJEMAHAN SOAL SELIDIK
Model Kesedaran Diabetes Mellitus (MKDM) / *Diabetes Mellitus Awareness Model (DMAM)*

Gejala Diabetes Mellitus			**Comments**
1	Saya kerap dahaga.	I frequently feels thirsty.	Exact
2	Saya sering membuang air kecil.	I urinate frequently.	Exact
3	Saya mengalami penurunan berat badan walaupun selera makan normal.	I experience weight loss despite normal appetite.	Exact
4	Saya sering keletihan atau lemah.	I am often tired or weak.	Exact
5	Pening merupakan salah satu gejala diabetes mellitus.	I often feels dizzy.	Exact
6	Saya mengalami kekaburan penglihatan.	I experienced a blurriness of vision.	Exact
7	Saya mengalami pernafasan yang pantas.	I experience rapid breathing.	Exact
8	Saya kerap lapar.	I often feels hungry.	Exact
9	Saya mengalami penyembuhan luka yang perlahan.	My wound heals slowly.	Exact

Universiti Malaysia PAHANG

BORANG SEMAKAN PENGESAHAN TERJEMAHAN SOAL SELIDIK

Model Kesedaran Diabetes Mellitus (MKDM) / *Diabetes Mellitus Awareness Model (DMAM)*

Kesedaran			Comments Malay
1	Saya sedar penyakit diabetes semakin meningkat di kalangan masyarakat di negara ini..	I realize that diabetes is worsening.	Acceptable; Translation is longer to assist readers understand
2	Saya mempunyai sejarah keluarga berkaitan diabetes.	I have a family history related with diabetes.	Exact
3	Diabetes boleh dicegah dengan menjalani gaya hidup sihat iaitu dengan mengamalkan pemakanan yang seimbang.	Diabetes can be prevented by leading a healthy lifestyle by adopting a balanced diet.	Exact
4	Diabetes boleh dicegah dengan menjalani gaya hidup sihat iaitu dengan bersenam secara konsisten.	Diabetes can be prevented by leading a healthy lifestyle by exercise regularly.	Exact
5	Komplikasi jangka panjang diabetes boleh dicegah.	Long-term complications of diabetes can be prevented.	Exact
6	Diabetes boleh dirawat.	Diabetes can be treated.	Exact
7	Diabetes mellitus tergolong sebagai penyakit kronik.	Diabetes is recognized as a chronic disease.	English version 'diabetic'. Malay version diabetic Mellitus
8	Saya sedar saya perlu mengawal berat badan secara berkala.	I realize the need to control my weight regularly.	Exact
9	Saya sering memantau tahap glukosa darah saya.	I always monitor my blood glucose level.	Exact
10	Diabetes boleh berlaku ketika hamil kali pertama.	Diabetes can occur during the first pregnancy.	Exact
11	Saya sedia maklum/tahu terdapat tiga jenis diabetes.	There are three types of diabetes.	Exact
12	Diabetes boleh berlaku terhadap sesiapa sahaja tidak mengira tahap umur mereka.	Diabetes can affect both children and adults.	Exact