Effect of Group Cognitive Behavioral Therapy on Pregnancy Outcomes in Women with Gestational Diabetes Mellitus: A Propensity Score Matching Study Postprint

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Abstract

Background Gestational diabetes mellitus (GDM) is a common complication during pregnancy. The compliance with individualized medical nutrition therapy alone is poor in pregnant women with GDM, and the effect of group cognitive behavioral therapy (GCBT) on pregnancy outcomes in GDM pregnant women remains unclear. Objective To investigate the role of group cognitive behavioral therapy in pregnancy outcomes of GDM, and to provide reference for improving pregnancy outcomes and developing effective GDM management protocols. Methods A retrospective study was conducted on 878 GDM pregnant women who received individualized medical nutrition therapy and delivered in our hospital from 2020 to 2021. GDM pregnant women who received GCBT constituted the observation group (n=141), while those without GCBT intervention constituted the control group (n=737). Differences in pregnancy outcomes between the two groups before and after propensity score matching were analyzed. Results After 1:2 propensity score matching, there were 134 GDM pregnant women in the observation group and 256 in the control group. After matching, the proportion of normal weight gain in the observation group (50.7%, 68/134) was higher than that in the control group (37.5%, 96/256) (P<0.05). The delivery gestational age in the observation group (38.99$\pm$1.14*weeks*)*waslongerthanthatinthecontrolgroup*(38.54$\pm$$1.73 weeks) (P<0.05), and the proportions of preterm infants (3.7%), macrosomia (1.5%), and low birth weight infants (2.2%) were lower than those in the control group (10.5%, 5.9%, 9.0%) (P<0.05). Conclusion GCBT can reduce the possibility of delivering preterm infants, low birth weight infants, and macrosomic infants in GDM pregnant women, providing reference for establishing a multidisciplinary management model for GDM.

Full Text

The Influence of Group Cognitive Behavioral Therapy on Pregnancy Outcomes among Pregnant Women with Gestational Diabetes Mellitus: A Propensity Score Matching Study

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Abstract

Background: Gestational diabetes mellitus (GDM) is a common complication during pregnancy. However, adherence to individualized medical nutrition therapy (IMNT) alone among women with GDM is often poor, and the impact of group cognitive behavioral therapy (GCBT) on pregnancy outcomes in this population remains unclear.

Objective: To investigate the role of GCBT in pregnancy outcomes among women with GDM and provide evidence for improving outcomes and developing effective GDM management protocols.

Methods: We retrospectively selected 878 pregnant women with GDM who received IMNT and delivered at our hospital between 2020 and 2021. Women who received GCBT were assigned to the observation group (n=141), while those who did not receive GCBT constituted the control group (n=737). Differences in pregnancy outcomes between the two groups were analyzed before and after propensity score matching.

Results: After 1:2 propensity score matching, the observation group included 134 women with GDM and the control group included 256 women with GDM. Post-matching, the proportion of women with normal gestational weight gain was higher in the observation group (50.7%, 68/134) compared to the control group (37.5%, 96/256) (P<0.05). The observation group also had longer gestational weeks at delivery (38.99$\pm$1.14)*thanthecontrolgroup*(38.54$\pm$\$1.73) (P<0.05), and lower rates of preterm infants (3.7%), macrosomia (1.5%), and low birth weight infants (2.2%) compared to the control group (10.5%, 5.9%, and 9.0%, respectively) (P<0.05).

Conclusion: GCBT can reduce the risk of delivering preterm infants, low birth weight infants, and macrosomic infants among women with GDM, providing a reference for establishing a multidisciplinary management model for GDM.

Keywords: Diabetes, gestational; Cognitive behavioral therapy; Fetal macrosomia; Infant, premature; Infant, low birth weight; Pregnancy outcome

Introduction

Gestational diabetes mellitus (GDM) is currently the most common complication during pregnancy in China, with an overall prevalence of approximately 14.8% [1]. Regional variations in lifestyle and dietary habits result in even higher prevalence rates in eastern China [2]. Prolonged hyperglycemia during pregnancy increases the risk of both maternal and fetal complications, including macrosomia, cesarean delivery, fetal distress, and preterm birth.

