DEVELOPMENT AND EFFECTIVENESS OF EDUCATIONAL MODULE ON PRE-PREGNANCY CARE AMONG WOMEN OF REPRODUCTIVE AGE WITH DIABETES IN TERENGGANU

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LIST OF SYMBOLS

>	More than
<	Less than
=	Equal to
≥	More than and equal to
≤	Less than and equal to
α	Alpha
β	Beta
%	Percentage
$\chi 2$	Chi-square

LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
CDC	Center of Disease Control and Prevention
DM	Diabetes Mellitus
FVI	Face Validation Index
FGD	Focus Group Discussion
HBM	Health Belief Model
I-CVI	Item-level Content Validation Index
NCD	Non-Communicable Diseases
NDR	National Diabetic Registry
PPC	Pre-Pregnancy Care
S-CVI	Scale-level Content Validation Index
SD	Standard Deviation
SPSS	Statistical Package for the Social Science
WHO	World Health Organization

ABSTRAK

PEMBANGUNAN DAN KEBERKESANAN MODUL PENDIDIKAN TENTANG PENJAGAAN PRA-KEHAMILAN DALAM KALANGAN WANITA PENGHIDAP KENCING MANIS PADA USIA REPRODUKTIF DI TERENGGANU

Latar Belakang: Kencing manis merupakan salah satu cabaran kesihatan global utama di abad ke-21. Apabila kencing manis tidak dikendalikan dengan baik, keadaan ini boleh menyebabkan peningkatan glukosa dalam plasma darah ibu, yang seterusnya boleh mengakibatkan komplikasi kepada ibu dan janin semasa kehamilan. Penjagaan Pra-Kehamilan (PPC) amat penting untuk ibu yang menghidap kencing manis kerana ia memberikan manfaat besar kepada kedua-dua ibu dan janin yang sedang berkembang.

Objektif: Untuk membina dan menilai keberkesanan Modul Pendidikan tentang Penjagaan Pra-Kehamilan dalam Kalangan Wanita Penghidap Kencing Manis Pada Usia Reproduktif di Terengganu.

Metodologi: Kajian ini telah dijalankan melalui dua fasa utama. Fasa pertama melibatkan penilaian keperluan, pembangunan modul pendidikan, dan pengesahannya. Manakala fasa kedua adalah kajian kuasi-eksperimen yang bertujuan untuk menilai keberkesanan modul tersebut. Pembangunan modul seperti model ADDIE yang merangkumi lima peringkat: 1) Penilaian Keperluan (A), 2) Perundingan Pakar untuk Reka Bentuk Modul (D), 3) Pengesahan Pasca-Pembangunan Modul

Pendidikan untuk Penjagaan Pra-Kehamilan bagi Wanita Diabetik Usia Reproduktif (D), dan 4) Pelaksanaan Pendidikan Kesihatan PPC. Fasa kuasi-eksperimen melibatkan 90 wanita diabetik usia reproduktif, dengan 45 dalam kumpulan intervensi dari Dungun dan 45 dalam kumpulan kawalan dari Kuala Nerus, dipilih melalui pensampelan rawak (I). Kumpulan intervensi menggunakan modul yang baru dibangunkan. Keberkesanan module ditentukan melalui analisis data merangkumi peningkatan dalam pengetahuan dan sikap tentang PPC menggunakan Analisis Varians Ukuran Berulang (RM-ANOVA) (E).

Keputusan: Penilaian keperluan pembinaan modul melalui Perbincangan Kumpulan Berfokus (FGDs) mengenal pasti empat tema utama: keperluan berkaitan pengetahuan, keperluan berkaitan sikap, keperluan berkaitan perkhidmatan kesihatan, dan keperluan berkaitan persepsi. Modul yang dibangunkan, dibahagikan kepada lima unit, meliputi: kesan diabetes pada ibu dan janin, kepentingan PPC untuk ibu diabetik, komponen PPC, manfaat kontrasepsi, dan diabetes terkawal untuk keselamatan ibu dan bayi. Pakar menilai kesahan kandungan (S-CVI) sebagai 1.0 dan kesahan wajah sebagai 0.99. Perubahan signifikan dalam skor pengetahuan sepanjang masa jelas ($F(1,88) = 76.87$, $p < 0.001$), dengan perbezaan ketara antara kumpulan intervensi dan kawalan dalam skor pengetahuan purata ($F(1,88) = 5.71$, $p < 0.019$) dan kesan interaksi yang signifikan ($F(1,88) = 210.32$, $p < 0.001$). Skor sikap juga menunjukkan perubahan keseluruhan yang signifikan dalam kumpulan sepanjang masa ($F(1,88) = 71.31$, $p < 0.001$), dengan perbezaan skor purata yang signifikan antara kumpulan tanpa mengira masa ($F(1,88) = 67.47$, $p < 0.001$) dan interaksi kumpulan-waktu yang ketara ($F(1,88) = 127.81$, $p = 0.042$).

