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Research Article

Obstetrical Characteristics and Glucose Profile of Singleton Primigravid Women with Gestational Diabetes Mellitus in Meru Mother and Child Health Clinic, Malaysia

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ABSTRACT

This study aims to explore the baseline obstetric characteristics of singleton, primigravid women with Gestational Diabetes Mellitus (GDM) from an experimental study. A total of 58 subjects with GDM, who were solely on diet control, were recruited from Meru Health Clinic in Selangor. The majority of the subjects (97%) were Malay. The mean age of the subjects was 27.6±3.2 years, with a pre-pregnancy weight of 68.9±17.8 kg, a height of 1.6±0.1 m, and Body Mass Index (BMI) of 28.1±6.7 kg/m^2. Most subjects in this study (93%) were diagnosed with GDM at their first Oral Glucose Tolerance Test (OGTT), conducted at a mean gestational age of 18.9±2.8 weeks. The OGTT readings at diagnosis were 5.1±0.6 mmol/L for Fasting Blood Glucose (FBG) and 7.9±1.5 mmol/L for 2-Hour Postprandial (2HPP). The Blood Sugar Profile (BSP) levels were recorded as follows: fasting at 4.8±0.4 mmol/L, pre-lunch at 5.1±0.5 mmol/L, post-lunch at 5.3±0.5 mmol/L, and post-dinner at 5.3±1.5 mmol/L. Macronutrient intake was within the recommended guidelines. The subjects delivered at a mean gestational age of 38.8±1.1 weeks, with a mean birth weight of 2.9±0.4 kg. No incidences of macrosomia were recorded in this study. In conclusion, the subjects underwent early GDM screening, had well-controlled antenatal blood glucose levels, and experienced no adverse pregnancy outcomes.

INTRODUCTION

Women at high risk of developing Gestational Diabetes Mellitus (GDM) are required to be screened as soon as possible upon registering for antenatal check-ups in the Malaysian clinical setting. According to the Malaysian Clinical Practice Guideline, women at risk of developing GDM include those with a pre-pregnancy Body Mass Index (BMI) of ≥27 kg/m^2, a previous history of GDM, a first-degree relative to diabetes, a history of macrosomia, a poor obstetric history, the occurrence of glycosuria ≥2 on two occasions, and current obstetric problems such as essential hypertension, pregnancy-induced hypertension, and polyhydramnios (MaHTAS 2017). However, high-risk women not diagnosed with GDM during their initial Oral Glucose Tolerance Test (OGTT) undergo an additional OGTT screening between gestational weeks 24 and 28, along with those aged 25 and above who do not exhibit other risk factors.

Recent data reveals a 10% increase in the prevalence of GDM in Malaysia over the past six years. According to the National Health and Morbidity Survey on maternal and child health, there has been a nationwide rise in GDM prevalence, increasing from 13.5% in 2016 to 27.1% in 2022 (IPH 2023). Furthermore, a study conducted by Logakodie *et al.* (2017) across 72 public health clinics in Selangor observed that 27.9% of 745 women were diagnosed with GDM. This significant rise in prevalence is concerning, as it highlights the escalating burden of GDM in Malaysia and the potential risks it poses to maternal and child health.

Primigravid women, those experiencing their first pregnancy, represent a particularly vulnerable group with unique obstetric challenges and an increased risk of adverse outcomes associated with GDM (Kampmann *et al.* 2015). These outcomes include hypertensive disorders, preterm birth, cesarean delivery, and macrosomia (Le *et al.* 2023). Recent studies highlight the importance of early detection and individualized management of GDM to improve pregnancy outcomes (Raets *et al.* 2021). Understanding the obstetrical characteristics and glucose profiles of primigravid women with GDM is essential for developing targeted interventions and improving maternal and fetal outcomes. Hence, this study aims to explore the baseline obstetrical characteristics and glucose profile among singleton primigravid women with GDM in an experimental study.

