FACTORS ASSOCIATED WITH GLYCEMIC CONTROL IN TYPE 2 DIABETIC PATIENTS AT KLINIK KESIHATAN JALAN MASJID, KUCHING, SARAWAK

Amirulazman Bin Abu Hassan

Master of Public Health 2013
Acknowledgements

I would like to express my sincere gratitude to my supervisor Dr. Cliffton Akoi who provided me in guiding, giving advices, criticism, comment and encouragement which has gave me new experience in doing research and has made the writing of this thesis an interesting and challenging exercise.

I would also like to thank Tan Sri Datu Prof. Dr. Hj. Mohamad Taha Arif, Assoc. Prof. Dr. Md Mizanur Rahman and my programme coordinator, Dr. Cheah Whye Lian for the support and encouragement during the process.

I shall not forget to thank Datu Dr. Zulkifli Jantan, Sarawak State Health Director and Dr. Donna, Medical Officer In charge of KK Jalan Masjid, who have kindly permitted me to carry out the research work at the KK Jalan Masjid and provided access to information on diabetic patient’s record.

Last but not least, I would like to thank all KK Jalan Masjid’s staffs that gave their cooperation and all the patients that involved and willing to give their support to the success of this study.

Finally, my deep appreciation goes to my wife, Rusmailani and our three children, Irdina, Amsyar and Almira as well as my friends and relatives for their continuous support, encouragement and constant prayer during this study.
Table of Contents

Acknowledgements .......................................................................................................................... ii
Table of Contents .......................................................................................................................... iii
List of Table ................................................................................................................................... vii
List of Abbreviation ........................................................................................................................ viii
List of Appendices .......................................................................................................................... ix
Abstract ........................................................................................................................................... x
Abstrak ............................................................................................................................................ xi

CHAPTER 1: INTRODUCTION ........................................................................................................ 1

1.1 Background ............................................................................................................................... 1

1.2 Statement of Problem / Research Questions ............................................................................. 3

1.3 Significance of the Study .......................................................................................................... 4

1.4 Literature Review ..................................................................................................................... 5

1.4.1 Types of Diabetes Mellitus (DM) .......................................................................................... 5

1.4.2 Diagnosis of DM Type 2 .................................................................................................... 8

1.4.3 Glycosylated Haemoglobin A1c (HbA1c) ............................................................................ 8

1.4.4 Glycaemic Control and its Related Factors ........................................................................ 10

1.4.5 Glycaemic Control and its Related Factors ........................................................................ 11

1.4.6 Summary ............................................................................................................................ 15
1.5 Objective of the Study .............................................................................................................. 15
1.5.1 General Objective .............................................................................................................. 15
1.5.2 Specific Objective .............................................................................................................. 16
1.6 Hypothesis Alternative .......................................................................................................... 16
1.7 List of Variables .................................................................................................................... 17
1.7.1 Dependent Variables ....................................................................................................... 17
1.7.2 Independent Variables ..................................................................................................... 17

CHAPTER 2: METHODOLOGY .................................................................................................... 19
2.1 Study Design ........................................................................................................................ 19
2.2 Place of study ....................................................................................................................... 19
2.3 Study Population .................................................................................................................. 19
2.4 Inclusion Criteria ................................................................................................................. 20
2.5 Exclusion Criteria ................................................................................................................. 20
2.6 Sample Size Calculation ..................................................................................................... 20
2.7 Sampling Technique ............................................................................................................. 20
2.8 Instruments Developments & Its Component ....................................................................... 21
2.9 Data Collection Methods .................................................................................................... 22
2.10 Data Entry and Data Management & Quality Control ....................................................... 22
2.11 Data Analysis ..................................................................................................................... 23
Limitation of Study ................................................................. 41
References .................................................................................. 43
List of Table