Kesimpulan: Kajian di Terengganu telah mengenal pasti keperluan penting untuk modul pendidikan PPC yang disesuaikan untuk wanita penghidap kencing manis dalam usia reproduktif, didorong oleh keinginan mereka untuk kehamilan yang sihat. Modul yang dibangunkan, yang telah disahkan kebolehpercayaan dan kepentingannya, telah berkesan meningkatkan pengetahuan dan sikap terhadap PPC dalam kumpulan intervensi, seperti yang ditunjukkan oleh hasil kajian kuasi-eksperimen ini.

Kata Kunci: Penjagaan Pra-Kehamilan, Wanita Diabetik Usia Reproduktif, Modul Pendidikan, Model ADDIE, Model Kepercayaan Kesihatan

ABSTRACT

DEVELOPMENT AND EFFECTIVENESS OF EDUCATIONAL MODULE ON PRE-PREGNANCY CARE AMONG WOMEN OF REPRODUCTIVE AGE WITH DIABETES IN TERENGGANU

Background: Diabetes Mellitus (DM) stands as one of the major global health challenges of the twenty-first century. When DM is not well-managed, marked by maternal hyperglycaemia before and during the early stages of pregnancy, it significantly increases the risk of severe complications for both the mother and the developing foetus. Pre-Pregnancy Care (PPC) is particularly crucial for mothers with diabetes, as it provides substantial benefits to both the mother and the developing foetus.

Objective: To develop and assess the effectiveness of the Educational Module on Pre-Pregnancy Care Among women of reproductive age with diabetes in Terengganu.

Methodology: This study was structured in two primary phases: The first phase involved conducting a needs assessment, developing the educational module, and validating it. The second phase was a quasi-experimental study aimed at evaluating the module's effectiveness. The module's development followed the ADDIE model and included five stages: 1) Needs Assessment (A) 2) Consulting Experts for Module Design (D) 3) Post-Development Validation of the Educational Module for Pre-Pregnancy Care in women of reproductive age with diabetes (D), and 4) Implementing PPC Health Education. The quasi-experimental phase involved 90 diabetic women of

reproductive age, with 45 in the intervention group from Dungun and 45 in the control group from Kuala Nerus, selected via simple random sampling. The intervention group utilized the newly developed module (I). The effectiveness of the module is determined through data analysis, encompassing improvements in knowledge and attitudes regarding PPC using Repeated Measures Analysis of Variance (RM-ANOVA) (E).

Result: Focus Group Discussions (FGDs) was employed to assess needs and found four main themes: knowledge-related needs, attitude-related needs, health service-related needs, and perception-related needs. The module, divided into five units, covers the impact of diabetes on mothers and babies, the importance of PPC for diabetic mothers, PPC components, benefits of contraception, and maintaining controlled diabetes for the safety of both mother and baby. Experts assessed its content validity (S-CVI) as 1.0 and face validity as 0.99. There were significant changes in knowledge scores over time ($F(1,88) = 76.87$, $p < 0.001$), with a notable difference between the intervention and control groups in mean knowledge scores ($F(1,88) = 5.71$, $p < 0.019$) and a significant interaction effect ($F(1,88) = 210.32$, $p < 0.001$). Attitude scores also showed significant overall changes within groups over time ($F(1,88) = 71.31$, $p < 0.001$), with a significant mean score difference between groups regardless of time ($F(1,88) = 67.47$, $p < 0.001$) and a notable group-time interaction ($F(1,88) = 127.81$, $p = 0.042$).

Conclusion: The study in Terengganu identified a significant need for a Pre-Pregnancy Care (PPC) educational module tailored for diabetic women of reproductive age, motivated by their desire for a healthy pregnancy. The developed module, validated for both reliability and relevance, effectively improved knowledge and attitudes towards PPC among the intervention group, as demonstrated by the quasi-experimental study's results.

Keywords: Pre-pregnancy care, women of reproductive age with diabetes, educational module, ADDIE Model, Health Belief Model

CHAPTER 1

INTRODUCTION

1.1 Overview of diabetes mellitus (DM) in reproductive age women

In developing nations, maternal mortality represents the foremost cause of death among young women globally. Deaths related to maternity and pregnancy can be classified into three extensive categories: direct maternal deaths, indirect maternal deaths, and incidental maternal deaths (Garland and Little, 2018). Globally, an obstetric transition is observed where the cause of maternal death transitions from direct to indirect obstetric causes. Indirect maternal mortality pertains to the death of a woman resulting from a pre-existing condition or a disease that develops during pregnancy. These conditions, while not directly associated with obstetric reasons, exacerbate the physiological effects of pregnancy (Hussein, 2017). A third of all indirect maternal deaths are attributed to non-communicable diseases, with DM being one of the most prevalent among women of reproductive age.

