UNIVERSITI PUTRA MALAYSIA

ASSOCIATION BETWEEN DIABETES KNOWLEDGE AND GLYCAEMIC CONTROL AMONG TYPE II DIABETES PATIENTS AT A GOVERNMENT PRIMARY HEALTH CLINIC IN NEGERI SEMBILAN

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ASSOCIATION BETWEEN DIABETES KNOWLEDGE AND GLYCAEMIC CONTROL AMONG TYPE II DIABETES PATIENTS AT A GOVERNMENT PRIMARY HEALTH CLINIC IN NEGERI SEMBILAN

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ABSTRACT

Introduction: The global and local prevalence of Type II Diabetes Mellitus (T2DM) had been increasing over the years. The high prevalence of diabetes was alarming as diabetes was linked to both macro-vascular and microvascular problems, especially when left untreated. Adequate glycaemic control was found closely associated with reduced diabetes-related complications. To achieve good glycaemic control, self-management played an essential role in chronic disease management. In relation to this, knowledge of diabetes had been recognised as an important prerequisite for proper self-management among diabetic patients. ***Objective:*** This study was conducted to determine the association between diabetes knowledge and glycaemic control among T2DM patients. ***Methods:*** A cross-sectional study design was used. A convenience sample of 221 T2DM patients who follow-up in Klinik Kesihatan Titi, Negeri Sembilan were recruited in this study. A self-administered questionnaire which consisted of two parts including socio-demographic data and Diabetes Knowledge Questionnaire (DKQ-24) was used. Glycaemic control was measured by the latest Haemoglobin A1c (HbA1c) retrieved from the patients' medical records. Statistical Package for Social Sciences (SPSS) version 22 software was used to analyse the data. ***Results:*** The mean age of the participants was 62.86 ± 11.90 years. They had a mean diabetes duration of 7.94 ± 6.20 years. The average HbA1c was 6.70 (IQR, 6.00 - 7.80) whereas the mean knowledge score was 14.55 ± 3.53. Age, ethnicity, income, type of treatment, and duration of diabetes were found significantly associated ($p < 0.05$) with glycaemic control. Diabetes knowledge was significantly associated ($p < 0.05$) with age, duration of diabetes, and body mass index. The correlation matrix showed a weak inverse correlation of total knowledge score with HbA1c ($r = -0.142$; $p = 0.036$). ***Conclusion:*** Diabetes knowledge was significantly correlated with glycaemic control. Having good knowledge enabled patients to have more control over their health, and thus increased the likelihood of achieving target glycaemic control. The findings were useful for healthcare providers in establishing effective diabetes educational programmes based on the learning needs and characteristics of patients.

Keywords: knowledge, glycaemic control, type II diabetes mellitus

HUBUNGAN ANTARA PENGETAHUAN DIABETES DAN KAWALAN GLISEMIK DALAM KALANGAN PESAKIT DIABETES JENIS II DI SEBUAH KLINIK KESIHATAN KERAJAAN DI NEGERI SEMBILAN

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ABSTRAK

Pengenalan: Peningkatan prevalensi diabetes mellitus jenis II (T2DM) selama ini amat membimbangkan. T2DM boleh menyebabkan masalah makro-vaskular dan mikrovaskular, terutamanya apabila tidak dirawat. Kawalan glisemik yang baik didapati berkait rapat dengan komplikasi diabetes yang berkurangan. Untuk mencapai kawalan glisemik yang baik, pengurusan diri memainkan peranan penting dalam pengurusan penyakit kronik. Sehubungan dengan ini, pengetahuan tentang diabetes telah diakui sebagai prasyarat penting untuk pengurusan diri yang betul di kalangan pesakit diabetes. ***Objektif:*** Kajian ini bertujuan untuk mengkaji hubungan antara pengetahuan diabetes dan kawalan glisemik di kalangan pesakit T2DM. ***Metodologi:*** Reka bentuk kajian keratan rentas digunakan. Seramai 221 pesakit T2DM yang membuat susulan di Klinik Kesihatan Titi, Negeri Sembilan direkrut dalam kajian ini melalui persampelan mudah. Instrumen kajian yang digunakan ialah Soal Selidik Pengetahuan Diabetes 24 item (DKQ-24). Soal selidik ini terdiri daripada dua bahagian termasuk data berkaitan sosio-demografi dan kesihatan dan DKQ-24. Kawalan glisemik diukur dengan Haemoglobin A1c (HbA1c) terkini yang diambil daripada rekod perubatan pesakit. Statistical Package for Social Sciences (SPSS) versi 22 digunakan untuk menganalisis data. ***Keputusan:*** Purata umur peserta ialah 62.86 ± 11.90 tahun. Mereka mempunyai tempoh diabetes min 7.94 ± 6.20 tahun. Purata HbA1c adalah 6.70 (IQR, 6.00 - 7.80) manakala skor pengetahuan min adalah 14.55 ± 3.53. Umur, bangsa, pendapatan, jenis rawatan, dan tempoh diabetes didapati berkaitan signifikan ($p < 0.05$) dengan kawalan glisemik. Pengetahuan diabetes berkaitan secara signifikan ($p < 0.05$) dengan umur, tempoh diabetes, dan indeks jisim badan. Matriks korelasi menunjukkan korelasi songsang yang lemah antara skor pengetahuan dengan HbA1c ($r = -0.141$; $p = 0.036$). ***Kesimpulan:*** Pengetahuan diabetes berkaitan secara signifikan dengan kawalan glisemik. Memiliki pengetahuan yang baik membolehkan pesakit mempunyai lebih banyak kawalan terhadap kesihatan mereka, dan dengan demikian meningkatkan kemungkinan mencapai kawalan glisemik sasaran. Penemuan ini berguna bagi anggota kesihatan dalam mewujudkan program pendidikan diabetes yang berkesan berdasarkan keperluan pembelajaran dan ciri-ciri pesakit.

Kata kunci: pengetahuan, kawalan glisemik, diabetes mellitus jenis II

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LIST OF ABBREVIATIONS

ADA	American Diabetes Association
COVID-19	2019 novel Coronavirus
DKQ	Diabetes Knowledge Questionnaire
H_o	Null hypothesis
HbA1c	Hemoglobin A1c
JKEUPM	Jawatankuasa Etika Untuk Penyelidikan Melibatkan Manusia
MDKT	Michigan Diabetes Knowledge Test
MOH	Ministry of Health
MREC	Medical Research and Ethics Committee
NCD	Non-communicable disease
NDR	National Diabetes Registry
NHMS	National Health and Morbidity Survey
NMRR	National Medical Research Register
SPSS	Statistical Package for the Social Sciences
T2DM	Type II Diabetes Mellitus
UPM	Universiti Putra Malaysia
WHO	World Health Organisation

CHAPTER 1

INTRODUCTION

1.1 Background of the study

According to the National Health and Morbidity Survey (NHMS) 2019, non-communicable diseases (NCDs) had contributed to 71% of premature deaths in Malaysia (Ministry of Health [MOH], 2019). Of these, diabetes was the NCD that showed an increasing trend of prevalence which was from 11.2% (2011), 13.4% (2015) to 18.3% (2019). When viewing in the global context, the estimated diabetes prevalence in 2019 was at 463 million with 4.2 million expected deaths, which accounted for 11.3% of global deaths (Alromaihi, Alamuddin & George, 2020). Low and middle-income countries had shown a more rapidly rising in the prevalence of diabetes compared to high-income countries (World Health Organization [WHO], 2020).

The high diabetes prevalence was indeed alarming as diabetes was closely associated with macro-vascular and microvascular complications, such as cardiovascular disorder, peripheral vascular disorder, nephropathy, neuropathy, and retinopathy, which may in turn result in greater healthcare cost and burden. In addition, diabetic patients were found to be susceptible to coronavirus infection (Sacks, Pham, Fleming, Neoh & Ekinci, 2020). They will have a more severe infection, poorer prognosis, and higher mortality rate if contracting COVID-19 infection (Sacks et al., 2020).

Therefore, adequate glycaemic control was found as the main therapeutic goal in preventing those adverse diabetes-related complications (Haghighatpanah, Sasan,

Nejad, Haghighatpanah, Thunga & Mallayasamy, 2018). The positive impacts of improved glycaemic control on microvascular and neurological complications due to diabetes had been demonstrated in various randomized controlled trials (Gaster & Hirsch, 1998). Several factors were affecting glycaemic control among diabetic patients, for example, age, duration of disease, comorbidities, disease knowledge, and self-care practice. Developed countries like Japan and Germany were found to have better glycaemic control compared to developing countries due to higher health literacy which results in higher disease knowledge (Ahmad, Islahudin & Paraidathathu, 2014). Although the importance of disease knowledge was emphasized in several studies (Szymona-Pałkowska et al., 2016; Shrestha et al., 2015), diabetes knowledge was seldom being included in the study of factors associated with poor glycaemic control in Malaysia (Awang et al., 2020; Sazlina et al., 2015; Ahmad et al., 2014).

Knowledge served as fundamental in disease management especially in the self-management of diabetes. An adequate level of knowledge empowered an individual to make an informed health decision. It was also a determinant in influencing an individual's perception of susceptibility, severity, and benefits which can result in behavioural change and better self-care practice in diabetes. False belief in an individual could result in varied accuracy of the knowledge. Therefore, adequate knowledge of one's illness had been stressed as an important cognitive factor that could have a profound effect on the adaptation of the patient to the illness and its treatment (Szymona-Pałkowska et al., 2016).

Thus, this study aimed to determine the level of diabetes-related knowledge and glycaemic control among diabetic patients and also to investigate the association between knowledge and glycaemic control.

1.2 Problem statement

The health services for NCD worldwide had been severely disrupted by the COVID-19 pandemic due to the shortage of staff, fewer public transport, and the cancellation of physical appointments (WHO, 2020). This situation posed a major threat to people living with diabetes as they were vulnerable groups who had a greater risk of severe COVID-19-related illness and mortality. There was a research that found that the implementation of lockdown during the COVID-19 outbreak caused worsening of glycaemic control among diabetic patients as they might face difficulty in getting treatment and blood glucose monitoring from the healthcare facilities (Tao et al., 2020). Moreover, many of them were afraid of attending the clinic for follow-up during the disease outbreak. Therefore, this study aimed to determine the level of glycaemic control among diabetic patients during this pandemic.

Moreover, the delivery of healthcare services in many countries had shifted from traditional in-person visits to virtual visits so-called telemedicine in response to the COVID-19 pandemic. This was to reduce the risk of transmission while at the same time ensure the continuity of patient care. Therefore, the level of diabetes knowledge might be different from previous studies due to the increased utilisation of telemedicine during the pandemic.

Since the traditional face-to-face visit in the clinic was reduced as a measure to contain the virus, proper self-care at home played a crucial role in ensuring good glycaemic control and in preventing any potential complications resulting from poor glycaemic control. Knowledge of diabetes especially self-care knowledge was the prerequisite for practising proper self-care and thus achieving a good glycaemic level. A study showed that patients who were more knowledgeable about diabetes had lower HbA1c levels and higher confidence in self-care practice (Badedi et al., 2016).

However, there were inconsistent findings regarding the association between diabetes knowledge and glycaemic control among diabetic patients in local and overseas studies. No significant association was found between diabetes knowledge and glycaemic control in a study done in the primary health clinics in Kuala Selangor, a diabetic clinic in King Saud Medical City, Riyadh, and the Dhaka Hospital in Bangladesh (Abdullah, Ismail, Ghazali, Juni, Shahar & Aziz, 2019; AlShareef et al., 2017; Islam et al., 2015). This was in contrast with the findings in other studies conducted in the hospital-based outpatient clinics in Penang and Kenya where the results showed a significant association between knowledge level and glycaemic control among type 2 diabetes patients (Sakari & William, 2019; Al-Qazaz et al., 2012). Therefore, the association between knowledge level and glycaemic control need to be explored further through this research.

Furthermore, to the best of my knowledge, there were only two local studies involved in examining the association between diabetes knowledge and glycaemic control among type II diabetes patients. The studies that had been done locally were in the

diabetes clinic of Hospital Pulau Penang, Penang and the primary health clinics in Kuala Selangor, Selangor (Abdullah et al, 2019; Al-Qazaz et al., 2012). Most of the local studies examine the relationship of knowledge level with sociodemographic characteristics like gender, age, educational level, and household income as in the studies carried out in the Kuala Muda District, Kedah and the Klang district, Selangor (Abbasi, Ooi, Ng, Balasubramanian, Yap & Paruchuri, 2018; Chinnappan, Sivanandy, Sagaran & Molugulu, 2017).

The healthcare providers must identify the issue of knowledge deficit faced by patients as they are the main person in disseminating disease-related knowledge and designing effective health-related interventions. To date, limited study has been done at the public health clinic in Negeri Sembilan which thoroughly examine the relationship between diabetes knowledge and glycaemic control. Hence, this study was undertaken to fill the research gap and to evaluate the general diabetes knowledge and its association with glycaemic control among type II diabetes patients at a public health clinic in Negeri Sembilan.

1.3 Research Questions

The followings research questions were to be answered in this study:

i. What is the level of diabetes knowledge among type II diabetes mellitus (T2DM) patients?

ii. What is the level of glycaemic control among T2DM patients?

iii. What is the association between diabetes knowledge and glycaemic control among T2DM patients?

1.4 Research objectives

1.4.1 General objective

To investigate the association between diabetes knowledge and glycaemic control among T2DM patients at a government health clinic in Negeri Sembilan.

1.4.2 Specific objectives

i. To identify the level of diabetes knowledge among T2DM patients.

ii. To identify the level of glycaemic control among T2DM patients.

iii. To determine the association between sociodemographic characteristics and diabetes knowledge among T2DM patients.

iv. To determine the association between sociodemographic characteristics and glycaemic control among T2DM patients.

v. To determine the association between diabetes knowledge and glycaemic control among T2DM patients.

1.5 Significance of the study

The present study helped to improve the general diabetes knowledge among T2DM patients. It also increased the awareness of patients and caregivers on the role of proper self-care in diabetes. Besides, it raised the awareness of healthcare providers on the importance of disease knowledge in glycaemic control and diabetes management.

In addition, this study helped to determine the knowledge level and to identify the knowledge gap among diabetic patients. It provided insight for healthcare providers to design appropriate and effective health interventions for diabetic patients. This can help diabetic them to achieve better glycaemic control and to prevent diabetes-related complications. Furthermore, it also helped to identify the common misconception about diabetes among diabetic patients. This enabled the healthcare providers to identify the area to focus on future health education.

Lastly, the present study will contribute by adding new knowledge regarding the association between diabetes knowledge and glycaemic control among diabetic patients in a rural primary health clinic in Negeri Sembilan. It also helped to identify the sociodemographic factors associated with diabetes knowledge level and glycaemic control. This helped the diabetes educators in delivering effective health education to diabetic patients and the general public with different socioeconomic backgrounds.

1.6 Hypotheses

1.6.1 Research hypotheses

H1: There is a significant association between socio-demographic characteristics and diabetes knowledge among T2DM patients at a p-value ≤ 0.05.

H2: There is a significant association between socio-demographic characteristics and glycaemic control among T2DM patients at a p-value ≤ 0.05.

H3: There is a significant association between diabetes knowledge and glycaemic control among T2DM patients at a p-value ≤ 0.05.

1.6.2 Null hypotheses

H_{01}: There is no significant association between sociodemographic characteristics and diabetes knowledge among T2DM patients at a p-value greater than 0.05.

H_{02}: There is no significant association between sociodemographic characteristics and glycaemic control among T2DM patients at a p-value greater than 0.05.

H_{03}: There is no significant association between diabetes knowledge and glycaemic control among T2DM patients at a p-value greater than 0.05.

1.7 Operational definition

T2DM patients:

Adults aged 18 and above, with physician-diagnosed T2DM and were receiving any antidiabetic treatment in Klinik Kesihatan Titi, Negeri Sembilan.

Diabetes knowledge:

Knowledge in this study referred to the understanding of diabetes information based on the 24-item Diabetes Knowledge Questionnaire (DKQ-24). It was measured by summing up the correct total score from the 24 items. The knowledge scores were categorized into three levels which were poor (less than or equal to 50%), moderate

(51 to 69%), and good (more than or equal to 70%) as adapted by Khan, Sarriff, Khan, and Mallhi (2014).