Table 1: HbA1c level and DM status ................................................................. 9
Table 2: Descriptive analysis on Patient demographic characteristic (n=303) ................................................................. 25
Table 3: Descriptive analysis on Factor related to the disease (n=303) ................................................................. 27
Table 4: Descriptive analysis on HbA1c level and HbA1c status (n=303) ................................................................. 28
Table 5: Patient perception on their knowledge towards DM (n=303) ........................................................................... 29
Table 6: Five sub-scales mean score and attitude status (n=303) ........................................................................... 29
Table 7: Univariate Analysis between Socio-demographic factor and Glycaemic Status (n=303) ........................... 30
Table 8: Mean difference of HbA1c in employment status (n=303) ................................................................. 31
Table 9: Univariate Analysis between Diseases related factor and Glycaemic status (n=303) ................................................................. 32
Table 10: Mean difference of HbA1c among Type of treatment (n=303) ................................................................. 33
Table 11: Univariate Analysis test between Attitude towards the disease and HbA1c status (n=303) ............ 34
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2HPP</td>
<td>2 hours post-prandial</td>
</tr>
<tr>
<td>ACEI</td>
<td>Angiotensin converting enzyme inhibitor</td>
</tr>
<tr>
<td>ADA</td>
<td>American Diabetes Association</td>
</tr>
<tr>
<td>AHA</td>
<td>Anti-hyperglycaemic agents</td>
</tr>
<tr>
<td>Anti-HPT</td>
<td>Anti-hypertensive</td>
</tr>
<tr>
<td>ARB</td>
<td>Angiotensin receptor blocker</td>
</tr>
<tr>
<td>BMI</td>
<td>Body mass index</td>
</tr>
<tr>
<td>BP</td>
<td>Blood pressure</td>
</tr>
<tr>
<td>CDC</td>
<td>Centres for Disease Control and Prevention, Atlanta.</td>
</tr>
<tr>
<td>CVD</td>
<td>Cardiovascular disease</td>
</tr>
<tr>
<td>DBP</td>
<td>Diastolic blood pressure</td>
</tr>
<tr>
<td>ED</td>
<td>Erectile dysfunction</td>
</tr>
<tr>
<td>FBS</td>
<td>Fasting blood sugar</td>
</tr>
<tr>
<td>FPG</td>
<td>Fasting plasma glucose test</td>
</tr>
<tr>
<td>HDL</td>
<td>High density lipoprotein</td>
</tr>
<tr>
<td>HPT</td>
<td>Hypertension</td>
</tr>
<tr>
<td>IDF</td>
<td>International Diabetes Federation</td>
</tr>
<tr>
<td>IHD</td>
<td>Ischaemic heart disease</td>
</tr>
<tr>
<td>LDL</td>
<td>Low density lipoprotein</td>
</tr>
<tr>
<td>MREC</td>
<td>Medical Research Ethics Committee</td>
</tr>
<tr>
<td>OGTT</td>
<td>Oral glucose tolerance test</td>
</tr>
<tr>
<td>RBS</td>
<td>Random blood sugar</td>
</tr>
<tr>
<td>RBS</td>
<td>Random blood glucose (capillary blood)</td>
</tr>
<tr>
<td>RPG</td>
<td>Random Plasma Glucose</td>
</tr>
<tr>
<td>SBP</td>
<td>Systolic blood pressure</td>
</tr>
<tr>
<td>SMBG</td>
<td>Self-monitoring of blood glucose</td>
</tr>
<tr>
<td>T2D</td>
<td>Type 2 diabetes</td>
</tr>
<tr>
<td>TG</td>
<td>Triglyceride</td>
</tr>
<tr>
<td>UKPDS</td>
<td>United Kingdom Prospective Diabetes Study</td>
</tr>
<tr>
<td>WC</td>
<td>Waist Circumference</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
</tr>
</tbody>
</table>

