

Effect of Medical Nutrition Therapy on glycemic control and adverse pregnancy outcomes with Gestational Diabetes Mellitus: A Systematic Review and Meta-Analysis

Boxuan Ha *, Mengsi Zhao

Beijing University of Chinese Medicine, Beijing, 100029, China

* Corresponding author: Boxuan Ha (Email: haboxuan@163.com)

Abstract: **Objective:** Medical nutrition therapy (MNT) and conventional dietary intervention were compared in this study to determine their respective impacts on glycemic regulation and the incidence of adverse pregnancy outcomes (APOs) in gestational diabetes mellitus (GDM). **Methods:** Through a systematic search of PubMed, Embase, Cochrane databases, Web of Science, as well as the Chinese Biomedical Literature Database (SinoMed), China National Knowledge Infrastructure (CNKI), Wanfang Data, and VIP databases, eligible randomized controlled trials (RCTs) comparing MNT with conventional dietary control were identified. The retrieval window included all records available since the establishment of the respective databases, with the final search date being September 6, 2025. Blood glucose control was studied by comparing glycated hemoglobin (HbA1c), fasting blood glucose (FBG), two-hour postprandial blood glucose (2hPBG) and fasting plasma glucose (FPG). The occurrence rate of APOs was investigated using comparative evidence on complications affecting mothers and neonates. Meta-analysis served as the analytical method, and either random-effects or fixed-effects modeling was used. **Results:** The meta-analysis incorporated 15 RCTs that enrolled a total of 1,479 patients with GDM. Relative to usual dietary control, MNT was linked to significant declines in HbA1c (MD = -0.99; 95% CI, -1.44 to -0.55; $P < 0.00001$), FBG (MD = -0.84; 95% CI, -1.07 to -0.60; $P < 0.00001$), 2hPBG (MD = -1.43; 95% CI, -1.87 to -0.98; $P < 0.00001$) and FPG (MD = -0.54; 95% CI, -0.58 to -0.32; $P < 0.00001$). Furthermore, MNT was associated with substantially diminished risks for maternal complications (RR = 0.41; 95% CI, 0.32 to 0.54) and neonatal complications (RR = 0.34; 95% CI, 0.26 to 0.44). Across the included studies, no serious adverse events that could be attributed to MNT were documented. **Conclusion:** For patients with GDM, the use of MNT during pregnancy is capable of improving blood sugar regulation and decreasing the risk of complications among mothers and neonates. For GDM management, MNT should be emphasized as a safe and effective non-pharmacological intervention measure. Further confirmation of its long-term effects requires additional RCTs with stronger study quality.

Keywords: Medical Nutrition Therapy; Gestational Diabetes Mellitus; Glycemic Regulation; Maternal-neonatal Adverse Outcomes; Evidence-based Nursing.

1. Introduction

Gestational diabetes mellitus (GDM), commonly occurring as a metabolic disorder in pregnancy, is formally described as “carbohydrate intolerance of variable severity with onset or first recognition during pregnancy” [1,2]. It is mostly manifested as a distinct elevation of blood glucose [3], and is often accompanied by adverse pregnancy outcomes (APOs). As documented by the International Diabetes Federation in the *Diabetes Atlas 2025* [4], the global burden of GDM was reported as 15.6% in 2024, and it continues to rise annually. The causes of GDM are related to the dysfunction of pancreatic β cells. Hormonal changes during pregnancy interfere with the action of insulin, thereby exacerbating insulin resistance [5,6,7,8,9]. Existing studies have indicated that dietary modification can help control blood glucose levels [10]. However, most interventions lack individualization, theoretical grounding, and robust evidence based on specific nutritional intervention theories.

Medical nutrition therapy (MNT) is a strategy that regulates nutritional status by using foods and nutrients, with applications in preventing and treating diseases and managing chronic diseases [11]. Clinical evidence shows that MNT can be helpful for patients with GDM by increasing insulin

sensitivity [12], lowering the risk of pregnancy complications [13, 14], improving the ability to achieve the blood sugar control targets during pregnancy [15, 16], and reducing excessive inflammatory and oxidative stress reactions in the placenta, thereby reducing APOs [17].

Pharmacological agents and lifestyle measures form the mainstay of current GDM management. Among drug therapies, metformin and glibenclamide are widely used, yet debates about their long-term safety and mechanisms continue. Metformin crosses the placenta, giving rise to similar drug concentrations in the mother and fetus [18], while prolonged glibenclamide administration may trigger excessive fetal insulin production and β -cell exhaustion [19]. These concerns have made lifestyle strategies—dietary modification, physical activity, and weight control—the key to sustained glycemic improvement and reduced medication dependence in GDM [20]. Merely adjusting the diet, however, has yielded limited glycemic benefits [21]. Research does confirm the capacity of MNT to improve pancreatic function and lower maternal and neonatal risks [22]; nonetheless, the evidence underpinning individualized MNT is still scattered and awaits systematic synthesis [23].

Randomized controlled trials (RCTs) continue to serve as the gold standard for generating top-tier scientific evidence [24]. This RCT-based meta-analysis systematically assessed

whether MNT could improve blood glucose regulation and lower the incidence of APOs among patients with GDM. A systematic review that specifically focuses on the impact of MNT on these GDM-related outcomes has, to our knowledge, not been conducted previously. Addressing this evidence gap, our study endeavors to elucidate the potential of MNT as an effective complementary approach to optimize glucose management and reduce APOs within this patient group.

2. Methods

2.1. Protocol and Guidance

We conducted this systematic review and meta-analysis following the PRISMA guidelines, and reported the results accordingly. The research protocol has been registered on the

PROSPERO platform (Registration No. CRD420251152211).

