UNIVERSITI PUTRA MALAYSIA

EFFECTS OF ADDING A LOW GLYCAEMIC INDEX DIET TO A CARBOHYDRATE EXCHANGE DIETARY ADVICE FOR WOMEN WITH GESTATIONAL DIABETES MELLITUS

NURUL ALIA AQILAH BT SAMIUN

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By

NURUL ALIA AQILAH BT SAMIUN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

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Chair: Associate Professor Barakatun Nisak Binti Mohd Yusof, PhD
Faculty: Medicine and Health Sciences

Carbohydrate exchange (CE) or low glycaemic index (GI) dietary advice for women with gestational diabetes mellitus (GDM) produces comparable benefits. Whether adding a low GI diet to CE dietary advice would further enhance glycaemic control in women with GDM is unclear. This study investigated the effects of adding a low GI diet to the CE dietary advice on maternal glycaemia, metabolic outcomes, weight gain and dietary intake in women with GDM.

This study employed a quasi-experimental study design conducted at Hulu Langat District Health Clinics. Four from the 12 clinics with the highest number of GDM cases were selected. Then, women with confirmed GDM at their second trimester from the two clinics were assigned to the CE alone (CE; n = 26). The other two were assigned to the intervention (addition of GI diet to the CE dietary advice) (LGI; n = 26). A simple random sampling were used when allocating the health clinics into it assigned group. The intervention performed at four visits similarly conducted for each group with the duration of intervention is 10 to 22 weeks. At baseline visit, similar CE dietary advice were given to each group by a research dietitian. Then, at visit 1, low GI dietary advice were given to the intervention group while the comparison group (CE) continues with the previous dietary plan. Maternal glycaemia (fasting blood glucose (FBG), glycated haemoglobin (HbA1c) and self-monitoring blood glucose (SMBG)) was a primary outcomes measure. The secondary outcome measures were maternal metabolic outcomes (blood pressure, high sensitivity C-reactive protein (hs-CRP) and insulin level), maternal weight gain and dietary intake.

In this study, the response rate was 87% with 13% of attrition rate. The baseline characteristics were homogenous between LGI and CE group. Regarding primary outcome measures, no differences were observed for FBG and HbA1c between groups even though the HbA1c increased significantly in both groups over time (time effect; $p < 0.05$). The SMBG at pre-breakfast and post-breakfast were significantly lower in LGI than the CE group (group effect; $p < 0.05$). The SMBG at post-lunch were significantly reduced over time (time effect; $p < 0.05$) with no significant differences between groups.

Regarding secondary outcome measures, the fasting insulin increased in both group, significantly higher in CE than LGI (group effect $p < 0.05$). Systolic blood pressure increased in LGI over time which on the other hand, reduced in CE group (time*group effect; $p < 0.05$). Other secondary outcomes did not differ significantly between groups. In dietary intake assessments, the energy, fat, dietary fibre, sugars, dietary GI and glycaemic load (GL) were significantly reduced in LGI than CE over time (time effect; $p < 0.05$) with no significant difference between groups. The sugars and dietary GI in LGI group reduced which on the other hand the dietary GI increased in CE (time*group effect; $p < 0.05$). LGI shows better adherence for fat and dietary GI intake compared to CE group ($p < 0.05$).

In conclusion, adding a low GI to CE dietary advice improved SMBG at pre and post breakfast meal, and improve intake of energy, fat, dietary fibre, sugars, dietary GI and GL. However, the increase in systolic blood pressure warrants future investigation. The low GI dietary advice is feasible and well accepted among GDM women. Low GI can be added to a current advice to further improve the postprandial glycaemic management in GDM.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk Ijazah Master Sains

KESAN MENAMBAH NASIHAT DIET RENDAH INDEKS GLISEMIK DALAM NASIHAT PERTUKARAN KARBOHIDRAT DI KALANGAN PESAKIT DIABETES GESTASI

oleh

NURUL ALIA AQILAH BT SAMIUN

November 2017

Pengerusi: **Profesor Madya Barakatun Nisak Binti Mohd Yusof, PhD**
Fakulti: **Perubatan dan Sains Kesihatan**