Prevention, Atlanta.
List of Appendices

Appendix 1: Questionnaire Part 1 (Self-administered) - ENGLISH ................................................................. 47
Appendix 2: Questionnaire Part 2 (Checklist) ........................................................................................................ 54
Appendix 3: Questionnaire Part 1 (Self-administered) – BAHASA MELAYU .............................................................. 55
Appendix 4: Respondent Information Sheet ......................................................................................................... 62
Appendix 5: Respondent Consent Form .............................................................................................................. 65
Appendix 6: Operational definition .................................................................................................................. 66
Appendix 7: Medical Research & Ethic Committee Approval ............................................................................... 68
Appendix 8: National Institute of Health Approval .......................................................................................... 69
Abstract

Good glycaemic control reduces the risk of diabetic complications. Despite this, achieving good glycaemic control remains a challenge in diabetic patients. The objective of this study is to identify the factors associated with glycaemic control among DM Type 2 patients at KK Jalan Masjid, Kuching, Sarawak. A clinic-based cross-sectional study was conducted on systematically sampled 303 DM Type 2 patients on a regular follow up. Data was collected using self-administered questionnaire and reviewing respective medical record. Data collection took place from 25 Mac 2013 till 6 May 2013. Optimal glycaemic control was defined HbA1c < 6.5%. Patients had a mean age of 54.0 (±9.2) years, 62% were females, the mean duration of since diagnosis was 7.3 (±5.3) years, 29.7% achieved optimal glycaemic control (HbA1c <6.5%), 74.7% were on oral anti diabetic agent (OAA) alone. Mean BMI for the patient was 27.3 (±4.3) kg/m². About 60.9 % of study participants had both Hypertension and Hyperlipidaemia. Chi-square test revealed, Employment status/working hours and Type of diabetic treatment had significant association with glycaemic control. Working 8 hours or more/day had significantly high mean HbA1c, 8.1% (±1.7%), compare to working 8 hour or less/day and unemployed group (P<0.000). Patients that were on OAA alone had significant lower mean HbA1c compare to patient on Insulin alone or on Combination treatment (Insulin and OAA). Most of the patient had positive attitude towards the disease, however, there were no significant association with glycaemic control. The proportion of patients with sub optimal glycaemic control was high, which resulted in the development of one or more complications regardless of duration of disease. Hence, appropriate management of a patient focusing on the relevant associated factors and independent predictors of poor glycaemic control would be of great benefit.

Keywords: Diabetes mellitus, factor, glycaemic control, HbA1c, Kuching
Abstrak

Tajuk: Kajian Tentang Faktor-Faktor Berkaitan Kawalan Gula Dalam Darah Bagi Pesakit Kencing Manis Yang Menerima Rawatan Susulan Di Klinik Kesihatan Jalan Masjid, Kuching, Sarawak.