2.2. Data Sources, Search Strategy and Definitions

We systematically searched PubMed, Embase, Cochrane Library, Web of Science, SinoMed, CNKI, Wanfang Data and VIP databases, and all available records from database inception through September 6, 2025 were searched with title, abstract, and keyword terms covering gestational diabetes mellitus (P), medical nutrition therapy (I), and randomized controlled trial (S), supplemented with appropriate synonyms. Figure 1 provides a representative example of the search strategy, displaying the version used for PubMed.

```
#1 Diabetes, Gestational"[Mesh]
#2 (Diabetes, Gestational[Title/Abstract]) OR (Diabetes Mellitus, Gestational[Title/Abstract]) OR
(Gestational Diabetes Mellitus[Title/Abstract]) OR (Diabetes, Pregnancy-Induced[Title/Abstract])
OR (Diabetes, Pregnancy Induced[Title/Abstract]) OR (Pregnancy-Induced
Diabetes[Title/Abstract]) OR (Gestational Diabetes[Title/Abstract])
#3 #1 OR #2
#4 Nutrition Therapy"[Mesh]
#5 (Nutrition Therapy[Title/Abstract]) OR (Therapy, Nutrition[Title/Abstract]) OR (Medical
Nutrition Therapy[Title/Abstract]) OR (Nutrition Therapy, Medical[Title/Abstract]) OR (Therapy,
Medical Nutrition[Title/Abstract])
#6 #4 OR #5
#7 "Randomized Controlled Trials as Topic"[Mesh]
#8 (Randomized Controlled Trial[Title/Abstract]) OR (Clinical Trials, Randomized[Title/Abstract])
OR (Trials, Randomized Clinical[Title/Abstract]) OR (Controlled Clinical Trials,
Randomized[Title/Abstract]) OR (random*[Title/Abstract]) OR (placebo[Title/Abstract])
#9 #7 OR #8
#10 #3 AND #6 AND #9
```

Figure 1. Caption. PubMed Search Terms

2.3. Eligibility Criteria and Study Selection Process

The study inclusion was restricted to peer-reviewed papers in Chinese or English that assessed MNT compared with usual dietary intervention for glycemic control and prevention of APOs among women experiencing GDM. The inclusion criteria are as follows: (1) The study adopts a RCT design, where the control group receives conventional diabetes diet intervention; (2) participant mean age greater than 20 years; (3) a confirmed diagnosis of GDM; and (4) participants possessed clear language expression and normal cognitive function. Exclusion criteria comprised comorbid psychiatric disorders, comorbid malignancies, receipt of psychological treatment within the preceding 6 months, acute delivery, and prenatal examination findings indicative of abnormal fetal development.

On the basis of the stated inclusion and exclusion criteria, two independent reviewers (Boxuan Ha and Mengsi Zhao) first conducted a preliminary screening of the titles and abstracts of all identified studies, and then carried out a further screening by reading the full texts of the screened items.

2.4. Data Extraction and Organization

The extraction and analysis of the data were independently carried out by two reviewers (Boxuan Ha and Mengsi Zhao). The collected information includes the author, publication year, the country where it was conducted, detailed information about the research subjects, participant features,

sample size, and the main evaluation indicators. For continuous variables, the mean changes and standard deviations of glycemic indicators from baseline to postintervention were extracted; the standard deviation of the change was computed following Cochrane criteria. For binary variables, the count of outcome events in each group was extracted. For continuous variable indicators, the mean difference (MD) is used to quantify the effect of medical nutrition intervention measures; while for binary variable indicators, the risk ratio (RR) is employed for assessment.

2.5. Risk of Bias Assessment

For each included study, two independent reviewers (Boxuan Ha and Mengsi Zhao) assessed methodological quality and risk of bias with the Cochrane Risk of Bias Tool.

2.6. Statistical Analysis

The data analysis of this study was conducted using Review Manager (RevMan) version 5.4. The mean difference (MD) is used to measure the differences in continuous indicators, while the risk ratio (RR) is used to measure the differences in binary categorical variable indicators; both are accompanied by a 95% confidence interval (95%CI). The degree of heterogeneity is reflected by the value of I^2 , where a higher value indicates stronger heterogeneity. Heterogeneity guided the choice of meta-analytic model: a fixed-effect model was selected for $I^2 \leq 50\%$; if $I^2 > 50\%$, a random-effect model is adopted, and the corresponding P value must be less than 0.05. Publication bias was investigated through funnel plot assessment when more than 10 studies contributed to an

outcome. The statistical significance of all comparisons was set at two-tailed $P < 0.05$.

3. Result

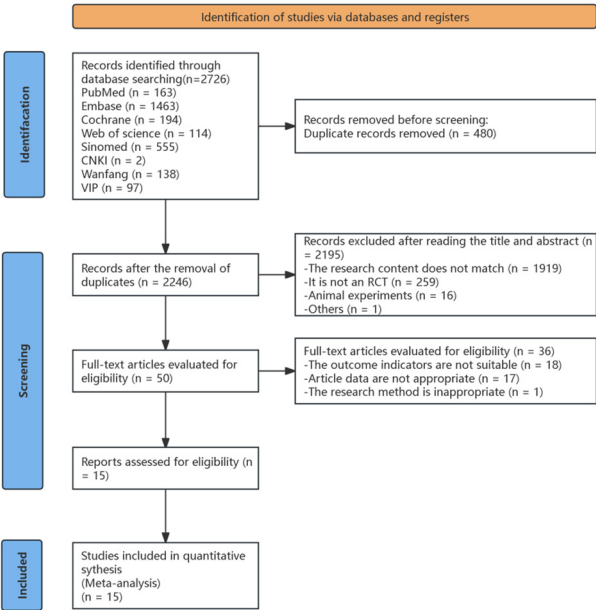


Figure 2. Caption. Flowchart of Studies

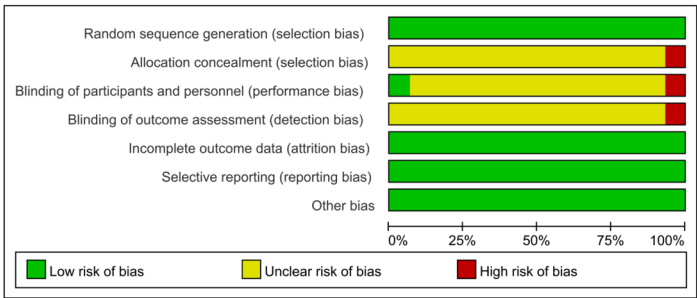


Figure 3. Caption. Literature Quality Evaluation Chart 1

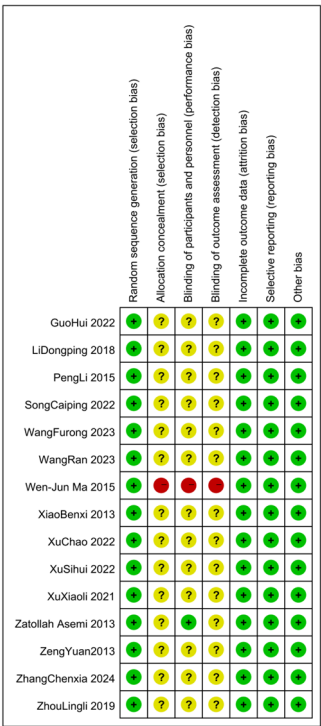


Figure 4. Caption. Literature Quality Evaluation Chart 2

Database and citation searches yielded a total of 2726 articles. A total of 480 duplicates were first eliminated, and 2195 articles were subsequently excluded based on title and abstract screening. Another 36 articles were excluded at the full-text review stage because of inappropriate outcome measures, unsuitable data, or mismatched study design. Thus, 15 RCTs [25-39] remained and satisfied the inclusion criteria (Figure 2).