METHODS

Design, location, and time

This study presents the baseline obstetric data from an experimental study design involving first-time mothers diagnosed with GDM. The experimental group received a series of breastfeeding modules during the antenatal period, with breastfeeding being explored as a potential preventive strategy to lower the risk of postnatal diabetes. Meanwhile, the control group continued with the standard antenatal care provided by the health clinic. Every participant was followed up until six months postpartum, resulting in a total duration of 10 months. This study was conducted from March 2022 to August 2023 at Meru Health Clinic, Selangor. It was registered with the National Medical Research Register (NMMR) (ID: NMMR-19-4204-52471(IIR)) and received ethics approval from the Research Ethics Committee (REC) of Universiti Teknologi MARA (ID: REC/08/2021(MR/678)). All subjects provided written consent before enrolment in this study.

Sampling

The sample size was determined using a formula developed by Ogston *et al.* (1991). This formula was used to calculate the sample size for two groups to compare the effects of the experimental and control interventions, based on the mean difference in HOMA-IR between the high-intensity and non-high-intensity breastfeeding groups, which was approximately 0.64 at 12 to 14 months after delivery. Group allocation was conducted using unrestricted randomization. A previous study reported a pooled standard deviation of 0.68 (Yasuhi *et al.* 2017). The necessary sample size to achieve 80% statistical power at a significance level of 5% was calculated. Therefore, a total of 58 subjects were recruited for both groups, with an additional 20% to account for potential dropouts. This study involved primigravid, singleton pregnant mothers with GDM, aged 18 to 45 years, at 20 weeks of gestation or later, who were on diet control alone and were Malaysians. Mothers with severe illness or infection, multiple pregnancies, or a prior diagnosis of Type 1 Diabetes Mellitus (T1DM) or Type 2 Diabetes Mellitus (T2DM) were excluded from this study.

Data collection

The obstetric data, maternal glucose parameters, nutrient intake, and pregnancy outcomes were retrieved from the subjects' medical records and face-to-face interviews. In Malaysia, mothers at high risk of developing GDM are diagnosed as early as possible. The diagnostic criteria for the subjects were based on the Malaysian Clinical Practice Guidelines (CPG), which specify that blood glucose levels must be either Fasting Blood Glucose (FBG) ≥5.1 mmol/L or 2-Hour Postprandial Blood Glucose (2HPP) ≥7.8 mmol/L (MaHTAS 2017). However, if mothers pass the first Oral Glucose Tolerance Test (OGTT), they undergo a second OGTT at weeks 24 to 28 of gestation. They are excluded from a GDM diagnosis if they pass the second OGTT.

Mothers with GDM are required to perform BSP at the clinic during fasting, pre-lunch, post-lunch, and post-dinner. The target blood glucose levels are as follows: FBG ≤5.3 mmol/L, 1-hour postprandial ≤7.8 mmol/L, and 2-hour postprandial ≤6.7 mmol/L. The BSP was conducted once or twice a month in this clinical setting, depending on the subjects' blood glucose control. Therefore, BSP readings during pregnancy reflect blood glucose levels during this period, as they represent the average BSP taken during antenatal care.

Subjects' nutrient intake was assessed using the Food Frequency Questionnaire (FFQ), adopted from Norimah *et al.* (2008), as soon as they were recruited in this study. This FFQ

includes 137 food items categorized into 14 food groups. Subjects were interviewed by a dietitian to report the frequency of their consumption of these food items over the previous month, specifying whether items were consumed daily, weekly, or never. Nutrient analysis was conducted using Dietary Plus Software, developed by Ng (2010). Most local foods consumed by the subjects were available in the database. In cases where specific foods were not present, they were deconstructed into individual ingredients, which were then analyzed alongside estimated amounts of added oil and salt, as previously done by Farhanah *et al.* (2017).

Data analysis

Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) software, version 26 (SPSS Inc., Chicago, USA). Descriptive statistics, including mean±SD, were used to provide an overview of the socio-demographic data, maternal baseline characteristics, and nutrient intake. Pearson correlation was used to observe the relationship between the level of 2HPP and birthweight. Numerical data were presented as mean and standard deviation.

