

THE RELATIONSHIP BETWEEN FOOD INSECURITY AND GLYCEMIC  
CONTROL AMONG TYPE 2 DIABETES MELLITUS PATIENTS AT  
HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA

by

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Dissertation submitted in partial fulfillment of the requirement for the degree  
of Bachelor of Health Sciences (Honours) (Dietetics)

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## DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at Universiti Sains Malaysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for teaching, research and promotional purposes.



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Aina Nadia Binti Anwar

Date: 30/6/2025

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## LIST OF ABBREVIATIONS

HPUSM	: Hospital Pakar Universiti Sains Malaysia
MFIES	: Malaysia Food Insecurity Experience Scale
HbA1c	: Glycated Hemoglobin A1c
FIS	: Food Insecurity
CPG	: Clinical Practice Guidelines
KPP	: Klinik Pakar Perubatan
KRK	: Klinik Rawatan Keluarga
OAD	: Oral Antidiabetic Drugs
NHANES	: National Health and Nutrition Examination Survey
MetS	: Metabolic Syndrome

**HUBUNGKAIT ANTARA KETIDAKJAMINAN MAKANAN DAN  
KAWALAN GLISEMIK DALAM KALANGAN PESAKIT DIABETES  
MELLITUS JENIS 2 DI HOSPITAL PAKAR UNIVERSITI SAINS  
MALAYSIA (HPUSM)**

**ABSTRAK**

Ketidakjaminan makanan (FIS) semakin dikenali sebagai salah satu halangan dalam pengurusan diabetes yang berkesan, namun bukti saintifik dalam populasi klinikal di Malaysia masih terhad. Kajian keratan rentas ini dijalankan bagi menentukan hubungkait antara ketidakjaminan makanan dengan kawalan glisemik dalam kalangan pesakit diabetes melitus jenis 2 (T2DM) di Hospital Pakar Universiti Sains Malaysia (HPUSM). Seramai 114 pesakit luar T2DM telah terlibat dalam kajian ini. Skala Pengalaman Ketidakjaminan Makanan Malaysia (MFIES) digunakan untuk menilai tahap ketidakjaminan makanan, manakala domain diet dalam instrumen *Summary of Diabetes Self-Care Activities* (SDSCA) digunakan untuk menilai tahap pematuhan diet. Nilai HbA1c dalam tempoh tiga hingga enam bulan pula diperoleh daripada rekod perubatan sebagai penunjuk kawalan glisemik. Subjek kajian terdiri daripada 89.5% kaum Melayu, dan 73.3% adalah berumur lebih daripada 60 tahun. Mengikut tahap sosioekonomi 73.7% subjek daripada kalangan B40 dengan pendapatan isi rumah bulanan kurang daripada RM4850. Keputusan menunjukkan bahawa 33.3% daripada peserta mengalami ketidakjaminan makanan. Sejumlah 68.4% pesakit menunjukkan kawalan glisemik yang teruk ( $HbA1c \geq 7.0\%$ ), dan pematuhan diet secara

keseluruhannya adalah rendah berdasarkan skor SDSCA (median=2.25, IQR=4.13). Analisis statistik uji *Spearman Correlation* menunjukkan tiada hubungan yang signifikan antara ketidakjaminan makanan dengan kawalan glisemik ( $p=0.984$ ,  $r=-0.002$ ), dan tiada hubungan yang signifikan antara ketidakjaminan makanan dengan pematuhan diet ( $p>0.05$ ) juga berdasarkan uji *Spearman Correlation*. Dapatan ini menunjukkan bahawa, dalam populasi ini, variasi ketidakjaminan makanan tidak mencerminkan perubahan dalam HbA1c atau tingkah laku pematuhan diet. Kajian lanjutan dengan saiz sampel lebih besar dan reka bentuk longitudinal diperlukan untuk mengesahkan hubungan ini.