Cochrane Risk of Bias Tool provides assessment across seven bias domains. In 13 of the 15 included studies, unclear risk was identified for allocation concealment, blinding of participants and personnel, and blinding of outcome assessment. Wen-Jun Ma 2015 was classified as high risk. Regarding Zatollah Asemi's research conducted in 2013, there are unclear risks regarding the confidentiality of the results and the assessment process, but the blinding of the study participants and staff is of low risk. For every included study, the remaining four aspects were evaluated as low risk (Figures 3 and 4).

The analyzed population comprised 1479 patients with GDM, with 738 classified in the intervention group and 741 in the control group. These groups were comparable at the baseline stage. The demographic and clinical characteristics of participants in the experimental groups were broadly consistent with those in the control group, and no statistically significant differences were noted. The intervention consisted of individualized MNT provided by a professional team, while usual care was administered to the controls. By

analyzing and comparing six outcome indicators, we evaluated the impact of MNT on the blood sugar control effect and APOs in patients with GDM: glycosylated hemoglobin (HbA1c), fasting blood glucose (FBG), fasting plasma glucose (FPG), and two-hour post-meal blood glucose (2hPBG), incidence of maternal complications, and incidence of neonatal complications. A summary of all the characteristics included in the study is presented in the **Table 1**.

Table 1. Characteristics of Included Studies

Source	Country	Participants (n)		Age, mean (SD)		BMI, mean (SD)		Course of treatment (weeks)	outcome variable
		Treatment	Control	Treatment	Control	Treatment	Control		
Zhang Chenxia et al.[25] 2024	China	51	50	28.21(1.53)	27.32(1.47)	22.88(3.96)	22.76(3.85)	12	1)2)3)4)5)
WANG Furong et al.[26] 2023	China	39	39	29.79(3.55)	29.86(3.12)	NR	NR	NR	1)2)3)4)
WangRan et al.[27] 2023	China	42	42	30.53(2.18)	30.21(2.16)	25.28(0.87)	25.31(0.86)	NR	2)5)
Song Caiping et al.[28] 2022	China	34	34	31.6(4.2)	30.6(5.8)	NR	NR	6	1)2)4)
Xu Chao et al.[29] 2022	China	38	38	30.64(4.07)	29.98(3.76)	23.68(0.81)	23.82(1.24)	4	1)2)3)5)
Guo Hui et al.[30] 2022	China	56	56	29.22(2.38)	29.38(2.16)	23.12(2.24)	23.15(2.63)	NR	1)2)3)
Xu Sihui et al.[31] 2022	China	40	40	31.45(1.65)	31.56(1.35)	23.23(1.85)	23.54(1.76)	NR	1)2)3)
XU Xiaoli et al.[32] 2021	China	55	55	29.1(2.3)	28.9(2.2)	NR	NR	NR	1)3)4)5)6)
Zhou Lingli et al.[33] 2019	China	70	70	29.2(3.9)	29.8(3.6)	26.1(2.7)	26.1(2.7)	12	2)3)4)5)
Li Dongping et al.[34] 2018	China	80	80	27.52(5.32)	26.84(5.35)	NR	NR	NR	2)3)4)5)
Wen-Jun Ma et al.[35] 2015	China	41	42	30(3.5)	30.1(3.8)	21.90(3.14)	21.15(2.75)	12-14	1)3)4)5)6)
Peng Li et al.[36] 2015	China	90	90	28.14(3.9)	28.8(4.2)	NR	NR	NR	1)2)3)
Zatollah Asemi et al.[37] 2013	Iran	17	17	30.7(6.7)	29.4(6.2)	29.0(3.2)	31.4(5.7)	4	1)6)
Xiao Benxi et al.[38] 2013	China	40	43	29.5(3.2)	29.9(3.4)	NR	NR	8-10	1)2)3)
Zeng Yuan et al.[39] 2013	China	45	45	30.33(3.99)	30.67(3.83)	22.69(3.47)	21.51(2.44)	4	2)3)

The outcome variables were as follows: 1) HbA1c, 2) FBG, 3)2hPBG, 4) maternal complication rate, 5) neonatal complication rate and 6) FPG; NR denotes not reported.

3.1. Results of Synthesis

3.1.1. Effect of MNT on HbA1c

HbA1c data were reported in eleven studies for MNT in GDM. Pooling these studies revealed a significant HbA1c

reduction with MNT (MD=-0.99; 95%CI,-1.44 to-0.55; P<0.0001). Due to the high heterogeneity ($I^2=97\%$, P<0.00001), we adopted the random effects model for the analysis. Figure 5 shows the pooled effect size, where MD<0 favors MNT and MD>0 favors control. MNT had a beneficial effect on improving HbA1c control in GDM patients (Figure 5).