Paras gula dalam darah yang di kawal dengan baik, dapat mengurangkan risiko komplikasi diabetes. Walaubagaimanapun, pengawalan paras gula dalam darah masih menjadi satu cabaran dan halangan kepada pesakit Diabetes. Objektif kajian ini adalah untuk mengenalpasti faktor-faktor yang berkaitan yang mempengaruhi pengawalan paras gula dalam darah untuk pesakit Diabetes Jenis 2 di KK Jalan Masjid, Kuching,Sarawak. Satu kajian-rentas telah dijalankan ke atas 303 pesakit Diabetes yang hadir ke KK Jalan Masjid, untuk rawatan ulangan. Pemilihan sampel dijalankan secara sistematik. Data di perolehi dengan menggunakan Soalan kajiselidik yang di jawab pesakit dan daripada rekod perubatan pesakit. Pengumpulan data dilakukan bermula tarikh 25 Mac 2013 hingga 6 Mei 2013. Definisi kawalan gula dalam darah yang optima adalah HbA1c < 6.5%. Purata umur pesakit yang terlibat dalam kajian adalah 54.0 (±9.2) tahun. 62% terdiri daripada kaum wanita, dengan purata jangkamasa penyakit adalah 7.3 (±5.3) tahun. Sebanyak 29.7% pesakit mencapai kawalan gula yang optima (HbA1c < 6.5). 74.7% pesakit hanya di rawat menggunakan satu jenis rawatan iaitu menggunakan hanya agen anti-diabetik yang di beri secara oral. Purata Indeks Jisim Badan adalah 27.3 (±4.3) kg/m². Sebanyak 60.9% pesakit mempunyai penyakit tekanan darah yang tinggi dan paras lemak yang tidak normal. Berdasarkan ujian ‘Chi-square’, Status pekerjaan atau tempoh masa bekerja dan jenis rawatan yang di terima di dapati mempunyai hubungan yang significant dengan paras gula dalam darah. Bekerja 8 jam atau lebih/hari didapati mempunyai purata HbA1c yang lebih tinggi
dibandingkan dengan kumpulan tidak bekerja atau bekerja kurang daripada 8 jam/sehari. Perbezaan purata HbA1c didapati signifikan. Pesakit yang hanya di beri rawatan agen anti-diabetik oral mempunyai purata HbA1c yang lebih rendah dan perbezaan ini adalah signifikan di bandingkan dengan rawatan Insulin atau gabungan rawatan insulin dan agen anti-diabetik oral. Kebanyakan pesakit mempunyai attitud yang positif ke atas Penyakit Diabetes, walaubagaimanapun, tiada hubungan yang signifikan dengan paras gula dalam darah. Pecahan pesakit yang gagal mencapai kawalan gula yang optima adalah tinggi. Ini akan menyebabkan terhasil satu atau dua komplikasi tanpa mengambil kira tempoh penyakit seseorang. Oleh yang demikian, merawat pesakit dengan memfokus kepada faktor yang ada kaitan dengan kawalan paras gula, dapat membantu pesakit mengawal paras gula.

Kata kunci: Diabetes mellitus, faktor, kawalan gula, HbA1c, Kuching
CHAPTER 1: INTRODUCTION

1.1 Background

Diabetes mellitus (DM) is a metabolic disorder characterized by hyperglycaemia resulting from defects in insulin secretion, insulin action, or both (WHO, 2006). Several aetiologies were involved, ranging from autoimmune destruction of pancreatic β-cells, resulting in insulin deficiency, to abnormalities that caused resistance to insulin action.

Insulin is used by about two-thirds of the body's cells to absorb glucose from the blood for use as fuel, for conversion to other needed molecules or for storage. Therefore deficiency of insulin or the insensitivity of its receptors, caused glucose improperly is absorbed by body cells that require it, in appropriately stored in the liver and muscles. Thus it results in persistently high levels of blood glucose, poor protein synthesis, and other metabolic derangements, such as acidosis.

Main complaint by diabetic patient are usually polyuria and polydipsia but now days DM has become one of the major public health issues worldwide because of its long term complications (Khattab et al., 2010). It is associated with significant morbidity such as coronary heart disease, stroke and nephropathy leading to increased mortality and healthcare cost to the patient and the community. There is increasing evidence that good glycaemic control and control of cardiovascular risk factors prevent or delay complications of DM (UK Prospective Diabetes Study, 1998). This in turn would restore quality of life.
The disease becomes one of the most common chronic diseases, among adults between 40 to 59 years of age (International Diabetes Federation (IDF), 2012). Globally, according to IDF (2012), number of adult’s age 20 to 79 years old, with diabetes in 2011 was estimated to be 366 million, with prevalence of 8.3% and 183 million people (50%) with diabetes are undiagnosed. By 2030, the estimated number would increase to 552 million with the prevalence of 9.9% (IDF, 2012). The number of deaths in adult due to diabetes is estimated to be 4.66 million per year and mortality rate of the disease in all ages is 6.8% (IDF, 2012).

