Gestational diabetes mellitus: management during and after pregnancy - a systematic literature review

Claudia Banowati Subartoa,1,\*, Mohammad Hakimib,2, Yuli Isnaeni a,3

a,b Universitas ‘Aisyiyah Yogyakarta, Jl. Siliwangi (Ring Road Barat) No. 63, Mlangi, Nogotirto, Gamping, Sleman, Daerah Istimewa Yogyakarta, 55122, Indonesia

b Universitas Gadjah Mada, Bulaksumur, Caturtunggal, Depok, Sleman, Daerah Istimewa Yogyakarta, 55281, Indonesia

1 celaudia99@gmail.com\*; 2 moh.hakimi@yahoo.com; 3 isnaeniyuli@unisayogya.ac.id

\* corresponding author

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| ARTICLE INFO |  | ABSTRACT |  |
| Article historyReceivedRevised Accepted |  | **Introduction:** Gestational Diabetes Mellitus (GDM) is one of the most common complications of pregnancy. Women with gestational diabetes have a higher risk of serious health outcomes for mother and baby such as preeclampsia, premature birth and the long term development of type 2 diabetes. This study was conducted to present a review of available research in several countries about GDM management during and after pregnancy.**Method**: Several databases including PubMed, ScienceDirect and EBSco were searched for relevant articles published between January 2009 and January 2019.**Result:** Of the 1186 initial articles identified, this study analyzed 7 relevant articles that met the inclusion criteria. This study showed that management for GDM includes medical nutrition therapy, exercise, monitoring of blood glucose, and insulin therapy if blood glucose is not achieved with that treatment. Exclusive breast feeding for at least three months has been shown reducing the risk of childhood obesity of children, particularly in those born to obese and mothers with GDM**Conclusion:** There is a need to increase awareness of long-term consequences on gestational diabetes, both in patients and in healthcare professionals. Counseling is needed for dietary intervention and physical activity for all postpartum women with a history of GDM to stay healthy or to improve future healthhttps://licensebuttons.net/l/by-sa/3.0/88x31.pngThis is an open access article under the [CC–BY-SA](http://creativecommons.org/licenses/by-sa/4.0/) license.  |  |
| **Keywords**Gestational diabetesRisk factorsInterventionManagementPost-partum |  |

# Introduction

Gestational Diabetes Mellitus (GDM) is defined as glucose intolerance with onset or first recognition during pregnancy [1][2]. GDM is estimated affecting around 7-10% of all pregnancies around the world[3] with an estimated GDM prevalence of 6-13% [4]. The prevalence of GDM varies from some country, European countries 5.4%, Africa 14% [5], and Asian countries range 0,7-51% [6]. The difference in prevalence can be caused by ethnic differences, diagnostic criteria, screening strategies, and population characteristics[7].

GDM is associated with adverse maternal and fetal outcome. The adverse maternal complications include gestational hypertension, pre-eclampsia, polyhydramnios, cesarean section, and shoulder dystocia[8]. Furthermore, children born to mothers with GDM have high risks of developing macrosomia, preterm birth, neonatal hypoglycemia, intensive care, and jaundice[9]. Not only when they are children, but when adolescents also, they have a risk of being obese or having type 2 diabetes[8]. Therefore, GDM management must be implemented as an integrated approach to reduce maternal and neonatal morbidity. Lifestyle changes are the most important component in GDM management[10]. GDM treatment begins with nutritional therapy, exercise, and glucose monitoring. 70-85% of mothers with GDM can control glycemic targets with lifestyle modification. However, about 15-35% of women with GDM need insulin therapy[11]. Women with severe hyperglycemia cannot achieve their glycemic goals with diet and exercise. They still need insulin to control their GDM [12]. It is important to understand earlier on how GDM is detected and managed appropriately so that maternal and neonatal morbidity can be reduced. This research identifies how GDM is managed during and after pregnancy in several countries. This study is useful in enriching the literature on GDM management best-practice.