Penggunaan pertukaran karbohidrat (CE) atau penambahan nasihat pemakanan indeks glisemik (GI) yang rendah untuk wanita dengan diabetes gestasi (GDM) menghasilkan manfaat yang setanding. Samada menambah diet rendah GI dalam CE akan meningkatkan pengawalan glisemik kepada wanita dengan GDM adalah tidak jelas. Kajian ini mengkaji kesan penambahan nasihat pemakanan rendah GI dalam nasihat pemakanan CE keatas glisemia ibu hamil, hasil metabolik, kadar penambahan berat badan dan pengambilan diet dalam kalangan wanita dengan GDM.

Kajian ini menggunakan reka bentuk kuasi-eksperimen yang telah dilaksanakan di klinik - klinik kesihatan daerah Hulu Langat. Empat dari 12 klinik dengan jumlah tertinggi pesakit GDM telah dipilih. Kemudian, wanita yang telah disahkan mengidap GDM dalam trimester kedua dari dua klinik ditetapkan memasuki kumpulan CE sahaja (CE; n = 26). Dua lagi klinik ditetapkan memasuki kumpulan intervasi (penambahan nasihat pemakanan rendah GI dalam CE) (LGI; n = 26). Persampelan rawak mudah digunakan apabila menentukan klinik-klinik kesihatan pada kumpulan yang telah ditetapkan. Intervasi kajian dijalankan dengan empat temu janji yang sama untuk setiap kumpulan dengan jangka masa intervasi selama 10 hingga 22 minggu. Pada temujanji asas, nasihat pemakanan CE yang sama diberikan pada setiap kumpulan oleh dietitian kajian. Kemudian, pada temujanji 1, nasihat pemakanan rendah GI diberikan pada kumpulan intervasi manakala kumpulan perbandingan (CE) meneruskan nasihat pemakanan sebelumnya. Aras glisemia ibu hamil (glukosa darah ketika puasa (FBG), *glycated haemoglobin* (HbA1c) dan pemantauan sendiri glukosa darah (SMBG)) adalah hasil utama kajian. Hasil kedua yang dikaji adalah hasil metabolik ibu hamil (kadar tekanan darah, *high sensitivity C-reactive protein* (hs-

CRP) dan aras insulin), penambahan berat badan ibu hamil dan pengambilan makanan.

Dalam kajian ini, kadar respon adalah 87% dengan 13% kadar keciciran. Ciri asas adalah *homogenous* di antara kumpulan LGI dan CE. Merujuk kepada hasil utama, tiada perbezaan diperhatikan untuk FBG dan HbA1c di antara kumpulan walaupun terdapat peningkatan ketara dalam HbA1c sepanjang kajian (kesan masa; $p < 0.05$). SMBG sebelum dan selepas sarapan pagi menunjukkan penurunan ketara dalam kumpulan LGI berbanding CE (kesan kumpulan; $p < 0.05$). SMBG selepas makan tengahari menunjukan penurunan ketara ke atas masa (kesan masa; $p < 0.05$) dengan tiada perbezaan ketara di atara kumpulan.

Merujuk kepada hasil kedua, insulin ketika berpuasa meningkat dalam kedua-dua kumpulan dengan peningkatan ketara dalam kumpulan CE berbanding LGI (kesan kumpulan; $p < 0.05$). Tekanan darah sistolik meningkat dalam kumpulan LGI ke atas masa sebaliknya menurun dalam kumpulan CE (kesan masa*kumpulan; $p < 0.05$). Hasil kedua yang lain tidak menunjukkan perbezaan ketara di antara kumpulan. Dalam penilaian pengambilan pemakanan, tenaga, lemak, serat diet, gula, diet GI dan beban glisemik (GL) menunjukan penurunan ketara dalam kumpulan LGI berbanding CE ke atas masa (kesan masa; $p < 0.05$) dengan tiada perbezaan ketara di atara kumpulan. Gula dan diet GI dalam kumpulan LGI menurun manakala diet GI meningkat dalam CE (kesan masa*kumpulan; $p < 0.05$). LGI menunjukan skor pematuhan yang lebih baik bagi pengambilan pemakanan lemak dan diet GI berbanding CE ($p < 0.05$).