# **THE RELATIONSHIP BETWEEN FOOD INSECURITY AND GLYCEMIC CONTROL AMONG TYPE 2 DIABETES MELLITUS PATIENTS AT HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA**

## **ABSTRACT**

Food insecurity (FIS) is increasingly recognized as a barrier to effective diabetes management. However, scientific evidence within Malaysian clinical populations remains uncertain. This cross-sectional study was performed to determine association between food insecurity and both glycemic control among patients with type 2 diabetes mellitus (T2DM) at Hospital Pakar Universiti Sains Malaysia (HPUSM). A total of 114 T2DM outpatients participated in this study. The Malaysia Food Insecurity Experience Scale (MFIES) was used to assess food insecurity, while the diet domain of the Summary of Diabetes Self-Care Activities (SDSCA) was employed to evaluate dietary adherence. HbA1c values from the previous three to six months were obtained from medical records to assess glycemic control. The majority of respondents were Malay (89.5%), and 73.3% were aged over 60 years. Socioeconomically, 73.7% of participants belonged to the B40 income group, with a monthly household income below RM4,850. The findings revealed that 33.3% of participants experienced food insecurity. Poor glycemic control ( $\text{HbA1c} \geq 7.0\%$ ) was observed in 68.4% of patients. Overall dietary adherence was low based on SDSCA scores (median=2.25, IQR=4.13). Data were analysed using Spearman Correlation test showed no significant relationship between food insecurity and glycemic control ( $p=0.984$ ,  $r=-0.002$ ), and between

food insecurity and dietary compliance ( $p > 0.05$ ) also using Spearman Correlation Test. These findings indicate that, in this population, variations in food insecurity do not reflect changes in HbA1c levels or dietary compliance behaviours. Further studies with larger sample sizes and longitudinal designs are needed to verify this relationship.

# CHAPTER 1: INTRODUCTION

## 1.1 Background of Study

Food that is cheap, high calorie, and big portion size but unhealthy is most likely to be consumed by food insecure household members, then heighten the risk of getting metabolic syndrome like obesity and diabetes mellitus (Casagrande *et al.*, 2022). The incident of diabetes was prominently raised among individuals struggling with severe food insecurity compared to the food secure groups of people, emphasizing the belief that food insecurity is one of the critical risk factor for the development of T2DM (Najibi *et al.*, 2019). In Malaysia, the Third National Health and Morbidity Survey revealed that prevalence of T2DM among adults aged 30 years old and above was found to be 14.9% in 2006, increased by about 79.5% in 10 years from 1996 to 2006. According to the Institute for Public Health (IPH, 2020) the incidence of diabetes rises from 11.2% in 2011 to 18.3% in 2019, indicating a 68.3% increase. Malaysia reported a national survey in 2019, indicate 3.6 million individuals aged 18 and above have diabetes, with 49% (3.7 million) of cases remaining undiagnosed.

T2DM prevention and management mainly influence by individuals' dietary habits (Ley *et al.*, 2014). Foods that is rich in low-glycemic carbohydrates, fresh vegetables and fruits resulting in substantial improvement in glycemic control (Ley *et al.*, 2014). Nevertheless, encouraging continuous compliance to diet modification in T2DM care remains a primary challenge for both patients and healthcare providers (Sugandh *et al.*, 2023). Food insecurity has been significantly confirmed as barriers that affects patient ability to comply with the dietary modifications (Seligman, Laraia & Kushel, 2010). The affected group having food insecurity will face insufficient access of fresh and nutrient-rich foods. Individuals affected with food insecurity will depend on cheaper food products that contain higher amounts of salt, unhealthy fats, refined carbohydrates as well as lower quantities of dietary fibre (Morales & Berkowitz, 2016). This dietary habits will lead to increase blood glucose level and heightened risk of type 2 diabetes mellitus. Diabetic individuals who also have food insecurity are susceptible to have poor glycemic control, compared to patients with food security (Shaheen, Kibe & Schrode, 2021). Prevention of both macrovascular and microvascular complications by achieving and maintaining optimal glycemic control is a primary therapeutic objective in management of diabetic patients (Azzam, Ibrahim & Abd El-Ghany, 2021). Glycemic control define as the management of blood glucose levels within the recommended range for individuals with diabetes mellitus (González Clemente & Cabot, 2010).