RESULTS AND DISCUSSION

The majority of the subjects in this study (97%) were Malay, while the other 3% were Indian. More than half (55%) of the subjects had a tertiary education level. Regarding occupation, 18 subjects were unemployed (31%), while the majority (57%) worked in the private sector. Four subjects (7%) were self-employed, and three subjects (5%) were government servants. The household income categories were based on the Department of Statistics Malaysia (2023). Most subjects' household income was categorized under the B40 household group, with only one subject (1%) in the T20 household group.

Table 1 presents the obstetric characteristics of the subjects in this study. The majority (93%) were diagnosed during their first OGTT, while a minority (7%) were diagnosed during their second OGTT. The subjects' age was 27.6±3.2 years, their pre-pregnancy weight was 68.9±17.8 kg, their height was 1.6±0.1 m, and their pre-pregnancy BMI was 28.1±6.7 kg/m². According to Asian categories, the pre-pregnancy BMI classifications showed that 46.0% were classified as overweight, 27.0% as Obese Class I, 17.0% as Obese Class II, and 9% as Obese Class III. Compared to previous studies conducted in Asian countries among women with GDM, the subjects in this study had a higher mean pre-pregnancy BMI of 28.1 kg/m². This contrasts with studies conducted in China (You *et al.* 2020) and Japan (Yasuhi *et al.* 2019), where the average pre-pregnancy BMI of subjects was 25.91 kg/m^2 and 23.9 kg/m^2, respectively. According to the National Health and Morbidity Survey 2019, the prevalence of overweight Malaysians was 50.1% in 2019, showing an increasing trend from 44.5% in 2011 to 47.7% in 2015 (Chong *et al.* 2023). Surprisingly, in 2023, the prevalence of overweight and obesity continued to rise, reaching a rate of 54.5% (IPH 2023). It was found that the female gender was significantly associated with a higher risk of being overweight (Chong *et al.* 2023). In Southeast Asia, overweight and obesity are recognized as significant risk factors for non-communicable and chronic diseases (Dans *et al.* 2011). The rising prevalence of overweight and obesity has been associated with adverse maternal outcomes, including an increased risk of macrosomia, GDM, eclampsia, and higher cesarean delivery rates among pregnant women in Southeast Asia. Consequently, it is anticipated that as obesity rates continue to rise, the incidence of diabetes in pregnancy will also increase (Bashir *et al.* 2024). A similar trend has been observed in Malaysia, where both the prevalence of GDM and obesity have seen a notable rise (IPH 2023).

It has been outlined that women at high risk of developing GDM should undergo screening for GDM promptly (MaHTAS 2017). This study recorded that the subjects underwent screening at an average gestational age of 18.9±2.8 weeks. This has been categorized as early GDM screening, as it is conducted within 13 to 20 weeks of gestation, according to Deitch *et al.* (2024). Furthermore, the majority (93%) of the subjects were diagnosed with GDM at their first OGTT. When compared to other studies, the gestational age at which women were diagnosed with GDM varied significantly. In Poland, Oleszczuk-Modzelewska *et al.* (2022) found that women were diagnosed at 25.4 weeks of gestation. In Northern California, the diagnosis was made at 24 weeks of gestation (Gunderson *et al.* 2015). In Japan, women with GDM were diagnosed at 28.1 weeks of gestation (Yasuhi *et al.* 2019). Meanwhile, a study in Indonesia found that among 35 subjects with GDM, only

Table 1. Obstetrical characteristics of the subjects

Characteristics	Mean±SD (N=58)	Range (Minimum–Maximum)	n (%)
Age (year)	27.6±3.2	28.8–28.4	
Pre-pregnancy weight (kg)	68.9±17.8	64.2–73.5	
Height (m)	1.6±0.1	1.5–1.6	
Pre-pregnancy BMI (kg/m^2)	28.1±6.7	26.3–29.8	
Week of OGTT measurements	18.9±2.8	18.2–19.7	
Birth weight (kg)	2.9±0.4	2.8–3.1	
Delivery week	38.8±1.1	38.4–39.0	
Pre-pregnancy BMI (kg/m^2)			
Overweight (23.0–27.4)			27 (46.0)
Obese class I (27.5–32.4)			16 (28.0)
Obese class II (32.5–37.4)			10 (17.0)
Obese class III (≥37.5)			5 (9.0)
Family history of Diabetes			
Yes			31 (53.0)
No			27 (47.0)
Mode of treatment			
Diet control			29 (100.0)
Metformin			-
Insulin			-
Number of OGTT			
First			54 (93.0)
Second			4 (7.0)
Mode of delivery			
Normal			38 (66.0)
SVD			32 (84.0)
Vac Ext			1 (3.0)
LFD			5 (13.0)
Caesarean			20 (35.0)
Incidence of Macromia			0 (0.0)