Glycaemic control:

Glycaemic control referred to the latest HbA1c value within the past 6 months. Glycaemic control was categorised into three groups indicated by good (less than 7%), moderate (7 to 8%), and poor (more than 8%) based on the recommendation by the Malaysian Clinical Practice Guidelines for the management of T2DM (MOH, 2020).

Sociodemographic characteristics:

Sociodemographic characteristics were defined as a combination of sociological and demographics and diabetes-related data including age, gender, ethnicity, educational level, monthly income, duration of diabetes, presence of comorbidities, type of antidiabetic treatment, and body mass index (BMI).

1.8 Conceptual framework

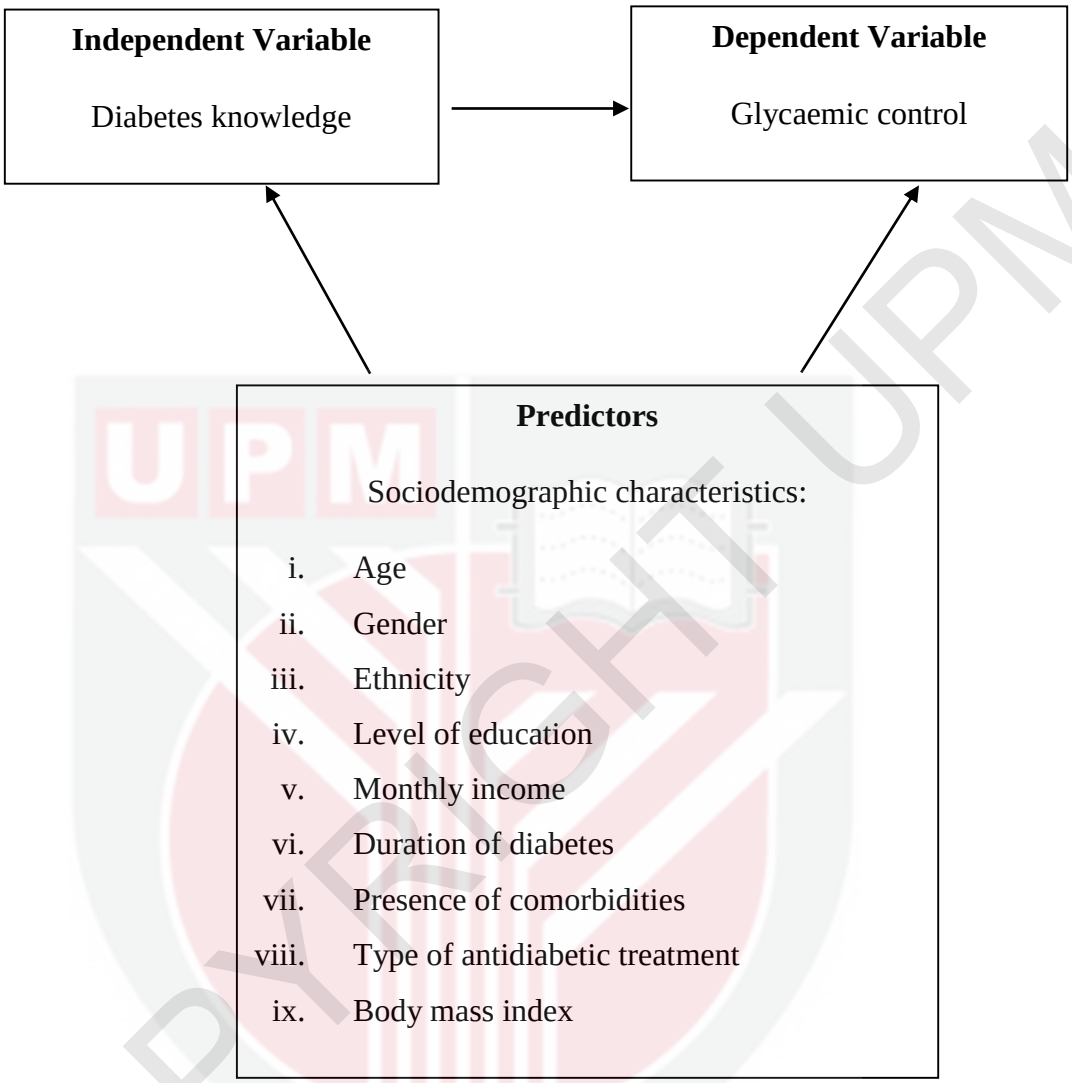


Figure 1.1: Conceptual framework of the study

The proposed theoretical framework of this study as shown in Figure 1.1 consisted of an independent variable and a dependent variable. The independent variable was diabetes knowledge whereas the dependent variable was glycaemic control. Socio-demographic characteristics including age, gender, ethnicity, level of education, monthly income, duration of diabetes, type of antidiabetic treatment, and BMI are the predictors for both independent and dependent variables.

The hypotheses are derived from the framework. The researcher will find out the association between the independent variable (diabetes knowledge) and the dependent variable (glycaemic control). Also, the researcher will find out the association between predictors (sociodemographic characteristics) and independent variable (diabetes knowledge) as well as the association between predictors (sociodemographic characteristics) and the dependent variable (glycaemic control).

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter provided an overview of previous researches on diabetes knowledge and glycaemic control to aid in the understanding of the research focus.

2.1 Type II diabetes mellitus

Type II diabetes mellitus (T2DM) is also known as non-insulin-dependent diabetes or adult-onset diabetes. It is a metabolic disorder characterised by hyperglycaemia in the absence of treatment due to insulin resistance, insufficient insulin secretion, and excessive glucagon secretion. Diabetes is a common chronic illness that can be found in every population worldwide. T2DM is the most common type of diabetes in which about 90-95% of diabetes cases being diagnosed are T2DM (Centers for Disease Control and Prevention [CDC], 2019). In Malaysia, the majority of diabetic patients (99.3% in 2019) who registered in the National Diabetes Registry were diagnosed with T2DM (MOH, 2020).

Based on the Malaysian Clinical Practice Guideline published in 2020, the diagnostic criteria for T2DM include:

i) A fasting plasma glucose (FPG) level ≥7.0 mmol/L (126 mg/dL), or

ii) A 2-hour plasma glucose level ≥11.1 mmol/L (200 mg/dL) during a 75g oral glucose tolerance test (OGTT), or

iii) A random plasma glucose ≥11.1 mmol/L (200 mg/dL) in a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, or

iv) A hemoglobin A1c (HbA1c) level ≥6.3% (45 mmol/mol)

One abnormal glucose value is diagnostic in symptomatic individuals, whereas two abnormal test results (plasma glucose and HbA1c) is required for diagnosis in asymptomatic individuals.

T2DM has emerged as a major public health concern worldwide. It remains the leading cause of visual loss, lower limb amputation, end-stage renal failure, heart attacks, and strokes (WHO, 2020). It leads to severe complications not only affecting patients' health but also their productivity and quality of life (Sami, Ansari, Butt & Hamid, 2017).

2.2 Glycaemic control

Glycaemic control refers to the typical blood glucose levels in a person with diabetes. Glycaemic control is the main therapeutic goal in diabetes management. Glycated haemoglobin (HbA1c) has been widely used as the gold standard in diagnosing diabetes and monitoring glycaemic control among diabetic patients. HbA1c reflects the average blood glucose levels of a person over the past two to three months before the test. In uncontrolled diabetic patients, the test should be performed every three months, and in well-controlled diabetic patients, it should be performed at least twice a year. (Musenge, Michelo, Mudenda & Manankov, 2016).

According to the American Diabetes Association (2019), the reasonable HbA1c target for most non-pregnant adults is <7% (53 mmol/mol). A more stringent HbA1c goal of <6.5% (48 mmol/mol) is for selected individuals such as those with short diabetes duration, treatment with lifestyle or metformin only, long life expectancy, or no significant cardiovascular disease, and if the goal can be achieved without causing significant hypoglycemia and adverse effects. Less stringent HbA1c goals of <8% (64 mmol/mol) may be appropriate for patients who have difficulty in achieving the goal despite adequate self-management education, glucose monitoring and treatment is given. For example, those who have a history of severe hypoglycaemia, short life expectancy, advanced diabetes-related complications, extensive comorbidities, or long diabetes duration.

According to Clinical Practice Guidelines by the Ministry of Health Malaysia (MOH) (2016), the glycaemic target for control of T2DM is HbA1c ≤6.5%. However, it should be individualised based on the patients' profiles to minimise the risk of hypoglycaemia. Tight glycaemic control (6.0-6.5%) is recommended for patients who are newly diagnosed with diabetes, relatively younger age, healthier (long life expectancy, no cardiovascular diseases or its complications), and low risk of hypoglycaemia. On the other hand, less tight glycaemic control (7.1-8.0%) is recommended for patients who have comorbidities (coronary artery disease, heart failure, renal failure, liver dysfunction), short life expectancy, and are prone to hypoglycaemia. Other than these two groups, the HbA1c target for all others is 6.6-7.0%.

Poor glycaemic control with high levels of HbA1c can result in diabetes-related complications and even death. According to one study, HbA1c levels in individuals with T2DM were related with decreased risks of macrovascular events and death down to a cut-off value of 7.0%, as well as lower chances of microvascular events down to a cut-off value of 6.5% (Zoungas et al., 2011). Thus, the major goal of glycemic control is to maintain an optimal level of HbA1c.

A cross-sectional study conducted in the University Teaching Hospital diabetes clinic in Lusaka, Zambia found that 61.3% of diabetic patients had poor glycaemic control (HbA1c >6.5%) whereas only 38.7% of patients maintained good glycaemic control (HbA1c ≤6.5%) (Musenge et al., 2016). Furthermore, a study result from six hospitals in Bangladesh showed that only 18.8% of respondents with T2DM had good control (HbA1c <7%), 19.78% had fair control (HbA1c 7-8%), 62% had poor glycaemic control (HbA1c >8%), and 54.7% had very bad control (HbA1c ≥9%) (Afroz, Ali, Karim, Alramadan, Alam, Magliano & Billah, 2019). Moreover, a cross-sectional study conducted in the diabetes clinics of hospitals in Dar es Salaam reported that 69.7% of participants with T2DM had poor glycaemic control with fasting blood glucose of ≥7.2 mmol/L (Kamuhabwa & Charles, 2014).

In Malaysia, a cross-sectional study carried out at the Diabetes Clinic of Penang General Hospital in Penang showed that the mean HbA1c of the study population was 7.94% (SD = 1.61%), with just 32.7% of them having good glycaemic control (HbA1c <7%). Besides, only 20.8% of the study participants achieved the Malaysian glycaemic target (Hba1c <6.5%) (Al-Qazaz, Sulaiman, Hassali, Shafie & Sundram, 2012). In

UKM Medical Centre, Selangor, a cross-sectional study among T2DM inpatients showed unsatisfactory glycaemic control with a median HbA1c value of 8.9 ± 4.4%. Only 21.3% of them met the target HbA1c level of <6.5% (Ismail, Suddin, Sulong, Ahmed, Kamaruddin & Sukor, 2016).

Only a quarter of patients in primary care clinics and one-eighth of patients in tertiary care hospitals were able to achieve optimal diabetes control, highlighting the need of paying close attention to the patient's glycemic control (MOH, 2016). Based on the Malaysian National Diabetes Registry Report 2013-2019, the mean HbA1c for diabetic patients handled at MOH primary health clinics ranged from 7.9 to 8.1%. The overall trend of patients attaining the Malaysian glycaemic target of HbA1c ≤6.5% had gradually grown over the years from 31.42% in 2018 to 32.41% in 2019. However, there were still more than half of the diabetic patients (77.45% in 2019) who had HbA1c of >7% (MOH, 2020).

2.3 Association between sociodemographic characteristics and glycaemic control

2.3.1 Age

A retrospective observational study in India by Haghighatpanah et al. (2018) based on inpatient and outpatient medical records found that age had a significant association with glycaemic control. The majority of patients in the age groups of 51-60 years and 60-70 years had poor glycaemic control which matched the findings of Woldu et al. (2014). On the other hand, a local study done in seven clinics in the Hulu Langat district found that senior patients (age 65 and above) had better glycaemic control than

younger patients. A study found that every year of age gained was related to a 3% increase in the chance of attaining glycaemic control target (Ahmad et al., 2014). The findings were in line with another local study done in Pasir Puteh district, Kelantan (Awang et al., 2020). Furthermore, a study in Australia and Singapore also found that younger T2DM patients had worse glycaemic control than the older age group (Nanayakkara et al., 2018; Toh, Wu & Leong, 2011). One of the reasons might be due to the more aggressive phenotype and more rapidly declining rate in beta-cell function in early-onset T2DM compared to later-onset T2DM (Song & Hardisty, 2009).

2.3.2 Gender

A significant relationship between gender and glycaemic control was found based on a cross-sectional study conducted in the hospitals in Bangladesh in which females had a higher frequency of poor glycaemic control (Afroz et al., 2019). This was similar to the results from a retrospective observational study in India by Haghighatpanah et al. (2018). However, no significant association between gender and glycaemic control was discovered in other studies (Awang et al., 2020; Wan Hamdzan, Juni, Salmiah, Azuhairi & Zairina, 2016; Ahmad et al., 2014).

2.3.3 Ethnicity

Ethnicity was an important factor in diabetes care especially in Malaysia, a country with multi-ethnic groups (Chew et al., 2011). A cross-sectional study in Malaysia among older T2DM patients by Sazlina et al. (2015) discovered that ethnicities of Malay and Indian were related to worse glycaemic control. This finding was in line with a Singapore study that reported that the Chinese had better glycaemic control than

Malay and Indians (Toh et al., 2011). This might due to the reason that Malay and Indians were found to have higher insulin resistance compared to Chinese. Another reason suggested by Sazlina et al. (2015) was because there were varied lifestyle habits in different ethnic groups.

2.3.4 Level of education

A study in Bangladesh showed that low education level was significantly associated with poor glycaemic control (Afroz et al., 2019). However, there was no significant difference in the glycaemic control among young diabetic patients (diagnosed before age 40) with different education levels as reported in a study in Peninsular Malaysia (Ismail et al., 2000).

2.3.5 Monthly income

In T2DM, socioeconomic position, as defined by household income, was not a major driver of glycemic control (Ismail et al., 2000). There was no evidence of significant association found between income status and glycaemic control (Wan Hamdzan, Juni, Salmiah, Azuhairi & Zairina, 2016).

2.3.6 Duration of diabetes

Duration of diabetes was also a predictor of poor glycaemic control. Patients who had longer diabetes duration were found to have poor glycaemic control more likely. This was probably due to the progressively impaired insulin secretion by beta-cell over time and increased insulin resistance and suddenly reduced insulin secretion (Mamo,

Bekele, Nigussie & Zewudie, 2019). The findings were similar to those of another study in which the duration of diabetes was linked to the glycemic control outcome (HbA1c). With each one year increase in diabetes duration, the chances of achieving target glycemic control decreased by 5%. (Ahmad et al., 2014). A study conducted by Haghighatpanah et al. (2018) discovered that having diabetes for more than 5 years was substantially connected with poor glycemic control.

2.3.7 Presence of comorbidities

The presence of comorbidities was significantly associated with poor glycaemic control. This might due to poor medication adherence as there was more medication for the comorbidity causing the increase of pill burden to the patient (Mamo et al, 2019). Poor glycemic control was linked to the existence of comorbidities such as dyslipidemia and peripheral neuropathy (Woldu et al., 2014).

2.3.8 Type of antidiabetic treatment

Types of antidiabetic treatment were associated with glycaemic control. Studies showed that those who took insulin or insulin and the oral antidiabetic drug had poorer glycaemic control compared to those who took the oral antidiabetic drug only (Ahmad et al., 2014; Haghighatpanah et al., 2018; Mamo et al., 2019). This could be because the prescription of insulin was usually for patients with more severe diabetes and a longer duration of disease.