Individualized medical nutrition therapy (IMNT) is designed to maintain blood glucose levels and appropriate gestational weight gain by developing personalized dietary plans based on pre-pregnancy body mass index (BMI), rate of gestational weight gain, and daily activity levels [3]. However, due to individual variations in the degree of hyperglycemia among women with GDM and the time-intensive nature of IMNT, clinical adherence is often suboptimal.

Group cognitive behavioral therapy (GCBT) is conducted in a group setting under the guidance of physicians and psychologists to correct inappropriate cognitions and negative emotions related to GDM, thereby improving attitudes and behaviors toward IMNT [4]. Previous research has demonstrated that psychological interventions can improve pregnancy outcomes in women with GDM [5]. Therefore, this retrospective observational study selected pregnant women with GDM who received IMNT and delivered at our hospital between 2020 and 2021. Using propensity score matching, we examined the impact of GCBT on pregnancy outcomes to provide evidence for improving outcomes and developing more effective multidisciplinary management models.

Methods

Study Subjects

We retrospectively selected 878 pregnant women with GDM who received IMNT at the Maternity Care Comprehensive Outpatient of Shanxi Maternal and Child Health Hospital between 2020 and 2021 and delivered at our hospital. Women who voluntarily participated in GCBT were assigned to the observation group (n=141), while those who did not receive GCBT constituted the control group (n=737).

Inclusion criteria: (1) Singleton pregnant women diagnosed with GDM according to the "Guidelines for the Diagnosis and Treatment of Hyperglycemia in Pregnancy (2022) [Part 1]" [3], who received IMNT, prenatal care, and delivered at our hospital; (2) Women and their families who provided informed consent and could actively cooperate with researchers.

Exclusion criteria: (1) Women with pre-existing abnormal glucose metabolism before pregnancy; (2) Women with other metabolic diseases such as hypertension or polycystic ovary syndrome; (3) Women with psychiatric disorders or communication difficulties; (4) Women who declined participation; (5) Women using insulin or other hypoglycemic medications; (6) Women who had previously participated in systematic diabetes health education programs.

Interventions

Control Group: IMNT Protocol After GDM diagnosis, women in the control group received at least four sessions of IMNT. Following diagnosis at 24-28 weeks of gestation, they attended nutritional counseling at the maternity care comprehensive outpatient clinic for a minimum of 40 minutes per session. Maternity care nutrition nurses distributed dietary diaries, daily exercise record forms, blood glucose monitoring sheets, and educational materials on hypoglycemia management and self-monitoring procedures.

The IMNT protocol included: (1) **Routine assessment:** Comprehensive evaluation of dietary patterns, physical activity, and fetal development based on prenatal records and reports from the women and their families; (2) **Personalized meal planning:** Nutritionists calculated daily energy requirements based on pre-pregnancy BMI, gestational age, and physical activity level, then developed individualized recipes specifying portions across eight food categories (grains, vegetables, legumes, dairy, meat/eggs, fruits, nuts, and oils). Equivalent food exchange tables were provided to facilitate dietary variety based on personal preferences and cooking methods; (3) **Self-monitoring of blood glucose:** Women were instructed to monitor blood glucose at home and complete monitoring forms; (4) **Follow-up and support:** A WeChat group was established for communication regarding diet, exercise, and self-monitoring. Women returned for a second IMNT session after one week, during which urine analysis, blood glucose records, weight, fundal height, and abdominal circumference were reviewed, with individualized nutrition and exercise plans adjusted as needed. Subsequent monthly prenatal visits included IMNT sessions where diabetes specialists adjusted recipes and exercise regimens based on self-monitoring data, weight gain, dietary/exercise diaries, urine results, complications, and fetal growth.

