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The influence of maternal physical activity on gestational diabetes mellitus

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Abstract
Gestational diabetes mellitus (GDM) is a prevalent pregnancy-related complication characterized by abnormal maternal glucose metabolism, leading to adverse pregnancy outcomes and long-term health implications. This review aims to investigate the effects of maternal physical activity during pregnancy on various aspects of GDM. It seeks to provide valuable insights into strategies for reducing the risk and severity of GDM, managing complications, and improving the overall health of both mother and fetus during pregnancy. To achieve this, we conducted a comprehensive literature search across various databases, using specific keywords related to GDM, exercise, physical activity, pregnancy, and gestational diabetes. The findings emphasize the potential of maternal physical activity as a promising strategy for preventing and managing GDM. Personalized exercise programs, supervised by qualified professionals, play a pivotal role in ensuring the safety and effectiveness of exercise during pregnancy. Adopting a holistic approach to GDM management, which includes physical activity, is crucial for enhancing the health outcomes of both the mother and the child. This review contributes to our understanding of the role of exercise in mitigating the risk and severity of GDM and its positive impact on overall maternal and fetal well-being.

Keywords: Exercise, Physical activity, Gestational diabetes mellitus, Diabetes, Gestational diabetes, Pregnancy
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Introduction

Gestational diabetes mellitus (GDM) as a common pregnancy-related complication is characterized by the development of diabetes due to abnormal maternal glucose metabolism during pregnancy. It heightens the risk of adverse pregnancy outcomes, including preterm birth, stillbirth, preeclampsia, and macrosomia (1). Although it typically resolves after delivery, women affected by GDM are more likely to experience its recurrence in subsequent pregnancies and may face an increased risk of developing cardiovascular disease and diabetes in the future, leading to enduring implications for both maternal and child well-being (2).

The primary objective of GDM treatment is to normalize maternal blood sugar levels while minimizing the risk of hypoglycemia. Management of GDM leads to better outcomes for infants and reduces the risk of adverse events. According to the American diabetes association, approximately three-quarters of women diagnosed with GDM can be effectively treated with lifestyle modifications, depending on the population and diagnostic criteria. The initial approach to management emphasizes educating patients about dietary and lifestyle choices, including changing eating habits, controlling weight, and increasing physical exercises (3, 4).

The promotion of a healthy diet, reducing the intake of simple sugars, and considering a low glycemic index diet are among the dietary recommendations for managing GDM. Nevertheless, there is limited evidence regarding the most effective diet for GDM management. While research demonstrated that dietary and lifestyle adjustments can enhance perinatal outcomes in GDM compared to standard care, there remains a debate about whether non-pharmacological methods are as effective as medication in GDM management (5, 6).

Diet and physical activity constitute the fundamental strategy for managing GDM, especially when women necessitate treatment involving oral medications or insulin therapy. Doing exercise before and during the early stages of pregnancy is suggested due to having a protective impact in reducing the risk of developing GDM. Once diagnosed, exercise plays a beneficial role in enhancing blood glycemic control and may bring about lasting changes in health-related behaviors (7). Exercise has been

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Implication for health policy/practice/research/ medical education

Gestational diabetes mellitus (GDM) is a common pregnancy-related complication. Although it typically resolves after delivery, women affected by GDM are more likely to experience its recurrence in subsequent pregnancies. Engaging in physical activity reduces the risk of complications and severity of the condition and enhances overall health outcomes for both the mother and child. Therefore, a comprehensive approach to GDM management is essential, with exercise as a fundamental component.

widely recognized and recommended as an adjunctive therapy for managing type 2 diabetes mellitus (T2DM) in non-pregnant people based on its ability to better blood sugar control by enhancing insulin sensitivity and increasing muscle glucose uptake stimulated by insulin (8).

This review aims to investigate the effects of maternal physical activity during pregnancy on various aspects of GDM. It seeks to provide valuable insights into strategies for reducing the risk and severity of GDM, managing complications, and improving the overall health of both mother and fetus during pregnancy.

Methods

In this narrative review, we endeavor to investigate the potential correlation between physical exercise and GDM. To achieve this, we searched and extracted relevant English publications from the Web of Science, Scopus, PubMed, and Google Scholar using specific keywords including GDM, exercise, physical activity, pregnancy, and Gestational diabetes. We attempted to find the relationship between physical exercise and GDM.

Results

Gestational diabetes mellitus is a condition characterized by impaired glucose tolerance, resulting in hyperglycemia, and it is typically diagnosed for the first-time during pregnancy. It is a global concern, affecting approximately 20% of expectant mothers (9). The development of GDM is associated with two key factors. Firstly, it involves the dysfunction of pancreatic beta cells or a delayed response of these cells to fluctuations in blood sugar levels. Secondly, it entails the induction of substantial insulin resistance due to hormonal releases originating from the placenta (9).