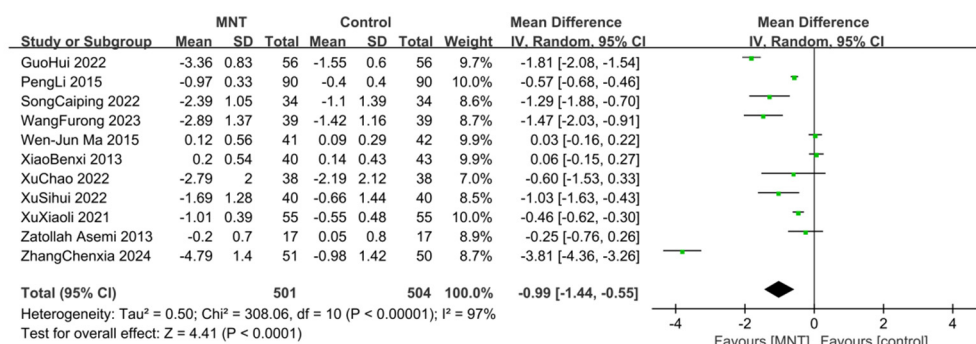


Figure 5. Caption. Meta-Analysis of the Impact of MNT Intervention on HbA1c in Patients with GDM

3.1.2. Effect of MNT on FBG

FBG outcomes from twelve studies were combined. A significant decrease in FBG was found with MNT (MD=-0.84; 95% CI, -1.07 to -0.60; $P<0.00001$). Due to the high degree of heterogeneity ($I^2=85\%$, $P<0.00001$), we employed a

random effects model for the analysis. Negative MD values indicate a benefit of MNT, whereas positive MD values indicate a benefit of the control; the pooled effect size is displayed in Figure 6. As shown in Figure 6, MNT improved FBG control in GDM patients.

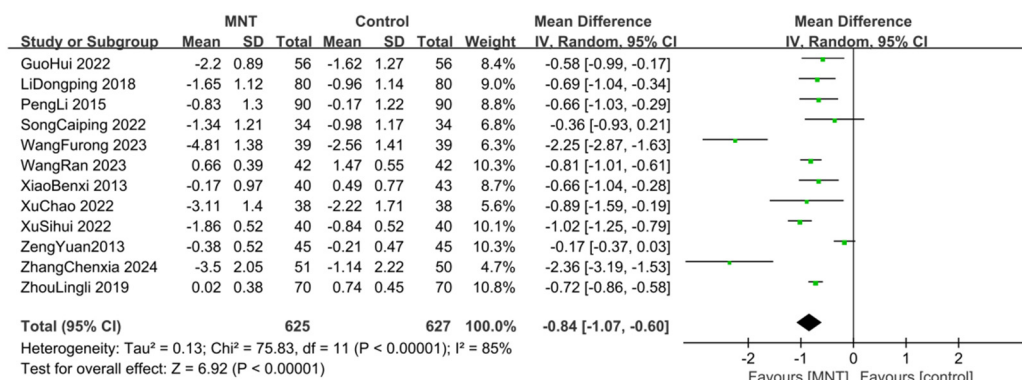


Figure 6. Caption. Meta-analysis of the impact of MNT intervention on FBG in patients with GDM

3.1.3. Effect of MNT on 2hPBG

Twelve studies contributed data on 2hPBG in GDM patients. The pooled estimate revealed a significant reduction with MNT (MD=-1.43; 95% CI, -1.87 to -0.98; $P<0.00001$). Owing to substantial heterogeneity ($I^2=91\%$, $P<0.00001$), we

chose the random effects model. Figure 7 displays the forest plot of the pooled effect size for 2hPBG; a negative MD indicates a benefit of MNT, while a positive MD indicates a benefit of the control intervention. Overall, MNT improved 2hPBG control in this population (Figure 7).

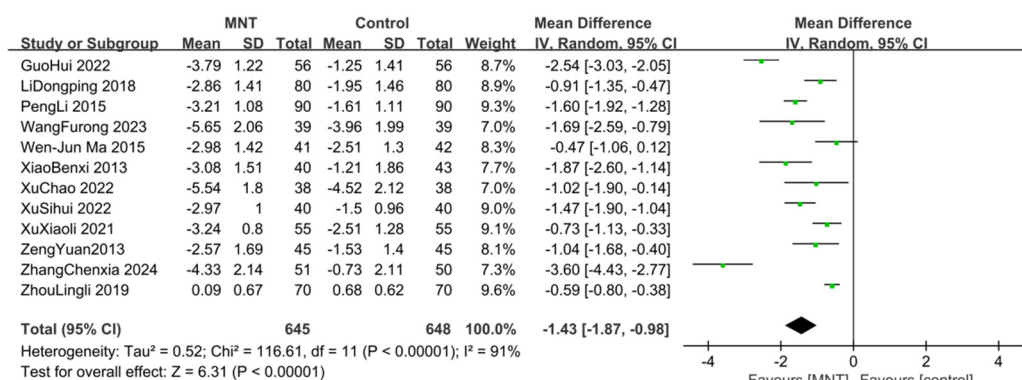


Figure 7. Meta-analysis of the impact of MNT intervention on 2hPBG in patients with GDM

3.1.4. Effect of MNT on FPG

Data on FPG were contributed by three studies. Pooling these studies revealed a significant reduction with MNT (MD = -0.45; 95% CI, -0.58 to -0.32; $P<0.00001$). Heterogeneity did not reach statistical significance in either of the two

comparative assessments ($I^2 = 0\%$, $P = 0.72$), and therefore we adopted the fixed-effect model for analysis. The forest plot (Figure 8) displays the pooled effect size, where a negative MD indicates a benefit of MNT and a positive MD indicates a benefit of the control intervention. As Figure 8 demonstrates, MNT improved FPG control in patients with GDM.

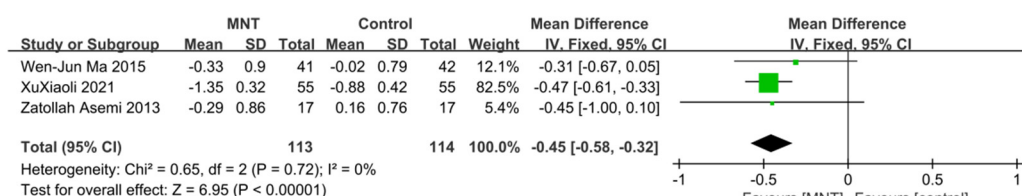


Figure 8. Caption. Meta-analysis of the impact of MNT intervention on FPG in patients with GDM

3.1.5. Effect of MNT on Maternal Complication Rate

Data from seven studies were combined to evaluate how MNT affects maternal complication incidence in GDM. The pooled estimate revealed that MNT led to a significant drop in the maternal complication rate (RR = 0.41; 95% CI, 0.32 to 0.54; $P<0.00001$). Due to the moderate heterogeneity ($I^2 =$

45%, $P = 0.09$), we adopted the fixed-effect model for the analysis. As presented in Figure 9, the forest plot shows the pooled effect size, where an RR below 1 supports MNT and an RR above 1 supports the control. MNT, therefore, had a favorable impact on lowering maternal complications in this population (Figure 9).

