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Current Application Status of low glycemic load (LGL) Diet in Gestational Diabetes Mellitus (GDM)

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Abstract:

During pregnancy, gestational diabetes is the most common metabolic disorder disease, it has a serious impact on mothers and infants, and the rate of illness is also showing an up trend year by year. Although the traditional anti-glycation drugs can control the blood sugar level, but it has certain limitations and it is no conducive to monitor the conditions about mothers and infants in real time. In recent years, new treatment options such as dietary therapy keep emerging, which provides more choices for patients with gestational diabetes. This thesis summarizes the research progress of low glycemic load (LGL) diets in GDM. According to current research, LGL diet can modify blood glucose levels, lipid profiles and nutritional intake in GDM patients and alter the consequence about mothers and infants, thereby revealing promising application prospects. However, the LGL diet plan has shortcomings at the research and practice levels. There is a lack of high-quality evidence-based evidence to support it. There is a standard consensus on constituting an ideal LGL/LGI diet, and there are significant individual differences among patients. These issues need to be further addressed. In the future, it is necessary to enhance clinical research on LGL diet and optimize treatment plans to improve the therapeutic effect and safety of GDM.

Keywords: Low glycemic load (LGL); Gestational diabetes mellitus (GDM); Glycemic index.

1. Introduction

GDM means a metabolic disorder disease where the blood sugar levels and sugar metabolism are normal before pregnancy, but the blood sugar levels increase during pregnancy. When pregnant women exhibit pronounced symptoms such as excessive thirst, frequent urination, increased appetite, abnormal weight gain, fatigue, dizziness, and skin itching, it can be diagnosed through an oral glucose tolerance test, and there may be varying degrees of impaired glucose tolerance. As the most common metabolic disorder

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during pregnancy, data from the International Diabetes Federation's Diabetes Atlas (11th Edition) indicates that the global incidence of GDM is rising annually. Currently, approximately 17% of women experience hyperglycemia during pregnancy, with about 80% of these cases attributable to GDM. Its core harm lies in increasing the risk of maternal and fetal complications, such as preeclampsia, miscarriage, preterm birth, various acute diabetic complications (e.g., ketoacidosis, skin abscesses), and macrosomia. It also heightens the risk of adverse long-term outcomes for offspring, including neonatal hypoglycemia and an increased risk of developing diabetes later in life.

The preferred approach for managing GDM is through dietary intervention to control carbohydrate intake, thereby regulating insulin and blood glucose levels. Common diets include the low glycemic load (LGL) diet, low glycemic index (GI) diet, Mediterranean diet, and high-fiber diet. Among them, the LGL dietary pattern centers on maintaining blood sugar balance as its primary objective; it shows positive potential in stabilizing blood sugar, regulating insulin, and improving maternal and infant outcomes. However, no studies have systematically organized and analyzed the overall principles and comprehensive application of the LGL diet, nor can it be verified whether it can replace current dietary therapies. Therefore, this study, based on the dietary patterns of GDM patients, aims to investigate the effects of the LGL diet on glycemic control and maternal-fetal outcomes in GDM patients, providing a theoretical reference for Further improving dietary arrangements for patients with GDM.

2. Diagnostic Criteria for GDM

Screening and diagnosis of GDM primarily rely on the 75-gram oral glucose tolerance test (OGTT), and the standard procedure requires pregnant women to fast for at least 8 hours between 24 and 28 weeks of gestation (high-risk individuals must be screened during their initial prenatal visit), ensuring normal dietary intake in the preceding three days. Followed by oral ingestion of 300ml of liquid containing 75g of glucose within 5 minutes. Venous blood samples are collected before glucose ingestion, and at 1 and 2 hours post-ingestion. A diagnosis is confirmed if blood glucose levels at any time point meet or exceed either of the following thresholds: fasting blood glucose (FBG) ≥5.1mmol/L or 2-hour glucose ≥8.5mmol/L; Pregnant women with high-risk factors such as obesity (BMI ≥ 28 kg/m²), a history of gestational diabetes mellitus (GDM), a history of delivering a macrosomic infant, polycystic ovary syndrome (PCOS), or a family history of diabetes should undergo screening immediately during their first prenatal visit. If the first result is normal, it still needs to be rechecked OGTT between 24 and 28 weeks, and it is necessary to recheck and confirm based on the monitoring results of glycated hemoglobin (HbA1c) and fasting blood glucose (FBG). Finally, it is up to physician to evaluate whether the pregnant woman is GDM based on the test results [1,2].