BMI: Body Mass Index; OGTT: Oral Glucose Tolerance Test; SVD: Spontaneous Vaginal Delivery; LFD: Low Forceps Delivery; Vac Ext: Vacuum Extraction Delivery; SD: Standard Deviation

4 (11.4%) were diagnosed during the second trimester, whereas the remaining 31 (88.6%) were diagnosed in the third trimester (Kwan & Susanto 2022). These findings indicate that the subjects in this study, who were overweight and obese, had a first-degree relative with diabetes, were classified as being at significant risk of GDM, and were diagnosed with GDM at an early stage. More than half (53%) had a family history of diabetes. Delivery occurred at a gestational age of 38.8±1.1 weeks, with 66.0% having delivered their babies normally. Among them, the majority (84.0%) had a Spontaneous Vaginal Delivery (SVD), one subject (3.0%) had a vacuum extraction delivery, and five subjects (13.0%) had a Low Forceps Delivery (LFD).

Table 2 shows the antenatal glucose parameters of the subjects. FBG level during the OGTT for GDM diagnosis was 5.1±0.6 mmol/L, and the 2HPP level was 7.9±1.5 mmol/L. In comparison to the Malaysian Clinical Practice Guidelines (CPG), 31% had an FBG level ≥5.1 mmol/L, 45% had a 2HPP level ≥7.8 mmol/L, and 24% had both FBG and 2HPP levels ≥5.1 and ≥7.8 mmol/L, respectively (Figure 1).

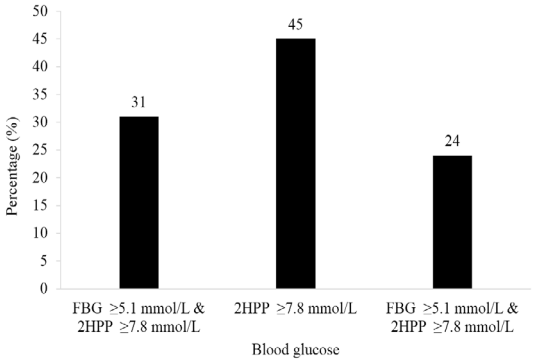
According to (Ryan *et al.* 2020), having elevated antenatal FBG levels was associated with a higher risk of Large-For-Gestational Age (LGA) and Hypertensive Disorders of Pregnancy (HDP) compared to elevated postprandial blood glucose levels among women with GDM. This association remained regardless of whether the mother received pharmacological intervention, predominantly insulin therapy. This finding was supported by a study in China involving 14,741 women, which found an approximately two-fold higher incidence of LGA, macrosomia, and cesarean section among women with elevated FBG compared to those with elevated postprandial blood glucose (Feng *et al.* 2017).

Contradicting the findings of this study, although 31% of the subjects had exceeded the cut-off point of FBG during diagnosis and 24% had exceeded both FBG and 2HPP, no incidence of macrosomia was observed. This outcome may be attributed to the fact that this study only included subjects who were on diet control alone. This is supported by previous research indicating that women with GDM on diet control alone tend to exhibit better blood glucose profiles compared to those requiring insulin therapy (Mecacci *et al.* 2021). Furthermore, women with GDM on insulin therapy are more likely to experience adverse pregnancy outcomes, such as preterm delivery and the need for cesarean section (Ye *et al.* 2022). However, the sample size of this study