From a physiological perspective, pregnancy leads to an increased demand for insulin. Various factors contribute to this heightened demand, such as maternal calorie intake, weight gain, placental hormones, heightened prolactin, and increased growth hormone secretion. As pregnancy advances, the pancreatic β-cell mass expands to meet the growing insulin requirements. Failure in this β-cell expansion results in GDM with a relatively insufficient increase in insulin secretion. It's noteworthy that hyperglycemia affects approximately 15% of pregnancies (10).

Risk factors of GDM

The risk of developing GDM increases under certain conditions. Clinical risk factors associated with its development include (11):

- Obesity, indicated by a body mass index (BMI) exceeding 25.
- Reduced levels of physical activity.
- Having a first-degree relative diagnosed with diabetes mellitus (DM).
- A prior history of GDM
- The delivery of a newborn with macrosomia (birthweight >4500 g)
- Low levels of high-density lipoprotein cholesterol.
- Triglyceride levels exceeding 250.
- Polycystic ovarian syndrome.
- Hemoglobin A1C levels exceeding 5.7.
- Abnormal oral glucose tolerance test.
- Any noteworthy sign of insulin resistance, such as acanthosis nigricans.
- Cardiovascular diseases (CVDs) as a Previous medical history.

Identifying the risk factors naturally segues into a discussion about modifiable lifestyle elements, with excess weight and obesity being prime examples of conditions that can be effectively changed.

The diagnosis of GDM

The diagnosis of GDM adhered to a one-step method by the guidelines set by the International Association of Diabetes in Pregnancy Study Groups (IADPSG). During the 24th to 28th weeks of pregnancy, all expectant mothers were given a 75 g glucose solution. Their blood glucose levels were subsequently assessed after a two-hour interval. Confirmation of GDM hinged on whether at least one of their plasma glucose readings met or exceeded the recommended thresholds. Upon receiving a GDM diagnosis, women were provided with guidance to adapt their lifestyle, dietary choices, and nutritional habits. Additionally, they were instructed to regularly monitor their blood glucose levels through the use of glucose meters. If these management strategies proved inadequate in maintaining fasting glucose levels below 95 mg/dL and 1-hour postprandial levels below 140 mg/dL, insulin therapy was prescribed. It is suggested to consider a screening approach for the detection of pre-GDM or GDM early in all women who are overweight/obese and exhibit one or more of the GDM risk factors (12).

The consequence of GDM

Gestational diabetes mellitus elevates the risk of complications during and after pregnancy for both the mother and child. Maternal risks associated with GDM include an elevated risk of developing T2DM and CVDs.

The rate of T2DM experiences a substantial increase in the months following delivery and continues to rise over time without reaching a plateau level. Women with a history of GDM exhibit a notably increased risk of metabolic syndrome, high blood pressure, and obesity all of which are recognized as risk factors for CVDs. More study is needed to pinpoint and validate biomarkers for CVD and to ascertain whether lifestyle changes and pharmaceutical interventions can effectively lower the risk of cardiovascular complications in these women(13).

Treatment approaches of GDM

The main aim of managing GDM is to control blood glucose levels to closely resemble normal levels, which is crucial in preventing excessive adiposity or fetal growth (14). In a majority of cases, these lifestyle modifications prove effective in achieving glycemic control during pregnancy. However, in the remaining instances where a pharmacological approach is required, injectable insulin is typically the first-choice treatment. Barriers to insulin therapy in pregnant women would include concerns related to accessibility, patient preferences, needle phobia, cost, and risk of hypoglycemia. In these situations, oral medications may be considered as an alternative treatment. It's important to note that some studies support the effectiveness of glyburide, an insulin secretagogue, or metformin in lowering blood glucose levels in pregnant women diagnosed with GDM. Many scientific organizations and standards, however, do not advise using these drugs as the main pharmacological therapy. One of the main reasons is that these antidiabetic medications such as metformin, unlike insulin, may cross the placenta and affect embryonic development (15). Metformin can serve as a viable pharmacological option for GDM management when medical nutrition therapy and physical activity fall short. However, caution is warranted because it can pass through the placenta and potentially influence fetal growth and development. Although some clinical data indicate potential benefits during pregnancy, such as preventing preeclampsia, further research is necessary to grasp its comprehensive effects on the long-term health of offspring. Ensuring the well-being of both the mother and child is a fundamental aspect of GDM management (16).