DM is a multi-etiological metabolic syndrome characterized by persistent hyperglycaemia and alterations in carbohydrate, lipid, and protein metabolism, resulting from abnormalities in insulin production (Choudhury and Devi Rajeswari, 2021). Diabetes contributes to complications in maternal and foetal health, leading to conditions such as foetal macrosomia, intrauterine growth restriction (IUGR), and hypertensive diseases during pregnancy (Gojnic et al., 2022). In women of reproductive age, DM manifests in one of three forms: Type 1 DM, Type 2 DM, or Gestational DM.

1.2 Global burden of DM in women

Diabetes represents one of the most significant global health crises of the twenty-first century. It is projected to affect 643 million by 2030, and further to 783 million by 2045 (International Diabetic Federation, 2021). Although the prevalence of diabetes is nearly identical in men and women, women are distinctively and often more severely affected by complications arising from diabetes. These include coronary heart disease, diabetic ketoacidosis (DKA), depression, and heightened risks during pregnancy (Wolfson et al., 2009).

Globally, Diabetes Mellitus (DM) is on the rise among younger individuals, with approximately 4-8% of those aged 20-44 years suffering from the disease. This increase is largely attributed to the escalating trend of obesity (Celik et al., 2021). Moreover, on a global scale, two out of every five women with diabetes are of reproductive age at any given time. An estimated 16.9%, or approximately 21.4 million, pregnancies worldwide are complicated by diabetes (MacKay et al., 2020; Williams and Evans Kreider, 2021).

The study conducted by Cheong et al. (2013) revealed that in Malaysia, about one-fifth of women with Type 2 Diabetes were of reproductive age. Notably, most of these women exhibited poor glycaemic control, despite having diabetes for less than five years and being free from complications. Additionally, the prevalence of obesity among Malaysian women aged 18 and above escalated from 5.7% in 1996 to 17.6% in 2011, thereby increasing the risk of gestational hyperglycaemia (Yong et al., 2018).

Furthermore, the incidence of diabetes during pregnancy appears to be increasing in Malaysia, rising from 14.8% in 2018 to 21.5% in 2020. This indicates that one in every five pregnant women in Malaysia is affected by diabetes. Concurrently, between 2018 and 2020, there was an increase in the rate of caesarean section deliveries among pregnant women with diabetes, and a rise in the number of macrosomic newborns (Jeganathan and Karalasingam, 2021).

1.3 Effect of DM on the mother and foetus

Poorly controlled DM, characterized by maternal hyperglycaemia before conception and during the first trimester of pregnancy, heightens the risk of severe complications for both the mother and the developing foetus. Research indicates that inadequately managed DM during pregnancy elevates the risk of serious congenital disabilities in 5-10% of pregnancies and increases the likelihood of spontaneous abortion in 15-20% of pregnancies (Ornoy et al., 2021). Additionally, inadequately managed diabetes during pregnancy escalates the risk of developing complications including nephropathy, retinopathy, and neuropathy. It also increases the likelihood of heart diseases, such as coronary heart disease (Kitzmiller et al., 2018).

DM is acknowledged as a significant risk factor for adverse pregnancy outcomes, including pre-eclampsia, the necessity for labour induction, and the requirement for caesarean section delivery. A comprehensive systematic review and meta-analysis encompassing 156 studies, which included more than 7,506,061 pregnancies, determined that women with pre-existing diabetes faced a 1.24 to 1.46 times higher risk of developing pre-eclampsia compared to women without diabetes (Ye et al., 2022). These findings indicate that DM elevates the risk of adverse maternal outcomes during pregnancy. It is crucial for healthcare providers to be cognizant of these risks. Close monitoring and timely management of diabetic women are essential to prevent complications and ensure the health and safety of both the mother and the developing foetus.

Maternal hyperglycaemia can initiate a series of physiological reactions in the developing foetus, leading to abnormal growth patterns. One such response is foetal hyperinsulinemia, which is triggered by maternal hyperglycaemia. This condition is mediated by the foetus's exposure to high blood sugar levels, leading to enhanced fuel utilization and growth. In pregnancies affected by diabetes, the consequences of this abnormal foetal growth can manifest as increased fat deposition, enlargement of internal organs, and a rapid growth in overall body mass (Kallem et al., 2020). Maternal diabetes can lead to several neonatal complications, including hypoglycaemia, respiratory distress syndrome, macrosomia, birth trauma, and an elevated risk of congenital anomalies. These conditions arise due to the altered intrauterine environment caused by maternal diabetes (Alejandro et al., 2020).