Observation Group: GCBT + IMNT The GCBT team comprised one chief physician, one psychologist, one nutritionist, one obstetric nurse, and one exercise coach. In addition to the IMNT protocol, women in the observation group and their primary family caregivers participated in two half-day GCBT group sessions lasting three hours total. GCBT components included: (1) **Theoretical instruction (30 minutes):** The chief physician explained GDM pathophysiology and common cognitive misconceptions to establish accurate understanding; (2) **Psychosomatic adjustment (30 minutes):** The

psychologist addressed emotional adjustment methods following GDM diagnosis, encouraged expression of negative emotions to reduce anxiety, and helped women recognize the importance of emotional self-monitoring to enhance self-empowerment and family support; (3) **Dietary guidance (30 minutes):** The nutritionist used food models to demonstrate selection of low glycemic index (GI) ingredients and appropriate cooking methods, addressing practical concerns such as reducing fat intake when dining out, accurate measurement techniques for family meals, and common dietary misconceptions (e.g., misclassifying root vegetables as vegetables); (4) **Exercise instruction (40 minutes):** A trained exercise coach led 20 minutes of indoor aerobic activity and demonstrated resistance exercises for late pregnancy, providing individualized guidance; (5) **Blood glucose monitoring training (20 minutes):** Nurses instructed proper glucometer use and measurement techniques; (6) **Review and problem-solving (30 minutes):** Healthcare providers reviewed dietary/exercise records and glucose monitoring data, identified issues, and provided solutions. A WeChat group facilitated ongoing peer support throughout pregnancy.

Data Collection

Trained outpatient nurses collected data including: (1) Baseline characteristics: age, pre-pregnancy weight, height, gravidity, parity, IVF conception, oral glucose tolerance test (OGTT) results, history of adverse pregnancy outcomes, uterine scarring, and family history of diabetes; (2) Electronic medical records provided pregnancy outcome data including gestational weight gain, delivery mode, gestational weeks at delivery, oligohydramnios, premature rupture of membranes, preterm birth, fetal distress, preeclampsia, and neonatal birth weight.

The area under the OGTT curve was calculated using the method described by Zhang et al. [6]: Area under the curve = fasting glucose/2 + 1-hour glucose + 2-hour glucose/2. Pre-pregnancy BMI classification followed the "Guidelines for Prevention and Control of Overweight and Obesity in Chinese Adults" (Chinese standards) [7]. Gestational weight gain classification followed the "Recommended Weight Gain Standards for Pregnant Women (WS/T801-2022)" [8].

Statistical Analysis

Data were analyzed using SPSS 26.0 software. Continuous variables were expressed as mean ± standard deviation and compared using independent samples t-tests. Categorical variables were expressed as frequencies and percentages, compared using ^{2} tests or Fisher's exact test with Bonferroni correction for pairwise comparisons. Propensity score matching was performed using the SPSS propensity score matching module at a 1:2 ratio with a caliper of 0.02. Variables showing between-group differences at baseline were included as covariates in the propensity score model [9], as these factors have been reported to affect pregnancy outcomes in women with GDM [6,10]. Statistical significance was defined as $P<0.05$.

Results

Baseline Characteristics Before and After Propensity Score Matching

Before propensity score matching, the two groups showed no significant differences in age, pre-pregnancy BMI, gravidity, parity, family history of diabetes, uterine scarring, or history of adverse pregnancy outcomes (P>0.05). However, the observation group had higher OGTT curve area and IVF conception rates compared to the control group (P<0.05). After matching, no significant differences remained between the groups in any baseline characteristics (P>0.05) .