2.3.9 Body mass index

Body-mass-index (BMI) was computed by dividing weight in kg by height in meters squared. The weight status was categorised into underweight (BMI < 18.5 kg/m^2), normal weight (BMI = 18.5–24.9 kg/m^2), overweight (BMI = 25–29.9 kg/m^2), and obese (BMI ≥ 30 kg/m^2). A study done by Haghighatpanah et al. (2018) showed that obesity was significantly associated with poor glycaemic control. This could be because diabetic patients with obesity frequently reported having inconsistent meal patterns which can contribute to poor glycaemic control.

2.4 Diabetes knowledge level

Knowledge of a disease is important in disease management especially for chronic diseases which require long term treatment and care. The knowledge of chronic diseases is a vital prerequisite for the implementation of behavioural changes and preventive and control strategies in an individual with chronic diseases (Tian et al., 2011). Enhancing health knowledge helps in increasing the awareness of health care. People will gain a better understanding of the diseases, improve their self-care ability, and practice a healthy lifestyle (Tian et al., 2011).

A study done at the Diabetes Clinic of the Penang General Hospital in Penang found that out of the 505 T2DM patients aged above 30 years, 211 (41.8%) had poor knowledge level, 236 (46.7%) had average knowledge level, and only 58 patients (11.5%) had good knowledge level on diabetes. Lower knowledge scores were observed in questions about nutritious food and sugar content (Al-Qazaz et al., 2011). A study conducted in Seremban Health Clinic among diabetic and non-diabetic patients found that the knowledge level of diabetic patients (81.8%) was statistically

higher than that of non-diabetic patients (64%). Both groups had an acceptable knowledge level (Ding, Teng & Koh, 2006). A study in Bangladesh found that overall the percentage of respondents who had good knowledge of diabetes (45.6%) was higher than those who had poor knowledge (16.7%). Although getting professional health education and care in a tertiary diabetic hospital, they had insufficient knowledge of the aetiology, management, and risk factors for diabetes. (Islam et al., 2015).

2.5 Association between sociodemographic characteristics and diabetes knowledge level

2.5.1 Age

Age was found associated with diabetes medications knowledge score. Consistent findings were showing that younger patients had higher knowledge scores (Alhaik, Anshasi, Alkhawaldeh, Soh & Naji, 2019; Chinnappan, Sivanandy, Sagaran & Molugulu, 2017; Al-Qazaz et al, 2012; McPherson, Smith, Powers & Zuckerman, 2008). However, another local study found that the overall knowledge score was significantly correlated with age in the non-diabetic group instead of the diabetic group (Ding, Teng & Koh, 2006).

2.5.2 Gender

There was no statistically significant difference between gender and knowledge (Alhaik et al., 2019; Bukhsh et al., 2019; Chinnappan et al., 2017; Ding et al., 2006). However, there was a contrasting finding showing that males had more knowledge than females, and this difference was statistically significant ($P < 0.001$) (Islam et al.,

2015). This was similar to another study where the female gender was found to be substantially connected with a lack of diabetes knowledge. (Mufunda, Wikby, Björn & Hjelm, 2012).

2.5.3 Ethnicity

Similar findings were found in which there was no statistically significant difference between knowledge and ethnicity among diabetic patients (Al-Qazaz et al., 2012; Ding et al, 2006).

2.5.4 Level of education

Lower education level was associated with lower knowledge scores and the differences were statistically significant. The findings were consistent in several studies (Bukhsh et al., 2019; Islam et al., 2015; Al-Qazaz et al., 2012). However, studies by Ding et al. (2006) showed that there was no statistically significant difference between knowledge and education level among diabetic patients.

2.5.5 Monthly income

Knowledge of diabetes was significantly associated with monthly income. The knowledge score was lower especially in the group who had low monthly income (Al-Qazaz et al, 2012; Islam et al., 2015). However, studies by Ding et al. (2006) showed that there was no statistically significant difference between knowledge and income level among diabetic patients.

2.5.6 Duration of diabetes

Knowledge on diabetes was significantly associated with the duration of illness in which a longer diabetes duration was associated with higher knowledge scores (Islam et al., 2015; Al-Qazaz et al., 2012; Tian et al, 2011). However, studies by Bukhsh et al. (2019) showed that there was no statistically significant difference between knowledge and duration of diabetes among diabetic patients.

2.5.7 Presence of comorbidities

Diabetes knowledge can help diabetic patients in reducing the chance of developing chronic diabetes-related comorbidities, which can have a substantial influence on their quality of life (Fatema et al., 2017).

2.5.8 Type of antidiabetic treatment

Patients who used only oral hypoglycaemic agents had significantly higher knowledge scores compared to those who used only insulin or insulin combined with oral hypoglycaemic agents (Bukhsh et al., 2019).

2.5.9 Body mass index

Studies found that individuals who were overweight or obese had higher diabetes knowledge scores than individuals with normal weight (Fatema et al., 2017; Kutbi, Mosli, Alhasan & Mosli, 2018).

2.6 Association between diabetes knowledge level and glycaemic control

A study conducted by McPherson, Smith, Powers & Zuckerman (2008) at an ambulatory care practice in Maryland, United States found that patients who had higher knowledge regarding their diabetes medications achieved better glycaemic control. There was a strong negative relationship between knowledge score and HbA1c level ($r=-0.61$; $P<0.001$). HbA1c was reduced by 1.5 units for each 1 unit rise in knowledge score among men whereas HbA1c was reduced by 1.6 units for each 1 unit rise in knowledge score among women.

In Pakistan, diabetes knowledge was significantly associated ($p<0.05$) with glycaemic control. The correlation matrix showed a strong negative correlation of the Diabetes Knowledge Questionnaire (DKQ) with HbA1c values ($r=-0.62$; $p<0.001$) (Bukhsh et al.,2019). Locally, a cross-sectional study in Penang by Al-Qazaz et al. (2011) found that the patients' knowledge about diabetes was significantly associated with better glycaemic control ($P<0.05$). A significant correlation was found between HbA1C and the Michigan Diabetes Knowledge Test (MDKT) scores ($r=-0.390$, $P<0.01$).

Moreover, findings from a study in Bangladesh by Islam et al. (2015) found that there was a statistically significant and weak inverse relationship between diabetes knowledge and HbA1c ($p < 0.001$). However, a qualitative study done overseas by Phillips, Rahman & Mattfeldt-Beman (2018) found that patients who had never received diabetes education had poorer diabetes knowledge scores and higher HbA1C compared to those who had received diabetes education previously although no significant difference was found.

CHAPTER 3

METHODOLOGY

3.0 Introduction

This chapter discussed in detail the research methodology that had been used in the study of the association between diabetes knowledge and glycaemic control among T2DM patients.

3.1 Study Type and Design

A cross-sectional study design was used to determine the association between diabetes knowledge and glycaemic control among T2DM patients. This was a quantitative study by using the survey questionnaire as the method for data collection. The study design was an observational study that measured the exposure (diabetes knowledge) and the outcome (glycaemic control) in the study participants at the same point of time. This design examined the association rather than the causal-effect relationship between outcome and exposure.

3.2 Study location

This study was conducted at the Klinik Kesihatan Titi in Kampung Titi. Klink Kesihatan Titi was a public health clinic located in the district of Jelebu in the state of Negeri Sembilan, Malaysia. It provided primary care to the rural community living around Titi, Sungai Rotan, Simpang Gelami, Felda Titi and beyond. Negeri Sembilan was chosen as the study state as it had the highest prevalence of overall raised blood glucose (33.2%) compared to other states in Malaysia according to the NHMS 2019. The outpatient department in Klinik Kesihatan Titi was chosen as the site for data

collection because most of the patients diagnosed with a chronic illness like diabetes will attend the public primary health clinic for follow up purposes. The patients were from different ethnicity including Malay, Indian, Chinese, and Orang Asli.

3.2 Study Population

The target population of this study was T2DM patients at a public health clinic in Negeri Sembilan. The sampling frame was the name list of all T2DM patients who were treated in the Outpatient Department of Klinik Kesihatn Titi, Jelebu. The sampling unit was T2DM patients who went follow up in the clinic. Any patients who met the inclusion and exclusion criteria were invited to participate in this study.

3.3. Inclusion Criteria

i. Adults aged 18 and above with physician-diagnosed with type 2 diabetes at least 1 year ago
ii. Followed up in Klinik Kesihatan Titi
iii. Had recent HbA1c result (not older than 6 months at the time of interview)

3.4 Exclusion Criteria

i. Had been diagnosed with other types of diabetes including gestational diabetes and type I diabetes mellitus
ii. Diagnosed with any red blood cell disorders
iii. Taking steroid, antipsychotic medication, or iron supplement
iv. Work as healthcare professionals

3.5 Withdrawal Criteria

Participants can choose to withdraw at any time. Participants may be withdrawn if the investigator deems that it is detrimental or risky for the participants to continue.

3.6 Sample Size

The sample size of this study was calculated based on Slovin's formula as shown below:

$$n = \frac{N}{1 + Ne^2}$$

Where,

n = Sample size

N = Population size

e = Margin of error

The estimated number of T2DM patients who follow up in Klinik Kesihatan Titi was 580 (Zakiah, personal communication, January 25, 2021). A confidence level of 95% (giving a margin error of 0.05) was considered sufficiently accurate for this study. By using Slovin's formula, the required sample size equalled:

$$n = \frac{580}{1 + 580(0.05)^2}$$

$$= 237 \text{ respondents}$$

Based on the calculation above, the appropriate minimum sample size was 237 respondents. Assuming an attrition rate of 10%, the final sample size required for this study was 261 respondents.

3.7 Sampling method

A convenience sampling method was used for this study to recruit the participants. The questionnaire was distributed randomly to all T2DM patients who went to the clinic for follow up. Convenience sampling was relatively simple to implement and efficient especially for a large sample size.

3.8 Study instrument

The questionnaire consisted of 2 parts, which were socio-demographic and health-related information (Part A) and diabetes knowledge questionnaire (Part B). The first part related to the participant's sociodemographic and health-related information included age, gender, ethnicity, level of education, monthly income, duration of disease, presence of comorbidities, type of antidiabetic treatment, body weight and height, and recent HbA1c result. The body weight and height were used for calculating the BMI of patients. The HbA1c result was filled by the investigator based on the data retrieved from the medical record. The HbA1c result was to measure the dependent variable of the study, glycaemic control. The third part will be the diabetes knowledge questionnaire to measure the independent variable of the study which was diabetes knowledge. 24-item Diabetes Knowledge Questionnaire (DKQ-24) in the Malaysian version has been proved to be valid and reliable and was used with permission from the authors (Qamar, Iqubal & Ahmad, 2019). DKQ-24 was designed by the Starr County Diabetes Education Study to evaluate patients' general knowledge of diabetes such as the cause of diabetes, complications, blood sugar levels, diabetes treatment and care (Garcia, Villagomez, Brown, Kouzekanani & Hanis, 2001). The questionnaire consisted of 24 questions with the answer options of "yes," "no," and "don't know". One point was given for the correct answer and zero for the incorrect

and unknown answer. The total score was the summation of the points from the whole scale. The knowledge score was categorized into three levels indicated by poor (⩽ 50%), moderate (51-69%), and good (⩾70%). The questionnaire was available in English and Malay versions.

3.9 Pre-test

A pre-test was conducted among 26 T2DM patients (10% of the required sample size) in Klinik Kesihatan Titi. The questionnaire was reviewed by the supervisor and a diabetes nurse at the study site to establish face validity. Besides, Cronbach's alpha test was used to test the reliability and internal consistency of the questionnaire. Cronbach's alpha test was performed using the Statistical Package for Social Sciences (SPSS) version 22 software. The acceptable reliability was $0.70 \leq \alpha \leq 0.95$. The reliability test reported a Cronbach's alpha of 0.766, suggesting an acceptable internal consistency of the questionnaire. Participants who were involved in the pre-test were not included in the main study.

3.10 Study Duration and Timeline

The duration of the study began from October 2021 to September 2021 whereas the duration for data collection was about 3 months from May 2021 to July 2021. Kindly refer to Gantt Chart attached in Appendix 4.

3.11 Data Collection

An online survey was used for data collection. The link to the survey form was distributed to the clinic and the patients were informed of the study during their usual

clinic visits. The participant information sheet and informed consent form together with the questionnaire were shared in the form of Google form. The participants of this study were provided with adequate information about the study and their rights to participate voluntarily. There were options to click on - I agree or I disagree to indicate their willingness to participate in the study. Informed consent was automatically obtained when the participants clicked on "I agree" and submitted the questionnaire. This practice was permitted for the survey study referring to the Malaysian Good Clinical Practice 2018 Standard. Furthermore, this was also done for safety consideration during the COVID-19 pandemic by minimising physical contact to the least extent. Lastly, participants' medical records were reviewed by the researcher by visiting the clinic to obtain relevant health information including the HbA1c laboratory results. The submitted questionnaires were re-examined by the researcher before data analysis.

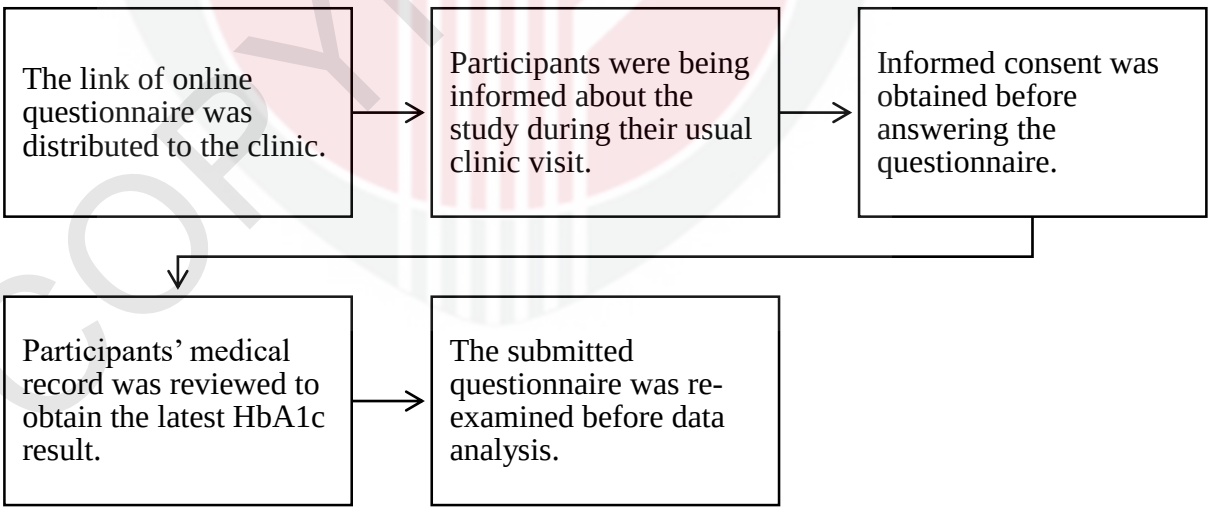


Figure 3.1: Flowchart of data collection

3.12 Data Analysis

Statistical Package for Social Sciences (SPSS) version 22 software was used to analyse the data collected. The data and results were presented in tables. All variables were analysed descriptively for their frequencies (n) and percentages (%) for all categorical data. Mean and standard deviation (SD) in descriptive statistics were used for analysing normally distributed continuous data whereas median and interquartile range (IQR) were used to analyse not normally distributed continuous data.

Normality tests such as skewness and kurtosis and the Shapiro-Wilk Test were done to see if the data was normally distributed which will then help in choosing the correct parametric or non-parametric test. A parametric test was used to analyse normally distributed data whereas a non-parametric test was for not normally distributed data.

The inferential statistic was used to test the hypothesis, where the level of significance was set at $p \leq 0.05$. Pearson Correlation, Independent T-Test and One Way Independent ANOVA were used depending on the nature of the independent variables. If the normality outcome was not normally distributed, a non-parametric test was used. Mann-Whitney U-test, Kruskal Wallis and Spearman's correlation were implemented instead. The detailed data analysis was presented in Table 3.1 and Table 3.2.