1.4 Pre-pregnancy care of women with DM

Pre-pregnancy care (PPC) encompasses a range of biomedical, behavioural, and social health interventions directed at women and couples prior to conception. The objective of PPC is to enhance their overall health status and mitigate behaviours, personal factors, and environmental influences that are associated with poor maternal and child health outcomes. This proactive approach is designed to optimize health before the onset of pregnancy. (World Health Organization, 2013). The American Diabetes Association (2019) guideline emphasises "patient-centred care," highlighting the importance of customising diabetes treatment to the patient and collaborative decision-making to meet care objectives, minimise therapeutic inertia, and promote self-management.

Personalising diabetes treatment might also involve assisting those who can become pregnant in pursuing their reproductive objectives while controlling the harmful effects of increased blood glucose on embryonic and foetal development (Marshall and Britton, 2020). PPC for diabetic women of reproductive age includes pre-pregnancy behaviours and screenings, such as folic acid supplementation and retinopathy screening, as well as pre-pregnancy counselling on pregnancy planning, effective contraception, and strict glycaemic control before pregnancy, beginning at puberty and continuing throughout the reproductive years (American Diabetes Association, 2018).

PPC is essential for diabetic mothers since it benefits both the mother and the developing foetus. In addition to lowering the risk of problems during pregnancy and delivery, PPC can help diabetic women achieve optimal glucose management, which is crucial for a healthy pregnancy. Congenital abnormalities and related complications, such as gestational diabetes, preeclampsia, and stillbirth, are reduced by reasonable glucose control (Stogianni et al., 2019).

In addition to its primary functions, PPC can assist women with diabetes in preparing for a healthy pregnancy by addressing any existing health issues and recommending lifestyle modifications. For instance, women with uncontrolled hypertension or elevated cholesterol levels might require medication to manage these conditions. Similarly, diabetic women can be educated about managing diabetes during pregnancy, which includes adopting healthy eating habits, engaging in regular physical activity, and conducting regular blood glucose testing.

Considering the vital importance of prenatal care for the health of both the mother and the baby, early identification of pregnancy enables the initiation of treatment at the earliest possible stage. PPC can aid in identifying potential pregnancy-related issues and in devising an appropriate treatment plan. Specifically, diabetic women with renal disease may require specialized measures to safeguard their kidney health during pregnancy (Choudhury and Devi Rajeswari, 2021). Enhancing PPC can be achieved by incorporating a health education module. The study done by Jusoh et al. (2020) in Malaysia indicated that there was a significant relationship between education level and attendance at PPC, demonstrating a strong link between access to education and healthcare services and comprehensive PPC knowledge.

A cross-sectional study was conducted in the community of northwest Ethiopia to assess women's awareness of PPC. The findings of the study indicate a critical need to prioritise and deliver comprehensive health education on PPC in order to enhance women's knowledge in this area (Ayalew et al., 2017). In addition, a systemic review by Hopkins et al. (2023) emphasized the importance of developing interventions to improve the uptake of PPC among women with type 2 diabetes. Interventions aimed at PPC, including educational modules, show a tendency to reduce the HbA1c levels in the first trimester of pregnancy, consequently minimising the likelihood of problems associated with pregnancy (Wahabi et al., 2020).

Thus, incorporating a health education module plays a crucial role in augmenting PPC. By enhancing women's knowledge and awareness regarding preconception care, it becomes possible to nurture healthier behaviours, enhance maternal and child health outcomes, and reduce the probability of complications during pregnancy and childbirth.

1.5 Problem statement

The prevalence of DM among women of reproductive age in Asia is a subject of significant concern in public health. Compared to adult men, adult women have a higher incidence of diabetes, making it an issue that demands attention. Recent research highlights the growing relevance of efforts to achieve better diabetes control as part of PPC in the current healthcare landscape (Z I et al., 2020). These efforts are identified as the primary factor for improved pregnancy outcomes.

Numerous studies have established a clear and significant linear link between diabetes during pregnancy and several adverse factors. These include an increased likelihood of greater birth weight, higher rates of caesarean section delivery, neonatal hypoglycaemia, and foetal hyperinsulinemia. These associations raise concerns about the potential risks and complications faced by diabetic women during pregnancy (Yong et al., 2018).

However, despite the observed associations between diabetes during pregnancy and adverse outcomes, research by Yong et al. (2018) suggests that there is a lack of improvement in both maternal and foetal outcomes among diabetic women. This finding indicates that while the impact on the newborn is evident, the overall health and well-being of both the mother and the foetus do not experience substantial improvement despite advances in medical care and diabetes management.

As a result, it is imperative to address diabetes as a significant public health concern among women of reproductive age in Asia. The focus should be on implementing effective interventions and strategies that emphasize preconception care and better diabetes control. By doing so, it is hoped that the adverse outcomes associated with diabetes during pregnancy can be mitigated, ultimately leading to improved health outcomes for both mothers and their babies.