# Method

# Our method was a Systematic Literature Review (SLR). SLR is a systematic way of collecting, critically evaluating, integrating, and presenting findings from various research studies regarding research topics or research questions that have been determined [13].

* 1. **Research Question**

We determined the research questions based on the objective of this study. Question format was helpful to structure a question that facilitated a focused search. One of the formats used was PICO. The PICO framework is commonly used in evidence-based clinical practice and considered a widely known strategy for framing a foreground research question [14]. This format identifies four concepts: Patient problem or Population, Intervention, the Comparison (if there is one), and Outcome(s)**.** PICO framework is provided in Table 1.

Table 1. PICO Framework

|  |  |  |  |
| --- | --- | --- | --- |
| Patient problem or Population | Intervention | Comparison | Outcomes |
| * Gestational diabetes mellitus
* Gestational diabetes
* Diabetes in pregnancy
* Maternal obesity
* Hyperglycemia
* Postpartum period
 | * Management
* Intervention
* Therapy
* Self-management
 | No treatment  | All study related to management of GDM during and after pregnancy |

PICO framework is helpful to determine the research question

1. RQ 1: How is intervention of gestational diabetes mellitus?

RQ 1 aims to identify forms of GDM intervention during pregnancy. GDM has a significant impact on the health of mother and baby. Moreover, it has a greater risk of pregnancy complications.

1. RQ 2: How is management of postpartum for women who have a history of gestational diabetes mellitus?

RQ 2 focuses on management of postpartum women with a history of GDM. Women with a history GDM have higher risk of GDM in subsequent pregnancies and the development of type II diabetes up to 25 years after giving birth.

* 1. **Search strategy design**

In order for a comprehensive systematic literature review, it is essential that all terms relevant to the research objective are covered in the search. Moreover, we needed to include relevant synonyms and relevant terms, both GDM management during and after pregnancy. The search used three categories of keywords. The first category included the following terms as synonyms for gestational diabetes mellitus: “gestational diabetes, diabetes in pregnancy, and hyperglycemia”. The second category focus on management and included the term “intervention, therapy, and self-management”. For the third category, time content of GDM, the following search terms were used: “during pregnancy, after pregnancy, and post-partum. Keywords and synonyms were connected to logical connector OR and AND. We used the Boolean ‘OR’ to enter alternative spellings and synonyms and used the Boolean ‘AND’ to link the major terms. The search process began with collecting articles from all database sources used, then selecting articles relevant to the research questions.

We used three electronic databases (PubMed, ScienceDirect and EBSco). Zotero software was used to collect and manage article search results. Study selection was performed by reading the titles, abstracts, or full text of the papers. Selected articles with following criteria: 1) Identification management of GDM during and after pregnancy; 2) Publication in the period 2009-2019 and presented in English; and 3) Original research articles. We exclude articles if found abstracts, letters to the editor, guidelines or recommendations, expert opinions, and narrative reviews. To systematize the process of inclusion of studies, we opted for Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). The selection of articles is presented in a flow diagram in Figure 1.



**Figure 1.** PRISMA-Flow diagram of screening, selection process and inclusion of studies.

This study found 12 relevant articles, then it was critically assessed using critical appraisal tool from *The Joanna Briggs Institute*. Critical appraisal is a systematic evaluation of articles to find out the truth and accuracy of the used methods [15]. Furthermore, the Joanna Briggs Institute (JBI) is evidence-based organizations formed to develop methodologies and guidelines on the process of conducting a systematic review [16]. The final result of PRISMA flow diagram was seven articles. To provide greater insight into the context and nature of the seven articles, an overview was provided in Table 2.