3. Pathogenesis and Influencing Factors of GDM

GDM high risk factors include both non-modifiable factors and modifiable factors. non-modifiable factors include advanced maternal age (≥35 years), due to the decline of ovarian function, the metabolic capacity decreases. Additionally, during pregnancy, the placenta secretes hormones such as cortisol and progesterone, which intensify the antagonistic effect on insulin and further aggravate insulin resistance (IR). At the same time, the function of pancreatic beta cells declines with age, unable to make up for the post meal hyperglycemia caused by insulin resistance [3,4]. The family history of diabetes damages the secretion function of pancreatic beta cells through genetic susceptibility (such as abnormal expression of glucose kinase genes and sulfonylurea receptor genes) and participates in the immune response through human major histocompatibility complex genes. Together with insulin resistance, it increases the risk of gestational diabetes mellitus; Patients with PCOS (Polycystic Ovary Syndrome) who have a history of hyperandrogenemia will further aggravate insulin resistance (IR), leading to an increase in endogenous glucose production and promoting gluconeogenesis, thereby raising blood sugar levels; Among the variable factors, obesity (before pregnancy BMI ≥ 28 kg/m²) blocks insulin receptor signal transduction by releasing free fatty acids and inflammatory factors from adipose tissue, directly aggravating IR and increasing the risk of gestational diabetes mellitus. The high sugar and high fat diet forces the pancreatic β cells to over secrete insulin, which, over time, leads to β cell failure and exacerbates insulin secretion defects [3,5]. Smoking and excessive drinking damage the function of vascular endothelium, while staying up late disrupts the cortisol rhythm, both of which indirectly increase blood sugar levels.

Most of the high risk factors contribute to the occurrence of GDM through a vicious cycle involving IR's inhibition of insulin-promoted glucose uptake, the inability of β cell function to compensate for the metabolic demands, and the persistent damage to pancreatic function caused by genetic and inflammatory mechanisms. Controlling modifiable factors (such as weight loss and improving diet) can partially reverse IR and protect β cell function, making it

a key intervention measure for reducing the risk of GDM.

4. GDM Treatment Protocols and Current Status

4.1 Medical Nutrition Therapy (MNT)

By implementing dietary intervention to control the intake of carbohydrates, the insulin levels and blood sugar levels can be regulated to be within the normal range, ensuring the nutritional intake for both the pregnant woman and infant. Common dietary approaches include the LGL diet, LGI diet, Mediterranean diet, and high-fiber diet. Among these, the LGL diet demonstrates notably effective results [5]. The LGL diet emphasizes selecting carbohydrates with a low glycemic index (GI) and high fiber content. This helps slow sugar absorption, maintain stable blood sugar levels, and improve insulin sensitivity, making it suitable for nutritional needs during pregnancy. Through personalized dietary guidance and nutrition education, pregnant women can effectively adjust their dietary structure to ensure fetal nutrition while achieving blood glucose control. This approach offers excellent feasibility and safety, making it easy to adhere to long-term.

The current novel treatment approach for GDM primarily combines continuous glucose monitoring (CGM) with dietary therapy, supplemented by appropriate exercise, to achieve an effective, safe, and stable treatment method. However, due to the lack of experimental data and clinical cases regarding dietary therapy, it remains challenging to establish clear standards for this therapeutic approach.