Table 3.1: Descriptive statistical tests for data analysis

DESCRIPTIVE STATISTIC			
Objectives	**Variables**	**Type of variables**	**Statistical measurement**
To determine the level of diabetes knowledge.	Knowledge score	Continuous	Mean and standard deviation.
	Knowledge level: Poor (≤50%) Moderate (51-69%) Good (≥70%).	Categorical	Frequency and percentage.
To determine the level of glycaemic control.	HbA1c values	Continuous	Median and interquartile range.
	Glycaemic control: Good (<7%) Moderate (7-8%) Poor (>8%)	Categorical	Frequency and percentage.
To determine the socio-demographic characteristics of patients	Age Monthly income Duration of diabetes BMI	Continuous	Mean and standard deviation.
	Gender Ethnicity Type of antidiabetic treatment Presence of comorbidities Education level BMI category	Categorical	Frequency and percentage.

Table 3.2: Inferential statistical tests for data analysis

INFERENTIAL STATISTIC			
Objectives	**Dependent variable**	**Independent variable**	**Parametric/ Non-parametric test**
To determine the association between sociodemographic characteristics and diabetes knowledge.	Diabetes knowledge	• Age • Monthly income • Duration of diabetes • BMI	Pearson Correlation
		• Gender • Presence of comorbidities	Independent T-Test
		• Ethnicity • Education level • Type of diabetes treatment	One-way Independent ANOVA
To determine the association between sociodemographic characteristics and glycaemic control.	Glycaemic control	• Age • Monthly income • Duration of diabetes • BMI	Spearman Correlation
		• Gender • Presence of comorbidities	Mann-Whitney Test
		• Ethnicity • Education level • Type of diabetes treatment	Kruskal Wallis Test
To determine the association between diabetes knowledge and glycaemic control.	Glycaemic control	Diabetes knowledge	Spearman correlation

3.15 Ethical Consideration

The ethical procedure was intervened prior to conducting this study. Written approval and permission were obtained from the Medical Research and Ethics Committee (MREC) via online registration and application through the National Medical Research Register (NMRR). After getting the approval, a written ethical approval letter was provided to the researcher. From there, the written ethical approval letter was sent o the Deputy Dean's Office (Research and Internationalization) attached with a copy of the proposal to inform them about the study. After that, a written permission letter was submitted to the health office of the district Jelebu to obtain permission to conduct this study in the respective clinic.

CHAPTER 4

RESULTS

4.0 Introduction

This chapter provided a descriptive analysis of the socio-demographic profile, level of diabetes knowledge and glycaemic control of T2DM patients who had participated in this study. Furthermore, the association between these variables were also determined. The results were based on 221 respondents who were sampled and answered the questionnaire that was distributed during the period of data collection.

4.1 Response Rate

A total of 221 T2DM patients had participated in this study. The response rate was 84.7% from the total required sample size of 261 participants.

4.2 Sociodemographic characteristics of T2DM patients

Table 4.1 showed the sociodemographic characteristics of the T2DM patients in this study. The mean age of the participants was 62.86 ± 11.90 years, of which 57.9% was female and 61.1% was Chinese. Most of them (37.6%) were educated up to secondary education, followed by 30.8% up to primary education, 19.9% had no formal education and 11.8% up to tertiary education. The mean duration of diabetes of these patients was 7.94 ± 6.20 years. Only 33.9% had a normal body mass index, whereas 38.0% were overweight and 26.7% were obese. Nearly all (97.7%) were presented with comorbidities and the majority (67.9%) were receiving only oral hypoglycaemic agent as the type of diabetes treatment.

Table 4.1: Sociodemographic characteristics of T2DM patients (n=221)

Characteristics	Mean ± SD	n (%)
Age	62.86 ± 11.90	
Gender		
Female		128 (57.9)
Male		93 (42.1)
Ethnicity		
Malay		76 (34.4)
Chinese		135 (61.1)
Indian		10 (4.5)
Level of Education		
No formal education		44 (19.9)
Primary education		68 (30.8)
Secondary education		83 (37.6)
Tertiary education		26 (11.8)
Monthly Income (RM)	978.73 ± 1018.00	
Duration of Diabetes (years)	7.94 ± 6.20	
Comorbidities		
Present		216 (97.7)
Absent		5 (2.3)
Type of Antidiabetic Treatment		
Diet control only		10 (24.5)
Oral medication		150 (67.9)
Insulin therapy		11 (5.0)
Both oral and insulin therapy		50 (22.6)
BMI (kg/m^2)	27.42 ± 5.20	
Underweight (<18.5)		3 (1.4)
Normal (18.5 – <25)		75 (33.9)
Overweight (25 – <30)		84 (38.0)
Obese (≥30)		59 (26.7)

4.3 Diabetes knowledge

The level of knowledge of T2DM patients based on the total score was shown in Table 4.2. The mean score of DKQ-24 was 14.55 ± 3.53. The majority of them (44.3%) had a moderate level of diabetes knowledge. About 28.5% had a good level of knowledge while 27.1% had a poor level of knowledge.

Table 4.2: Knowledge level of T2DM patients

Variables	Mean (SD)	N (%)
DKQ-24 Total Score	14.55 ± 3.53	
Knowledge Level		
Good (⩾70%)		63 (28.5)
Moderate (51-69%)		98 (44.3)
Poor (⩽50%)		60 (27.1)

Table 4.3 showed the distribution of the correct response for each question in DKQ-24. The item that received the most correct responses were, “Cuts and abrasions on diabetes heal more slowly” (93.2%), “Diabetics should take extra care when cutting their toenails (91.9%)”, and “Diabetes can damage my kidneys (91.9%)”. On the other hand, the questions that had the least correct response were, “A person with diabetes should cleanse a cut with iodine and alcohol” (11.3%), “A diabetic diet consists mostly of special foods” (18.1%), and “Eating too much sugar and other sweet foods is a cause of diabetes” (24.0%). Only 25.8% can recognize the signs of hypoglycaemia. Besides, more than 50% agreed that medication was more important than diet and exercise to control diabetes.

Table 4.3: Correct response for each question by the respondents

No.	Questions	Correct answer, n (%)
1.	Eating too much sugar and other sweet foods is a cause of diabetes.	53 (24.0)
2.	The usual cause of diabetes is a lack of effective insulin in the body.	177 (80.1)
3.	Diabetes is caused by the failure of the kidneys to keep sugar out of the urine.	69 (31.2)
4.	Kidneys produce insulin.	129 (58.4)
5.	In untreated diabetes, the amount of sugar in the blood usually increases.	200 (90.5)
6.	If I am diabetic, my children have a higher chance of being diabetic.	194 (87.8)
7.	Diabetes can be cured.	134 (60.6)
8.	A fasting blood sugar level of 11.7 mmol/L (210 mg/dL) is too high.	185 (83.7)
9.	The best way to check my diabetes is by testing my urine.	72 (32.6)
10.	Regular exercise will increase the need for insulin or other diabetic medication.	147 (66.5)
11.	There are two main types of diabetes: Type 1 (insulin-dependent) and Type 2 (non-insulin-dependent).	139 (62.9)
12.	An insulin reaction is caused by too much food.	160 (72.4)
13.	Medication is more important than diet and exercise to control my diabetes.	91 (41.2)
14.	Diabetes often causes poor circulation.	180 (81.4)
15.	Cuts and abrasions on diabetes heal more slowly.	206 (93.2)
16.	Diabetics should take extra care when cutting their toenails.	203 (91.9)
17.	A person with diabetes should cleanse a cut with iodine and alcohol.	25 (11.3)
18.	The way I prepare my food is as important as the foods I eat.	172 (78.3)
19.	Diabetes can damage my kidneys.	203 (91.9)
20.	Diabetes can cause loss of feeling in my hands, fingers, and feet.	194 (87.8)
21.	Shaking and sweating are signs of high blood sugar.	57 (25.8)
22.	Frequent urination and thirst are signs of low blood sugar.	68 (30.8)
23.	Tight elastic hoses or socks are not bad for diabetes.	115 (52.0)
24.	A diabetic diet consists mostly of special foods.	40 (18.1)

4.4 Glycaemic control

The glycaemic control of T2DM patients based on the HbA1c result was shown in Table 4.4. The mean HbA1c value among T2DM patients was 7.21 ± 1.79 with a median of 6.70 (IQR = 6.00 - 7.80). 57.5% of the participants had good glycaemic control, followed by 21.7% had moderate glycaemic control, and 20.8% had poor glycaemic control.

Table 4.4: Glycaemic control of T2DM patients

Variables	Median (IQR)	N (%)
HbA1c	6.70 (6.00 – 7.80)	
Glycaemic Control		
Good (< 7%)		127 (57.5)
Moderate (7% - 8%)		48 (21.7)
Poor (> 8%)		46 (20.8)

4.5 Association between sociodemographic characteristics and diabetes knowledge

A normality test had been conducted for the total knowledge score and it was found that the knowledge score was normally distributed with skewness -0.034 and kurtosis -0.195. The Shapiro-Wilk test of normality showed that the p-value was 0.084. Since the p-value was more than 0.05, the null hypothesis that the data were normally distributed was not rejected. Thus, parametric tests were used to determine the association between sociodemographic characteristics and diabetes knowledge.

Pearson correlation analysis showed that there was a significant association between sociodemographic characteristics and diabetes knowledge for age ($r = 0.163$, $p = 0.016$), duration of diabetes ($r = 0.171$, $p = 0.011$), and BMI ($r = -0.151$, $p = 0.025$). However, other sociodemographic characteristics including gender, ethnicity, education level, comorbidities, type of treatment, and monthly income were found insignificantly associated with diabetes knowledge. Details of the data was described in Table 4.5.

Table 4.5: Association between sociodemographic characteristics and diabetes knowledge

Characteristics	Diabetes knowledge		
	Mean ± SD	r-value	p-value
Age		0.163	0.016[a]*
Gender			0.122[b]
Female	14.48 ± 3.75		
Male	14.65 ± 3.24		
Ethnicity			0.323[c]
Malay	14.12 ± 3.60		
Chinese	14.84 ± 3.53		
Indian	14.00 ± 2.94		
Level of Education			0.698[c]
No formal education	15.05 ± 3.18		
Primary education	14.41 ± 3.74		
Secondary education	14.33 ± 3.56		
Tertiary education	14.81 ± 3.70		
Monthly Income (RM)		-0.085	0.210[a]
Duration of Diabetes (year)		0.171	0.011[a]*
Comorbidities			0.922[b]
Present	14.66 ± 3.46		
Absent	9.60 ± 3.44		
Type of Antidiabetic Treatment			0.948[c]
Diet control only	14.20 ± 3.99		
Oral medication	14.49 ± 3.51		
Insulin therapy	14.91 ± 3.94		
Both oral and insulin therapy	14.72 ± 3.51		
BMI (kg/m^2)		-0.151	0.025[a]*
Underweight (<18.5)	13.00 ± 3.61		
Normal (18.5 – <25)	14.81 ± 3.64		
Overweight (25 – <30)	14.76 ± 3.15		
Obese (≥30)	14.00 ± 3.89		

Keys:

[a] = Pearson correlation

[b] = Independent T-Test

[c] = One-way ANOVA

* Significant at p-value < 0.05

4.6 Association between sociodemographic characteristics and glycaemic control

The glycaemic control was expressed in HbA1c and the value was tested for normality. The HbA1c was not normally distributed with skewness 1.470 and kurtosis 2.328 which was out of the normal range of -1 to 1. The Shapiro-Wilk test of normality with a p-value of 0.001 also showed that the p-value was less than 0.05, thus rejecting the null hypothesis stating that the data were normally distributed. Hence, non-parametric tests were used to determine the association between sociodemographic characteristics and glycaemic control.

Table 4.6 showed the inferential analysis of the association between sociodemographic characteristics and glycaemic control. Age ($r = -0.248$, $p = 0.001$), monthly income ($r = 0.145$, $p = 0.032$), and duration of diabetes ($r = 0.180$, $p = 0.007$) were found significantly associated with glycaemic control. The Kruskal-Wallis test revealed that there was a statistically significant difference in HbA1c results between at least two groups for ethnicity ($p = 0.029$) and type of antidiabetic treatment ($p = 0.001$). The post hoc test results showed that there was a significant difference between the group of Chinese and Indians ($p = 0.042$). However, no significant differences were found between the group of Malay and Chinese ($p = 0.494$) and the group of Malay and Indian ($p = 0.214$). Next, the post hoc analysis for the type of antidiabetic treatment showed that there were significant differences in all pairs of the groups ($p < 0.05$) except the group between insulin and both oral and insulin therapy ($p = 1.00$). The details of the post hoc analysis for ethnicity and type of antidiabetic treatment were shown in Table 4.7 and Table 4.8 respectively.

Table 4.6: Association between sociodemographic characteristics and glycaemic control

Characteristics	Glycaemic control		
	Median (IQR)	r-value	p-value
Age		-0.248	0.001[a]*
Gender			0.300[b]
Female	6.80 (6.10 – 7.85)		
Male	6.60 (5.90 – 7.80)		
Ethnicity			0.029[c]*
Malay	6.75 (6.10 – 8.35)		
Chinese	6.70 (5.90 – 7.40)		
Indian	7.90 (7.00 – 10.48)		
Level of Education			0.128[c]
No formal education	6.80 (5.93 – 7.10)		
Primary education	6.55 (6.10 – 7.38)		
Secondary education	6.90 (5.90 – 8.40)		
Tertiary education	7.35 (6.25 – 9.60)		
Monthly Income (RM)		0.145	0.032[a]*
Duration of Diabetes (year)		0.180	0.007[a]*
Comorbidities			0.926[b]
Present	6.70 (6.00 – 7.70)		
Absent	9.50 (5.70 – 11.05)		
Type of Antidiabetic Treatment			0.001[c]*
Diet control only	5.55 (5.23 – 6.20)		
Oral medication	6.45 (5.90 – 7.20)		
Insulin therapy	7.90 (6.50 – 10.40)		
Both oral and insulin therapy	7.95 (7.00 – 9.53)		
BMI (kg/m^2)		0.100	0.139[a]
Underweight (<18.5)	5.90 (5.65 – 6.00)		
Normal (18.5 – <25)	6.60 (5.85 – 7.40)		
Overweight (25 – <30)	6.90 (6.15 – 7.90)		
Obese (≥30)	6.70 (6.10 – 7.80)		

Keys:

[a] = Spearman correlation

[b] = Mann-Whitney Test

[c] = Kruskal-Wallis Test

* Significant at p-value < 0.05

Table 4.7: Post hoc pairwise comparisons of ethnicity

Sample 1 – Sample 2	p-value
Chinese – Malay	0.494
Chinese – Indian	0.042*
Malay – Indian	0.214

* Significant at p-value < 0.05

Table 4.8: Post hoc pairwise comparisons of antidiabetic treatment

Sample 1 – Sample 2	p-value
Diet control only – Oral medication	0.025*
Diet control only – Insulin therapy	0.001*
Diet control only – Both oral and insulin therapy	0.001*
Oral medication – Insulin therapy	0.028*
Oral medication – Both oral and insulin therapy	0.001*
Insulin therapy – Both oral and insulin therapy	1.000

* Significant at p-value < 0.05

4.7 Association between diabetes knowledge and glycaemic control

The association between diabetes knowledge and glycaemic control was tabulated in Table 4.9. Spearman correlation analysis showed that diabetes knowledge was significantly associated with glycaemic control ($p < 0.05$). Correlation matrix showed a weak inverse correlation of diabetes knowledge score with HbA1c ($r = -0.142$, $p < 0.036$).

Table 4.9: Association between diabetes knowledge and glycaemic control

Variables	Glycaemic control	
	r-value	p-value
Diabetes knowledge	-0.142	0.036[a]*

Keys:

[a] = Spearman correlation

* Significant at p-value < 0.05

CHAPTER 5

DISCUSSION

5.0 Introduction

In this chapter, the findings of the current study were being discussed and introduced as the main interest. The main objective of this study is to investigate the independent relationship between diabetes knowledge and glycaemic control among T2DM patients at a public health clinic in Negeri Sembilan. Thus, results from the analysed data will be discussed according to the specific objectives of this study.