**Table 2. Overview of articles**

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| --- | --- | --- | --- | --- | --- | --- |
| **Author** |  | **Main objective of study** | **Study design** | **Data collection** | **Sample size** | **Result** |
| Au et al. [17] | Australia | To describe neonatal outcomes in full term infants from GDM mothers and hyperglycemic mothers | Cross-sectional study | Data on mothers and newborns are collected from hospital records | There are 609 respondents (mother and baby). Of these, there were 532 women who had normal glucose tolerance and 67 were identified as GDM | Glycemic control can be achieved in the majority of GDM mothers. GDM infants were more likely to be induced (p = 0.013) and born earlier than infants with non-GDM mothers (p <0.001) |
| Sklempe Kokic et al. [18] | Croatia | To investigate the impact of a structured exercise program consisting of aerobic exercise and resistance on glycemic control parameters | A randomized control trial | Participants were randomly assigned to a randomized block using a web-based computerized procedure into two groups: experimental and control | 42 women diagnosed with GDM were enrolled in the trial and randomized into two groups: 20 for the experimental group and 22 for the control group | The experimental group had lower postprandial glucose levels at the end of pregnancy (P <0.001). So there is no significant difference between groups in fasting glucose levels at the end of pregnancy. Also, there were no significant differences in the rates of complications during pregnancy and birth |
| Elvebakk et al. [19] | Norwegia | To assess whether women's food and beverage intake with GDM is different from non-GDMT | A longitudinal study | Trials and invitations to participate are sent by mail, together with invitations for ultrasound scanning at 17-19 week gestation | Respondents were participants in the Training in Pregnancy trial, a two-armed, two- centered randomized controlled trial. 855 women fulfill as inclusion criteria | There is a difference food intake in women with GDM and non-GDM. However no relationship was found between food variables and OGTT values. This study explains that there is no reason for differences in diet that can develop GDM |
| Utz et al. [20] | Morocco | To test the hypothesis that GDM screening and initial management at the primary service level will reduce the incidence of macrosomia | A cluster randomized controlled trial | Respondents were collected from pregnant women who attended antenatal services and who were offered offers for GDM screening. Women diagnosed with GDM are given education about nutrition, exercise and further monitoring | Statistical analysis was performed on 210 women who were selected regardless of gestational age at diagnosis and their adherence based on the intention-to-treat principle  | GDM screening and care through antenatal services in primary health facilities can have a positive impact on the outcome of the baby, the birth weight of the baby |
| Rayanagoudar et al. [21] | United Kingdom | To assess the knowledge and health professionals in postpartum care in women with a history of GDM | Questionnaire-based survey | The questionnaire used aims to assess postpartum screening practices, service provision, future risks, and strategies to prevent diabetes in women with a history of GDM. | The study surveyed 106 health professionals including fields, general practitioners, obstetricians and diabetes experts | Most midwives (81%) and obstetricians (52%) underestimate the responsibility of screening immediately after giving birth to mothers with a history of GDM. they are referred to as elements of diabetes risk in the future. |
| Wang et al. 2015 [22] | China | To evaluate whether exercise interventions can be applied to pregnant women with GDM to control excess weight gain during pregnancy and to handle GDM-related outcomes . | A large retrospective study | The questionnaire was designed to obtain information on all pregnant women and collect their medical records after giving birth. | 14,168 single pregnant women without diabetes from 15 hospitals | 19.4% of pregnant women were diagnosed with GDM, 74.9% of them received sports intervention during pregnancy with a starting time of 25 week of pregnancy. They had the lowest increase in BMI during late and mid-pregnancy compared to women with GDM without sports intervention. However, women with GDM with exercise interventions with diet have the lowest macrosomia rates. |
|  |
| Persson Winkvist & Mogren [23] | Sweden | To investigate the associations between lifestyle and health outcomes. | Retrospective study | Random samples were identified from the Medical Birth Register and questionnaires sent by post to eligible women about four years after pregnancy | 882 were identified from the Medical Birth Register and 444 women (50.8%) agreed to participate,  | Counseling is needed by postpartum women with a history of GDM to educate about dietary interventions and physical activity in order to continue to improve health in the future. Counseling should be carried out by registered nutritionists and experienced nutritionists in GDM management |

# Results and Discussion

# The seven articles were originated from developed and developing countries in Europe, Africa and Australia, perhaps reflected a greater governmental and researcher attention to deal with GDM issues. Among the seven studies investigated in this systematic review, five studies focused on GDM management for pregnant women[18][19][20][22][23], one showed neonatal outcome of GDM [17], and another one showed postpartum care of women with GDM [21].