About 80% of people with DM live in low- and middle-income countries. The Western pacific region including Malaysia, with an estimated diabetes-affected population of 132 million in 2011 is at the forefront of the current epidemic (IDF, 2012). The greatest increase is expected to occur in Asia and Africa. The increase in incidence of DM in developing countries follows the trend of population growth, aging, urbanization and lifestyle changes. The rise in prevalence is more in developing countries with an estimated projection, of 170% compared to 42% in developed countries to the year 2025 (WHO, 2006).

Malaysia, a rapidly developing economy, comprising of multi ethnic population possesses all favourable environment to support DM progression and its complications via urbanization, westernization and sedentary life style. People with DM in Malaysia have almost doubled in a span of 2 decades from 6.3% in 1986 to 11.6% in 2006, with a WHO prediction of a total affected population of 2.48 million by 2030 (Mafauzy et al., 2011).
In the year 2000, DM was estimated to be the seventh leading cause of burden of disease in Malaysia, accounting for 3.7% of total disability adjusted life years (Mafauzy, 2005). In addition, admission to public hospitals due to DM has increased from 33,187 in 2002 to 39,358 in 2004 (Tan and Magarey, 2008).

With this increase in prevalence of DM, it has become imperative to monitor diabetes management, control strategies and complication profile for improvement in quality of care. It motivated the involvement of the Ministry of Health to initiate diabetes resource care centres, training and awareness programs for diabetes nurse educators. This was also supported by expanded availability of HbA1c tests in hospitals and clinics. Glycaemic control remains the major therapeutic objective for prevention of target organ damage and other complications arising from diabetes (Mastura et al., 2011).

1.2 Statement of Problem / Research Questions

Despite the evidence from large randomized controlled trials establishing the benefit of intensive diabetes management in reducing micro vascular and macro vascular complications, high proportion of patients remain poorly controlled (Khattab et al., 2010).

Many studies in Malaysia had showed that patient failed to achieve optimal glycaemic control with a high prevalence of complications. DiabCare (2001) study from primary health care centres in Malaysia and DiabCare (2003) in specialist centres reported poor glycaemic control among diabetic patients. DiabCare (2008), showed deteriorating glycaemic control with mean HbA1c of 8.66 ± 2.09% with only 22% of the patients achieving American Diabetic Association
target of HbA1c <7%. An audit done in Sarawak General Hospital, showed 26% achieving target of HbA1c <7% (Tan et al., 2008).

UK Prospective Diabetes Study showed 34% of DM Type 2 patients achieving target in United Kingdom in 1998. Poor and inadequate glycaemic control among patients with DM Type 2 constitutes a major public health problem and major risk factor for the development of diabetes complications.

In clinical practice, optimal glycaemic control is difficult to obtain on a long-term basis because the reasons for poor glycaemic control in DM Type 2 are complex (Khattab et al., 2010). Both patient and health care provider related factors may contribute to poor glycaemic control (Rury et al., 2008).

With increased duration of disease, oral anti-diabetic medications often lose effectiveness and consequently there is a need to add insulin to maintain glycaemic control. Despite the increase in insulin use, the majority of insulin-treated patients are not able to attain and maintain satisfactory long-term glycaemic control (Lu et al., 2010).

1.3 Significance of the Study

To date, not many studies on DM Type 2 patients have been documented or published for Kuching or Sarawak population. Therefore this study was proposed to determine factors associated with poor glycaemic control among patients with Type 2 diabetes who attended the Klinik Kesihatan (KK) Jalan Masjid, Kuching, Sarawak.

If the factors associated with poor glycaemic control can be identified, the attempts to further study the factors should be of value. It is hope that the outcome of this study can
complement the current management of the disease in order to achieve better health outcome that can benefit diabetic patient, their families, healthcare provider and the healthcare systems.

1.4 Literature Review

DM is a metabolic disorder characterized by hyperglycaemia resulting from defects in insulin secretion, insulin action, or both (WHO, 2006). There are several aetiologies involved with the development of the disease. These range from autoimmune destruction of pancreatic β-cells, resulting in insulin deficiency, to abnormalities that cause resistance to insulin action. Carbohydrate, protein, and fat metabolism are affected by the decreased insulin secretion or the diminished insulin effectiveness (WHO, 2006). Thus, many metabolic processes are unable to proceed normally due to inadequate secretion of insulin or a decreased tissue response at one or more points in the complex pathways regulated by this hormone.