Kesimpulannya, menambah diet rendah GI dalam nasihat pemakan CE dapat menambah baik SMBG sebelum dan selepas sarapan pagi, meningkatkan tekanan darah sistolik dan menurunkan pengambilan tenaga, lemak, serat diet, gula, diet GI dan GL. Nasihat diet rendah GI boleh dilaksanakan dan boleh diterima dengan terbuka di peringkat penjagaan primer. Diet rendah GI boleh di tambah ke dalam nasihat semasa untuk penambahbaikkan glisemia selepas makan dalam pengurusan GDM.

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I certify that a Thesis Examination Committee has met on 1 November 2017 to conduct the final examination of Nurul Alia Aqilah bt Samiun on her thesis entitled "Effects of Adding a Low Glycaemic Index Diet to a Carbohydrate Exchange Dietary Advice for Women with Gestational Diabetes Mellitus" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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Declaration by Graduate Student

I hereby confirm that:

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Signature: _____
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Signature: _____
Name of Member of Supervisory Committee: Professor Winnie Chee Siew Swee

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LIST OF ABBREVIATIONS

ACOG	American College Obstetricians & Gynecology
ADA	American Diabetes Association
BMI	Body Mass Index
CE	Carbohydrate Exchange Dietary Advice Group
CDA	Canadian Diabetes Association
CRP	C-Reactive Protein
DM	Diabetes Mellitus
DRI	Dietary Reference Intake
DDG	Germany Diabetes Association
ER	Energy Requirement
FBG	Fasting Blood Glucose
GDM	Gestational Diabetes Mellitus
GI	Glycemic Index
GL	Glycemic Load
GWG	Gestational Weight Gain
HbA1c	Glycated Haemoglobin
HOMA-IR	Homeostasis Model Assessment
IADPSG	International Association of Diabetes & Pregnancy Study Groups
IOM	Institute of Medicine and National Research Council
LGA	Large for Gestational Age
LGI	Carbohydrate Exchange Dietary Advice Added with Low GI Dietary Advice Group
MDA	Malaysian Dietitian's Association
MNT	Medical Nutrition Therapy
MOH	Ministry of Health

MOSTI	Ministry of Science, Technology and Innovation
MyGISPO	Malaysian Glycaemic Index Study and Pregnancy Outcomes
NCCFN	National Coordinating Committee on Food Nutrition
NCP	Nutritional Care Process
NHLBI	National Heart, Lung & Blood Institute
NICHD	National Institute of Child Health & Development
NICE	National Institute for Health and Care Excellent
NOR	National Obstetric Registry
OGTT	Oral Glucose Tolerance Test
RNI	Reference Nutrient Intake
SMBG	Self-Monitoring Blood Glucose
SPSS	Statistic Package for Social Sciences
SVYM	Swami Vivekananda Youth Movement
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Study of Background

Gestational Diabetes Mellitus (GDM), defined as any degree of glucose intolerance that is first detected during pregnancy is one of the most common medical issues (American Diabetes Association [ADA], 2013). Maternal hyperglycaemia in GDM is associated with several complications both to the mothers and infants. For the mothers, pre-eclampsia, stillbirth, caesarean section and birth trauma are well reported. For the infants, they are at risk of being a macrosomic baby, having hypoglycaemic upon delivery, shoulder dystocia, and indeed type 2 diabetes later in their life (Ouzounian et al., 2011; Pintaudi et al., 2015; Rosenstein et al., 2012).