Table 2. Antenatal glucose parameters of the subjects

Parameters	Mean±SD (N=58)	Range (Minimum–Maximum)
OGTT		
Fasting (mmol/L)	5.1±0.6	4.9–5.2
2HPP (mmol/L)	7.9±1.5	7.5–8.2
BSP		
Fasting (mmol/L)	4.8±0.4	4.7–4.9
Pre-lunch (mmol/L)	5.1±0.5	4.9–5.1
Post-lunch (mmol/L)	5.3±0.5	5.2–5.4
Post-dinner (mmol/L)	5.3±1.5	4.9–5.7
Blood pressure (mm/hg)		
Systolic	116±10.3	113.6–119.1
Diastolic	73±9.3	69.7–74.6

OGTT: Oral Glucose Tolerance Test; 2HPP: Two-Hour Postprandial Blood Glucose, BSP: Blood Sugar Pofile; SD: Standard Deviation



FBG: Fasting Blood Glucose; 2HPP: 2 Hour Post-Prandial

Figure 1. Oral glucose tolerance test during diagnosis compared to the Malaysian clinical practice guidelines

is insufficient to establish a definitive correlation between blood glucose levels and pregnancy outcomes. This limitation aligns with the main objective of this study, which is to observe the baseline obstetrical characteristics of the subjects.

The BSP levels during pregnancy were monitored four times daily, showing readings of 4.8±0.4 mmol/L (fasting), 5.1±0.5 mmol/L (pre-lunch), 5.3±0.5 mmol/L (post-lunch), and 5.3±1.5 mmol/L (post-dinner). The Mean±SD of the antenatal blood pressure was 116/73 mmol/L. Figure 2 shows the antenatal BSP readings of the subjects in comparison to the Malaysian Clinical Practice Guidelines. The blood glucose levels for BSP indicate that the FBG must be ≤5.3 mmol/L, 1-hour postprandial should be ≤7.8 mmol/L, and 2-hour postprandial must

FBG: Fasting Blood Glucose

Figure 2. Antenatal blood sugar profile compared to the Malaysian clinical practice guidelines

be ≤6.7 mmol/L. The overall mean shows that the Mean±SD of BSP readings was within the specified guidelines (Table 2). However, further analysis has been conducted to categorize the levels of BSP. The findings indicate that a small proportion (9%) of the subjects exceeded the cut-off points during fasting, while 2% and 3% of the subjects exceeded the recommended guidelines during post-lunch and post-dinner, respectively.

Based on a report of systematic review and analysis, it has been documented that blood glucose monitoring has been associated with favorable pregnancy outcomes. These outcomes include a lower incidence of macrosomia, a lower mean birth weight, and a lower rate of shoulder dystocia (Yeh *et al.* 2023). Consistent with the findings of this study, most of the BSP readings were within the recommended range, with a mean birth weight recorded at 2.9±0.4 kg and no incidences of macrosomia observed. To further support this outcome, a small positive correlation was observed between the level of 2HPP levels after lunch and birthweight (r=0.2, p=0.2), suggesting that the lower level of 2HPP levels corresponded to lower birthweight. However, it is important to note that this relationship did not reach statistical significance. The management guidelines for diabetes in pregnancy state that women with GDM who are on diet control alone must deliver before 40 weeks of gestation (Nurain *et al.* 2019). Subjects in this study adhered to the recommended guidelines, with a recorded delivery at week 38.8±1.1 of gestation.

The nutrient intake of the subjects was meticulously analyzed, with the Mean±SD values for energy, carbohydrate, protein, and fat recorded as 1,591±563 kcal/day, 198.7±78.9 g, 74.3±29.3 g, and 54.8±24.5 g, respectively. In terms of macronutrient distribution, carbohydrates accounted for 50% of Total Energy Intake (TEI), protein made up 19% of TEI, and fat contributed 31% of TEI (as shown in Table 3). According to the Malaysian guidelines for the management of diabetes in pregnancy, particularly for women with GDM, maintaining optimal glucose control and achieving appropriate GWG is crucial. The guidelines advise women with GDM to consume a minimum of 175 g of carbohydrates per day, with carbohydrates contributing 50% to 55% of TEI. Additionally, protein intake should be at least 71 g daily, accounting for 15% to 20% of TEI, while fat intake should range between 25% and 35% of TEI (MaHTAS 2017; ADA 2022). The results of this