PPC utilisation in Malaysia remains low, ranging from 43 to 44 per cent, due to a lack of promotion and education about the need for PPC, which has been demonstrated to be critical for all reproductive women, especially those with underlying medical issues (Abu Talib et al., 2018; Sutan et al., 2021). Almost 41.7 per cent of diabetic women of reproductive age in Terengganu lacked sufficient information, while 84.1 per cent lacked a favourable attitude toward PPC (Mukhali et al., 2022). Due to a lack of awareness and attitudes toward PPC in Terengganu, it is necessary to design health education interventions for PPC, emphasising the impact of pregnancy on diabetes complications and the most effective contraceptive options.

1.6 Rationale of the study

Even with the challenges associated with diabetes care during pregnancy, diabetic women express a desire for encouragement and reassurance to help manage their blood glucose levels and ensure a safe pregnancy. To enhance the utilization of Pre-Pregnancy Care (PPC), it is crucial to establish a norm that encourages all women with diabetes to engage in PPC, irrespective of whether they are actively contemplating motherhood.

With the notable increase in the prevalence of diabetes among women of reproductive age, there is an urgent need to transform preconception care services to maximize maternal and foetal outcomes. The direct provision of an educational module to diabetic women of reproductive age presents an opportunity to address service delivery challenges. Limited knowledge of PPC may hinder its utilization; therefore, improving patient education and raising awareness would be beneficial in promoting PPC among diabetic women.

A validated educational module on PPC among diabetic women would directly benefit the women by enhancing their awareness and, consequently, promoting increased uptake of PPC and optimal diabetes management before pregnancy. The module, developed in accordance with the specific needs of the target population, ensures its suitability and representativeness. Moreover, the module serves as a crucial tool for healthcare providers, enabling them to deliver effective health promotion to diabetic women in the reproductive age group.

1.7 Research questions

1. What do women of reproductive age with diabetes think about the necessity of creating an Educational Module on PPC?

2. Is the PPC Educational Module a valid tool to improve the knowledge and attitude of women of reproductive age with diabetes towards PPC?

3. How effective is the PPC Educational Module in improve the knowledge and attitude of women of reproductive age with diabetes towards PPC?

1.8 Objectives

1.8.1 General objective

To develop and evaluate the Educational Module on Pre-Pregnancy Care among women of reproductive age with diabetes in Terengganu

1.8.2 Specific objectives

Phase 1

1. To explore the need for the development of the Educational Module on Pre-Pregnancy Care among women of reproductive age with diabetes in Terengganu
2. To develop and validate the Educational Module on Pre-Pregnancy Care among women of reproductive age with diabetes

Phase 2

3. To determine the within group (time-effect) and between group differences (treatment effect, and time-treatment interaction effect) of knowledge score towards PPC among women of reproductive age with diabetes in Terengganu

4. To determine the within group (time-effect) and between group differences (treatment effect, and time-treatment interaction effect) of attitude score towards PPC among women of reproductive age with diabetes in Terengganu.

1.9 Research hypotheses

1. The newly developed PPC Educational Module is valid for women of reproductive age with diabetes in Terengganu

2. There is significant difference of within group and between group differences of mean knowledge score towards PPC among women of reproductive age with diabetes in Terengganu
3. There is significant difference of within group and between group differences of mean attitude score towards PPC among women of reproductive age with diabetes in Terengganu

CHAPTER 2

LITERATURE REVIEW

2.1 PPC and Safe motherhood initiative

In 1987, the World Health Organisation (WHO) launched the Safe Motherhood Initiative, aimed at enhancing maternal and reproductive health services worldwide. This initiative's primary goal is to ensure safe pregnancies and childbirth for women, leading to the birth of healthy children, with a particular focus on reducing maternal mortality. Recognizing DM as a chronic disease affecting pregnancy, the initiative emphasizes the importance of comprehensive and culturally sensitive maternal health services to mitigate the increased risk of diabetes-related complications in pregnant women with diabetes (Stanton et al., 2018).

The Safe Motherhood Initiative highlights the critical role of PPC in ensuring a healthy pregnancy and favourable outcomes for both mother and child. This initiative aims to raise awareness about the importance of PPC, enhance their availability and accessibility, and promote their delivery in a culturally sensitive and respectful manner. By offering comprehensive PPC, the program aims to reduce the risk of pregnancy complications and enhance the health and well-being of women and their families (Boulet et al., 2006; Chapman, 2003).

The Safe Motherhood Initiative acknowledges the significance of PPC for women with diabetes, incorporating it into its overarching strategy to enhance maternal health. This aspect of the initiative stresses the need for education and awareness among all women, particularly those living with diabetes. It focuses on highlighting the potential risks and challenges associated with diabetes during pregnancy. The initiative encourages women to make well-informed decisions and take necessary actions to manage their condition prior to conception. Additionally, it advocates for expanding access to healthcare services for all expectant mothers, including diabetic women. This expansion ensures that women have access to specialized healthcare providers like endocrinologists and diabetologists, who can offer pre-pregnancy counselling and assist in optimizing blood glucose levels before pregnancy (Tulchinsky et al., 2023).