According to Clinical Practice Guidelines (CPG) on Diabetes Mellitus (2020), glycemic control in patients with type 2 diabetes mellitus can be measured using three key parameters which are fasting blood glucose or pre-prandial blood glucose, post-prandial blood glucose and Hemoglobin A1c (HbA1c). HbA1c is considered as the gold standard for assessing glycemic control during the previous three months (Monnier & Colette, 2009). Key to foster more effective treatment and identifying the needs of adults with T2DM is by discovering the reasons that may influence glycemic control and there are still many factors influence glycemic control that is unknown (Bin Rakhis *et al.*, 2022). Based on presents findings, patients with good and poor glycemic control can be distinguish based on age, duration of diabetes mellitus, drug utilization pattern and adherence to antidiabetic drug (Ahmad, Islahudin & Paraidathathu, 2014). Meanwhile, for self-management behavior, like diet and non-smoking were not associated with good glycemic control (Ahmad, Islahudin & Paraidathathu, 2014).

Despite notable improvements in diagnosis and management, many patients still have not achieved targeted glycemic control. It may be due to the ineffective strategies and intervention by health-care practitioners. However, the association between food insecurity and glycemic control has not been evaluated in clinical populations of adult patients with diabetes, and mechanisms for a relationship between food insecurity and glycemic control

remain unclear. Our objective was to examine the relationship whether glycemic control associated with food insecurity among type 2 diabetes mellitus patients in the HPUSM.

## **1.2 Problem Statements**

T2DM is impacting millions worldwide and constituting a considerable public health challenge because of this chronic metabolic condition characterized by insulin resistance and hyperglycemia. Effective management of type 2 diabetes mellitus really depending on maintaining a good glycemic control, this will be evaluated via glycated hemoglobin (HbA1c). Food insecurity define by inconsistent and limited access to enough and healthy food, has become a significant problem impacting health status. This will increase burden to vulnerable individuals as it may left them with limited healthy food choices, bad food habits, increase stress level, and reduce compliance with diabetes care management, consequently compromising glycemic control and worsening disease outcome.

Food insecurity prevalence in Asia increase from 3% to 26% in 2020 (Mahmood, Rajaram & Guinto, 2022). The pandemic highlighted the vulnerability of current food systems, specifically in developing economies relying on large-scale agriculture and international food trade (Mahmood, Rajaram & Guinto, 2022). The global food-insecure population is projected to increase by another 10% by 2050 if no action is taken, or even more if another global crisis happens (Mahmood, Rajaram & Guinto, 2022). Limited access

to diabetic-friendly foods because of food insecurity significantly impact glycemic managements of patients with T2DM.

This circumstance may result in elevated HbA1C values, worsen diabetes-related problems, and diminished overall health outcomes (Centers for Disease Control and Prevention, 2024). Moreover, food-insecure individuals may encounter erratic meal patterns or extended fasting, which exacerbates blood glucose management challenges (Gucciardi *et al.*, 2014). Prior research has suggested a possible association between food insecurity and inadequate glycemic control (Holben, Brown & Shubrook, 2019); however, results are inconsistent owing to differences in demographic characteristics, measuring instruments, and study methodologies. In spite of that, an extensive knowledge of the association between food insecurity and poor HbA1c levels in individuals with T2DM in Malaysia is still insufficient, especially among low socio-economic group, indicating a significant gap in the current literature.

Despite increasing acknowledgement of the impact food insecurity to chronic disease management, there is still lack of research examining its association with glycemic control in individuals with T2DM (Seligman *et al.*, 2012). Many current research concentrates on larger groups or neglect to consider cultural, socioeconomic, and healthcare access gaps that may specifically impact this group. The absence of localized data results in a deficiency in comprehending the impact of food insecurity on HbA1c levels, so depriving healthcare

practitioners and policymakers of the necessary evidence to customize programs that successfully tackle the dual challenges of diabetes and food insecurity (Shahar *et al.*, 2019).

Addressing this deficiency is essential for formulating diabetes care regimens that consider social determinants of health, including food security. Establishing the correlation between food insecurity and glycemic regulation might guide focused interventions, such as community-oriented nutrition initiatives or legislation that enhance access to affordable, diabetes-compatible foods (Levi, Bleich & Seligman, 2023). Ultimately, these initiatives can optimize disease management, mitigate the risk of complications, decrease healthcare expenditures, and elevate the overall quality of life for T2DM patients. Comprehending this correlation is crucial for formulating equitable healthcare policies that target disadvantaged communities disproportionately impacted by food insecurity (Gregg *et al.*, 2023).