4.2 Pharmacological Treatment

Current drug therapy primarily involves insulin injections and oral hypoglycemic medications. Insulin therapy involves controlling fasting blood glucose or 2 hour postprandial blood glucose through diet or exercise, using basal insulin (such as insulin glargine) combined with mealtime insulin (such as insulin aspart). Insulin dosages must be individually adjusted by a physician based on the patient‘s specific needs. The commonly used oral hypoglycemic agent is metformin, but this treatment is only indicated for individuals who refuse insulin therapy and require close fetal monitoring by a physician [3]. However, while current drug therapies can control blood glucose levels, they come with issues such as weight gain, risk of hypoglycemia, and poor compliance, making it difficult to meet the dual demands of safe glucose control and balanced nutrition during pregnancy.

4.3 Exercise Therapy

Patients are advised to develop healthy lifestyle habits and engage in regular, appropriate exercise. Under the guidance of a healthcare professional, perform moderate-intensity aerobic exercise (such as walking, prenatal yoga, or other gentle activities) for 30 minutes at least five times per week. Additionally, it is recommended that pregnant women take a 10 to 15 minute walk after meals. This exercise effectively boosts metabolism, lowers blood sugar levels, and enhances insulin sensitivity, thereby exerting a therapeutic effect on GDM [3].

5. The Effect of LGL Diet on GDM

The LGL diet is a food plan designed for the regulation of blood sugar level and fluctuation by issuing foods having a lower glycemic load. It comprises carbohydrates, vegetables, proteins, fats, and so forth and keeps the priority for balancing the foods' "glycemic index (GI)" and "carbohydrate content" for regulation of level. It primarily evaluates the overall blood sugar level by managing the carbohydrate-containing level of foods. The LGL diet holds high potential and efficiency for the prevention of diabetes and blood sugar regulation. It primarily chooses the foods having a lower glycemic load and those that are higher in dietary fiber, which decrease the rate of entry of glucose to the body, reduce the carbohydrate level, delay the post-meal increase of blood sugar level, and relieve the workload of the pancreas, keeping the stable secretion of the insulin stable and functioning properly [6,7].

5.1 Reducing Inflammation, Controlling Blood Sugar

Interleukin-6 (IL-6) plays a central role in mediating subacute inflammation in pregnancy and aggravating insulin resistance (IR). It is possible to lower the levels of inflammation that inhibit carbohydrate metabolism by decreasing the levels of IL-6. Analysis of research on pregnant diabetic women and type 2 diabetic women revealed that a diet for a low GI significantly lowered the level of IL-6 in the serum of GDM patients when compared to a diet for a high GI diet [8]. Moreover, in diabetic women, the level of IL-6 in the group that followed the diet for a low GI/GL significantly lower than when they followed the diet for a medium/high GI/GL. Macrophage count in the placenta tissue in high-risk patients with GDM increased 2-3 times and the levels of mRNA of IL-1, TNF-α, and IL-6 significantly increased. This indicates that the LGL diet has the ability to lower the release of the factors that are pro-inflammatory factors, reduce inflammation and thereby delay carbohydrate conversion to sugar, stabilize

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sugar in the blood and prevent sudden spikes in sugar in the blood that may have adverse effects on the fetus for patients with GDM [9].

5.2 Improving Pregnancy Outcomes

A meta-analysis of 10 randomized controlled studies (n=2304) examined the impact of low glycemic index or glycemic load diets during high-risk pregnancy with gestational diabetes upon the outcomes for the mother and the newborn. Results indicated that the low GI/GL diet significantly regulated the weight gain range in pregnant women (mean reduction of 1.01 kg), significantly lowered excessive weight gain in pregnancy risk (OR=0.69), and significantly lowered the number of large-for-gestational-age newborns (OR=0.32) and the number of preterm newborns (OR=0.45). The subgroup analysis further established that for pregnant women with a body mass index >30, a diet of low GI also lowered the risk of cesarean delivery [10].

A controlled research for 110 GDM cases consisted of a conventional dieting group and a observation group using LGL diet (55 cases for each) revealed that the rates of preterm delivery (5.45% vs. 18.18%), macrosomia (7.27% vs. 21.82%), and fetal stress (10.91% vs. 27.27%) significantly decreased in the LGL dieting group when contrasted with the conventional dieting group ($p<0.05$ for all). This demonstrates the LGL diet's promising effects for the better result of pregnancy in GDM patients [11].