1.4.1 Types of Diabetes Mellitus (DM)

There are some specific types of DM that are manifested as a result of certain genetic syndromes, surgery, drugs, malnutrition, infections, and other illnesses. Common types of DM are Pre-diabetic, DM Type 1, DM Type 2 and Gestational DM. However the most prevalent type of DM is DM Type 2, which accounts for 90% to 95% of all cases (American Diabetes Association, 2012).

Pre-diabetic

It is a condition in which individuals have blood glucose or HbA1c levels higher than normal but not high enough to be classified as diabetes (WHO, 2006). People with pre-diabetic have an increased risk of developing DM Type 2, cardiovascular diseases and stroke. Studies have shown
that people with pre-diabetic who lose weight and increase their physical activity can prevent or
delay the progress to develop DM Type 2 and in some cases return their blood glucose levels to
normal (McEligot et al., 2010, Centers for Disease Control and Prevention, 2011). In 2005–2008,
based on fasting glucose or HbA1c levels, 35% of U.S. adults aged 20 years or older had Pre-
diabetic and 50% of those aged 65 years or older had Pre-diabetic (Centers for Disease Control
and Prevention, 2011).

Diabetes Mellitus Type 1

DM Type 1 was previously called insulin-dependent diabetes mellitus (IDDM) or juvenile-onset
diabetes. DM Type 1 develops when the body’s immune system destroys pancreatic beta cells,
the only cells in the body that make the hormone insulin that regulates blood glucose (WHO,
2006). To survive, people with DM Type 1 must have insulin delivered by injection or a pump.
This form of diabetes usually strikes children and young adults, although disease onset can occur
at any age (The Diabetes Control and Complications Trial Research Group, 1993). In adults, DM
Type 1 accounts for approximately 5% of all diagnosed cases of diabetes (WHO, 2006). Risk
factors for DM Type 1 may be autoimmune, genetic, or environmental. There is no known way to
prevent DM Type 1. Several clinical trials for preventing DM Type 1 are currently in progress or
are being planned.

DM Type 2

DM Type 2 was previously called non-insulin-dependent diabetes mellitus (NIDDM) or adult-
onset diabetes. DM Type 2 is the most common form of DM. In adults, DM Type 2 accounts for
about 90% to 95% of all diagnosed cases of DM (WHO, 2006).
DM Type 2 usually begins as insulin resistance, a disorder in which the cells do not use insulin properly. As the need for insulin rises, the pancreas gradually loses its ability to produce it (American Diabetes Association, 2012). Those with DM Type 2 are usually not dependent on exogenous insulin for survival, but insulin may be needed to help control blood glucose (BG) levels. DM Type 2 is the cause of 90 per cent of cases of impaired glucose tolerance (IGT) (WHO, 2006).

Some groups have a higher risk for developing DM Type 2 than others and many are unaware they are at high risk. DM Type 2 is associated with older age, obesity, family history of diabetes, history of gestational DM, impaired glucose metabolism, physical inactivity, and race/ethnicity (Davis et al., 2003).

Symptoms of DM Type 2 diabetic include frequent urination, unusual thirst, extreme hunger, unusual weight loss, extreme fatigue, irritability, frequent infections, blurred vision, cuts/bruises that are slow to heal, tingling/numbness in the hands or feet, and recurring skin, gum or bladder infections. However, people with DM Type 2 often have no symptoms in the early stages (American Diabetes Association, 2012).