2.2 Components of PPC for women with DM

In diabetic patients, PPC is a collaborative and comprehensive method to improving a woman's health prior to conception. The critical importance of PPC originates from the long-held belief that diabetes has a significant impact on both maternal and foetal health outcomes. PPC includes strict blood glucose monitoring and regulation, lifestyle changes, folic acid supplements, early detection and management of diabetes-related problems, and successful family planning options. Each component plays an important role in reducing the hazards of pregnancy in diabetic patients and contributing to an ideal prenatal environment, emphasising the importance of complete PPC (Anastasiou et al., 2020; Buschur and Polsky, 2021; Lewis et al., 2018).

2.2.1 Optimal Timing for Pregnancy

The importance of achieving target blood glucose levels in diabetic women prior to pregnancy cannot be overstated, as it plays a crucial role in ensuring a healthy pregnancy outcome. Women with pre-existing diabetes who do not adequately manage their blood glucose levels both before and during pregnancy are at an increased risk of experiencing severe complications that can affect both the mother and the foetus (Nwolise et al., 2020). The emphasis is on stabilizing blood glucose levels before conception to minimize the risk of adverse effects during pregnancy.

The American Diabetes Association strongly advises that women with diabetes receive preconception counselling and strive to improve their blood glucose control before becoming pregnant (Grady and Geller, 2016). This approach significantly reduces the risks associated with pregnancy. Clinical evidence supports that diligent blood glucose management in the pre-pregnancy phase and throughout the first trimester markedly decreases the incidence of birth defects in infants born to diabetic mothers, especially when compared to those who did not receive PPC (Maxwell et al., 2019)

Contemporary guidelines generally recommend maintaining a glycosylated haemoglobin (HbA1c) level below 6.5%, without episodes of hypoglycaemia, as a safe threshold for women with diabetes mellitus or elevated blood glucose levels to achieve favourable pregnancy outcomes (Wei et al., 2020). In addition to this, it is advised that all women of reproductive age with diabetes be informed about the critical importance of PPC (Alexopoulos et al., 2019). This care involves achieving optimal glucose control and employing contraception until such control is established.

Women with pre-existing diabetes during pregnancy are encouraged to meet glycaemic targets through consistent diabetes self-management practices. These practices include regular self-monitoring of blood glucose levels and precisely adjusting insulin doses based on blood glucose readings and carbohydrate consumption (Sushko et al., 2022). These measures are essential to maintain the recommended glycaemic control, thereby enhancing the chances of a healthy pregnancy and minimizing risks to both the mother and the baby.

2.2.2 Healthy lifestyle

The implementation and consistent adherence to a comprehensive preconception health regimen have the potential to significantly increase the chances of a successful pregnancy and the delivery of a healthy baby. The comprehensive strategy involves the adoption of a nourishing dietary pattern, regular participation in physical exercise, effective weight control, and the abstention from harmful practises such as smoking and excessive alcohol intake.

For diabetic women aiming for optimal pregnancy outcomes, adopting a healthy lifestyle prior to pregnancy is of paramount importance. Key lifestyle interventions, such as nutrition therapy and regular exercise, are vital in managing diabetes and enhancing overall health. Nutrition therapy, particularly, plays a crucial role in this context. For adults with diabetes, dietary modifications are essential, with a focus on managing the intake of fats, proteins, and carbohydrates to maintain stable blood glucose levels. These dietary adjustments are not just about restricting certain foods; they involve a comprehensive approach to eating that supports blood glucose management (Kandel et al., 2021).

Furthermore, combining these nutritional strategies with regular physical activity has been shown to significantly improve glycaemic control. This combination is especially beneficial for women with diabetes during pregnancy, as it contributes to better health outcomes for both the mother and the baby. By integrating a balanced diet and exercise into their daily routine, diabetic women can create a healthier environment for pregnancy (Dingena et al., 2023).

The rising prevalence of obesity and diabetes in women of reproductive age is increasingly alarming, with studies indicating a heightened risk of type 2 diabetes in this group. Notably, younger women have been identified as having poorer glycaemic control, underscoring the necessity for specific interventions to enhance diabetes management among them (Hasbullah et al., 2021). Moreover, the positive impact of lifestyle changes, such as diet and exercise, is significant in lowering the risk of gestational diabetes mellitus (GDM) and enhancing pregnancy outcomes (Xiao et al., 2015). Additionally, engaging in physical activity during pregnancy is linked to a decreased occurrence of preterm birth and gestational diabetes, particularly in overweight and obese women, thereby reinforcing the critical role of exercise in fostering the health of both mother and child.