5.3 Postpartum Outcomes

The risk of postpartum development of type 2 diabetes in GDM patients is 10 times higher than that in the general pregnant population, and they also face a higher risk of early cardiovascular diseases [9]. A clinical study with 60 type 2 diabetes patients implemented an appropriate LGL diet for 6 months. The results showed significant reductions in fasting blood sugar, hemoglobin A1c (HbA1c), and total cholesterol. Additionally, the intake of energy, nutrients, and low glycemic foods significantly increased, indicating that the LGL diet can improve blood sugar, blood lipids, and nutrient intake in type 2 diabetes patients within 6 months [12].

6. Limitations of LGL Diet in Managing GDM

Although the LGL diet has shown multiple significant benefits in improving GDM patients' conditions, there are still certain limitations when it comes to implementing dietary interventions.

6.1 Individual Differences

Several factors must be taken into consideration when using the LGL diet, and the most important of these are the cognitive and execution capabilities demanded of GDM patients. Points of background difference, culture, and physical states may all lead to greater challenges when using the LGL diet or may result in its inability to be implemented. Points such as allergy to soy products, kidney impairment, nut allergy, or religious concerns may all become issues. It has been noted by guidelines that overlooked cultural differences may result in patient adherence to the diet reducing by 30%-50% and that this may hinder the reaching of target blood sugar levels of control (e.g., fasting blood sugar < 5.3 mmol/L and 2-hour postprandial blood sugar < 6.7 mmol/L). For patients with soy product allergy or those patients with kidney impairment or nut allergy, guidelines indicate that around 15%-20% of these patients would have to modify the basic LGL diet format. The proportion of carbohydrates to proteins also would have to be recoupled by a dietitian. Thus, a blanket solution using the LGL diet is not appropriate for all. Making the diet individual to the individual patient's condition makes the implementation all the harder [13].

6.2 Lack of Evidence-Based Support

There are also a number of contentious issues in the diagnosis and treatment of GDM. A number of high-quality studies have established that the LGL diet and conventional diabetic diets show no statisically significant difference in the outcomes for GDM mothers and newborns, and the benefits of the LGL diet have also failed to stand the test. For instance, the UK UPBEAT trial that involved obese pregnant women specifically established that when the dietary GL was lowered using intervention, it also failed to lower the risk of the occurrence of GDM or the prevalence of large-for-gestational-age infants. This indicates that the intervention effects for the LGL diet are restricted for the high-risk population of obese pregnant women. Moreover, the LGL diet failed to lower the requirement for the utilization of insulin or offer clear evidence that it is a more realistic diabetic dietary treatment than the conventional diabetic diet treatments, owing to contradictory data in pertinent studies [9].

7. Conclusion

There is a current lacuna in the scientific study and clinical implementation of GDM (Gestational Diabetes Mellitus) diet interventions. There is insufficient powerful experimental evidence to justify these interventions, not to mention a consensus on standards that represent an ideal

LGL (Low Glycemic Load) or LGI (Low Glycemic Index) diet. Moreover, high-quality studies investigating the effects on infants and newborns are scarce, limiting the effectiveness of the effectiveness of LGL/LGI diets. The non-existence of international standards translates into a lack of coordinated guidance for clinical applications. Furthermore, study designs are also subject to ethical limitations, making long-term consequences for maternal and child health traceable. The inadequate awareness among healthcare providers and the frail multidisciplinary coordination mechanism also limit the extensive dissemination and accurate implementation of low-GI diets. Furthermore, major variations at the individual level among pregnant women, non-existence of active monitoring, and poor awareness and compliance with the public on the aspect of low-GL diets are also obstacles to enhancing management effectiveness.