5.1 Diabetes knowledge

The majority of the participants had a moderate level of knowledge which was similar to the findings of some of the studies (Zowgar, Siddiqui & Alattas, 2018; Qamar et al., 2017; Ishak et al., 2017; Al-Qazaz et al., 2012; Mufunda et al., 2012). Nonetheless, this result was contradicted to another study conducted by Karaoiu (2018) and Parimalakrishnan, Dussa and Sahay (2015) which reported a majority of poor knowledge level, and also studies by Sedek (2019) and Islam et al., (2015) which reported a majority of good knowledge. The varied level of knowledge might be due to the different socio-economic backgrounds of the population and the frequency of health promotion programmes held in the area. Besides, different study instruments used with different levels of difficulty and categorization of scores might also affect the result of the knowledge level.

Despite the majority of the participants had a moderate level of knowledge, several misconceptions and false beliefs were discovered and need to be addressed. Our study

showed a similar result with the study by Menino, Mariados and Clarisse (2017). Most of the diabetic patients did not know the cause and physiology of diabetes and had a lack of knowledge regarding appropriate self-management. Although a majority of them were aware of the complications of diabetes towards their renal, circulatory, and neurosensory system, they did not know the measure to reduce the risk of these complications. About half of them wrongly believed that wearing tight socks was not bad for diabetes and taking medication was more important than having healthy dietary habits and exercise. A study was done by Islam et al. (2015) also found that many diabetic patients had limited knowledge on the causes, management and risk factors for diabetes.

Furthermore, it was found that the majority of the diabetic patients did not have adequate knowledge on wound management especially the cleansing solution to be used. The question, "A person with diabetes should cleanse a cut with iodine and alcohol" had the least correct response was similar to the findings in the study by Qamar et al. (2017). Moreover, most of the participants were unable to differentiate between the signs and symptoms of hypo- and hyperglycaemia. A study found that many diabetic patients reported having the experience of excessive perspiration, shaking, and confusion but they incorrectly attributed these to hyperglycaemia (Jackson, Adibe, Okonta & Ukwe, 2014). This implied that healthcare providers should place a greater emphasis on hypoglycaemia and hyperglycaemia symptoms, as well as the appropriate management of both.

5.2 Glycaemic control

The finding of this study revealed that a higher percentage of T2DM patients from Klinik Kesihatan Titi who participated in this study had good glycaemic control. This was in contrast with the findings in several studies (Afroz et al., 2019; Ismail et al., 2016; Musenge et al., 2016; Kamuhabwa & Charles, 2014). However, based on the Malaysian National Diabetes Registry Report 2013-2019, the overall trend of patients achieving the Malaysian glycaemic target of HbA1c ≤6.5% was gradually increasing over the years from 2018 (31.42%) to 2019 (32.41%). Since convenience sampling was used, not every diabetic patient had an equal chance to participate in this study which might have missed those with poorer glycaemic control and did not attend the clinic for follow up.

5.3 Association between sociodemographic characteristics and diabetes knowledge

There was a statistically significant association between age, duration of diabetes, and BMI with diabetes knowledge in this study. The findings revealed that diabetes knowledge increased with age. This was in line with the study by Cántaro, Jara, Taboada, and Mayta-Tristán (2016) where good knowledge was significantly associated with diabetes duration for more than 12 years and being over 70 years old. The fact that knowledge grows with experience may explain the outcome. Older people were more likely to be exposed to a variety of experiences, and hence had more information as they became older, which can lead to a greater understanding of the illness. However, the findings were in contrast to recent studies showing a negative correlation in which younger patients had higher knowledge scores (Alhaik, Anshasi, Alkhawaldeh, Soh & Naji, 2019; Chinnappan, Sivanandy, Sagaran & Molugulu, 2017).

Furthermore, diabetes knowledge was found improved in patients with a longer duration of disease. The result was consistent with the findings of a cross-sectional study in Bangladesh (Islam et al., 2015). According to Tian et al. (2011), people with chronic conditions for a longer time were more likely to have enough health information, which could explain why they paid more attention to disease control over time. They may have been more inclined to consult clinicians to get health-related information and self-care advice compared to people who had a short duration of chronic disease.

Moreover, our study found that lower BMI was significantly associated with better diabetes knowledge. The result implied that people with lower BMI had better knowledge especially in terms of nutrition and a healthy lifestyle. People with higher nutrition knowledge and awareness somehow influenced their eating habits, leading to healthier dietary habits and a lower obesity rate (Bonaccio et al., 2013). However, our study findings had contradicted the studies which found that individuals who were overweight or obese had better knowledge about diabetes compared to individuals who had normal weight (Fatema et al., 2017; Kutbi, Mosli, Alhasan & Mosli, 2018).

There was no statistically significant difference between gender and knowledge as in-line in several studies (Alhaik et al., 2019; Bukhsh et al., 2019; Chinnappan et al., 2017). This could be explained by Chinnappan et al. (2017) as both men and women in Malaysia had equal rights and access to education. Besides, there were no significant differences in knowledge across participants with different levels of education

(Chinnappan et al., 2017). This indicated that, regardless of the level of education, everyone had nearly the same amount of knowledge about diabetes. However, the findings were contrary to several studies which found that lower education level was significantly associated with lower knowledge (Bukhsh et al., 2019; Islam et al., 2015; Al-Qazaz et al., 2012).

5.4 Association between sociodemographic characteristics and glycaemic control

Older age was associated with better glycaemic control. The findings were in line with several studies (Awang et al., 2020; Haghighatpanah et al., 2018; Nanayakkara et al., 2018). A study found that an increase in 1 year of age was associated with an increase of 3% in the chance of achieving glycaemic target (Ahmad et al., 2014). Moreover, consistent findings showed there was a significant difference among ethnic groups. Indian diabetic patients were found to have the highest baseline HbA1C followed by Malay and Chinese (Wan et al., 2021). This might be due to Asian Indians was found to have higher insulin resistance compared to other ethnicities (Toh et al., 2011). Another reason suggested by Sazlina et al. (2015) was that different ethnic groups practised different lifestyle habits.

Moreover, a significant association between income level and glycaemic control were found in our study. The findings showed that better glycaemic control was associated with lower income. However, this was in contrast with another study where low income was associated with poor glycaemic control (Yosef, Nureye & Tekalign, 2021). The lower-income group was found to have a lack of financial resources to purchase

diabetic self-monitoring gadgets and diabetes-friendly foods that aid in achieving adequate glycaemic control. To explain our findings that went the other way round, the reason was probably that the respondents in our study who reported having no income were mostly retired or worked as a housewife, and this did not mean that they were living in poverty and having financial constraint to afford better self-care.

Next, a similar result was found in the study by Mamo, Bekele, Nigussie, and Zewudie (2019) in which longer diabetes duration was found significantly associated with poorer glycaemic control. This might be due to the increased insulin resistance and the progressively impaired insulin secretion by beta cells over time. Furthermore, there were significant differences between the type of antidiabetic treatment received by the patients. The findings were in line with the studies that showed that those who took insulin or both oral and insulin therapy had poorer glycaemic control compared to those who took the oral antidiabetic drug only (Mamo et al., 2019; Haghighatpanah et al., 2018; Ahmad et al., 2014). This was probably because patients who had been prescribed insulin or a combination of oral medication and insulin often had more severe diabetes.

Lastly, although there was no significant association between BMI and glycaemic control, patients with higher BMI showed higher HBA1c results. This was in line with the study findings by Wan et al. (2021). Also, a study by Anari, Amani, and Veissi (2016) found no significant association between BMI and glycaemic control. However, in contrast to our findings, a study in India found that obesity was significantly associated with poor glycaemic control (Haghighatpanah et al., 2018). Since obesity

can lead to impaired insulin resistance and an increased mortality rate from the cardiovascular problem, weight reduction was strongly advised in this population although no significant association was found in this study.

5.5 Association between diabetes knowledge and glycaemic control

Our findings were similar to a study in Bangladesh which found a weak significant correlation between diabetes knowledge and glycaemic control (Islam et al., 2015). Besides, a study in Pakistan found that diabetes knowledge was significantly associated with glycaemic control and there was a strong inverse correlation between them (Bukhsh et al., 2019). Patients with a low degree of diabetes knowledge were least likely to adhere to diabetes treatment and instructions from healthcare providers (Berhe, Gebru, Kahsay & Kahsay, 2014). Improvement in knowledge allowed diabetic patients to better contribute to their own care. Good knowledge helped to enhance self-care activities and raised the awareness of disease control. The correlation was weak probably due to not everyone will put knowledge into action to yield a better outcome.

CHAPTER 6

LIMITATION AND RECOMMENDATION

6.0 Introduction

This chapter discussed further the aspects to be improved based on the findings and limitations identified.

6.1 Limitation

There were a few limitations in this study that may have affected its outcomes. Firstly, this study was carried out at only one public health clinic in the rural community in Negeri Sembilan. This may impede the ability to generalise the findings to the general diabetes population in the state and Malaysia. Furthermore, the convenience sampling method used to recruit the participants might result in sampling error and increase the tendency of response bias. Next, the number of respondents were not evenly distributed among each ethnicity as Indian only made up 4.5% of the total respondents which caused difficulties in comparison between groups. Moreover, the language barrier was the problem faced during the data collection since many of the diabetic patients were older adults with low education backgrounds and high illiteracy levels. The questionnaire was explained and translated verbally to the language that they understood to help them in finishing the questionnaire. This might result in translation bias and response bias which could interfere with patients' real knowledge about diabetes. Lastly, the use of closed-ended questions (i.e. yes/ no/ don't know), which might allow the respondents to guess the correct answer.

6.2 Recommendation

6.2.1 Nursing practice

In general, assessing a patient's knowledge is crucial in determining his or her knowledge deficit. Nurses should always assess the understanding of the diabetic patients about their course of illness and treatment, so that appropriate intervention can be implemented to suit the different learning needs. Health education must be prioritised and given on a continual basis regardless of the disease duration to keep patients updated with the current knowledge and practice. Besides, nurses must clarify and correct the common misconception about diabetes among diabetic patients and the general public. Nurses should also place emphasis on the knowledge of diabetes self-care practices to help patients and caregivers better manage the disease at home instead of relying solely on the medical treatment provided. Furthermore, nurses should encourage patients to practice a healthy lifestyle and assist them in making necessary lifestyle changes as the prevalence of obesity is high among the diabetic population.

6.2.2 Nursing education

The healthcare system should organize more educational classes and programmes for nurses to provide them with more intensive information about diabetes and its related management. This allows nurses to be well-equipped with knowledge and indirectly help to enhance patient care. Nurses should also read more journal and research articles related to diabetes to improve their knowledge and to gain more evidence-based insight.

6.2.3 Nursing research

The study should be conducted at various locations to better represent the target

population and to increase the generalizability of the result. Furthermore, it would be recommended to employ random selection sampling to increase the power of the study. Besides, forward and back translations of the study instrument need to be conducted if it has to be translated into another version of the language. Lastly, future research should look into other potential factors that could affect glycaemic control. The relationship between BMI and glycaemic control remains unclear and need to be explored further. Also, further research can be conducted to discover in-depth the knowledge deficit in each aspect of diabetes self-care among diabetic patients.

6.3 Conclusion

The study of the association between diabetes knowledge and glycaemic control was found to be negatively correlated. Having good knowledge enabled patients to have more control over their health, and thus increased the likelihood of achieving target glycaemic control. The findings of this study provided additional information in the enhancement of diabetes educational programmes in hospital and community healthcare settings. Regular and ongoing health education based on the learning needs and characteristics of patients helped to improve the knowledge level of patients and increase the awareness of diabetes control.

REFERENCES

Abbasi, Y. F., Ooi. G. S, Ng, Y. P., Balasubramanian, G. P., Yap, C. H., & Paruchuri, S. (2018). Diabetes knowledge, attitude, and practice among type 2 diabetes mellitus patients in Kuala Muda District, Malaysia - A cross-sectional study. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 12*(6):1057-1063. https://doi.org/10.1016/j.dsx.2018.06.025

Abdullah, N. A., Ismail, S., Ghazali, S. S., Juni, M. H., Shahar, H. K., & Aziz, N. R. F. (2019). Predictors of good glycemic controls among type 2 diabetes mellitus patients in two primary health clinics, Kuala Selangor. *Malaysian Journal of Medicine and Health Sciences*, *15*(SP3), 58–64.

Afroz, A., Ali, L., Karim, M. N., Alramadan, M. J., Alam, K., Magliano, D. J., & Billah, B. (2019). Glycaemic Control for People with Type 2 Diabetes Mellitus in Bangladesh - An urgent need for optimization of management plan. *Scientific reports*, *9*(1), 10248. https://doi.org/10.1038/s41598-019-46766-9

Ahmad, N. S., Islahudin, F., & Paraidathathu, T. (2014). Factors associated with good glycemic control among patients with type 2 diabetes mellitus. *Journal of diabetes investigation*, *5*(5), 563–569. https://doi.org/10.1111/jdi.12175

Al-Qazaz, H. K., Sulaiman, S. A., Hassali, M. A., Shafie, A. A., Sundram, S., Al-Nuri, R., & Saleem, F. (2012). Diabetes knowledge and control of glycaemia among type 2 diabetes patients in Penang, Malaysia. *Journal of Pharmaceutical Health Services Research*, *3*, 49–55. https://doi.org/10.1111/j.1759-8893.2011.00073.x

Al-Qazaz, H. K., Sulaiman, S. A., Hassali, M. A., Shafie, A. A., Sundram, S., Al-Nuri, R., & Saleem, F. (2011). Diabetes knowledge, medication adherence and glycemic control among patients with type 2 diabetes. *International Journal of Clinical Pharmacy*, *33*, 1028–1035. https://doi.org/10.1007/s11096-011-9582-2

Alhaik, S., Anshasi, H. A., Alkhawaldeh, J., Soh, K. L., & Naji, A. M. (2019). An assessment of self-care knowledge among patients with diabetes mellitus. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 13*(1), 390-394.

Alromaihi, D., Alamuddin, N., & George, S. (2020). Sustainable diabetes care services during COVID-19 pandemic. *Diabetes Research and Clinical Practice*, *166*, 108298. https://doi.org/10.1016/j.diabres.2020.108298

AlShareef, S. M., AlWabel, A. A., AlKhathlan, M. A., AlKhazi, A. A., AlMaarik, A. K., AlGarni, A. M., … AlMutairi, M. D. (2017). Glycemic Control in Diabetic Patients in Saudi Arabia: The Role of Knowledge and Self-Management - A Cross-Sectional Study. *Global Journal of Health Science, 9*(12), 25. https://doi.org/10.5539/gjhs.v9n12p25

American Diabetes Association. (2019). 6. Glycemic Targets: Standards of Medical Care in Diabetes-2019. *Diabetes Care, 42(*Suppl. 1), S61-S70. https://doi.org/10.2337/dc19-S006

Anari, R., Amani, R., & Veissi, M. (2016). Obesity and poor glycemic control in patients with type 2 diabetes. *International Journal of Research in Medical Sciences, 4*, 584-588. https://doi.org/10.18203/2320-6012.ijrms20160320

Awang, H., Ja'afar, S. M., Wan Ishak, N. A., YusofZainal, M., Mohamed Aminuddin, A. M., & Dollah, Z. (2020). Poor Glycemic Control: Prevalence and Risk Factors Among Patients with Type 2 Diabetes Mellitus in Northeast State of Peninsular Malaysia. *International Journal of Human and Health Sciences, 4*(3), 206-214. http://dx.doi.org/10.31344/ijhhs.v4i3.202

Badedi, M., Solan, Y., Darraj, H., Sabai, A., Mahfouz, M., Alamodi, S., & Alsabaani, A. (2016). Factors Associated with Long-Term Control of Type 2 Diabetes Mellitus. *Journal of Diabetes Research, 2016*. https://doi.org/10.1155/2016/2109542

Berhe, K. K., Gebru, H. B., Kahsay, H. B., & Kahsay, A. A. (2014). Assessment of Diabetes Knowledge and its Associated Factors among Type 2 Diabetic Patients in Mekelle and Ayder Referral Hospitals, Ethiopia. *Journal of Diabetes and Metabolism, 5*, 378. https://doi.org/10.4172/2155-6156.1000378

Bukhsh, A., Khan, T. M., Sarfraz Nawaz, M., Sajjad Ahmed, H., Chan, K. G., & Goh, B. H. (2019). Association of diabetes knowledge with glycemic control and self-care practices among Pakistani people with type 2 diabetes mellitus. *Diabetes, metabolic syndrome and obesity: targets and therapy*, *12*, 1409–1417. https://doi.org/10.2147/DMSO.S209711

Cántaro, K., Jara, J. A., Taboada, M., & Mayta-Tristán, P. (2016). Association between information sources and level of knowledge about diabetes in patients with type 2 diabetes. *Endocrinol Nutr., 63*(5), 202-11. https://doi.org/10.1016/j.endonu.2016.01.005.