In the past decade, the prevalence of GDM has significantly increased by 50% in the world with Asian women having a higher incidence rate ranging from 8 – 15% as compared with 4 – 7% among Caucasians (Hunsberger, Rosenberg, & Donatelle, 2010). Malaysia has not been spared from this medical issue. Although national data is unavailable, the prevalence was recorded from 12.7 to 24.9% observed from various studies performed between 1993 and 2003 (Chan, 1993; Idris et al., 2009; Shamsuddin et al., 2001). This observation seems higher than the global rate which was between 1.4 and 14.0% (ADA, 2013). It has become no surprise as Malaysia has the highest obesity rate of about 48.6% within Southeast Asian especially among Malaysian women (Ng et al., 2014). This is likely because obesity contributes strongly to the risk of GDM where the occurrence of GDM seen four times higher in obese women compared with non-obese women (Kerrigan & Kingdon, 2010).

Medical Nutrition Therapy (MNT) is the cornerstone of effective GDM management which positively influence pregnancy outcomes of the mother and child health (Shi et al., 2016). The primary goal of MNT is to achieve and maintain optimal maternal glycaemia and at the same time to provide adequate nutrition for the mother and foetal throughout the pregnancy (ADA, 2017). MNT for women in GDM is primarily based on a carbohydrate-controlled meal plan with the emphasized given to the amount rather than the type of carbohydrates to promote optimal nutrition for maternal and foetal health (Moreno-Castilla et al., 2013). Dietary carbohydrate has been the mainstay of MNT recommendations because it is directly influenced maternal glycaemia (Magon & Seshiah, 2011; Moreno-Castilla et al., 2013). In Malaysia, flexible carbohydrate exchange is mainly used by dietitians to quantify the amount of carbohydrate advice without emphasizing on the type of carbohydrate (Farhanah et al., 2014; Malaysian Dietitians' Association [MDA, 2015])

Different types of carbohydrate produce different glycaemic responses (Walsh et al., 2012), a concept known as a glycaemic index (GI). The GI concept was initiated in the 1980s' by Professor David Jenkins and his team from University of Toronto. The concept was introduced to determine glycaemic responses following different type of carbohydrates. The study compared the effects of 62 commonly eaten foods and sugars on a glycaemic level over 2-hours among 5 to 10 healthy volunteers. This study provided initial evidence that different carbohydrates even within the same amount produce different impact on glycaemic level (Jenkins et al., 1981).

Asian dietary patterns are much different from Caucasians (Barakatun-Nisak et al., 2014). Compared to Western diets, Asian studies reported relatively high carbohydrate intake (Barakatun Nisak et al., 2009; Villegas et al., 2007). White and glutinous rice of Asian's staple foods is known to be high in GI that increases the postprandial glycaemic response (Soriguer et al., 2013). An excessive rise in postprandial glycaemic response increases GDM-related complications and lead to excessive foetal growth (Metzger et al., 2008).

The lower the GI of the foods the better the response to the postprandial glycaemic level than the higher GI version. Hence, a lower GI of food may reduce the maternal glycaemia and other metabolic outcomes in women with GDM. Postprandial glycaemia can be reduced by slowing down the rate of carbohydrate digestion and absorption and therefore, consumption of low GI meal seems a good alternative strategy for reducing postprandial glycaemia in GDM (Louie et al., 2011).

1.2 Problem Statement

In the most two recent studies in Malaysia, the GDM prevalence was 5.3% and 8.66% (Kampan et al., 2013; Nalliah, 2015). In Kampan et al. (2013), the study was conducted at Universiti Kebangsaan Malaysia Medical Centre among 400 women from 2005 to 2009 while Nalliah (2015) study was obtained data from National Obstetric Register in 2010 involving 14 major government hospitals. The interesting part in Kampan et al. (2013) study was the identified of most GDM women required dietary intervention alone (76.2%) as compared to pharmacotherapy (19.8%). This highlighting the needs of having MNT as the first line defences in the management of GDM (Hernandez et al., 2013).