In the future, prevention and treatment work against GDM will prioritize three innovations: First, enhancing the scientific basis by proving the long-term advantage of LGL diets with large-scale clinical studies and advocating international standards. Second, improving personalized control by creating dynamic eating schemes adapted to pregnant women's characteristics and enhancing the main health support system. Third, public education and partnership innovation by taking advantage of digital media to increase compliance and constructing a cross-profession common diagnosis and treatment mechanism. Even though problems like high-input cost for research, difficulty in cultural adaptation, and lag in policy support are still existing, with combined efforts and resource coordination, we can build up a full-cycle, accurate GDM prevention and control system gradually, eventually lowering the health risk for pregnant mothers and babies.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

References

[1] Dutta D, Kumar M, Jindal R, Joshi A, Kamrul-Hasan ABM, Bhattacharya S. Hypoglycaemia During Oral Glucose Tolerance Test in Pregnancy and Feto-Maternal Outcomes: A Systematic Review and Meta-Analysis. Indian J Endocrinol Metab. 2025 Jul-Aug;29(4):381-393.

[2] Moon JH, Jang HC. Gestational Diabetes Mellitus: Diagnostic Approaches and Maternal-Offspring Complications. Diabetes Metab J. 2022 Jan;46(1):3-14.

[3] Ma, W. Y., Wang, X. Y., Hu, L. L., Zhang, X., Huang, Q. J., & Mei, X. Y. Research progress on prenatal care for pregnant women with gestational diabetes mellitus. Health Medicine Research and Practice,2024, 21(S2), 328-331.

[4] Yu, J., Zhang, Q., & Xiao, X. H. Key points and interpretation of the key content of the "Chinese Guideline for the Co-Management of Mother and Infant in Gestational Diabetes Mellitus (2024 Edition)". Journal of Chongqing Medical University, 1-3.

[5] Hao, Y. J., & Zhang, J. Current status and progress in the pathogenesis of gestational diabetes mellitus. China Medicine, 2023,18(10), 1587-1591.

[6] Lu, Q. X., Bu, F., Cui, J., Xiao, G. K., Peng, T. Y., Li, Y. P., ... & Li, M. Exploring the effect of low glycemic load diet combined with mobile dietary management on blood glucose improvement in patients with type 2 diabetes. In Abstract Book of the 14th Asian Congress of Nutrition--Clinical Nutrition 2023, 220.

[7] Jing Zhao,Lingjuan Wang,Xiaojing Xu.The influence of low-glycemic-load dietary intervention on maternal gestational weight management and neonatal outcomes[J].Hainan Medicine,2021,32(05):599-602

[8] Ojo O, Ojo OO, Wang XH, Adegboye ARA. The Effects of a Low GI Diet on Cardiometabolic and Inflammatory Parameters in Patients with Type 2 and Gestational Diabetes: A Systematic Review and Meta-Analysis of Randomised Controlled Trials. Nutrients. 2019 Jul 12;11(7):1584.

[9] Mavroeidi I, Manta A, Asimakopoulou A, Syrigos A, Paschou SA, Vlachaki E, Nastos C, Kalantaridou S, Peppa M. The Role of the Glycemic Index and Glycemic Load in the Dietary Approach of Gestational Diabetes Mellitus. Nutrients. 2024 Jan 30;16(3):399.

[10] Liu L, Liu Z, Duan B, Zhang Q, Zhou Z, Liu W. Effects of a low glycemic index or low glycemic load diet on pregnant women at high risk of gestational diabetes: Ameta-analysis of randomized controlled trials. Nutr Metab Cardiovasc Dis. 2023 Oct;33(10):2006-2018.

[11] Na Wang.The effect of applying the low glycemic load food exchange method on the pregnancy outcomes of patients with gestational diabetes[J].Journal of Henan Medical College of Junior Learning,2022,34(01):30-33.

[12] Huirong Li,Li Yang,Chunwei Li,.The effect of low glycemic index diet and low glycemic load diet on blood glucose control in diabetic patients[J].Nursing Research,2015,29(17):2061-2063.

[13] Zhifen Yang, Chunyang Wang. Interpretation of Guidelines for Diagnosis and Treatment of Gestational Diabetes Mellitus in 2021[J]. Journal of Hebei Medical College, 2021, 42(9).