Considering the elevation in incidence of T2DM and the escalating concern of food insecurity as a public health issue, it is crucial to examine the interrelation of these factors (Gucciardi *et al.*, 2014). Recognizing the relationship between food insecurity and glycemic control, as indicated by HbA1c levels, is essential for determining major barriers to efficient diabetes management. Although studies on the association between household food insecurity and nutritional status of Malaysians are recognized (Shariff & Khor, 2008), there is no prevalent study on these variables among type 2 diabetes mellitus patients in Malaysia. This study aims to enhance health outcomes for T2DM patients experiencing food insecurity.

through evidence by fill the knowledge gap linking food insecurity and glycemic control to inform targeted therapies and policies. Hence, this study is planned to determine the association between these factors among type 2 diabetes mellitus patients in Malaysia which may serve as a foundation for suitable and effective intervention plan.

### **1.3 Research Objectives**

#### **1.3.1 General Objectives**

To determine the association between food insecurity with glycemic control (HbA1c) among type 2 diabetes mellitus patients in HPUSM.

#### **1.3.2 Specific Objectives**

1. To determine the level of food insecurity among type 2 diabetes mellitus patients at HPUSM
2. To determine the status glycemic control (HbA1c) among type 2 diabetes mellitus patients at HPUSM
3. To determine the diet compliance status of type 2 diabetes mellitus patients at HPUSM

4. To determine the association between food insecurity and glycemic control among type 2 diabetes mellitus patients at HPUSM
5. To determine the relationship between food insecurity and diet compliance among type 2 diabetes mellitus patients at HPUSM

#### **1.4 Research Question**

- a. What is food insecurity status among type 2 diabetes mellitus patients at HPUSM?
- b. What is the level of glycemic control (HbA1c) among type 2 diabetes mellitus patients at HPUSM?
- c. What is diet compliance status of type 2 diabetes mellitus patients at HPUSM?
- d. Is there any significant relationship between food insecurity and glycemic control (HbA1c) among type 2 diabetes mellitus patients at HPUSM?
- e. Is there any significant relationship between food insecurity and diet compliance?

## **1.5 Hypotheses**

Ho1: There is no significant relationship between food insecurity and glycemic control

Ha1: There is significant relationship between food insecurity and glycemic control

Ho2: There is no significant relationship between food insecurity and diet compliance

Ha2: There is significant relationship between food insecurity and diet compliance

## **1.6 Significance of Research**

Food insecurity in Malaysia is a major concern that severely impacts public health, especially within low-income households. The 2014 Malaysian Adult Nutrition Survey (MANS) revealed that a majority of the population experiences insufficient food access, with 25% of adults reporting inadequate food quantity and 25.5% unvaried diet (Ahmad *et al.*, 2020).

Moderate and severe food insecurity rose from 5.1% in 2017 to 18.7% in 2019 emphasizes an alarming trend associated to rising poverty levels (Mahmood, Rajaram & Guinto, 2022).

In type 2 diabetes mellitus, food insecurity not only influences nutritional status but also will intensifies chronic health problem because of the tendency relying on cheap, big portion but poor-quality diet. This will increase susceptibility for obesity and metabolic disorders like diabetes mellitus (Levi, Bleich & Seligman, 2023). In spite of established association between household food insecurity and nutritional status among Malaysian, but still there is knowledge gap on research that is focusing in determining the impacts of food insecurity on glycemic control specifically among type 2 diabetes mellitus patients (Gucciardi *et al.*, 2014).

A study revealed 59.1% of households experienced food insecurity forcing them to adapt with inconsistent access of healthy food by opting for cheap food and reducing meal portions (Bakeri *et al.*, 2023). In household with food insecurity, a significant relationship found in between low household income, high food expenditure, and renting homes (Seo & Park, 2021). This conclude that those with lower socioeconomic status were more affected. Most respondents declared moderate to good nutrition knowledge, but still this did not associate significantly with their food security status, urging that economic factors primarily influence food access issues (Bakeri *et al.*, 2023).