A significant approach to achieving this goal is by adjusting the composition and timing of carbohydrate intake, favoring low-to-medium glycemic index carbohydrates, and increasing meal frequency. It is worth noting that there is limited available data on a specific dietary regimen for GDM. As per international guidelines, women diagnosed with GDM are advised to promptly initiate a tailored nutritional plan and engage in physical activity to maintain maternal fasting and post-meal blood glucose levels within the recommended targets (15).

The exercise guidelines in GDM

Safety during pregnancy is paramount, and studies have demonstrated that a range of exercises, from gentle activities like yoga to more vigorous ones like aerobic classes and jogging, would be safe for both the mother and child. However, certain precautions must be observed. Avoid exercises with a higher risk of forceful contact or falling, supine positions after the first trimester, motionless standing, and scuba diving. Recreational physical activity is encouraged, as it enhances general well-being and pregnancy outcomes, while also benefiting maternal mood and mental health (17).

Here are the recommended exercise guidelines for GDM based on the types of exercise:

Aerobic exercise

- Type of Exercise: Aerobic activities involving major muscle groups characterized by rhythmic motion, such as walking, running, swimming, and cycling.
- Intensity: Moderate, maintain an exercise intensity within the range of 60% to 90% of your Age Predicted Heart Rate Maximum (APHRM), coupled with a rate of perceived exertion (RPE) scale of 12-14. Individuals who have been predominantly sedentary and are overweight or obese should commence training at an intensity of 20%-30% of their age predicted VO2 reserve (APVO2R) with an RPE of 12-14.
- Vigorous: strive for an RPE of 14-16.
- Duration: participate in these activities for a maximum of 30 minutes without interruption, with the option of extending to 45 minutes if self-paced.
- Frequency: exercise on non-consecutive days with no more than two consecutive sessions.

Resistance exercise

- Type of exercise: resistance exercises involving multiple joints that engage large muscle groups, including the utilization of dumbbells, resistance bands, and involvement in pregnancy Pilates.
- Intensity: maintain a moderate exercise intensity equivalent to 50% of your one-repetition maximum (1RM).
- Exercises: incorporate 5-10 distinct exercises.
- Repetitions: execute 8-15 repetitions for each exercise.
- Sets: aim for 1-2 sets.
- Duration: dedicate approximately 60 minutes to resistance exercises.
- Frequency: ideally, partake in resistance exercises at least 2 times a week, with the optimal frequency being 3 times a week.

These exercise guidelines provide a systematic framework for upholding a healthful exercise regimen during pregnancy, accommodating various intensity levels, durations, and frequencies to cater to individual requirements and circumstances (18).

Discussion

Effective management of GDM is a critical aspect of

ensuring the well-being of both the mother and the child. Among the strategies for GDM management, the role of physical activity is of particular interest. In terms of GDM treatment, exercise has been shown to effectively manage glucose levels, potentially reducing or delaying the need for insulin therapy. Doing exercise before and during the early stages of pregnancy is suggested due to having a protective impact in reducing the risk of developing GDM. Once diagnosed, exercise plays a beneficial role in enhancing blood glycemic control and may bring about lasting changes in health-related behaviors (7). Exercise has been widely recognized and recommended as an adjunctive therapy for managing T2DM in non-pregnant people based on its ability to better blood sugar control by enhancing insulin sensitivity and increasing muscle glucose uptake stimulated by insulin (8).

Pre-pregnancy inactivity prompts consultation with a healthcare provider and the inclusion of an exercise physiologist for tailored exercise guidance. Pregnancy brings contraindications, including absolute cases, which require caution, and relative ones, mandating individual assessment. The exercise physiologist's role lies in carefully interpreting healthcare provider advice to balance benefits and exercise-related risks based on both absolute and relative contraindications during pregnancy. The specific guideline for physical activity in women with GDM recommends engaging in moderate-intensity exercise for 30 to 60 minutes, three times a week. A previous study observed that GDM women who participated in over 60 minutes of physical exercise had a reduced risk of experiencing abnormal plasma glucose levels. However, there is limited evidence available regarding the optimal duration and quantity of physical activity needed to effectively manage elevated glucose levels in women with GDM. Additionally, there remains a gap in research examining the impact of moderate-intensity physical activity on glucose control during fasting and two hours after a meal (18,19).

Conclusion

Maternal physical activity represents a promising management and treatment strategy for women at risk of or diagnosed with GDM. Engaging in physical activity reduces the risk of complications, and severity of the condition, and enhances overall health outcomes for both the mother and child. Therefore, a comprehensive approach to GDM management, with exercise as a fundamental component, is essential. It is imperative that exercise programs be personalized by qualified professionals to ensure a safe and effective approach to pregnancy exercise.

Authors' Contribution

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Conflicts of interest

All authors declare that they have no conflict of interests.

Ethical issues

Ethical issues (including plagiarism, data fabrication, and double publication) have been completely observed by the authors.

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