2.2.3 Folic Acid intake

Beyond glycaemic control, PPC involves several other critical elements. It is strongly recommended for women of reproductive age, including those with diabetes, to take folic acid supplements (Yamamoto et al., 2018). Folic acid's role is particularly vital for diabetic women of childbearing age, as it not only optimizes pregnancy outcomes but also helps prevent various adverse health conditions. Research indicates that folic acid supplementation can influence pregnancy outcomes, potentially reducing the risk of complications like preeclampsia, anaemia, foetal growth restriction, and autism (Moussa et al., 2016).

Preconception folic acid intake has been linked to better metabolic health in offspring, highlighting its essential role during pregnancy. As a key component in embryonic growth and development, folic acid is crucial in preventing congenital malformations, making it a significant global health concern (Mahmoud et al., 2022). Adequate folate status is especially important for women of reproductive age due to its involvement in gene expression, cell division, and reproduction (Hamill et al., 2014).

Women with diabetes planning to conceive are advised to take a higher dose of folic acid from preconception through at least the 12th week of pregnancy to enhance pregnancy outcomes (Hamill et al., 2014). Nonetheless, the challenges in adhering to folic acid supplementation and the lack of knowledge among many pregnant women underscore the necessity for targeted education and counselling. Additionally, understanding the factors that influence folic acid supplementation both before and during pregnancy is key to increasing its use and mitigating the detrimental

effects of folic acid deficiency on the health of mothers and infants (Ezzeddin et al., 2019).

2.3 Factors influencing uptake of PPC among diabetic women

Lack of understanding and awareness of PPC is the most significant obstacle to diabetic women of reproductive age becoming PPC clients. Most women will participate in the PPC until they are ready to get pregnant. However, most believed the pre-pregnancy information supplied was irrelevant until they were pregnant. Women said that being aware of issues and having access to tools to help them live a healthy lifestyle was crucial. However, individuals who depended primarily on information from family and friends got inaccurate knowledge (O'Higgins et al., 2014; Sina et al., 2018).

Awareness of the risk of DM during pregnancy and the significance of diabetic control and lifestyle changes during pregnancy are the most critical factors that are facilitated using PPC. In contrast, belief on the lack of necessity and confidence in the quality of PPC are the barriers for diabetic women to engage in PPC (Abedini et al., 2018; Earle et al., 2017). Shame and stigma against obese diabetic mothers and negative perceptions among health care providers prevented diabetic mothers from attending PPC (Ferry et al., 2023) .

In the context of diabetes care, the impact of patient-provider communication on the uptake of PPC among non-pregnant women of reproductive age is of utmost importance. Previous research has indicated that those who reported experiencing an optimal level of communication quality exhibited notably higher levels of adherence to diabetic care management in comparison to those who reported a substandard level

of communication quality (Forde et al., 2016). The presented evidence highlights the crucial significance of efficient communication between healthcare professionals and women diagnosed with diabetes in promoting the adoption of PPC.

The benefits of effective communication are extensive, since they include increased self-management, enhanced treatment adherence, and an overall increase in patients' well-being. Fundamentally, the development of a reliable and nurturing relationship between patients and healthcare providers is seen as a crucial factor in promoting patient involvement and adherence to prescribed treatment, which includes the adoption of PPC (Bandyopadhyay, 2021; Maxwell et al., 2019; Peimani et al., 2020).

It is thus recommended that healthcare providers are, therefore, encouraged to prioritize the implementation of effective communication strategies. Such strategies empower diabetic women, enabling them to actively participate in their healthcare journey and make informed decisions, particularly with regard to their reproductive health.

2.4 The PPC in Malaysia

The PPC in Malaysia stretches back to the early twentieth century when the country was introduced to modern medicine. Medical services were limited during that period and primarily focused on treating infectious diseases. The Malaysian government began to prioritise mother and child health more in the 1950s and 1960s, and the country's health system was enlarged to enable better access to care for women and children (Ravichandran and Ravindran, 2014). During this time, mother and child

health clinics were constructed, and efforts were made to promote family planning and safe pregnancy practises.

PPC in Malaysia has changed and improved throughout the years. Malaysia launched the PPC initiative with the publication of its Perinatal Care Manual in 2002. In 2012, registration documentation, a reten form at all health clinics, and monitoring data from health clinics and hospitals ensured it was fully implemented in all health institutions. In 2015, the Health Screening Form [Borang Saringan Kesihatan (BSSK)] for women was expanded to include risk pregnancies to identify women at risk and send them to the PPC (Kementerian Kesihatan Malaysia, 2019).

Today, the country has a well-established healthcare system that offers women and children comprehensive care, including prenatal care. In recent years, a greater focus has been placed on educating women about the need for PPC and promoting healthy lifestyles to guarantee excellent pregnancy outcomes.