Gestational DM

It is a form of glucose intolerance, that diagnosed during pregnancy which developed in 2 to 10% of all pregnancies but disappeared when pregnancy was over (WHO, 2006). It is more common among obese women and women with a family history of DM. During pregnancy, gestational DM requires treatment to optimize maternal blood glucose levels to reduce the risk of complications to the infant. Women who had gestational DM are at an increased risk for developing DM Type 2 later in life (Hadden et al., 2003). Immediately after pregnancy, 5% to
10% of women with gestational diabetes were found to have DM, usually DM Type 2. Women who had gestational diabetes have a 35% to 60% chance of developing DM in the next 10–20 years (Centers for Disease Control and Prevention, 2011).

1.4.2 Diagnosis of DM Type 2

It is difficult to pinpoint a single number by which to judge everyone’s glucose levels. The old standards for diagnosing diabetes are as follows: fasting plasma glucose (FPG) concentration ≥ 1260 mg/dL or 2 hour glucose concentration on the oral glucose tolerance test (OGTT) ≥ 200 mg/dL. These values were used because some people whose values exceeded these subsequently developed retinopathy three to eight years later (Davidson, 2000).

According to Clinical Practice Guidelines (CPG), published by Ministry of Health Malaysia in 2009, there are three different tests that can use to measure blood glucose level and used as tool for screening and diagnosis. This includes Random Blood Sugar (RBS), 75g Oral Glucose Tolerance Test (OGTT), Random Plasma Glucose (RPG) and Fasting Plasma Glucose (FPG).

RBS is mainly done for screening purposes. It used capillary blood, by using glucose meters and strips. In children and adolescents at risk of developing diabetes, screening should be initiated at 10 years old or at onset of puberty if puberty occurs at a younger age. Screening is performed every two years (Ministry of Health Malaysia, 2009).

1.4.3 Glycosylated Haemoglobin A1c (HbA1c)

HbA1c refers to glycosylated haemoglobin, which identifies average plasma glucose concentration (American Diabetes Association, 2012). HbA1c occurs when haemoglobin joins
with glucose in the blood. Haemoglobin molecules make up the red blood cells in the bloodstream. When glucose sticks to these molecules it forms a glycosylated haemoglobin molecule, also known as A1c and HbA1c. The more glucose found in the blood the more HbA1c will be present (American Diabetes Association, 2012). Due to the fact that red blood cells survive for 8-12 weeks before renewal, by measuring HbA1c, an average blood glucose reading can be returned.

In Malaysia, HbA1c used to measure blood glucose approximately every 3 to 6 months to ensure that glycaemic targets are being met as shown in Table 1.

Table 1: HbA1c level and DM status

<table>
<thead>
<tr>
<th>Disease status</th>
<th>HbA1c level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-diabetics</td>
<td>Usual reading is 4-5.9%.</td>
</tr>
<tr>
<td>People with diabetes</td>
<td>An HbA1c level of 6.5% is considered good control</td>
</tr>
<tr>
<td>People at greater risk of hypo</td>
<td>May be given a target HbA1c of 7.5% (prevents too many low blood sugars from occurring)</td>
</tr>
<tr>
<td>glycaemia</td>
<td></td>
</tr>
</tbody>
</table>

Source: American Diabetes Association (2012)

HbA1c measurement is different from blood glucose levels which fluctuate constantly, literally on a minute by minute basis. Therefore, for micro adjustments and regular checking, blood glucose testing is advised. The HbA1c level changes very slowly over a 10 week period.

In Feb 2011, the WHO expert consultation recommends the acceptability of HbA1c, as an additional test to diagnose DM. HbA1c does not require a fasting state, no need oral glucose challenge and reflects average blood glucose levels over preceding 2-3 months. As a result, it
facilitates early diagnosis and reduces the health burden associated with diabetes complications. Cost for using HbA1c as screening or for diagnosis may be high for certain country.

HbA1c level alone does not predict diabetes complications. Good control is known to lower the risk of complication. If people with DM Type 2 reduce their HbA1c level by 1%, there is a 19% reduction is cataract extractions, 16% decrease in heart failure and 43% reduction in amputation or death due to peripheral vascular disease (Rury et al., 2008).