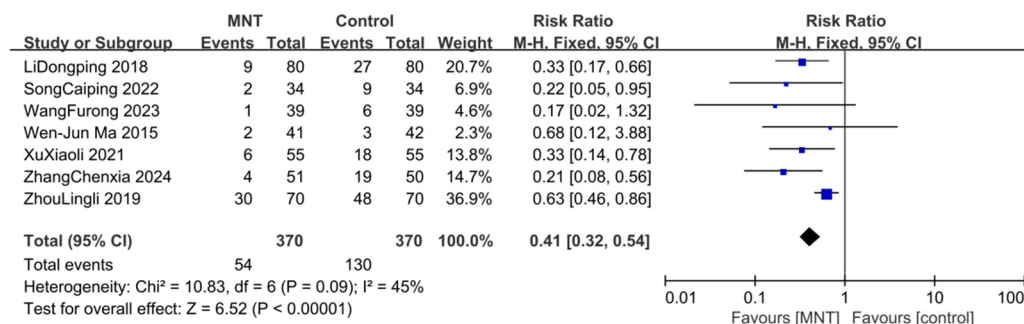


Figure 9. Caption. Meta-Analysis of the impact of MNT Intervention on the Maternal Complication Rate in Patients with GDM

3.1.6. Effect of MNT on Neonatal Complication Rate

Seven studies contributed data on how MNT affects neonatal complication rates in GDM. After analysis, it was concluded that MNT can significantly reduce the incidence of complications in newborns (RR = 0.34; 95% CI, 0.26 to 0.44; P < 0.00001). Since no significant differences were observed (I² = 13%, P = 0.33); we chose the fixed-effect model for the

analysis. Figure 10 provides the forest plot summarizing the pooled effect size; If the RR value is less than 1, it indicates that the MNT group has a greater advantage; whereas if the RR value is higher than 1, it suggests that the conventional diabetes diet intervention has a greater advantage. In conclusion, MNT has an effect in reducing the incidence of neonatal complications in pregnant women with GDM (Figure 10).

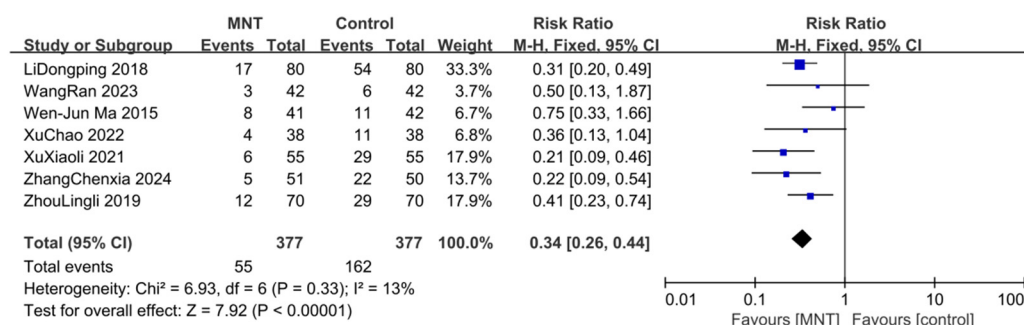


Figure 10. Caption. Meta-Analysis of the impact of MNT Intervention on the Neonatal Complication Rate in Patients with GDM

4. Discussion

Based on the synthesized RCT evidence, this systematic review and meta-analysis indicates that MNT for patients with GDM is significantly associated with better glucose control and reduced APOs, as supported by significant reductions in the main glycemic indicators, including HbA1c, FBG, FPG, and 2hPBG. Simultaneously, they reported a notable decrease in maternal complications (cesarean section, gestational hypertension) and neonatal complications (big baby, neonatal hypoglycemia) as well. To the best of our knowledge, the current study is the first to conduct a systematic evaluation and meta-analysis of the association of MNT with glycaemic control and APOs in pregnant women with GDM. This offers a complete support of evidence that will be useful for future clinical application of MNT for GDM.

This research has great research and clinical significance. To start with, we objectively verified that medical nutrition intervention provides an adjunctive benefit in the treatment of GDM by quantitatively pooling the data from RCTs. This confirms the role of medical nutrition intervention as a key therapy that may be adopted prior to or in conjunction with the commencement of drugs. Second, there is significant variance in the implementation of nutritional management for GDM across regions and between health facilities, with no common or measurable operational standards in place. Based on the existing RCT evidence, this study has obtained comprehensive effect assessment results of medical

nutritional therapy on blood sugar and APOs incidence in facilitating the standardization of clinical GDM care and evidence-based advancement. Moreover, the significant risk reduction in maternal complications (RR = 0.41) and neonatal complications (RR = 0.34) provided essential evidence to assist health care decision-makers to guide resource allocation and prioritization of personalized nutrition intervention.

Our findings reinforce those of previous studies while showcasing the unique complementary merit of the present study. According to systematic review evidence, high-quality diet adherence in the pre-pregnancy or pregnancy period significantly reduces GDM risk. Gao et al. [40] demonstrated it. Our study shows this protective effect being extended from the prevention stage to treatment stage. MNT is proven to be equally effective in patients with existing GDM. According to Kusinski et al. [41], in the RCT, it was found that a strictly controlled energy-restricted diet (1200 kcal/day) could reduce the requirement for long-acting insulin, but this approach did not affect maternal weight nor the newborn birth weight. But our meta-analysis on varied real-world MNT strategies showed an overall improvement in HbA1c, FBG, 2hPBG and maternal- fetal-neonatal complications, indicating that the clinical utility of MNT could be due to the combination of various nutritional strategies rather than energy restriction alone. Cheong et al. [42] highlighted conflicts and cultural adaptability issues in connection with the implementation of MNT. Our meta-analysis gives quantitative evidence to show the effectiveness of the MNT. In addition, this offers evidence

for the modified nutrition strategies in the review. Altogether, our study and the above literature provide evidence on the prevention and treatment of GDM. This recommendation suggests that MNT should be part of a comprehensive GDM approach.

4.1. Limitations and Future Directions

Several study limitations should be carefully accounted for when interpreting its findings, and these shortcomings simultaneously highlight avenues for subsequent research.