Realizing the relationship between food insecurity and glycemic control, as seen by HbA1c levels, is crucial for recognizing barriers to efficient diabetes management. This study seeks to address these uncertainties by observing the association between these parameters in T2DM patients in Malaysia. The research will employ localized data to manage customized interventions and policies focused at enhancing health outcomes for individuals facing both diabetes and food insecurity. This method is essential for formulating effective healthcare solutions that tackle the specific issues encountered by vulnerable groups that is impacted by food insecurity.

### **1.7 Conceptual Framework**

Figure 1 showed conceptual framework that has been coordinated to determine relationship between food insecurity and glycemic control, and relationship between food insecurity and diet compliance. The conceptual framework roughly contribute to the idea of interrelation between food insecurity, dietary choices, and T2DM. Low SES individuals prone to experience extreme food insecurity because of the limitation in accessing to adequate and healthy food. Consequently, this will lead to unbalanced diet and poor nutrition characterized by high amounts of refined carbohydrates, unhealthy fats, and salt, while inadequate intake of fresh fruits and vegetables (Morales & Berkowitz, 2016). Based on the food insecurity

assessment, individuals with low SES are also prone to experience extreme food insecurity because of the inconsistent mealtime, and food insecurity has been significantly confirmed as barriers that affects patient ability to comply with the antidiabetic management modification (Seligman, Laraia & Kushel, 2010). Increment of the incidence of T2DM in Malaysia call attention to all healthcare professionals in tackling this issue to ensure deliver effective dietary recommendations in managing blood glucose level (Sugandh et al., 2023). However, food insecurity acts as major barrier to comply with the intervention given by the healthcare provider (Seligman, Laraia & Kushel, 2010). Consequently, individuals living with food insecurity have high tendency to have poorer glycemic control than those with food secure households (Najibi et al., 2019).

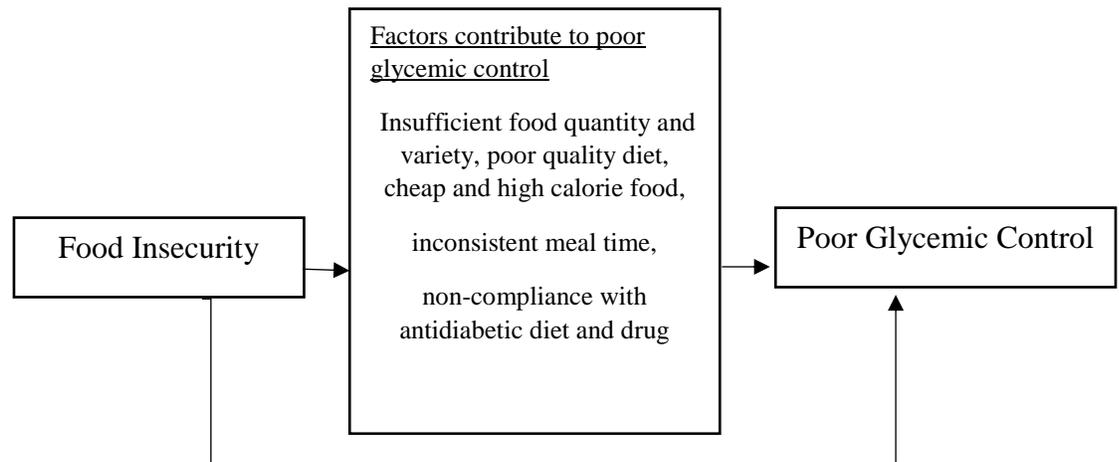


Figure 1: Conceptual Framework of Food Insecurity and Glycemic Control

## **CHAPTER 2: LITERATURE REVIEW**

### **2.1 Food Insecurity**

#### **2.1.1 Prevalence of Food Insecurity in Malaysia**

Food insecurity was defined by the Food and Agriculture Organization (FAO) with restricted or inconsistent access to sufficient safe and nutritious food, detrimentally affecting persons' health and well-being (Odey et al., 2022). According to Malay Food Insecurity Experience Scale (MFIES), food insecurity is classified into four tiers: food security, mild food security, moderate food security, and severe food security, the last signifying significant disturbances in dietary habits and diminished food consumption (Mat Ya *et al.*, 2023).