* 1. **Management of GDM**

The initial treatment of GDM involves diet modification, glucose monitoring, and moderate exercise. If diet management is deemed to have failed to achieve a blood glucose levels, oral anti-diabetes drugs or insulin must be used. These findings highlight that medical nutritional therapy is the basis of GDM treatment [23] and is defined as the process of planning eating patterns, adapting the eating patterns and assessing the success of dietary interventions [24]. Persson Winkvist and Mogren [23] found that food plans should provide adequate calorie intake to improve fetal and maternal health, to acquire glycemic goals, and to increase weight according to gestational age. Similar findings were identified in the American Diabetes Association (ADA)[25] that the daily meal plan for GDM includes three small to moderate-sized meals and two-four snacks. One of which should be at bedtime to prevent the development of ketosis overnight. Meals were defined as three main eating occasions “breakfast, lunch and dinner”. Some women consume snacks as recommendations from health professionals, their own preferences due to hunger/appetite or out of habit [24].

Moreover, The American College of Obstetricians and Gynecologists (ACOG) [2] has identified that nutrition therapy for women with GDM must pay attention to calorie distribution of carbohydrate restriction. The ACOG guidelines recommend a calorie distribution of 33-40% carbohydrates, 20% protein, and 40% fat. Complex carbohydrate intake is better than simple carbohydrate intake because complex carbohydrates are less likely to cause postprandial hyperglycemia [2]. This literature [23] showed that Swedish born woman with a history of GDM known to have irregular eating habits compared to women with history of normal pregnancy. Previous study [26] has shown that consuming fruits and vegetables in large quantities and reducing starchy foods, red meat, and sugary drinks may delay or prevent the development of type 2 diabetes. Health services regarding GDM also reported by Utz et al. [20] explaining that screening and initial management of GDM at health facilities followed routine practice using national recommendations. All women with GDM must receive food counseling at the time of diagnosis, which is provided by a registered or experienced nutritionist in GDM management.

Similar to medical nutrition therapy, Sklempe Kokic et al[18] reported that physical activity is a key component in initial GDM management. Physical activity improves insulin sensitivity and reduces fasting and postprandial glucose concentrations in patients with DMG. This study underlines that exercise interventions performed early in pregnancy can reduce the risk of excessive Gestational Weight Gain (GWG) in the first and early second trimester and can possibly reduce the incidence of GDM[19][27]. ADA and ACOG recommends a moderate exercise program consisting of 30 minutes almost every day of the week for women with GDM who do not have medical contraindications for physical activity [28]. Blumer *et al* found that moderate exercise include brisk walking, recumbent bicycling, or 10 minutes of seated arm exercises after each meal [29]. Furthermore, the result of this study also found that combining aerobic and resistance exercises has beneficial effects on glycemic control. Moreover, it is a safe therapeutic strategy for pregnant women with gestational diabetes mellitus [18]. Shepherd et. al explained that each of the dietary and exercise interventions aimed for prevention of type 2 diabetes. But recently there has been a shift that combines the two interventions to get an effective lifestyle intervention [30].

Women with GDM are advised to control their blood glucose immediately after the diagnosis of GDM in order to minimize adverse pregnancy outcomes. Women are instructed to monitor blood glucose 4 times a day, fasting glucose (upon awakening), and one or 2 hour post-meals (after the first bite of a meal) [31]. Other study has suggested that blood glucose monitoring between four and seven times per day (including fasting and post-prandial measurements) can contribute to improving maternal and perinatal outcomes [32]. The target glycemic goal for women with GDM is to keep the fasting glucose ≤ 5-5.3 mmol/l (90-95 mg/dl), and either one-hour post-meal ≤ 7.8 mmol/l (140 mg/dl) or 2-h post-meal ≤ 6.7 mmol/l (120 mg/dl). Management of GDM allow patients to understand the relationship between meals, snacks, physical activity, and blood glucose levels [33]. GDM is one indication for induction cases (79%). There was also a higher rate of labor induction in GDM group treated with insulin compared to women with GDM who were predominantly diet-controlled only [17]. Most of the available data on the safety of non-insulin antihyperglycemic agents in pregnancy focus on glyburide and metformin. In Europe and South Africa, glyburide and metformin have been used in pregnancy for years without reporting side effects on the fetus [31].