Comparison of Pregnancy Outcomes Before and After Matching

Before propensity score matching, the groups differed significantly in gestational weight gain distribution (P<0.05), with the observation group showing lower rates of excessive weight gain and higher rates of normal weight gain compared to the control group (P<0.05). The observation group also had a lower macrosomia rate (P<0.05). No significant differences were observed in cesarean delivery rates, gestational weeks at delivery, oligohydramnios, premature rupture of membranes, preterm birth, fetal distress, preeclampsia, or low birth weight infant rates (P>0.05).

After propensity score matching, significant differences persisted in gestational weight gain distribution (P<0.05), with the observation group maintaining higher rates of normal weight gain (P<0.05). The observation group demonstrated longer gestational weeks at delivery and lower rates of preterm infants, macrosomia, and low birth weight infants compared to the control group (P<0.05). No significant differences were observed in cesarean delivery, oligohydramnios, premature rupture of membranes, fetal distress, or preeclampsia rates (P>0.05) .

Discussion

Research on psychological interventions to improve pregnancy outcomes in women with GDM remains limited [11]. This study utilized propensity score matching to investigate the impact of GCBT on pregnancy outcomes, finding that participation in GCBT reduced the incidence of adverse outcomes including preterm birth, macrosomia, and low birth weight.

Health education is crucial in the “five pillars” of diabetes management. In 2011, Peking University First Hospital pioneered the “GDM One-Day Clinic” model, which has since been adopted by other institutions [12]. Liu et al. [13] found that while One-Day Clinic intervention was not associated with reduced preterm birth or low birth weight, it did decrease macrosomia rates. Li et al. [14] reported no significant differences in macrosomia or preterm birth rates between women who participated in One-Day Clinic interventions and those who did not. Our

study found that GCBT reduced preterm birth rates, suggesting that GCBT may be superior to the One-Day Clinic model for women with GDM.

The preterm birth rate in China is approximately 6.9% [15], while women with GDM face a 1.5-fold increased risk compared to women without GDM [16]. Preterm birth adversely affects long-term offspring health [17]. Lei et al. [18] identified preterm birth as an independent risk factor for low birth weight. Li et al. [14] reported a low birth weight rate of 2.35% among women with GDM, while Liu et al. [13] reported 7.74%, both higher than our observation group's rate of 2.2% (3/134). This may be attributed to GCBT's emphasis on regular meal timing and adequate intake, which corrected the misconception that glucose control requires reduced food intake, thereby reducing preterm birth and low birth weight rates.

Globally, 25-40% of infants born to women with GDM are macrosomic [18]. Most studies on GDM pregnancy outcomes have found that One-Day Clinic interventions reduce macrosomia rates [19-21]. Zhong et al. [22] reported a macrosomia rate of 5.7% among women with GDM, while Yuan [23] reported 6.3%, both substantially higher than our observation group's rate of 1.5% (2/134). Our sample size was similar to these studies [22-23], suggesting that GCBT may effectively reduce preterm birth, low birth weight, and macrosomia, though further research is needed to confirm these effects. Future large-scale, multicenter studies on GCBT interventions for women with GDM are warranted to validate these findings.

Our study found that women who participated in GCBT had higher rates of normal gestational weight gain and longer gestational weeks at delivery, which may be important mediators underlying the reduced rates of low birth weight, macrosomia, and preterm birth. Future research should examine the mediating effects of appropriate gestational weight gain and prolonged gestation in GCBT interventions.

This preliminary study demonstrates that GCBT reduces adverse pregnancy outcomes including preterm birth, low birth weight, and macrosomia in women with GDM, providing evidence for establishing multidisciplinary management models for this population. Limitations include potential selection bias, as participants were recruited from a single hospital. Future multicenter, prospective cohort studies are needed to explore the long-term effects of GCBT on pregnancy outcomes and offspring health, ultimately providing more effective management strategies to improve maternal and neonatal outcomes.

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Table 1 Comparison of General Information of Pregnant Women Between the Two Groups

Table 2 Comparison of Pregnancy Outcomes of the Pregnant Women with GDM Between the Two Groups

Note: Figure translations are in progress. See original paper for figures.