Around 2.3 billion individuals worldwide affected by food insecurity, comprise of 29.3% of the total population. Malaysian Adult Nutrition Survey (MANS) 2014 report approximately 25% of individuals in Malaysia encountering some degree of food insecurity and World Bank reveals recent data about 8.7% of Malaysian facing moderate or severe food insecurity in

2021 (Ahmad *et al.*, 2020). Numerous surveys and research has been conducted to determine the frequency of food insecurity in Malaysia as a critical issue arose. The 2014 Malaysian Adult Nutrition Survey (MANS) assessed food insecurity levels by using 6-items or questions which were adapted from the USDA 18-item Household Food Security Survey Module indicated that approximately 25% of adults faced insufficient food quantity, meanwhile 25.5% experienced inadequate food variety (Ahmad *et al.*, 2020). Furthermore, about 21.9% showed reduction in meal portion, and 15.2% revealed to skip their meals as a result of financial constraints (Ahmad *et al.*, 2020). Higher rates of food insecurity was among low-income households which ranging from 33% to 39% (Ahmad *et al.*, 2020).

A research on the prevalence of food insecurity in Kelantan revealed a notable disproportion between rural and urban households. In this study, the Malaysian Coping Strategy Index (MCSI) was used to evaluate food insecurity. This instrument assess household coping strategy when battling with food shortages, classifying responses into level of severity based on habits like reducing meal sizes, skipping meals, or starving. In Kelantan, incidence of food insecurity was 68.1%, comprised of 33.9% classified as moderate and 34.2% as severe (Sulaiman, Shariff & Jalil, 2012). These findings acknowledge the importance of addressing food insecurity especially in rural area, where most of severe cases were founded.

Socio-economic factors affecting food insecurity encompass household income, as individuals earning below RM 2,300 are considerably more likely to encounter food

insecurity than those with greater incomes (Mat & Ku Amir, 2019). The data highlights an urgent necessity for focused measures to tackle the escalating problem of food insecurity in Malaysia and provide fair access to nutritious food for all demographics. Many factors contribute to food insecurity, including financial constraints such as insufficient income or employment status, social determinants including racial and ethnic discriminations, and environmental challenges such as climate change that disrupt food supply chains (Kakaei et al., 2022).

### **2.1.2 Socioeconomic Status on Food Insecurity**

Food insecurity is a critical issue among low-income households in Malaysia, and most found in the East Coast Economic Region (ECER), which includes Kelantan, Terengganu, and Pahang. A study conducted among 460 households founds that only 52.8% of the households were food secure, while 47.2% experienced varying levels of food insecurity: 23.3% mildly, 14.3% moderately, and 9.6% severely (Alam *et al.*, 2016). In extremely poor households, only 38% were food secure, and 40% faced moderate to severe food insecurity. But study revealed even among non-poor households, about one-third still facing some level of food insecurity (Alam *et al.*, 2016). This indicate that poverty alone does not reflect the current

issues. Food insecurity heighten the burden of greater vulnerable groups when it involves household with larger family size, higher number of children, and unemployed mother.

Food insecurity significantly impacts persons' health and well-being. This frequently leads to nutrient-deficient meals that can worsen health issues such as diabetes and hypertension (Wetherill, White & Rivera, 2017). Moreover, it presents difficulties in managing diet-related chronic illnesses due to restricted availability to nutritious meals (Murthy, 2016). Coping mechanisms for those facing food insecurity involve modifying portion sizes, diminishing dietary variety, or depending on less nutritional yet more economical food choices (Biadgilign, 2023). Despite comprehensive studies on food insecurity, gaps persist in discovering its complete impact across various groups. There is a necessity for additional localized research to investigate the distinct experiences of food insecurity among particular populations. This requires analyzing the convergence of socioeconomic factors with access to nutritional food (Sulaiman et al., 2021).