An elevated HbA1C is associated with many micro vascular and neuropathic complications (The Diabetes Control and Complications Trial Research Group, 1993). In both DM Type 1 and DM Type 2, a positive correlation between HbA1C levels and retinopathy and neuropathy has been documented in randomized clinical trials conducted over six to ten years. Based on results of four studies that included thousands of patients, the upper limit of normal for HbA1C was set at 6.5% because complications did not develop or grow worse if the HbA1C was kept below 7.0% (Gavin et al., 1997). When HbA1C levels reached 7.0% to 8.0%, neuropathic and retinopathy conditions did develop and progressed slowly. In those that had HbA1C levels above 8.0%, complications increased greatly (Carole et al., 2007).

1.4.4 Scope of Treatment

In January 2002, the American Diabetes Association and American Dietetic Association published a position paper on the treatment and prevention of diabetes and related complications. The position paper described several goals for those with DM (Franz et al., 2002).
Attain and maintain optimal metabolic outcomes including

The aims of this goal are to achieve blood glucose levels in the normal range, or as close to normal as is safely possible to prevent or reduce the risk of complications of diabetes. Also to monitor blood pressure levels and manage lipid profile that can reduces the risk for macro and micro vascular disease

Prevent and treat the chronic complications of diabetes.

Aims are to improved health through healthy food choices and physical activity. Address individual nutritional needs taking into consideration personal, ethnic and cultural preferences and lifestyle while respecting the individual’s wishes and willingness to change. Modify nutrient intake and lifestyle as appropriate for the prevention and treatment of obesity, dyslipidaemia, cardiovascular disease, hypertension, and nephropathy.

1.4.5 Glycaemic Control and its Related Factors

Patient related factors

Age, gender, sex, body mass index (BMI), smoking, depression and level of knowledge on diabetes, were among common factors included in patient related factors (Abdelaziz et al., 2006). Control of DM Type 2 was poor among younger adults (< 60 years) compared to elders (O.R. = 1.61, 95 % C.I. = 1.11 to 2.33) and males (O.R. = 0.80, 95 % C.I. = 0.72 to 0.88) had better DM Type 2 control compared to females (Sanal et al., 2011).

Type 2 diabetic in children and adolescents, although still rare, is being diagnosed more frequently among American Indians, African Americans, Hispanic/Latino Americans, and Asians/Pacific Islanders (Centers for Disease Control and Prevention, 2011)
Study among White Caucasian (WC), Afro-Caribbean (AC) and Asian of Indian Origin (IA), shows important ethnic differences in body weight, lipid profiles, and blood pressure, but not glycaemic control, during 9 years after diagnosis of DM Type 2 (Davis et al., 2001).

Habit of smoking (O.R. = 0.89, 95 % C.I. = 0.75 to 1.06) and presence of depression (O.R. = 0.93, 95 % C.I. = 0.69 to 1.26) had no association with poor control. However, there was a difference in mean BMI of poorly controlled and well controlled diabetics (Sanal et al., 2011).

Study by David et al. (2010), show that respondents were highly aware of the duration of their diabetes, and almost 75% have had the opportunity to discuss the chronic nature of the illness and the importance of key lifestyle changes to help prevent or retard the progression of the disease. However, almost 40% of patients were not aware of the type of diabetes they had, and one in five have not received diabetes self-management education from their health care providers.

Most important aim of diabetes education is to alter self-care behaviour of patients with diabetes. In order to change their behaviour, its determinants must be known. A review of literature on this subject shows that level of knowledge and anxiety, health focus of control, attitude to self-care, social environment and demographic variables are important determinants. An integration of these determinants into a theoretical framework is necessary to create a guideline for future developments of diabetes education programmes.

Disease related factors
Major clinical problems in DM include microangiopathy (nephropathy, retinopathy and neuropathy) and macroangiopathy (ischemic heart disease, stroke and diabetic foot). DM patients