Table 3. Nutrient intake of the subjects during pregnancy

Nutrient	Mean±SD (N=58)	RNI
Energy (kcal)	1,591±563	-
Protein (g)	74.3±29.3	Minimum of 71 g
TEI protein (%)	19	15%–20%
Fat (g)	54.8±24.5	-
TEI fat (%)	31	30%
Carbohydrate (g)	198.7±78.9	Minimum of 175 g/day
TEI Carbohydrate (%)	50	50%–55%
Sugar(g)	64.5±35.9	-
Dietary Fiber (g)	15.5±8.2	25 g
Calcium (mg)	662.6±291.6	1,000 mg/day
Sodium (mg)	1,500.0±852.7	1,500 mg/day
Ferum (mg)	94.1±62.0	e
Potassium (g)	1,766.6±674.1	4,700 mg/day
Cholesterol (mg)	267.5±139.4	-
Dietary glycemic index	57.4±5.8	-
Dietary glycemic load	115.1±50.5	-

TEI: Total Energy Intake; RNI: Recommended Nutrient Intake; e: Iron supplementation; Sources: Ministry of Health Malaysia (2017) and ADA (2022); SD: Standard Deviation

study indicate that the macronutrient intake of the subjects was consistent with these recommended guidelines. The study found that the dietary fiber intake of the subjects averaged 15.5±8.2 g/day, which falls short of the Recommended Nutrient Intake (RNI) for Malaysians, set as 25 g per day (Ministry of Health Malaysia 2017). A diet containing more than 25 g of dietary fiber is associated with numerous health benefits, including a reduced risk of Type 2 Diabetes Mellitus (T2DM), Cardiovascular Diseases (CVD), and support in maintaining a healthy weight (Ministry of Health Malaysia 2017).

The National Institute for Health and Care Excellence (NICE) guidelines recommend that women with GDM substitute high glycemic index foods with those that have a lower Glycemic Index (GI) (NICE 2015). A study by Farhanah *et al.* (2017) observed that women adhering to a low GI diet (50±9 units), rich in dietary fiber and calcium, had favorable outcomes. In this study, the dietary GI and Glycemic Load (GL) were found to be 57.4±5.8 and 115.1±50.5, respectively. Although the dietary fiber was below the recommended levels, the dietary GI was moderate (57.4±5.8). This moderate dietary GI, despite low fiber intake, could be attributed to the high fat intake recorded during pregnancy (54.8±24.5, accounting for 31% of total energy intake). It was reported that the presence of fats can prolong the transit time of food through the intestine, thereby slowing carbohydrate digestion and consequently lowering the dietary GI (Eleazu 2016).

The strength of this study is that it provides information on the obstetrical characteristics of first-time mothers with GDM at the Meru Mother and Child Health Clinic in Malaysia. This study will serve as preliminary data, including demographics, medical history, and

other relevant clinical parameters. The data will be used for future research on women with GDM, particularly in Malaysia. However, this study had a small sample size and was limited to primigravid women with GDM who were treated with diet alone.

CONCLUSION

This study provides valuable insights into the baseline obstetrical characteristics of primigravid women with GDM who were managed solely through diet control. The findings emphasize the critical role of early GDM screening, which enables timely and effective management to maintain optimal blood glucose levels during pregnancy. This, in turn, supports favorable maternal and neonatal outcomes in pregnancies complicated by GDM.

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DECLARATION OF CONFLICT OF INTEREST

The authors have no conflicts of interest.

REFERENCES

[ADA] American Diabetes Association. 2022. 15. Management of diabetes in pregnancy: Standards of medical care in diabetes-2022. 45:S232–S243. https://doi.org/10.2337/dc22-S015

Chong CT, Lai WK, Mohd Sallehuddin S, Ganapathy SS. 2023. Prevalence of overweight and its associated factors among Malaysian adults: Findings from a nationally representative survey. Plos One 18(8):e0283270. https://doi.org/10.1371/journal.pone.0283270

Dans A, Ng N, Varghese C, Tai ES, Firestone R, Bonita R. 2011. The rise of chronic non-communicable diseases in southeast Asia: Time for action. The Lancet 377(9766):680–689. http://doi.org/10.1016/S0140-6736(10)61506-1