## **2.2 Glycemic Control in T2DM**

### **2.2.1 Prevalence of Type 2 Diabetes Mellitus in Malaysia**

Hyperglycemia due to insulin resistance and decreased insulin production is an indicator of chronic metabolic syndrome like Type 2 Diabetes Mellitus (T2DM) that affecting 462 million individuals represents 6.28% of the global population (Khan et al., 2020). It shows a substantial global public health issue. T2DM is anticipated to rise markedly and impact 643 million individuals by 2030 and 783 million by 2045 (Hossain et al. 2024). According to World Health Organization (WHO) this increment most likely affect individuals in low- and middle-income countries (LMICs), where access to healthcare is limited (Hamid *et al.*, 2020). In Malaysia, prevalence of diabetes also has been increasing significantly from 11.2% in 2011 to 18.3% in 2019 (Akhtar *et al.*, 2022). It represents Malaysia among the nations with the highest diabetes rates in the Western Pacific region (Akhtar et al. 2022). This evidence exhibits awareness public health issues due to the relationship healthcare expenditures and the pressure of addressing diabetes-associated comorbidities. In Kelantan, the incidence of type 2 diabetes mellitus (T2DM) showing significant increment over the years. National Morbidity Health Survey (NHMS) revealed a worrying truth about increment prevalence of diabetes mellitus from 11.3% in 2015 to 19.5% in 2019 among Kelantan population (Omar et al., 2023). Therefore, emphasizing its persistent challenge in giving treatment and

management of diabetes mellitus. In Pasir Mas district, the prevalence of T2DM is 11.6% with determinant factors including age, family history and hypercholesterolemia (Fakri et al., 2023).

### **2.2.2 Target Glycemic Control**

Hemoglobin A1c (HbA1c) is a blood test expressed as percentage that evaluates a person's average blood glucose levels during the previous 3 month. HbA1c test chosen as an indicator of blood glucose control because of the hemoglobin that presents only in red blood cells. It helps transport the oxygen in bloodstream from lungs to the body's cell and can become glycated or cover with glucose. So, when more blood glucose attached to hemoglobin, blood glucose level will increase. Therefore, increase HbA1c level (O'Brien, 2022). In Malaysia, according to Clinical Practice Guidelines (CPG), they classify HbA1c levels to assists healthcare professional in assessing and managing glycemic control of type 2 diabetes mellitus. The CPG indicates the proposed target indicate good control of blood glucose level for the majority of individuals with T2DM is HbA1c level under 7.0 % (Ministry of Health

Malaysia, 2023). An HbA1c score of 7.0% or more suggests inefficient glycemic management, correlate with elevated risks of diabetes-related issue (Wan *et al.*, 2023). The guidelines emphasize the importance of achieving and maintaining target HbA1c levels to alleviate long-term complications related to diabetes, including cardiovascular disease and microvascular issues such as retinopathy and nephropathy (Wan *et al.*, 2023).

### **2.2.3 Factors Affecting Glycemic Control**

Individuals with T2DM are affected in many ways that influence their glycemic control including dietary practices, medication compliance, and lifestyle decisions (Bin Rakhis *et al.*, 2022). Diet is a key components that need attention in the management of an optimum blood glucose level. So, unhealthy eating habits like consumption of refined carbs and sugars will certainly elevate HbA1c levels (Sami *et al.*, 2017). Conversely, healthy and balanced diet like low-glycemic index food, fibre, essential vitamin and minerals has been proved to improve glycemic control (Zafar *et al.*, 2019). Moreover, another factors that may contribute to the glycemic management including lifestyle factors, age, diabetes duration and socioeconomic level (Richards, Wijeweera & Wijeweera, 2022). Socioeconomic determinants, such as income level and accessibility to social support systems significantly affect the capability to maintain a healthy lifestyles, balanced diet and comply with medical

recommendation (Pampel, Krueger & Denney, 2010). Individuals with stable socioeconomic status are more likely to be able to follow the dietary guidelines, and then enhancing glycaemic control (Shaheen, Kibe & Schrode, 2021).

#### **2.2.4 Relationship between Food Insecurity and Glycemic Control**

Studies continuously stated that food-insecure individuals are more likely to have poorer glycemic control which is raised HbA1c levels ( $\text{HbA1c} > 7.0\%$ ) than individuals with food security (Casagrande *et al.*, 2022). Food-insecure adults are more likely to eat less nutritious foods, as they tend to consume fewer fruits and vegetables and choose more processed, high-calorie, and unhealthy options. These dietary practices worsen hyperglycemia and increased insulin resistance. Financial constraints significantly escalate the struggle of individuals with T2DM in maintaining good glycemic control. Research found that impoverished individuals always struggle in between the need of buying diabetic medication or food. Therefore, they missed doses and failed to monitor efficiently their blood glucose level (Casagrande *et al.*, 2022). Furthermore, food insecurity also affects self-efficacy in properly managing blood glucose control and acts as a barrier to comply with the treatment and dietary guidelines (Becerra, Allen & Becerra, 2016). Exacerbation of insulin resistance and glycemic