An important limitation lies in the fact that we used the PRISMA protocol with a PICO-based search scope, but the included studies showed a clear concentration in China as the research setting. Among the 15 RCTs incorporated into this meta-analysis, 14 RCTs enrolled Chinese participants, potentially limiting the applicability of our findings to other ethnic populations, dietary practices, and healthcare settings. Regional differences in maternal baseline characteristics (e.g., age and BMI), dietary patterns (e.g., carbohydrate sources and cooking methods), institutional nutritional management protocols, and patient adherence may all influence outcomes. Therefore, the external validity of the conclusion we have reached requires careful consideration. Future investigations should prioritize multinational, multicenter RCTs to verify the effectiveness of MNT across diverse populations.

Another factor that may pose limitations is the search strategy. Although the retrieval process covered Chinese as well as English databases, most of the studies incorporated into the review were Chinese-language articles, indicating that the search results from the English database were relatively scarce. This may stem from the specific combination of search terms, the language restriction (limited to English and Chinese), or a tendency for certain studies to be published in domestic journals. As a result, the pool of eligible studies remained modest, geographically concentrated in China, and generally lacked high methodological quality. Several studies exhibited unclear or high risk of bias, particularly regarding allocation concealment and blinding. These observations highlight the overall scarcity of rigorously designed RCTs in nutritional interventions for GDM and underscore the need for future trials to adhere strictly to established methodological standards. Future systematic reviews may benefit from expanding the search scope to grey literature and conference proceedings, and optimizing strategies to capture studies published in additional languages.

Further heterogeneity was observed for several outcome measures (HbA1c, FBG, 2hPBG). Potential sources of this heterogeneity include the lack of a unified quantitative standard for MNT, with individualized nutrition protocols differing considerably across studies in terms of energy composition, carbohydrate proportion, and follow-up frequency; differences in participant baseline characteristics (gestational age, BMI, history of GDM, etc.), which may influence responses to the intervention; inconsistent definitions of "usual care" or "control diet" across studies; and variability in outcome measurement tools and timing of glucose assessments. Although we employed a random effects model to account for the heterogeneity of the data, it is still possible that this might affect the persuasiveness of the evidence. Thus, future research should focus on optimizing the balance between the standardization and personalization of medical nutrition intervention measures, and develop metabolic regulation treatment plans that are both structured

and individualized. For example, mobile health applications featuring dynamic dietary recording and real-time feedback could enhance adherence and provide a more consistent metric for subsequent meta-analyses.

Given these limitations, future research should focus on systematically collecting key variables (such as pre-pregnancy body mass index, socioeconomic status, etc.) to enhance the assessment and adjustment of potential confounding factors. Where feasible, combining dietary frequency questionnaires with biomarkers (such as urine ketone bodies or glycemic variability indicators) can provide a more objective measure of adherence. There is also a clear imperative to investigate the sustained impact of MNT. The majority of current studies have limited follow-up to the delivery period, neglecting postpartum metabolic outcomes (e.g., glucose tolerance recovery, incidence of type 2 diabetes) and long-term offspring health (e.g., childhood obesity, metabolic syndrome). Longer-duration follow-up should be considered in future trials to assess the enduring benefits of MNT.

5. Conclusion

More and more people face obesity worldwide, and more are adopting unhealthy dietary patterns, this will likely keep driving up cases of GDM. We really need effective strategies to deal with this right now. These strategies should help enhance glycemic control and improve pregnancy outcomes for people in this group. For this systematic review and meta-analysis, we analyzed data from 15 RCTs, and found that MNT is significantly linked to improvements in blood sugar indicators, and may cut down the incidence of complications for both mothers and newborns a lot. Seems like MNT's foundational role in GDM management hasn't gotten enough notice. Clinicians and policymakers should pay more attention on MNT's basic role here, they should strongly promote individualized nutrition interventions to boost maternal-infant health in large, growing patient group.

References

- [1] Genuth, S. M., Palmer, J. P., & Nathan, D. M. (2018). Classification and diagnosis of diabetes. In C. C. Cowie (Ed.), *Diabetes in America* (3rd ed.). National Institute of Diabetes and Digestive and Kidney Diseases (US).
- [2] National Diabetes Data Group. (1979). Classification and diagnosis of diabetes mellitus and other categories of glucose intolerance. *Diabetes*, 28(12), 1039–1057.
<https://doi.org/10.2337/diab.28.12.1039>
- [3] Li, Q., Guo, Z., Xia, A., & Wang, X. (2023). Effect of early comprehensive nursing intervention combined with continuing care on blood glucose control and pregnancy outcome in gestational diabetes mellitus patients. *Diabetes New World*, 26(15), 147–150.
<https://doi.org/10.16658/j.cnki.1672-4062.2023.15.147>
- [4] Duncan, B. B., Magliano, D. J., & Boyko, E. J. (2025). *IDF Diabetes Atlas 11th edition 2025: global prevalence and projections for 2050*. Nephrology, Dialysis, Transplantation: Official Publication of the European Dialysis and Transplant Association-European Renal Association, 41(1), 7–9.
<https://doi.org/10.1093/ndt/gfaf177>
- [5] Catalano, P. M., Huston, L., Amini, S. B., & Kalhan, S. C. (1999). Longitudinal changes in glucose metabolism during pregnancy in obese women with normal glucose tolerance and