Deitch JM, Lee IL, Yates CJ, Kathpal E, Lawton P, Shahid I, Hamblin PS, Dutta D, Krishnamurthy B, Said JM et al. 2024. Simplified gestational diabetes screening with a triaging fasting plasma glucose reduces the burden of oral glucose tolerance tests during pregnancy – A large tertiary comparative cohort study. Diabetes Res Clin Pract 209:111120. http://doi.org/10.1016/j.diabres.2024.111120

Department of Statistics Malaysia. 2023. Economic Cencus. http://economiccencus.dosm.gov.my/ec2/index.php/en/info-banci-ekonomi/perutusan-ketua-perangkaan [Accessed 9th June 2024].

Eleazu CO. 2016. The concept of low glycemic index and glycemic load foods as panacea for type 2 diabetes mellitus; Prospects, challenges and solutions. Afr Health Sci 16(2):468–479. http://doi.org/10.4314/ahs.v16i2.15

Farhanah AS, Barakatun Nisak MY, Zalilah MS, Nor Azlin MI. 2017. Low-glycaemic index diet to improve dietary intake among women with gestational diabetes mellitus. Pertanika J Sci & Technol 25(S7):31–42

Feng H, Zhu WW, Yang HX, Wei YM, Wang C, Su RN, Hod M, Hadar E. 2017. Relationship between oral glucose tolerance test characteristics and adverse pregnancy outcomes among women with gestational diabetes mellitus. Chin Med J 130(9):1012–1018. http://doi.org/10.4103/0366-6999.204928

Gunderson EP, Hurston SR, Dewey KG, Faith MS, Charvat-Aguilar N, Khoury VC, Nguyen VT, Quesenberry CP. 2015. The study of women, infant feeding and type 2 diabetes after GDM pregnancy and growth of their offspring (SWIFT Offspring study): Prospective design, methodology and baseline characteristics. BMC Pregnancy Childbirth 15(1):1–15. http://dx.doi.org/10.1186/s12884-015-0587-z

[IPH] Institute for Public Health. 2023. Technical Report National Health and Morbidity Survey (NHMS) 2022. Malaysia (KL): Maternal and Child Health.

Kampmann U, Madsen LR, Skajaa Go, Iversen DS, Moeller N, Ovesen P. 2015. Gestational diabetes: A clinical update.

World J Diabetes 6(8):1065. http://doi.org/10.4239/wjd.v6.i8.1065

Kunasegaran T, Balasubramaniam, VR, Arasoo VJT, Palanisamy UD, Ramadas A. 2021. Gestational diabetes mellitus in Southeast Asia: A scoping review. Int J Environ Res Public Health 18(3):1272. http://doi.org/10.3390/ijerph18031272

Kwan DP, Susanto R. 2022. Prevalence and characteristics of gestational diabetes mellitus at x hospital West Jakarta for the period of January 2021–April 2022. Science Midwifery 10(4):2484–2489. https://doi.org/10.35335/midwifery.v10i4.677

Le DC, Vu TB, Tran TN, Nguyen TL, Nguyen TB, Nguyen DC, Hoang VT. 2023. The effectiveness of lifestyle changes in glycemic control among pregnant women with gestational diabetes mellitus. Medicina 59(9):1587. http://doi.org/10.3390/medicina59091587

Logakodie S, Azahadi O, Fuziah P, Norizzati Bib, Tan SF, Zienna ZZR, Norliza M, Noraini J, Hazlin M, Noraliza MZ *et al.* 2017. Gestational diabetes mellitus: The prevalence, associated factors and foeto-maternal outcome of women attending antenatal care. Malays Fam Physician 12(2):9–17

[MaHTAS] Malaysia Health Technology Assessment Section. 2017. Clinical Practice Guidelines (CPG): Management of Diabetes in Pregnancy. http://www.moh.gov.my/moh/resources/Penerbitan/CPG/Endocrine/1a.pdf [Accessed 2nd July 2024]

Mecacci F, Lisi F, Vannuccini S, Ottanelli S, Rambaldi MP, Serena C, Simeone S, Petraglia F. 2021. Different gestational diabetes phenotypes: Which insulin regimen fits better? Front Endocrinol 12. http://doi.org/10.3389/fendo.2021.630903

Ministry of Health Malaysia. 2017. RNI: Recommended Nutrient Intakes for Malaysian. Malaysia (KL): Ministry of Health Malaysia.