As previously mentioned, amount of carbohydrates were emphasized more in the MNT of GDM women rather than the types of carbohydrate itself (Moreno-Castilla et al., 2013). Although the amount of carbohydrate plays an important role in MNT, types of carbohydrate also important as it influences postprandial blood glycaemia. This is evidence by a study conducted by Louie et al. (2012a) among GDM women in Royal Prince Alfred Hospital, Australia. Low GI breakfast

showed a significant reduction in postprandial glycaemia than a high GI breakfast.

Based on the systematic review done by Barakatun Nisak et al. (2014), there are three studies (Grant et al., 2011; Louie et al., 2011; Moses et al., 2009) on the effectiveness of low GI dietary intervention for the treatment of GDM. These studies show an improvement towards the intervention however, there was no significant differences were observed in overall glycaemic control and pregnancy outcomes in GDM women. It worth to note that earlier intervention on the other hand shows a tendency for lower birth weight and birth centile. Although the low GI diet was acceptable in those studies, factors such as genetic, environment and food pattern discrepancies among Western are different from Asian context. This systematic review however, did not include local studies.

There are another two overseas studies arise after this systematic review (Afaghi et al., 2013; Perichart-Perera et al., 2012). Both studies shows a significant reduction in fasting and 2-hour postprandial glucose however found no significant different between groups on metabolic parameters. The effectiveness of the GI concept may be different across different population. The previous of these four studies were conducted in Western countries (Grant et al., 2011; Louie et al., 2011; Moses et al., 2009 and Perera et al., 2012) and among Persians (Afaghi et al., 2013) which the dieting and lifestyle pattern are different from Malaysia. In Asia, the staple diet consists of polished white rice and refined wheat which high GI and glycaemic load (GL) values (Ludwig, 2002). Excessive consumption of white rice has been associated with increased glycaemia levels among Japanese and Chinese women (Murakami et al., 2006).

From these previous five studies conducted in overseas, interestingly the results of low GI dietary intervention has been inconsistent and produces comparable benefit to a carbohydrate controlled meal plan or a high fibre diet except low GI further improves in postprandial glycaemia and reduces the needs of insulin (Grant et al., 2011; Louie et al., 2011; Moses et al., 2009 and Perera et al., 2012; Afaghi et al., 2013). The role of combine both the amount and types of carbohydrate intervention has not been studied. Hence, it can be speculated whether combining both the amount and type of carbohydrate in dietary advice may enhance the metabolic benefits in women with GDM.

In Malaysia context, there was two studies that were conducted among GDM women related to MNT. Farhanah (2015) investigated the acute impact of delivering a low GI dietary advice or carbohydrate exchange for four weeks duration at a teaching hospital in Kuala Lumpur. While the low GI group improved postprandial glucose levels at 1-hour following a breakfast meal, none of the changes in other clinical outcomes differed significantly between groups. In other words, both dietary advice produced comparable benefits without significant

harmful effects. Despite the encouraging short-term intervention benefits of low GI diet, its long-term intervention benefits are still unclear.

This study also documented the feasibility of providing a low GI intervention for women with GDM. The study provided food baskets where the participants were encouraged to consume provided food within the four weeks period. Generalisation of the result to other women with GDM who have to make their own decision on selecting food intake may be different. Furthermore, provision of the food baskets may not be sustainable in the long run. On the other hand, study conducted by Fatin Nasirah (2015) aimed to develop and evaluate the effectiveness of nutrition education package for GDM in Malaysia but not using dietary GI as a primary intervention. While there was an improvement in terms of knowledge, rate of weight gained and fasting glycaemia level, other outcomes were not differed significantly between intervention and control groups.

There are also another two GI intervention related studies done in Malaysia among different population. Shyam et al., (2013) investigate the effect of low GI for 6 month of randomized trial period among healthy women with previous history of GDM. In this study, it was found that there was significant improvement for glucose tolerance and body weight reduction in intervention group compared to control group. The effectiveness of a low GI intervention in Malaysian population has also been observed in patients with type 2 diabetes mellitus (DM) (Barakatun Nisak et al., 2009a). Significant reduction on postprandial glycaemia and insulin responses were found after consuming low GI meal compared to high GI meal among patients with DM.