- gestational diabetes mellitus. *American Journal of Obstetrics and Gynecology*, 180(4), 903–916.
[https://doi.org/10.1016/s0002-9378\(99\)70662-9](https://doi.org/10.1016/s0002-9378(99)70662-9)
- [6] Buchanan, T. A. (2001). Pancreatic B-cell defects in gestational diabetes: Implications for the pathogenesis and prevention of type 2 diabetes. *The Journal of Clinical Endocrinology and Metabolism*, 86(3), 989–993.
<https://doi.org/10.1210/jcem.86.3.7339>
- [7] Black, M. H., Fingerlin, T. E., Allayee, H., Zhang, W., Xiang, A. H., Trigo, E., Hartiala, J., Lehtinen, A. B., Haffner, S. M., Bergman, R. N., McEachin, R. C., Kjos, S. L., Lawrence, J. M., Buchanan, T. A., & Watanabe, R. M. (2008). Evidence of interaction between PPARG2 and HNF4A contributing to variation in insulin sensitivity in Mexican Americans. *Diabetes*, 57(4), 1048–1056. <https://doi.org/10.2337/db07-0848>
- [8] Kim, C., Newton, K. M., & Knopp, R. H. (2002). Gestational diabetes and the incidence of type 2 diabetes: A systematic review. *Diabetes Care*, 25(10), 1862–1868.
<https://doi.org/10.2337/diacare.25.10.1862>
- [9] Hu, C. (2021). Effect of early comprehensive nursing intervention on blood glucose control and pregnancy outcome in patients with gestational diabetes mellitus. *Journal of Practical Gynecologic Endocrinology*, 8(24), 96–99.
- [10] Dingena, C. F., Arofikina, D., Campbell, M. D., Holmes, M. J., Scott, E. M., & Zulyniak, M. A. (2023). Nutritional and exercise-focused lifestyle interventions and glycemic control in women with diabetes in pregnancy: A systematic review and meta-analysis of randomized clinical trials. *Nutrients*, 15(2), 323. <https://doi.org/10.3390/nu15020323>
- [11] Briggs Early, K., & Stanley, K. (2018). Position of the Academy of Nutrition and Dietetics: The role of medical nutrition therapy and registered dietitian nutritionists in the prevention and treatment of prediabetes and type 2 diabetes. *Journal of the Academy of Nutrition and Dietetics*, 118(2), 343–353. <https://doi.org/10.1016/j.jand.2017.11.021>
- [12] Vasile, F. C., Preda, A., Ștefan, A. G., Vladu, M. I., Forțofoiu, M. C., Clenciu, D., Gheorghe, I. O., Forțofoiu, M., & Moța, M. (2021). An update of medical nutrition therapy in gestational diabetes mellitus. *Journal of Diabetes Research*, 2021, 5266919. <https://doi.org/10.1155/2021/5266919>
- [13] Oken, E., Ning, Y., Rifas-Shiman, S. L., Rich-Edwards, J. W., Olsen, S. F., & Gillman, M. W. (2007). Diet during pregnancy and risk of preeclampsia or gestational hypertension. *Annals of Epidemiology*, 17(9), 663–668.
<https://doi.org/10.1016/j.annepidem.2007.03.003>
- [14] Hernandez, T. L., Van Pelt, R. E., Anderson, M. A., Reece, M. S., Reynolds, R. M., de la Houssaye, B. A., Heerwagen, M., Donahoo, W. T., Daniels, L. J., Chartier-Logan, C., Janssen, R. C., Friedman, J. E., & Barbour, L. A. (2016). Women with gestational diabetes mellitus randomized to a higher-complex carbohydrate/low-fat diet manifest lower adipose tissue insulin resistance, inflammation, glucose, and free fatty acids: A pilot study. *Diabetes Care*, 39(1), 39–42.
<https://doi.org/10.2337/dc15-0515>
- [15] Mayo, K., Melamed, N., Vandenbergh, H., & Berger, H. (2015). The impact of adoption of the international association of diabetes in pregnancy study group criteria for the screening and diagnosis of gestational diabetes. *American Journal of Obstetrics and Gynecology*, 212(2), 224.e1–224.e2249.
<https://doi.org/10.1016/j.ajog.2014.08.027>
- [16] Colletti, A., Cravotto, G., Citi, V., Martelli, A., Testai, L., & Cicero, A. F. G. (2021). Advances in technologies for highly active omega-3 fatty acids from krill oil: Clinical applications. *Marine Drugs*, 19(6), 306.
<https://doi.org/10.3390/md19060306>
- [17] Al-Gubory, K. H. (2012). Mitochondria: Omega-3 in the route of mitochondrial reactive oxygen species. *The International Journal of Biochemistry & Cell Biology*, 44(9), 1569–1573.
<https://doi.org/10.1016/j.biocel.2012.06.003>
- [18] Langer, O., Conway, D. L., Berkus, M. D., Xenakis, E. M., & Gonzales, O. (2000). A comparison of glyburide and insulin in women with gestational diabetes mellitus. *The New England Journal of Medicine*, 343(16), 1134–1138.
<https://doi.org/10.1056/NEJM200010193431601>
- [19] Barbour, L. A., Scifres, C., Valent, A. M., Friedman, J. E., Buchanan, T. A., Coustan, D., Aagaard, K., Thornburg, K. L., Catalano, P. M., Galan, H. L., Hay, W. W., Jr., Frias, A. E., Shankar, K., Simmons, R. A., Moses, R. G., Sacks, D. A., & Loeken, M. R. (2018). A cautionary response to SMFM statement: Pharmacological treatment of gestational diabetes. *American Journal of Obstetrics and Gynecology*, 219(4), 367.e1–367.e7. <https://doi.org/10.1016/j.ajog.2018.06.013>
- [20] Yamamoto, J. M., Kellett, J. E., Balsells, M., García-Patterson, A., Hadar, E., Solà, I., Gich, I., van der Beek, E. M., Castañeda-Gutiérrez, E., Heinonen, S., Hod, M., Laitinen, K., Olsen, S. F., Poston, L., Rueda, R., Rust, P., van Lieshout, L., Schelkle, B., Murphy, H. R., & Corcoy, R. (2018). Gestational diabetes mellitus and diet: A systematic review and meta-analysis of randomized controlled trials examining the impact of modified dietary interventions on maternal glucose control and neonatal birth weight. *Diabetes Care*, 41(7), 1346–1361. <https://doi.org/10.2337/dc18-0102>
- [21] Mo, Q., Liu, X., Zhao, Q., Wang, H., Hang, Y., Niu, J., & Yang, Q. (2023). Influencing factors of gestational diabetes mellitus and effect of individualized medical nutrition therapy. *China Maternal and Child Health Care*, 38(15), 2829–2832. <https://doi.org/10.19829/j.zgfybj.issn.1001-4411.2023.15.030>
- [22] Chen, J., Fan, Y., & Lin, S. (2024). Effect of medical nutrition therapy combined with exercise intervention on delivery outcomes of gestational diabetes mellitus parturients. *Chinese Journal of Modern Drug Application*, 18(20), 157–160. <https://doi.org/10.14164/j.cnki.cn11-5581/r.2024.20.044>
- [23] Li, P. (2023). Effect of individualized comprehensive medical nutrition therapy on maternal and infant outcomes in patients with gestational diabetes mellitus. *Diabetes New World*, 26(19), 42–45. <https://doi.org/10.16658/j.cnki.1672-4062.2023.19.042>
- [24] Hariton, E., & Locascio, J. J. (2018). Randomised controlled trials—the gold standard for effectiveness research: Study design: Randomised controlled trials. *BJOG: An International Journal of Obstetrics and Gynaecology*, 125(13), 1716.
<https://doi.org/10.1111/1471-0528.15199>
- [25] Zhang, C., Jin, C., Wei, X., Cui, X., Chen, X., & Liu, S. (2024). Effect of comprehensive nutrition management intervention on glycolipid metabolism and pregnancy outcomes in patients with gestational diabetes mellitus. *Chinese Journal of Clinical Nutrition*, 32(1), 8–14.
- [26] Wang, F., & Guo, J. (2023). Analysis of the effect of individualized medical nutrition therapy on blood glucose and maternal and infant outcomes in patients with gestational diabetes mellitus. *Diabetes New World*, 26(10), 38–41. <https://doi.org/10.16658/j.cnki.1672-4062.2023.10.038>
- [27] Wang, R., Li, W., & Jiang, K. (2023). Application effect of nutrition therapy in early pregnancy in patients with gestational diabetes mellitus. *Chinese Journal of Practical Medicine*, 50(7), 76–79.
- [28] Song, C. (2022). Observation on the effect of early individualized nutrition intervention on blood glucose and complication control in pregnant women with gestational