Centers for Disease Control and Prevention. (2019). *Type 2 Diabetes.* Retrieved from https://www.cdc.gov/diabetes/basics/type2.html

Chew, B. H., Mastura, I., Lee, P. Y., Wahyu, T. S., Cheong, A. T., & Zaiton, A. (2011). Ethnic differences in glycaemic control and complications: the adult diabetes control and management (ADCM), Malaysia. *Medical Journal of Malaysia, 66*(3), 244-8

Chinnappan, S., Sivanandy, P., Sagaran, R., & Molugulu, N. (2017). Assessment of Knowledge of Diabetes Mellitus in the Urban Areas of Klang District, Malaysia. *Pharmacy (Basel, Switzerland), 5*(1), 11. https://doi.org/10.3390/pharmacy5010011

Eid, M., Mafauzy, M., & Faridah, A.R. (2004). Non-achievement of clinical targets in patients with type 2 diabetes mellitus. *Med J Malaysia, 59*(2), 177–184.

Fatema, K., Hossain, S., Natasha, K., Chowdhury, H. A., Akter, J., Khan, T., & Ali, L. (2017). Knowledge attitude and practice regarding diabetes mellitus among Nondiabetic and diabetic study participants in Bangladesh. *BMC Public Health, 17*(364). https://doi.org/10.1186/s12889-017-4285-9

Garcia, A. A., Villagomez, E. T., Brown, S. A., Kouzekanani, K., & Hanis, C. L. (2001). The Starr County Diabetes Education Study Development of the Spanish-language diabetes knowledge questionnaire. *Diabetes care*, *24*(1): 16-21. https://doi.org/10.2337/diacare.24.1.16

Gaster, B., & Hirsch, I. B. (1998). The Effects of Improved Glycemic Control on Complications in Type 2 Diabetes. *Archives of Internal Medicine*, *158*(2), 134–140. https://doi.org/10.1001/archinte.158.2.134

Haghighatpanah, M., Nejad, A. S. M., Haghighatpanah, M., Thunga, G., & Mallayasamy, S. (2018). Factors that Correlate with Poor Glycemic Control in Type 2 Diabetes Mellitus Patients with Complications. *Osong Public Health and Research Perspectives*, *9*(4), 167–174. https://doi.org/10.24171/j.phrp.2018.9.4.05

Ishak, N. H., Mohd Yusoff, S. S., Rahman, R. A., & Kadir, A. A. (2017). Diabetes self-care and its associated factors among elderly diabetes in primary care. *Journal of Taibah University Medical Sciences*, *12*(6), 504–511. https://doi.org/10.1016/j.jtumed.2017.03.008

Islam, S. M., Niessen, L. W., Seissler, J., Ferrari, U., Biswas, T., Islam, A., & Lechner, A. (2015). Diabetes knowledge and glycemic control among patients with type 2 diabetes in Bangladesh. *SpringerPlus*, *4*, 284. https://doi.org/10.1186/s40064-015-1103-7

Ismail, A., Suddin, L. S., Sulong, S., Ahmed, Z., Kamaruddin, N. A., & Sukor, N. (2016). Profiles and Factors Associated with Poor Glycemic Control Among Inpatients with Diabetes Mellitus Type 2 as a Primary Diagnosis in a Teaching Hospital. *Indian journal of community medicine: official publication of Indian Association of Preventive & Social Medicine*, *41*(3), 208–212. https://doi.org/10.4103/0970-0218.183590

Ismail, I. S., Nazaimoon, W. M., Mohamad, W. B., Letchuman, R., Singaraveloo, M., Pendek, R., … Khalid, B. A. (2000). Sociodemographic determinants of glycaemic control in young diabetic patients in peninsular Malaysia. *Diabetes Res Clin Pract.*, *47*(1), 57-69. https://doi.org/10.1016/s0168-8227(99)00104-7

Kamuhabwa, A. R., & Charles, E. (2014). Predictors of poor glycemic control in type 2 diabetic patients attending public hospitals in Dar es Salaam. *Drug, healthcare and patient safety*, *6*, 155–165. https://doi.org/10.2147/DHPS.S68786

Khan, Y., Sarriff, A., Khan, A., & Mallhi, T. (2014). Knowledge, Attitude and Practice (KAP) Survey of Osteoporosis among Students of a Tertiary Institution in Malaysia. *Tropical Journal of Pharmaceutical Research*, *13*(1), 155. https://doi.org/10.4314/tjpr.v13i1.22

Kutbi, H. A., Mosli, H. H., Alhasan, A. H., & Mosli, R. H. (2018). Diabetes knowledge and its association with the weight status among residents of Jeddah City, Saudi Arabia. *Nutrition & Diabetes*, *8*(48). https://doi.org/10.1038/s41387-018-0055-8

Mamo, Y., Bekele, F., Nigussie, T., & Zewudie, A. (2019). Determinants of poor glycemic control among adult patients with type 2 diabetes mellitus in Jimma University Medical Center, Jimma zone, south west Ethiopia: a case control study. *BMC endocrine disorders*, *19*(1), 91. https://doi.org/10.1186/s12902-019-0421-0

Menino, E., Mariados, A., & Clarisse, M. (2017). Validation of Diabetes Knowledge Questionnaire (DKQ) in the Portuguese Population. *Diabetes and Obesity International Journal, 2(*S1), 000S1-002.

McPherson, M. L., Smith, S. W., Powers, A., & Zuckerman, I. H. (2008). Association between diabetes patients' knowledge about medications and their blood glucose control. *Research in Social and Administrative Pharmacy, 4*(1), 37-45. https://doi.org/10.1016/j.sapharm.2007.01.002

Ministry of Health Malaysia. (2016). Clinical Practice Guidelines Management of Type 2 Diabetes Mellitus (5th ed.). Retrieved from https://www.moh.gov.my/moh/resources/Penerbitan/CPG/Endocrine/3b.pdf

Ministry of Health Malaysia. (2020). Clinical Practice Guidelines Management of Type 2 Diabetes Mellitus (6th ed.).

Ministry of Health Malaysia. (2019). *National Health and Morbidity Survey 2019: Non-Communicable disease, healthcare demand and health literacy*. Retrieved from http://iku.moh.gov.my/images/IKU/Document/REPORT/NHMS2019/Report_NHMS2019-NCD_v2.pdf

Ministry of Health Malaysia. (2020). *National Diabetes Registry Report 2013-2019.* Retrieved from https://www2.moh.gov.my/index.php/database_stores/attach_download/554/80

Mufunda, E., Wikby, K., Björn, A., & Hjelm, K. (2012). Level and determinants of diabetes knowledge in patients with diabetes in Zimbabwe: a cross-sectional study. *Pan Africa Medical Journal, 13*, 78.

Musenge, E. M., Michelo, C., Mudenda, B., & Manankov, A. (2016). Glycaemic Control and Associated Self-Management Behaviours in Diabetic Outpatients: A Hospital Based Observation Study in Lusaka, Zambia. Journal of Diabetes Research, 2016, 1–9. https://doi.org/10.1155/2016/7934654

Nanayakkara, N., Ranasinha, S., Gadowski, A. D., Davis, W. A., Flack, J. R., Wischer, N., … Zoungas, S. (2018). Age-related differences in glycaemic control, cardiovascular disease risk factors and treatment in patients with type 2 diabetes: a cross-sectional study from the Australian National Diabetes Audit. *BMJ Open, 8,* e020677. https://doi.org/10.1136/bmjopen-2017-020677

Parimalakrishnan, S., Dussa, K., & Sahay, R. (2015). Assessment of Diabetes Knowledge Using Diabetes Knowledge Questionnaire Among People with Type 2 Diabetes Mellitus. *Asian Journal of Pharmaceutical and Clinical Research, 8*, 254-256.

Phillips, E., Rahman, R., & Mattfeldt-Beman, M. (2018). Relationship Between Diabetes Knowledge, Glycemic Control, and Associated Health Conditions. *Diabetes spectrum: a publication of the American Diabetes Association*, *31*(2), 196–199. https://doi.org/10.2337/ds17-0058

Qamar, M., Iqubal, R. M., & Ahmad, S. (2019). Psychometric Analysis of the newly translated Malaysian version of Diabetes Knowledge Questionnaire by Rasch analysis. *Front. Pharmacol. Conference Abstract: International Conference on Drug Discovery and Translational Medicine 2018 (ICDDTM '18) "Seizing Opportunities and Addressing Challenges of Precision Medicine".* https://doi.org/10.3389/conf.fphar.2018.63.00077

Sacks, L. J., Pham, C. T., Fleming, N., Neoh, S. L., & Ekinci, E. I. (2020). Considerations for people with diabetes during the Coronavirus Disease (COVID-19) pandemic. *Diabetes Research and Clinical Practice*, *166*, 108296. https://doi.org/10.1016/j.diabres.2020.108296

Sakari, F. L., & William, K. K. (2019). Utilization of Diabetes Knowledge and Glycemic Control, a Case of Butere Subcounty Hospital, Kakamega County, Kenya. *Asian Journal of Research and Reports in Endocrinology*, *2*(1), 1–10.

Sami, W., Ansari, T., Butt, N. S., & Hamid, M. (2017). Effect of diet on type 2 diabetes mellitus: A review. *International journal of health sciences, 11(*2), 65–71.

Sazlina, S. G., Mastura, I., Cheong, A. T., Bujang Mohamad, A., Jamaiyah, H., Lee, P. Y., … Chew, B. H. (2015). Predictors of poor glycaemic control in older patients with type 2 diabetes mellitus. *Singapore medical journal*, *56*(5), 284–290. https://doi.org/10.11622/smedj.2015055

Sedek, R., & Saari, S. N. (2019). Knowledge of Type 2 Diabetes Mellitus among Adults with and Without Diabetes in Universiti Kebangsaan Malaysia. *Pakistan Journal of Nutrition*, *18*(2), 109-116. https://doi.org/10.3923/pjn.2019.109.116

Shrestha, N., Yadav, S. B., Joshi, A. M., Patel, B. D. P., Shrestha, J., & Bharkher, D. L. (2015). Diabetes Knowledge and Associated Factors among Diabetes Patients in Central Nepal. International Journal of Collaborative Research on Internal Medicine & Public Health, 7(5), 82-91.

Song, S. H. & Hardisty, C. A. (2009). Early onset type 2 diabetes mellitus: a harbinger for complications in later years–clinical observation from a secondary care cohort. QJM, 102(11), 799-806. https://doi.org/10.1093/qjmed/hcp121

Szymona-Pałkowska, K., Janowski, K., Pedrycz, A., Mucha, D., Ambroży, T., Siermontowski, P., … Kraczkowski, J. (2016). Knowledge of the Disease, Perceived Social Support, and Cognitive Appraisals in Women with Urinary Incontinence. *BioMed Research International, 2016, 1–7.* https://doi.org/10.1155/2016/3694792

Tao, J., Gao, L., Liu, Q., Dong, K., Huang, J., Peng, X., Yang, Y., Wang, H., & Yu, X. (2020). Factors contributing to glycemic control in diabetes mellitus patients complying with home quarantine during the coronavirus disease 2019 (COVID-19) epidemic. *Diabetes Research and Clinical Practice*, *170*, 108514. https://doi.org/10.1016/j.diabres.2020.108514

Tian, M. M., Chen, Y. C., Zhao, R., Chen, L., Chen, X., Feng, D., & Feng, Z. C. (2011). Chronic disease knowledge and its determinants among chronically ill adults in rural areas of Shanxi Province in China: a cross-sectional study. *BMC Public Health*, *11*, 948. Retrieved from http://www.biomedcentral.com/1471-2458/11/948

Toh, M., Wu, C., & Leong, H. (2011). Association of Younger Age With Poor Glycemic and Cholesterol Control in Asians With Type 2 Diabetes Mellitus in Singapore. *Journal Of Endocrinology And Metabolism, 1*(1), 27-37. https://doi.org/10.4021/jem13e

Wan Hamdzan, W. F. F., Juni, M. H., Salmiah, M., Azuhairi, A., & Zairina, A. (2016). Factors Associated with Glycaemic Control Among Type 2 Diabetes Mellitus Patients. *International Journal of Public Health and Clinical Sciences, 3*(3):89-102

Wan, K. S., Hairi, N. N., Mustapha, F. I., Mohd Yusof, K., Mohd Ali, Z., & Moy, F. M. (2021). *Predictors of glycosylated haemoglobin A1C trend among type 2 diabetes patients in a multi-ethnic country. Scientific Reports, 11(1).* https://doi.org/10.1038/s41598-021-86277-0

Woldu, M. A, Wami, C. D., Lenjisa, J. L., Tegegne, G. T., Tesafye, G., & Dinsa, H. (2014). Factors Associated with Poor Glycemic Control among Patients with Type 2 Diabetes Mellitus in Ambo Hospital, Ambo; Ethiopia. *Endocrinology & Metabolic Syndrome, 3*(4), 1000143. https://doi.org/10.4172/2161-1017.1000143

World Health Organization. (2020). *Diabetes.* Retrieved from https://www.who.int/en/news-room/fact-sheets/detail/diabetes

World Health Organization. (2020). *Results of a rapid assessment.*

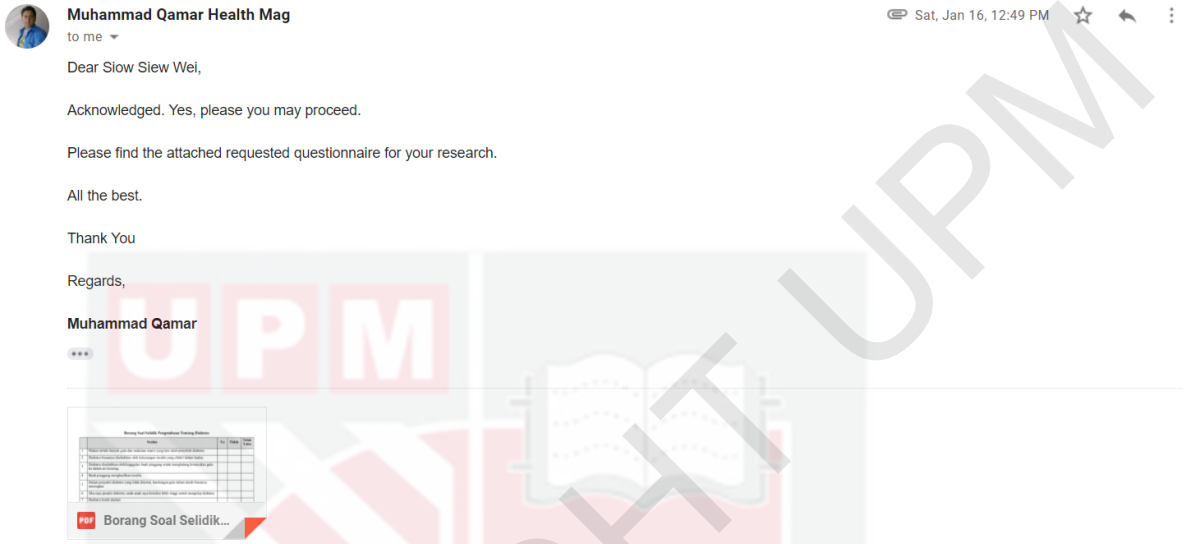
Yosef, T., Nureye, D., & Tekalign, E. (2021). Poor Glycemic Control and Its Contributing Factors Among Type 2 Diabetes Patients at Adama Hospital Medical College in East Ethiopia. *Diabetes Metab Syndr Obes., 14,* 3273-3280 https://doi.org/10.2147/DMSO.S321756

Zoungas, S., Chalmers, J., Ninomiya, T., Li, Q., Cooper, M. E., Colagiuri, S., … Woodward, M. (2011). Association of HbA1c levels with vascular complications and death in patients with type 2 diabetes: evidence of glycaemic thresholds. *Diabetologia*, *55(*3), 636–643. https://doi.org/10.1007/s00125-011-2404-1

Zowgar, A. M., Siddiqui, M. I., & Alattas, K. M. (2018). Level of diabetes knowledge among adult patients with diabetes using diabetes knowledge test. *Saudi Med J., 39(*2), 161-168. https://doi.org/10.15537/smj.2017.2.21343.