* 1. **Neonatal outcome**

The relation between a woman with GDM and negative outcomes has been widely discussed in several studies. Therefore, it is not surprising that neonates born to women with GDM are much heavier, premature, and were delivered more often by cesarean section than children of woman without diabetes [34]. It includes fetal distress, cesarean section and poor Apgar score, large gestational age, neonatal hypoglycemia, and intensive care at the NICU. Other study conducted by Domanski et al. [34] showed that neonatal hypoglycemia is a complication often found in GDM. Research from Kamana [35] explained that hypoglycemia causes more serious complications such as central nervous system and cardiopulmonary disorders disruption. Long-term complications can cause mental retardation, recurrent seizures and developmental delays. In addition, explained that neonates with macrosomia requires high oxygen demand. This can lead to an increase in bilirubin, resulting in neonatal jaundice. Releated with Junior et. al [36] that fetal macrosomia is a clinical risk factor for shoulder dystocia and associated with increased risk of cesarean section or trauma in normal births. Children suffering from neonatal hypoglycaemia may develop motor and learning impairments and behavioral difficulties. Au et al. [17] confirmed that women with GDM who had proper management, neonatal complication were not significantly increased significantly.

* 1. **Postpartum care of women with GDM**

The postpartum period is the right time to start and improve a healthy lifestyle [23]. ADA, ACOG, and the World Health Organization (WHO) recommended that women with GDM have to be tested for abnormal glucose tolerance from 6 to 12 weeks postpartum. Also in women with a history of GDM must undergo lifetime screening for the development of glucose intolerance, at least every 3 years. Furthermore, ADA recommends that all women with a history of GDM should be educated about lifestyle modification, while ACOG recommended women with additional risk factors such as obesity to receive diet, exercise, and weight management counseling [2]. In postpartum, exclusive breast feeding for at least three months has been evidenced in reducing the risk of childhood obesity in children, particularly in those born to obese and mothers with GDM [17].

Releated with research of Junior et.al [37] that benefits of breastfeeding is good for mothers who are overweight or who have GDM because breastfeeding is associated with a reduced risk of type 2 diabetes and the potential for weight loss in the postpartum period. Morever, Persson Winkvist & Mogren [23] reported that counseling is needed for dietary intervention and physical activity for all postpartum women with a history of GDM in order to stay healthy or to improve future health. Midwives must consistently screen postpartum women with a history of GDM for using a glucose tolerance either fasting blood sugar or a 2-hour oral glucose test, and motivate this woman to exercise regularly and lose weight if they are overweight or obese [38]. Their knowledge and attitude have an impact on mother’s behavior, especially adherence to follow-up an antenatal care. In this review, Rayanagoudar et al. [21] showed that many obstetricians and general practitioners underestimated, or are uncertain about the increased risk type 2 diabetes for mothers with a history of GDM. It might be the reason why some care providers do not continue to follow up if it is early post-partum screening test.

# Conclusion

GDM management involves diet modification, exercise and glucose monitoring. Insulin has become an alternative treatment when lifestyle interventions do not maintain glycemic control during pregnancy. Diet and exercise interventions have proven to be effective lifestyle interventions for GDM. Women with a history of GDM must undergo life-long screening for the development of glucose intolerance, at least every 3 years. Exclusive breastfeeding with a minimum of three months has been shown to reduce the risk of obesity in children, especially those born to GDM or obese mothers, also related to a reduced risk of type 2 diabetes and weight gain in the postpartum period. Therefore, increased awareness of the long-term consequences of GDM is needed for both patients and health professionals. Midwives have a pivotal role in antenatal and postnatal care because they are often associated with pregnant women and new mothers.

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