- diabetes mellitus. *Women's Health Research*, (24), 155–156, 187.
- [29] Xu, C. (2022). Effect of individualized nutrition intervention on blood glucose level and pregnancy outcome in patients with gestational diabetes mellitus. *Chinese Health Care*, 40(22), 140–142.
- [30] Guo, H., & Zhang, Y. (2022). Effect of medical nutrition intervention on blood glucose level and pregnancy outcome in patients with gestational diabetes mellitus. *Journal of Qiannan Medical College for Nationalities*, 35(1), 47–49.
- [31] Xu, S., Zhao, J., & Wang, X. (2022). Effect of medical nutrition therapy on blood glucose control, pregnancy outcome and neonatal outcomes in pregnant women with gestational diabetes mellitus. *Heilongjiang Medicine*, 35(2), 431–433. <https://doi.org/10.14035/j.cnki.hljyy.2022.02.072>.
- [32] Xu, X. (2021). Study on the effect of nutritional diet in the treatment of gestational diabetes mellitus. *Diabetes New World*, 24(17), 41–45. <https://doi.org/10.16658/j.cnki.1672-4062.2021.17.041>
- [33] Zhou, L., Yang, H., Jin, F., Zhang, R., Shen, W., & Bao, L. (2019). Effect of nutritional intervention in early pregnancy on glucose and lipid metabolism and fetal prognosis in women at high risk of gestational diabetes mellitus. *Maternal and Child Health Care of China*, 34(11), 2460–2462.
- [34] Li, D., Shan, Y., Zou, D., Bao, X., & Tian, L. (2018). Effect of personalized nutrition intervention during pregnancy on glucose and lipid levels and pregnancy outcomes in women with gestational diabetes mellitus. *Progress in Modern Biomedicine*, 18(23), 4510–4513, 4570. <https://doi.org/10.13241/j.cnki.pmb.2018.23.026>
- [35] Ma, W. J., Huang, Z. H., Huang, B. X., Qi, B. H., Zhang, Y. J., Xiao, B. X., Li, Y. H., Chen, L., & Zhu, H. L. (2015). Intensive low-glycaemic-load dietary intervention for the management of glycaemia and serum lipids among women with gestational diabetes: A randomized control trial. *Public Health Nutrition*, 18(8), 1506–1513. <https://doi.org/10.1017/S1368980014001992>
- [36] Peng, L. (2015). Study on the effect of nutritional intervention model on blood glucose level in pregnant women with gestational diabetes mellitus. *Women's Health Research*, (1), 11.
- [37] Asemi, Z., Tabassi, Z., Samimi, M., Fahiminejad, T., & Esmailzadeh, A. (2013). Favourable effects of the Dietary Approaches to Stop Hypertension diet on glucose tolerance and lipid profiles in gestational diabetes: A randomised clinical trial. *The British Journal of Nutrition*, 109(11), 2024–2030. <https://doi.org/10.1017/S0007114512004242>.
- [38] Xiao, B., Qi, B., Zhang, Y., Li, Y., Yu, W., & Ma, W. (2013). Effect of nutritional intervention on glucose and lipid metabolism in pregnant women with abnormal blood glucose during pregnancy. *Food and Nutrition in China*, 19(11), 76–79.
- [39] Zeng, Y., Yuan, L., Wang, L., Kang, L., Wan, J., Meng, S., & Mi, M. (2013). Evaluation of different medical nutrition therapy methods for gestational diabetes mellitus. *Journal of Third Military Medical University*, 35(10), 1030–1033. <https://doi.org/10.16016/j.1000-5404.2013.10.014>.
- [40] Gao, X., Zheng, Q., Jiang, X., Chen, X., Liao, Y., & Pan, Y. (2023). The effect of diet quality on the risk of developing gestational diabetes mellitus: A systematic review and meta-analysis. *Frontiers in Public Health*, 10, 1062304. <https://doi.org/10.3389/fpubh.2022.1062304>.
- [41] Kusinski, L. C., Jones, D., Atta, N., Turner, E., Smith, S., Oude Griep, L. M., Rennie, K., De Lucia Rolfe, E., Sharp, S. J., Farewell, V., Murphy, H. R., Taylor, R., & Meek, C. L. (2025). Reduced-energy diet in women with gestational diabetes: The dietary intervention in gestational diabetes DiGest randomized clinical trial. *Nature Medicine*, 31(2), 514–523. <https://doi.org/10.1038/s41591-024-03356-1>
- [42] Cheong, L., Law, L. S., Tan, L. Y. L., Amal, A. A., Khoo, C. M., & Eng, P. C. (2025). Medical nutrition therapy for women with gestational diabetes: Current practice and future perspectives. *Nutrients*, 17(7), 1210. <https://doi.org/10.3390/nu17071210>