management also influence by chronic stress related to food insecurity due to physiological alterations, including increased inflammatory markers and stress hormones (Levi, Bleich & Seligman, 2023). Studies continuously stated that food-insecure individuals are more likely to have poorer glycemic control which is raised HbA1c levels (HbA1c > 7.0%) than individuals with food security (Casagrande *et al.*, 2022). This numerous studies highlighted significant association between food insecure individuals and poor glycemic control.

### **2.2.5 Relationship between Food Insecurity and Diet Compliance**

Several studies revealed a significant relationship between food insecurity and diet compliance. For example, food insecure diabetic patients in the United States encountered difficulty in following dietary recommendations due to financial constraints, inconsistent meal pattern, and reliance on inexpensive, and high glycemic foods (Levi, Bleich & Seligman, 2023). Besides, findings from Drisdelle *et al.* (2020) also reported food-insecure individuals were significantly more likely to reduce intake of fruits and vegetables and opt for high calorie, poor quality foods due to affordability and accessibility constraints.

Further confirming this relationship, 73% of participants experienced some level of food insecurity involving 401 adult patients with T2DM from safety-net primary care clinics in Tennessee, USA. Study found there was a high prevalence of food insecurity who were also in low socio-economic status among sample of patients with Type 2 diabetes. Food

insecurity was significantly associated with self-care behaviours including less compliance to a general diet (AOR 0.9, P = 0.02) (Heerman et al., 2016).

In the Malaysian context a study by Zalilah et al. (2006) conducted in low income rural communities reported that food insecure households had larger household sizes, more school children, and non working mothers compared to food secure households (n = 84). Importantly, the coping strategies adopted by these food insecure households such as reducing meal frequency, cooking only with available ingredients, and borrowing money for food reflect adaptive behaviours that may compromise diet quality and compliance to dietary recommendations.

These findings underline that food insecurity hold varied barrier to effective dietary self-management in diabetes care. The inability to afford, access, or prioritize healthy food due to economic constraints leads not only to inadequate dietary sources but also to behavioural challenges such as reduced self-monitoring, lower motivation, and decreased adherence to nutrition counseling (An, 2013). Consequently, education, behavioral strategies, and socioeconomic interventions are important while addressing food insecurity to improve dietary adherence and glycemic outcomes (Blitstein *et al.*, 2021).

## CHAPTER 3: METHODOLOGY

### 3.1 Research Design

The study design was a cross-sectional study and conducted to assess food insecurity, glycemic control, and diet compliance. Observational studies have been chosen for its widely used, easy to conduct, and cost-effective (Gilmartin-Thomas, Liew & Hopper, 2018).

### 3.2 Research Location

The study was conducted in Hospital Pakar Universiti Sains Malaysia (HPUSM), located at Jalan Raja Perempuan Zainab II, Kubang Kerian, 16150, Kota Bharu, Kelantan. Data collection was collected among patients that attend clinic as listed: *Klinik Dietetik Pesakit Luar*, *Klinik Pakar Perubatan (KPP)*, *Klinik Rawatan Keluarga (KRK)*, or *Klinik Warga USM*.

### **3.3 Research Population**

This research study was among T2DM patients who sought treatment in Hospital Pakar Universiti Sains Malaysia, Kubang Kerian, Kelantan.

### **3.4 Subject Criteria**

There are several inclusion and exclusion criteria which have been fixed and become the main requirement to enable the respondents to participate in this study.

#### **3.4.1 Inclusion**

- Aged 19 years and older.
- Diagnosed with Type 2 Diabetes Mellitus.
- Patient had the latest 3 to 6 months HbA1c result in medical folder and registered at clinic as listed: *Klinik Dietetik Pesakit Luar*, *Klinik Pakar Perubatan (KPP)*, *Klinik Rawatan Keluarga (KRK)*, or *Klinik Warga USM*.