APPENDICES

Appendix 1: Written Permission for Study Instrument



Muhammad Qamar Health Mag Sat, Jan 16, 12:49 PM

to me

Dear Siow Siew Wei,

Acknowledged. Yes, please you may proceed.

Please find the attached requested questionnaire for your research.

All the best.

Thank You

Regards,

Muhammad Qamar

PDF Borang Soal Selidik...

Appendix 2: Participant Information Sheet and Informed Consent Form

PARTICIPANT INFORMATION SHEET

1. **Title of study:**
   Association Between Diabetes Knowledge and Glycaemic Control Among Type II Diabetes Mellitus Patients at a Government Health Clinic in Negeri Sembilan

2. **Name of Investigator and Institution:**
   a. Siow Siew Wei (Principal Investigator), Faculty of Medicine and Health Sciences, Universiti Putra Malaysia (UPM)
   b. Prof. Madya Dr. Lee Khuan (Supervisor), Faculty of Medicine and Health Sciences, Universiti Putra Malaysia (UPM)
   c. Dr. Lim Poh Ying (Co-supervisor), Faculty of Medicine and Health Sciences, Universiti Putra Malaysia (UPM)

3. **Name of sponsor:** Self-sponsored

4. **Introduction**
   You are invited to participate in a research study because you fulfil the criteria for this study that require your general knowledge and understanding of diabetes. The details of the research are described in this document. It is important that you understand why the research is being done and what it will involve. Please take your time to read through and consider this information carefully before you decide if you are willing to participate. Ask the study staff if anything is unclear or if you would like more information. After you are properly satisfied that you understand this study and you wish to participate, you must sign the informed consent form.

   Your participation in this study is voluntary. You do not have to be in this study if you do not want to. You may also refuse to answer any questions you do not want to answer. If you volunteer to be in this study, you may withdraw from it at any time. If you withdraw, any data collected from you up to your withdrawal will still be used for the study. Your refusal to participate or withdrawal will not affect any medical or health benefits to which you are otherwise entitled.

   This study has been approved by the Medical Research and Ethics Committee, Ministry of Health Malaysia.

5. **What is the purpose of the study?**
   This study is conducted to investigate the association between diabetes knowledge and glycaemic control among type II diabetes mellitus patients. This research is necessary to improve the understanding of diabetes to ensure proper self-management among diabetic patients.

   This research will be conducted for 5 months which is from 1 April 2021 until 1 September 2021. The expected number of participants is 261 individuals.

6. **What are my responsibilities when taking part in this study?**
   Firstly, you will be randomly selected by the researcher if you meet the inclusion criteria of this study. Then, you will be given a link to the online survey form to answer during your appointment at the clinic. You need to read through the participant information sheet and give your informed consent before participating in this study. The questionnaire contains two sections that will enquire about your socio-demographic data and diabetes knowledge. You must answer all of the questions asked in the survey form honestly and completely which will take about 10-15 minutes of your time.

   After you have finished answering the survey form, click on the "Submit" button to submit your response. If you decide to withdraw from the study midway, you could exit the site freely and no measures will be used to preserve the data you have filled in, thus all data will be destroyed.

7. **What are the potential risks and side effects of being in this study?**
   Participation in this study will not affect your treatment, and the risk is minimal. You are free to decline to answer any of the questions that you feel uncomfortable with.

8. **What are the benefits of being in this study?**
   a. **To you as the subject?**
      The information that you provided regarding your knowledge and understanding of diabetes is valuable and much appreciated. It has no direct benefits to the respondent, but it will create awareness about the importance of diabetes knowledge in the disease management of diabetic patients. There will be no payment given to the respondent as this participation is voluntary. Besides, this study is also conducted by an undergraduate student and it is self-sponsored.

   b. **To the investigator?**
      The information and data obtained from this study will allow the researcher to assess the diabetes knowledge level and its association with glycaemic control among type II diabetes patients. The researcher can identify the knowledge deficit and common misconceptions among diabetic patients. Besides, the findings from the study can suggest any improvement in future health education and intervention program for diabetic patients.

9. **Who is funding this research?**
   This study has no external funding as it is self-sponsored.

10. **Can the research or my participation be terminated early?**
    The researcher can terminate this study and your participation anytime if not fulfil the inclusion criteria of participants. If this study is to be ended early, you will be informed immediately.

11. **Will my medical information be kept private?**
    All your information obtained in this study will be kept and handled confidentially, following applicable laws and/or regulations. When publishing or presenting the study results, your identity will not be revealed without your

expressed consent. Individuals involved in this study, qualified monitors and auditors, and governmental or regulatory authorities may inspect the study data, where appropriate and necessary.

12. Will I be informed of the study findings?

If the study is published in the journal form, the article link will be shared to the participating location which is Klinik Kesihatan Titi. If the study is published in the form of a written thesis, the abstract of this study will be shared at Klinik Kesihatan Titi to notify you regarding the result. Permission from the Director-General of Health, Malaysia will be obtained before publication and no personal information of the subjects will be published.

13. Who should I call if I have questions?

If you have any questions about the study, please contact one of the people listed below:

i. **Researcher**
Siow Siew Wei
Contact no.: +60109006831
Email: 194389@student.upm.edu.my

ii. **Supervisor**
Prof. Madya Dr. Lee Khuan
Contact no.: +603 9769 2438
Email: leekhuan@upm.edu.my

iii. **Co-supervisor**
Dr. Lim Poh Ying
Contact no.: +603 9769 2950
Email: pohying_my@upm.edu.my

If you have any questions about your rights as a participant in this study, please contact the Secretary of Medical Research & Ethics Committee, Ministry of Health Malaysia at 03-3362 8407/8205/8888.

INFORMED CONSENT FORM

Title of Study:
Association Between Diabetes Knowledge and Glycaemic Control Among Type II Diabetes Mellitus Patients at a Government Health Clinic in Negeri Sembilan

By signing below, I confirm the following:

- I have been given oral and written information for the above study and have read and understood the information given.
- I have had sufficient time to consider participation in the study and have had the opportunity to ask questions and all my questions have been answered satisfactorily.
- I understand that my participation is voluntary and I can at any time free withdraw from the study without giving a reason and this will in no way affect my future treatment. I am not taking part in any other research study at this time. I understand the risks and benefits, and I am free to give my informed consent to participate in the conditions stated. I understand that I must follow the study doctor's (investigator's) instructions related to my participation in the study.
- I understand that research staff, qualified monitors and auditors, the sponsor or its affiliates, and governmental or regulatory authorities, have direct access to my medical record to make sure that the study is conducted correctly and the data are recorded correctly. All personal details will be treated as STRICTLY CONFIDENTIAL.
- I will receive a copy of this subject information/informed consent form signed and dated to bring home.
- I agree/disagree* with my participation in this study.

Subject:
Signature: I/C number:
Name: Date:

An investigator conducting informed consent:
Signature: I/C number:
Name: Date:

Impartial witness: *(Required if contents of the participant information sheet are orally communicated to the subject)*
Signature: I/C number:
Name: Date:

RISALAH MAKLUMAT PESERTA

1. **Tajuk Penyelidikan:**
   Hubungan Antara Pengetahuan Diabetes dan Kawalan Glisemik Di Kalangan Pesakit Diabetes Mellitus Jenis II di Sebuah Klinik Kesihatan Kerajaan Negeri Sembilan

2. **Nama penyelidik dan Nama Institusi:**
   a. Siow Siew Wei (Principal Investigator), Faculty of Medicine and Health Sciences Universiti Putra Malaysia (UPM)
   b. Prof. Madya Dr. Lee Khuan (Supervisor), Faculty of Medicine and Health Sciences, Universiti Putra Malaysia (UPM)
   c. Dr. Lim Poh Ying (Co-supervisor), Faculty of Medicine and Health Sciences, Universiti Putra Malaysia (UPM)

3. **Nama Penaja**: Tiada penaja (Pembiayaan sendiri)

4. **Pengenalan**:
   Anda telah dijemput untuk menyertai penyelidikan ini kerana anda memenuhi kriteria untuk kajian ini yang memerlukan pengetahuan umum dan pemahaman anda mengenai diabetes. Risalah ini menjelaskan hal-hal berkenaan penyelidikan tersebut dengan lebih mendalam dan terperinci. Amat penting anda memahami mengapa penyelidikan ini dilakukan dan apa yang dilakukan dalam penyelidikan ini. Sila ambil masa yang secukupnya untuk membaca dan mempertimbangkan dengan teliti penerangan yang diberi sebelum anda bersetuju untuk menyertai penyelidikan ini. Jika ada sebarang kemusykilan ataupun maklumat lanjut yang anda ingin tahu, anda boleh bertanya dengan mana-mana kakitangan yang terlibat dalam penyelidikan ini. Setelah anda berpuas hati bahawa anda memahami penyelidikan ini, dan anda berminat untuk turut serta, anda dikehendaki untuk menandatangani Borang Persetujuan atau Keizinan Peserta, pada muka surat akhir risalah ini.

   Penyertaan anda dalam penyelidikan ini adalah secara sukarela. Anda tidak perlu menyertai penyelidikan ini jika anda tidak mahu. Anda juga mempunyai hak untuk tidak menjawab mana-mana soalan yang anda tidak mahu jawab. Anda juga boleh menarik diri daripada penyelidikan ini pada bila-bila masa sahaja. Jika anda menarik diri, segala maklumat yang telah diperolehi sebelum anda menarik diri tetap akan digunakan dalam penyelidikan ini. Jika anda tidak mahu menyertai ataupun menarik diri dari penyelidikan ini, tindakan anda tidak akan menjejaskan segala hak dan keistimewaan perubatan kesihatan yang selayaknya anda terima.

   Penyelidikan ini telah mendapat kehulusan Jawatankuasa Etika dan Penyelidikan Perubatan, Kementerian Kesihatan Malaysia.

5. **Apakah tujuan penyelidikan ini dilakukan?**
   Tujuan penyelidikan ini dilakukan adalah untuk mengkaji hubungan antara tahap pengetahuan diabetes dan kawalan glisemik di kalangan pesakit diabetes jenis II. Penyelidikan ini diperlukan kerana dapat meningkatkan pemahaman diabetes untuk memastikan pengurusan diri yang betul di kalangan pesakit diabetes.

Penyelidikan ini akan berlangsung selama 5 bulan iaitu daripada 1 April 2021 hingga 1 September 2021. Dijangka bahawa 261 individu akan mengambil bahagian dalam kajian ini.

6. **Apakah tanggungjawab saya sewaktu menyertai penyelidikan ini?**
Pertama, anda akan dipilih secara rawak oleh penyelidik jika anda memenuhi kriteria kemasukan kajian ini. Kemudian, anda akan diberikan pautan borang kaji selidik dalam talian untuk dijawab semasa temujanji anda di klinik. Anda perlu membaca risalah maklumat peserta dan memberi persetujuan anda sebelum menyertai kajian ini. Soal selidik ini mengandungi dua bahagian yang akan bertanya tentang data sosio-demografi dan pengetahuan diabetes anda. Adalah penting untuk anda menjawab semua soalan yang ditanya dalam borang kaji selidik dengan jujur dan lengkap yang akan mengambil masa kira-kira 10-15 minit masa anda.

   Selepas anda selesai menjawab borang kaji selidik, klik pada butang "Serah" untuk menyerahkan jawapan anda. Jika anda memutuskan untuk menarik diri dari pertengahan kajian, anda boleh keluar dari laman web ini dengan bebas dan tiada langkah-langkah akan digunakan untuk mengekalkan data yang telah anda isi, oleh itu semua data akan dimusnahkan.

7. **Apakah risiko dan kesan-kesan sampingan menyertai penyelidikan ini?**
Risiko untuk penyertaan penyelidikan ini yang adalah minima dan tidak akan menjejaskan rawatan anda. Anda berhak untuk tidak menjawab jika rasa tidak selesa dengan mana-mana soalan kajian.

8. **Apakah manfaatnya saya menyertai kajian ini?**
   a. **Kepada anda sebagai peserta?**
   Kami amat menghargai segala maklum balas anda berkaitan pengetahuan dan pemahaman anda mengenai diabetes. Tiada manfaat yang akan anda terima secara langsung, tetapi kajian ini akan meningkatkan tahap kesedaran terhadap kepentingan pengetahuan diabetes dalam pengurusan diri untuk penyakit diabetes dalam kalangan responden. Tiada bayaran kepada responden kerana penyertaan anda adalah secara sukarela. Selain itu, kajian ini juga dijalankan oleh pelajar sarjana muda dan segala pembayaran dalam kajian ini ditanggung oleh penyelidik sendiri.

   b. **Kepada penyelidik?**
   Maklumat yang diterima semasa kajian ini membolehkan penyelidik menilai tahap pengetahuan diabetes dan perkaitannya dengan kawalan glisemik di kalangan pesakit diabetes jenis II. Pengkaji dapat mengenal pasti kekurangan pengetahuan dan salah tanggapan umum di kalangan pesakit kencing manis. Selain itu, dapatan daripada kajian ini boleh mencadangkan sebarang penambahbaikan dalam program pendidikan kesihatan dan intervensi masa depan untuk pesakit diabetes.

9. **Siapakah yang membiayai penyelidikan ini?**
Kajian ini adalah sara diri dan tiada organisai yang membiayai kajian ini.

10. Bolehkah penyelidikan ataupun penyertaan saya ditamatkan lebih awal daripada yang dirancang?

Penyelidik boleh menamatkan penyelidikan ini ataupun menamatkan penyertaan anda dalam penyelidikan ini pada bila-bila masa sekiranya anda tidak memenuhi kriteria untuk kajian ini. Anda akan dimaklumkan jika penyelidikan ini dihentikan terlebih awal atas sebab-sebab tertentu.

11. Adakah maklumat saya akan dirahsiakan?

Segala maklumat anda yang diperolehi dalam penyelidikan ini akan disimpan dan dikendalikan secara sulit, bersesuaian dengan peraturan-peraturan dan/ atau undang-undang yang berkenaan. Sekiranya hasil penyelidikan ini diterbitkan atau dibentangkan kepada orang ramai, identiti anda tidak akan didedahkan tanpa kebenaran anda terlebih dahulu. Pihak-pihak tertentu seperti individu yang terlibat dalam penyelidikan ini, juruaudit dan jurupantau yang terlatih, pihak berkuasa kerajaan atau undang-undang, boleh memeriksa maklumat atau data kajian jika diperlukan.

12. Adakah saya akan dimaklumkan mengenai penemuan kajian ini?

Jika kajian diterbitkan dalam borang jurnal, pautan artikel akan dikongsi ke lokasi yang mengambil bahagian iaitu Klinik Kesihatan Titi. Jika kajian diterbitkan dalam bentuk tesis bertulis, abstrak kajian ini akan dikongsi di Klinik Kesihatan Titi untuk memaklumkan anda mengenai hasilnya. Kebenaran daripada Ketua Pengarah Kesihatan Malaysia akan diperolehi sebelum penerbitan dan tiada maklumat peribadi mata pelajaran akan diterbitkan.

13. Siapakah yang perlu saya hubungi sekiranya saya mempunyai sebarang pertanyaan?

Anda boleh menghubungi penyelidik pada nombor telefon seperti berikut sekiranya anda mempunyai sebarang pertanyaan mengenai penyelidikan ini.

a. **Penyelidik**
   Siow Siew Wei
   Contact no.: +60109006831
   Email: 194389@student.upm.edu.my

b. **Supervisor**
   Prof. Madya Dr. Lee Khuan
   Contact no.: +603 9769 2438
   Email: leekhuan@upm.edu.my

c. **Co-supervisor**
   Dr. Lim Poh Ying
   Contact no.: +603 9769 2950
   Email: pohying_my@upm.edu.my

Jika anda mempunyai sebarang pertanyaan berkaitan dengan hak-hak anda sebagai pesakit dalam penyelidikan ini, sila hubungi: Setiausaha, Jawatankuasa Etika & Penyelidikan Perubatan, Kementerian Kesihatan Malaysia, melalui talian telefon 03-3362 8407/8205/8888.