2.5 Knowledge of PPC among women of reproductive age with diabetes

The PPC is an important element of women's reproductive health, especially for diabetic women. However, PPC knowledge among diabetic women is unsatisfactory, due to limitations such as a lack of institutional processes to include PPC into diabetes management and a limited capacity of health professionals to give support (R. Forde et al., 2020; Forde et al., 2016). Furthermore, issues such as a lack of understanding about the need of PPC, a lack of communication between women and health professionals, and a lack of awareness among women and professionals all contribute to suboptimal PPC uptake (Hopkins et al., 2023; Yehuda, 2016).

Inadequate knowledge of the diabetic woman about the positive outcomes of PPC in reducing the adverse effects on the infant and the mother resulted in 29.6% of Maltese diabetic women attending PPC before becoming pregnant. More than half of the women claimed they were unaware of the significance of diabetes care before becoming pregnant (Sapiano et al., 2012). Many women reported a lack of engagement with PPC because they were not informed about why it was necessary. One woman stated, “she would have attended preconception care if she had known the service existed”, whereas type 1 diabetic women were more knowledgeable than type 2 diabetic women about the significance of PPC (Celik et al., 2021; Hendrieckx et al., 2021).

Barriers and facilitators to attending PPC have been identified, with women's awareness of PPC being influenced by their relationship with healthcare providers (Wahabi et al., 2010). Factors such as age, education level, family history of chronic disorders, income, and number of children have been associated with knowledge of PPC (Munthali et al., 2021; Shibata et al., 2023). Moreover, the availability of infrastructure and women's knowledge have been identified as significant factors related to women's behaviour related to PPC (Ayalew et al., 2017).

The understanding of PPC within Asian countries exhibits variability, as evidenced by studies indicating disparities in awareness and knowledge levels among women across distinct geographical regions. To illustrate, research conducted in Sri Lanka has documented a notable level of awareness and knowledge regarding the use of folic acid during the pre-conception period (Pathiraja and Prathapan, 2020). Conversely, findings from a survey conducted in Penang indicate that merely 38.8 percent of surveyed patients possessed awareness of PPC (Leow et al., 2020).

Similarly, in Terengganu, 41.7 percent of diabetic mothers surveyed exhibited insufficient knowledge regarding PPC (Mukhali et al., 2022). Moreover, the heightened susceptibility of adverse antenatal outcomes among women with diabetes underscores the critical significance of effective PPC in mitigating this risk (Song et al., 2020). Additionally, there is a compelling demand for customized interventions aimed at enhancing the provision of PPC to women diagnosed with type 2 diabetes, with particular attention to those hailing from ethnic minority backgrounds and residing in economically disadvantaged areas (Hopkins et al., 2023). These revelations accentuate the imperative for focused initiatives geared toward augmenting awareness and facilitating access to pre-conception care within Asian countries, especially among high-risk cohorts like women afflicted by diabetes.

2.6 Attitudes of women of reproductive age with diabetes toward PPC

Various factors are reported to influence attitudes toward PPC. The presence of positive professional attitudes among healthcare providers delivering PPC is essential for encouraging and maintaining attendance while reducing anxiety. The presence of positive professional attitudes among healthcare providers delivering PPC is essential for encouraging and maintaining attendance while reducing anxiety (O'Higgins et al., 2014). Although many women have a strong desire to be well-prepared for pregnancy, they express concerns about potential embarrassment associated with seeking PPC counselling. A common belief among these women is that not all pregnancies are planned, and they may hesitate to disclose their pregnancy to colleagues if they haven't sought assistance before conception (Spence et al., 2010).

Women who exhibit readiness for pregnancy, characterized by extensive planning and a positive outlook on pre-pregnancy preparations, typically demonstrate a commitment to their pre-pregnancy health and well-being (MacKay et al., 2020). Furthermore, it is crucial that all women, especially those with diabetes, receive guidance on pregnancy planning, as it has been linked to a decrease in unfavourable outcomes (Wotherspoon et al., 2017). The connection between input from healthcare professionals and the adoption of healthy behaviours before pregnancy is a novel discovery that should inspire efforts to enhance awareness and participation in pre-pregnancy healthcare, ultimately yielding broader advantages for public health (Barrett et al., 2015).

Promoting health and providing education on PPC for diabetic women can play a pivotal role in shaping their beliefs and attitudes. This can extend to encouraging the avoidance of unintended pregnancies, fostering a proactive approach to seeking PPC, and highlighting the importance of adopting healthy lifestyle practices during the pre-pregnancy phase (Holmes et al., 2012; Khan et al., 2019). These findings underscore the critical role of positive attitudes and support from healthcare professionals in advancing PPC and planning. It is clear that women's attitudes towards PPC are influenced by their interactions with healthcare providers and their level of readiness for pregnancy.