Ng KT. 2010. Dietplus- a user-friendly '2 in 1' food composition database and calculator of nutrient intakes. Malays J Nutr 16(1):125–130.

[NICE] National Institute for Health and Care Excellence. 2015. NICE National Institute for Health and Care Excellence Guideline. Diabetes in pregnancy: Management from preconception to the postnatal period. https://www.nice.org.uk/guidance/ng3 [Accessed 1st April 2024].

Norimah Jr AK, Safiah M, Jamal K, Haslinda S, Zuhaida H, Rohida S, Fatimah S, Norazlin S, Poh BK, Kandiah M et al. 2008. Food consumption patterns: Findings from the Malaysian Adult Nutrition Survey (MANS). Malays J Nutr 14(1):25–39.

Nurain MN, Marmuji LZ, Mastura I, Hoong MF, Barakatun-Nisak MY, Yusof MAM, Rohana AG, Norasyikin AW, Syima IN, Adam NL et al. 2019. Management of diabetes in pregnancy in primary care. Malays Fam Physician 14(3):55–59.

Ogston SA, Lemeshow S, Hosmer DW, Klar J, Lwanga SK. 1991. Adequacy of sample size in health studies. Biometrics 47(1):347–348. http://doi.org/10.2307/2532527

Oleszczuk-Modzelewska L, Malinowska-Polubiec A, Romejko-Wolniewicz E, Zawiejska A, Czajkowski K. 2022. What is the "cost" of reducing adverse pregnancy outcomes in patients with gestational diabetes mellitus - risk factors for perinatal complications in a retrospective cohort of pregnant women with GDM. BMC Pregnancy Childbirth 22(1):654. http://doi.org/ 10.1186/s12884-022-04980-w

Raets L, Beunen K, Benhalima K. 2021. Screening for gestational diabetes mellitus in early pregnancy: What is the evidence? J Clin Med 10(6):1257. http://doi.org/10.3390/jcm10061257

Ryan EA, Savu A, Yeung RO, Moore LE, Bowker SL, Kaul, P. 2020. Elevated fasting vs post-load glucose levels and pregnancy outcomes in gestational diabetes: A population-based study. Diabet Med 37(1):114–122. http://doi.org/10.1111/dme.14173

Yasuhi I, Yamashita H, Maeda K, Nomiyama M, Mizunoe T, Tada K, Yorozu M, Ogawa M, Kodama T, Yamaguchi K et al. 2019. High-intensity breastfeeding improves insulin sensitivity during early post-partum period in obese women with gestational diabetes. Diabetes Metab Res Rev 35(4):e3127. http://doi.org/10.1002/dmrr.3127

Yasuhi I, Soda T, Yamashita H, Urakawa A, Izumi M, Kugishima Y, Umezaki Y. 2017.

The effect of high-intensity breastfeeding on postpartum glucose tolerance in women with recent gestational diabetes. Int Breastfeed J 12(1):1–9. http://doi.org/10.1186/s13006-017-0123-z

Ye W, Luo C, Huang J, Li C, Liu Z, Liu F. 2022. Gestational diabetes mellitus and adverse pregnancy outcomes: Systematic review and meta-analysis. BMJ 377:e067946. http://doi.org/10.1136/bmj-2021-067946

Yeh PT, Kennedy CE, Rhee DK, Zera C, Tunçalp Ö, Lucido B, Gomez Ponce de Leon R, Narasimhan M. 2023. Self-monitoring of blood glucose levels among pregnant individuals with gestational diabetes: A systematic review and meta-analysis. Front Glob Womens Health 4:1006041. http://doi.org/ 10.3389/fgwh.2023.1006041

You H, Lei A, Xiang J, Wang Y, Luo B, Hu J. 2020. Effects of breastfeeding education based on the self-efficacy theory on women with gestational diabetes mellitus. Medicine 99(16):e19643. http://doi.org/10.1097/md.0000000000019643