BORANG PERSETUJUAN/KEIZINAN PESERTA

Tajuk Penyelidikan:
Hubungan Antara Pengetahuan Diabetes dan Kawalan Glisemik Di Kalangan Pesakit Diabetes Mellitus Jenis II di Sebuah Klinik Kesihatan Kerajaan Negeri Sembilan

Dengan menandatangani borang ini, saya mengesahkan bahawa:

- Saya telah dimaklumkan tentang penyelidikan ini secara lisan dan bertulis dan saya telah membaca dan memahami segala maklumat yang diberikan.
- Saya diberikan masa yang cukup untuk mempertimbangkan penyertaan saya dalam kajian ini dan diberikan peluang untuk bertanyakan soalan dan semua persoalan telah dijawab dengan sempurna dan memuaskan.
- Saya faham bahawa penyertaan saya adalah secara sukarela dan bebas untuk menarik diri pada bila-bila masa daripada kajian ini tanpa memberi sebarang alasan. Saya tidak mengambil bahagian dalam mana-mana penyelidikan lain pada masa ini. Saya juga memahami tentang risiko dan manfaat penyelidikan ini dan saya secara sukarela memberi persetujuan untuk menyertai penyelidikan ini di bawah syarat-syarat yang telah dinyatakan di atas. Saya faham saya harus mematuhi nasihat dan arahan yang berkaitan dengan penyertaan saya dalam kajian ini daripada penyelidik.
- Saya menerima satu salinan Risalah Maklumat Peserta dan Borang Persetujuan atau Keizinan Peserta yang telah lengkap dengan Tarikh dan tandatangan untuk dibawa pulang ke rumah.
- Saya setuju/tidak setuju* untuk menyertai kajian ini.

Subjek:
Tandatangan: Nombor K/P:
Nama: Tarikh:

Penyelidik yang mengendalikan proses menandatangani borang keizinan:
Tandatangan: Nombor K/P:
Nama: Tarikh:

Saksi tidak-berpihak/adil:
Tandatangan: Nombor K/P:
Nama: Tarikh:

Appendix 3: Questionnaire

UNIVERSITI PUTRA MALAYSIA

FACULTY OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT OF NURSING

BACHELOR OF NURSING

RESEARCH TITLE:

ASSOCIATION BETWEEN DIABETES KNOWLEDGE AND GLYCAEMIC CONTROL AMONG TYPE II DIABETES MELLITUS PATIENTS AT A GOVERNMENT HEALTH CLINIC IN NEGERI SEMBILAN

QUESTIONNAIRE

RESEARCHER	: SIOW SIEW WEI (194389)
SUPERVISOR	: PROF. MADYA DR. LEE KHUAN
CO-SUPERVIOR	: DR. LIM POH YING

INSTRUCTION:

This study is conducted for academic purposes. All information will be kept private and confidential. Thank you for your cooperation in answering this questionnaire.

Part A: Socio-demographic and Health-related Information

Instruction:

All the answers given are to complete your background information. Please answer each question appropriately by ticking (√) or writing down in the box or at the space provided respectively.

1. Age: _____
2. Gender:

   [ ] Female [ ] Male
3. Ethnicity:

   [ ] Malay [ ] Chinese [ ] India [ ] Others
4. Educational level:

   [ ] No formal education [ ] Primary school

   [ ] Secondary school [ ] College/ University
5. Monthly income: RM_____
6. Duration of diabetes: _____ year(s)
7. Presence of comorbidities:

   [ ] Hypertension [ ] Dyslipidemia [ ] Others: _____ [ ] No
8. Type of diabetes treatment:

   [ ] Diet only [ ] Oral medication

   [ ] Insulin therapy [ ] Both oral and insulin therapy
9. Body weight: _____ kg Height: _____cm
10. HbA1c latest results within past 6 months (fill by investigator): _____

Part B: Diabetes Knowledge Questionnaire

Instruction: This questionnaire is designed to access your level of general knowledge on diabetes. Please tick (/) the most appropriate answer. Choose only ONE answer.

No.	Questions	Yes	No	Don't Know
1.	Eating too much sugar and other sweet foods is a cause of diabetes.			
2.	The usual cause of diabetes is a lack of effective insulin in the body.			
3.	Diabetes is caused by the failure of the kidneys to keep sugar out of the urine.			
4.	Kidneys produce insulin.			
5.	In untreated diabetes, the amount of sugar in the blood usually increases.			
6.	If I am diabetic, my children have a higher chance of being diabetic.			
7.	Diabetes can be cured.			
8.	A fasting blood sugar level of 11.7 µmol/L (210 mg/dL) is too high.			
9.	The best way to check my diabetes is by testing my urine.			
10.	Regular exercise will increase the need for insulin or other diabetic medication.			

11.	There are two main types of diabetes: Type 1 (insulin-dependent) and Type 2 (non-insulin-dependent).			
12.	Hypoglycaemia (low blood sugar) is caused by too much food.			
13.	Medication is more important than diet and exercise to control my diabetes.			
14.	Diabetes often causes poor circulation.			
15.	Cuts and abrasions on diabetes heal more slowly.			
16.	Diabetics should take extra care when cutting their toenails.			
17.	A person with diabetes should cleanse a cut with iodine and alcohol.			
18.	The way I prepare my food is as important as the foods I eat.			
19.	Diabetes can damage my kidneys.			
20.	Diabetes can cause loss of feeling in my hands, fingers, and feet.			
21.	Shaking and sweating are signs of high blood sugar.			
22.	Frequent urination and thirst are signs of low blood sugar.			
23.	Tight elastic hoses or socks are not bad for diabetes.			
24.	A diabetic diet consists mostly of special foods.			

UNIVERSITI PUTRA MALAYSIA

FAKULTI PERUBATAN DAN SAINS KESIHATAN

JABATAN KEJURURAWATAN

BACELOR KEJURURAWATAN

TAJUK PENYELIDIKAN:

HUBUNGAN ANTARA PENGETAHUAN DIABETES DAN KAWALAN GLISEMIK DI KALANGAN PESAKIT DIABETES MELLITUS JENIS II DI SEBUAH KLINIK KESIHATAN KERAJAAN NEGERI SEMBILAN

SOAL SELIDIK

PENYELIDIK : SIOW SIEW WEI (194389)

SUPERVISOR : PROF. MADYA DR. LEE KHUAN

CO-SUPERVIOR : DR. LIM POH YING

ARAHAN:

Kajian ini dijalankan untuk tujuan akademik. Semua maklumat akan disimpan secara peribadi dan sulit. Terima kasih atas kerjasama anda dalam menjawab soal selidik ini.

Bahagian A: Maklumat Berkaitan Sosiodemografi Dan Kesihatan

Arahan:

Semua jawapan yang diberikan adalah untuk melengkapkan maklumat latar belakang anda. Sila jawab setiap soalan dengan tepat dengan menandakan (√) atau tuliskan di kotak atau di ruang yang disediakan masing-masing.

1. Umur: _____

2. Jantina:

   [ ] Perempuan [ ] Lelaki

3. Bangsa:

   [ ] Melayu [ ] Cina [ ] India [ ] Lain-lain

4. Tahap pendidikan:

   [ ] Tiada pendidikan formal [ ] Sekolah rendah

   [ ] Sekolah Menengah [ ] Kolej/ Universiti

5. Pendapatan bulanan: RM_____

6. Tempoh Diabetes: _____ tahun

7. Penyakit lain:

   [ ] Darah tinggi [ ] Dislipidemia [ ] Lain-lain: _____ [ ] Tiada

8. Rawatan diabetes:

   [ ] Pengawalan makanan sahaja [ ] Ubat oral

   [ ] Terapi insulin [ ] Ubat oral dan terapi insulin

9. Berat badan: ____kg Ketinggian: _____ cm

10. HbA1c terkini dalam tempoh 6 bulan yang lalu (diisi oleh penyelidik): _____

Bahagian B: Ujian Pengetahuan Diabetes

Arahan:

Soal selidik ini direka untuk mengakses tahap pengetahuan umum anda mengenai diabetes. Sila bulatkan atau tandakan (/) pada jawapan yang paling sesuai. Pilih hanya SATU jawapan.

No.	Soalan	Ya	Tidak	Tidak Tahu
1.	Makan terlalu banyak gula dan makanan manis yang lain ialah penyebab diabetes.			
2.	Diabetes biasanya disebabkan oleh kekurangan insulin yang efektif dalam badan.			
3.	Diabetes disebabkan oleh kegagalan buah pinggang untuk menghalang kemasukan gula ke dalam air kencing.			
4.	Buah pinggang menghasilkan insulin.			
5.	Dalam penyakit diabetes yang tidak dirawat, kandungan gula dalam darah biasanya meningkat.			
6.	Jika saya pesakit diabetes, anak-anak saya berisiko lebih tinggi untuk mengidap diabetes.			
7.	Diabetes boleh diubati.			
8.	Kandungan gula dalam darah sebanyak 11.7 µmol/L (210 mg/dL) semasa berpuasa adalah terlalu tinggi.			
9.	Cara terbaik untuk memeriksa diabetes saya ialah melalui ujian air kencing.			
10.	Senaman yang kerap akan meningkatkan keperluan terhadap insulin atau ubat-ubatan diabetes yang lain.			
11.	Terdapat dua jenis diabetes yang utama: Jenis 1 (bergantung kepada insulin) dan Jenis 2 (tidak bergantung kepada insulin).			

12.	Hipoglisemia (kekurangan gula dalam darah) disebabkan oleh terlalu banyak makanan.			
13.	Ubat-ubatan lebih penting daripada diet dan senaman untuk mengawal diabetes.			
14.	Diabetes sering menyebabkan peredaran darah yang lemah.			
15.	Luka dan kesan lecet pada pesakit diabetes mengambil masa yang lama untuk sembuh.			
16.	Pesakit diabetes perlu berhati-hati apabila memotong kuku kaki mereka.			
17.	Pesakit diabetes perlu membersihkan luka dengan iodin dan alkohol.			
18.	Cara penyediaan makanan adalah sama pentingnya dengan apa yang saya makan.			
19.	Diabetes boleh merosakkan buah pinggang saya.			
20.	Diabetes boleh menyebabkan kehilangan deria rasa pada tangan, jari dan kaki saya.			
21.	Menggeletar dan berpeluh adalah tanda-tanda kandungan gula yang tinggi dalam darah.			
22.	Kerap membuang air kencing dan dahaga adalah tanda-tanda kandungan gula yang rendah dalam darah.			
23.	Sarung kaki atau stokin yang ketat adalah sesuai untuk pesakit diabetes.			
24.	Diet untuk pesakit diabetes kebanyakannya mengandungi makanan yang khusus.			

TAMAT

Terima kasih atas kerjasama anda

Appendix 4: Gantt Chart

Project	2020			2021								
	OCT	NOV	DEC	JAN	FEB	MAC	APRIL	MAY	JUNE	JULY	AUG	SEP
Identify research problem												
Review literature work												
Proposal write-up												
Proposal presentation and proposal correction												
Ethical application from MREC												
Pre-test												
Data collection												
Data analysis and discussion												
Thesis compilation and submission												

Appendix 5: Budget

No.	Item	Quantity X RM/unit	Total Cost
1.	Printing	2 x RM25	RM50
2.	Binding	2 x RM10	RM20
3.	Stationery	2 x RM5	RM10
4.	Transport	4 x RM30	RM120
TOTAL			**RM200**

Appendix 6: Approval from the Medical Research and Ethics Committee (MREC)

JAWATANKUASA ETIKA & PENYELIDIKAN PERUBATAN
(Medical Research & Ethics Committee)
KEMENTERIAN KESIHATAN MALAYSIA
d/a Kompleks Institut Kesihatan Negara
Blok A, No 1, Jalan Setia Murni U13/52,
Seksyen U13, Bandar Setia Alam,
40170 Shah Alam, Selangor.
Tel: 03-3362 8888/8205

Ref : KKM/NIHSEC/ P21- 599 (4)
Date: 16-April-2021

SIOW SIEW WEI
UNIVERSITY PUTRA MALAYSIA (UPM)

Dear Sir/ Mdm,

ETHICS INITIAL APPROVAL: NMRR-21-211-58158 (IIR)

ASSOCIATION BETWEEN DIABETES KNOWLEDGE AND GLYCAEMIC CONTROL AMONG TYPE 2 DIABETES MELLITUS PATIENTS AT A PUBLIC HEALTH CLINIC IN NEGERI SEMBILAN

This letter is made in reference to the above matter.

2. The Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (MOH) has provided ethical approval for this study. Please take note that all records and data are to be kept strictly **CONFIDENTIAL** and can only be used for the purpose of this study. All precautions are to be taken to maintain data confidentiality. Permission from the District Health Officer / Hospital Administrator / Hospital Director and all relevant heads of departments / units where the study will be carried out must be obtained prior to the study. You are required to follow and comply with their decision and all other relevant regulations, including the Access to Biological and Benefit Sharing Act 2017.

3. The investigators and study sites involved in this study are:

   KLINIK KESIHATAN TITI
   Dr Lee Khuan
   Dr Lim Poh Ying
   Siow Siew Wei (Principal Investigator)

4. The following study documents have been received and reviewed with reference to the above study:

Documents received and reviewed with reference to the above study:
1. Study Protocol Version 6, dated 08-April-2021
2. Patient information sheet (English) & Informed Consent Form (English) Version 2, dated 08-April-2021
3. Patient information sheet (BM) & Informed Consent Form (BM) Version 2, dated 08-April-2021
4. Questionnaire Version 2, dated 01-February-2021
5. Investigator's documents : Declaration of Conflict of Interest (COI), IA-HOD-IA, and CV:
a) Dr Lee Khuan
b) Dr Lim Poh Ying
c) Siow Siew Wei (Principal Investigator)

LAMPIRAN 2

Protokol (*full protocol*)

Ringkasan Projek Penyelidikan

Tajuk Penyelidikan:

Association Between Diabetes Knowledge And Glycaemic Control Among Type 2 Diabetes Mellitus Patients At A Public Health Clinic In Negeri Sembilan

Nama dan Jabatan Ketua Penyelidik:

Siow Siew Wei, Pelajar Bacelor Kejururawatan, Jabatan Kejururawatan, Fakulti Perubatan dan Sains Kesihatan, Universiti Putra Malaysia

Nombor pendaftaran NMRR: NMRR-21-211-58158

Rujukan kelulusan MREC: KKM/NIHSEC/ P21- 599 (4)

Tarikh mula penyelidikan: 1 April 2021

Tarikh tamat penyelidikan: 1 September 2021

Objektif penyelidikan:

Tujuan penyelidikan ini adalah untuk mengkaji hubungan antara tahap pengetahuan diabetes dan kawalan glisemik di kalangan pesakit diabetes jenis 2 di Klinik Kesihatan Titi, Negeri Sembilan. Hasil dapatan daripada penyelidikan ini akan dijadikan sebagai rujukan untuk sebarang penambahbaikan dalam program pendidikan kesihatan dan intervensi untuk pesakit diabetes pada masa depan.

Ringkasan metodologi penyelidikan:

Kajian ini adalah kajian berbentuk kajian rentas silang. Oleh itu, setiap peserta akan menerima satu set soal selidik melalui Google Form yang terdiri daripada dua bahagian iaitu bahagian maklumat latar belakang dan bahagian pengetahuan tentang diabetes. Semua peserta dikehendaki untuk menjawab semua soalan yang terdapat dalam setiap bahagian. Ia akan mengambil masa selama 10 hingga 15 minit. Penyertaan peserta dalam kaji selidik ini adalah secara sukarela dan mereka berhak untuk menarik diri daripada kajian ini pada bila-bila masa. Selain itu, penyelidik juga akan mengakses rekod perubatan pesakit diabetes di klinik berkenaan untuk mengumpul data untuk tujuan penyelidikan.