Furthermore, these previous studies conducted in Malaysia and overseas performed in a tertiary care setting. Tertiary level of management may not capture the scenario at a primary care setting. Most of the GDM mothers were first contact at the primary health clinics and the cases in tertiary level may be of high risk cases that was referred from smaller district hospitals or facilities which explained that it does not reflect the true scenario of GDM outcome in Malaysian population (Kampan et al., 2013). Providing nutrition intervention earlier at the primary care level may benefits in GDM metabolic outcomes (Moyer, 2014). Hence, highlight the need of having a similar study conducted at primary health clinics.

Most of the studies produce comparable benefits when using a single intervention of amount versus types of carbohydrate. The benefit of combining the amount and types of carbohydrate in the intervention is still unclear. Compared to Farhanah (2015) study that was conducted among 3rd trimester women with GDM, this study will provide earlier intervention among 2nd trimester women with GDM. Although Shyam et al., (2013) conducted a 6 month of intervention, the population is not among women with GDM. This study however, will provide longer duration of low GI dietary advice intervention (10 to 22 weeks)

focusing among women with GDM at primary care setting. The applicability of the low GI study in primary care setting is still unknown. To address these research gaps, this study investigate the combination of amount (CE) and type of carbohydrate (LGI) that may extend the benefits to improve glycaemic management in GDM.

1.3 Study Significance

The results from this study may provide evidence regarding the effectiveness of combining a low GI diet to carbohydrate exchange dietary advice as part of the MNT delivery. This is important as to convince the policy makers and dietitians before implementing the low GI diet in managing GDM. In Malaysia, advice to incorporate low GI foods is still in its infancy. It has been reported that only 11% of dietitians in Malaysia incorporated GI into the management of GDM (Farhanah et al., 2014).

This study may also provide a real-life clinical application in the setting of primary care that mimics the real-health care setting. As it is performed as part of the routine practices in health clinics, the data obtained may also support its feasibility for women with GDM. Academic medical centres usually are tertiary care centres with a patient population that is frequently different from community health centres in terms of socio-demographic background and education level. Thus, interventions can have different effects in different settings especially when it comes to behavioural interventions whether it can influence patients' dietary change or not. Last but not least, the result of this study can affirm the benefits of low GI diet in the management of GDM.

1.4 Research Question

What is the effect of adding low GI food to the carbohydrate exchange dietary advice on maternal glycaemia, metabolic outcomes, weight gain, dietary intake and adherence among women with GDM at primary health clinics?

1.5 Study Objectives

1.5.1 General Objective

To investigate the effect of adding low GI diet to the carbohydrate exchange dietary advice for women with GDM at a primary health clinics.

1.5.2 Specific Objectives

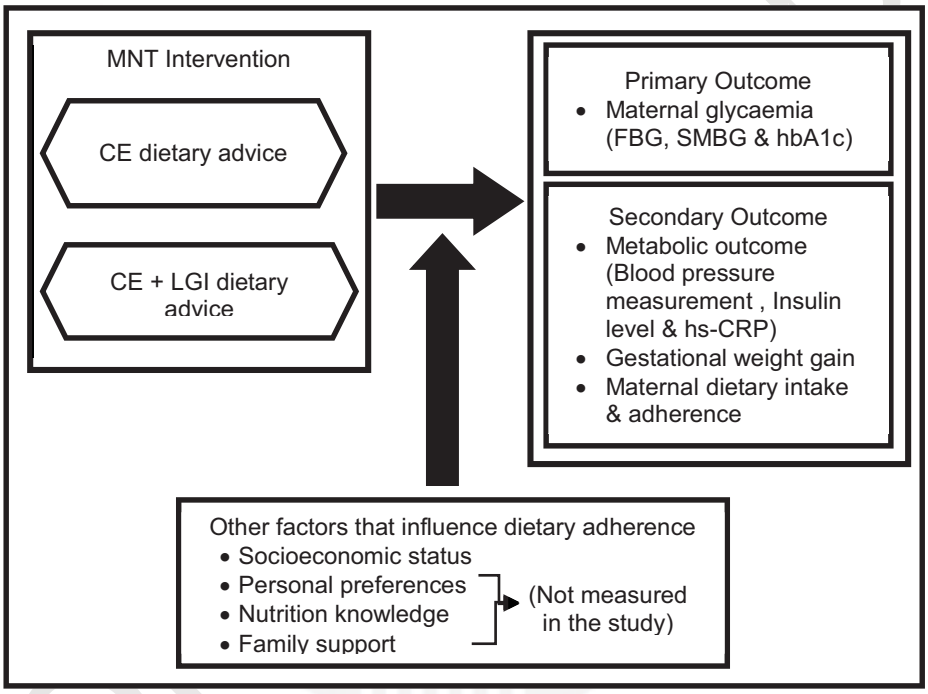
1. To determine and compare baseline characteristics between intervention group with added low GI diet to the carbohydrate exchange (LGI) versus comparison group of carbohydrate exchange (CE) dietary advice alone.
2. To determine the effect of adding LGI to CE dietary advice on the maternal blood glucose (fasting plasma glucose (FBG), glycated haemoglobin (HbA1c), Self-monitoring Blood Glucose (SMBG)) before and after intervention.
3. To determine the effect of adding LGI to CE dietary advice on the maternal metabolic outcomes (blood pressure and inflammatory marker (high sensitivity C-reactive protein (hs-CRP), insulin level and requirement for insulin treatment) before and after intervention.
4. To determine the effect of adding LGI to CE dietary advice on the maternal weight gain (rate and amount) before and after intervention.
5. To determine the effect of adding LGI to CE dietary advice on the maternal dietary intake and adherence before and after intervention.

1.6 Hypothesis

Adding low GI food to the carbohydrate exchange dietary advice will significantly improve maternal glycaemia, metabolic outcomes, prevent excessive weight gain, dietary intake and adherence when compared to carbohydrate exchange alone in women with GDM at primary health clinics.

1.7 Conceptual Framework

The conceptual framework of this study is visualised in Figure 1.1. This conceptual framework was based on other relevant studies determining the effect of adding a low GI diet to a carbohydrate exchange dietary advice diet for women with GDM. In this study, the improvement in maternal glycaemia as primary outcomes measures was expected after following low GI diet. The improvement in metabolic outcome, weight gain, dietary intake and adherence as secondary measures were also assessed.



CE= Carbohydrate exchange
LGI = Low glycaemic index
FBG = Fasting blood glucose
SMBG = Self-monitoring blood glucose
hbA1c = Glycated haemoglobin
hs-CRP = High sensitivity c-reactive protein

Figure 1.1: Conceptual Framework

The digestion and absorption of low GI foods are more slowly than high GI foods and have been found to reduce postprandial glycaemia in healthy individuals (Brand-Miller et al., 2009). Therefore, by following a carbohydrate exchange dietary advice adding with low GI diet, maternal glycaemia may be controlled. The study has shown that providing low GI dietary advice such as substituting white rice, a high GI food, with a low GI staple food in the diet of women with GDM resulted in significantly reduced blood glucose levels (Hu et al., 2014).

Moreover, those who received LGI dietary advice results in significantly less weight gained during pregnancy (McGowan et al., 2013). Studies also show that low GI dietary intervention in pregnancy significantly reduced maternal dietary GI (Grant et al., 2011; Louie et al., 2011; McGowan et al., 2013; Moses et al., 2009).

There are several factors which include personal food preferences, nutrition knowledge, socioeconomic status and family support influences dietary intervention in GDM women (Hui et al., 2014a). In this context, only socioeconomic status were considered. This warrant for future investigation to consider also other factors that influence dietary intervention in GDM. It is vital to understand the individuals eating pattern, habit and factors that influence their dietary behaviours in order to improve the diets in any population (Emadian, England & Thompson, 2017).

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