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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Date: 2023-04-03T00:00:00+00:00

Abstract

Background: Gestational Diabetes Mellitus (GDM) is a common complication during pregnancy. The compliance with simple individualized medical nutrition therapy is poor among 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 a reference basis for improving pregnancy outcomes and formulating effective GDM management protocols.

Methods: We retrospectively selected 878 GDM pregnant women who received individualized medical nutrition therapy and delivered in our hospital from 2020 to 2021 as study subjects. GDM pregnant women who received GCBT constituted the observation group (n=141), while those who did not receive GCBT intervention constituted the control group (n=737). Differences in pregnancy outcomes between the two groups of GDM pregnant women 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$1.14)*wasgreaterthanthatinthecontrolgroup*(38.54$\pm$1.73) (P<0.05), and the proportions of preterm infants (3.7%), macrosomic infants (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 a reference basis 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 poor, and the impact of group cognitive behavioral therapy (GCBT) on their pregnancy outcomes remains unclear.

Objective: To examine the effect of GCBT on pregnancy outcomes in women with GDM and provide evidence for improving pregnancy outcomes and developing effective GDM management programs.

Methods: A retrospective study was conducted among 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, 134 women with GDM remained in the observation group and 256 in the control group. The proportion of women with appropriate gestational weight gain was significantly 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$1.14*vs*.38.54$\pm$$1.73 weeks, P<0.05) and lower rates of preterm infants (3.7% vs. 10.5%), macrosomia (1.5% vs. 5.9%), and low birth weight infants (2.2% vs. 9.0%) (all P<0.05).

Conclusion: GCBT can reduce the risk of preterm birth, low birth weight, and macrosomia 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]. Due to variations in lifestyle and dietary habits across regions, the incidence of GDM is particularly high 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 develop personalized and reasonable dietary plans based on pre-pregnancy body mass index (BMI), rate of gestational weight gain, and daily activity levels to maintain blood glucose control and appropriate gestational weight gain [3]. However, because the degree of hyperglycemia varies among individuals with GDM and IMNT requires long-term implementation, clinical adherence is often poor.

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 about GDM, thereby changing attitudes and behaviors toward IMNT [4]. Previous studies have found 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 to investigate the effect of GCBT on pregnancy outcomes using propensity score matching, providing evidence for improving pregnancy outcomes and developing more effective multidisciplinary management models.

Methods

Study Participants

A total of 878 pregnant women with GDM who received IMNT and delivered at the Maternity Care Comprehensive Outpatient of Shanxi Maternal and Child Health Hospital between 2020 and 2021 were selected as study subjects. 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) Diagnosed with GDM according to the "Guidelines for the Diagnosis and Treatment of Hyperglycemia in Pregnancy (2022) [Part 1]" [3], and received IMNT, prenatal care, and delivery at our hospital as singleton

pregnancies; (2) Provided informed consent and could actively cooperate with researchers.

Exclusion criteria: (1) Pre-existing abnormal glucose metabolism before pregnancy; (2) Other metabolic diseases such as hypertension or polycystic ovary syndrome; (3) Psychiatric disorders or communication disabilities; (4) Refusal to participate; (5) Use of insulin or other hypoglycemic medications; (6) Participation in systematic diabetes health education programs.

Treatment Protocols

Control Group: After GDM diagnosis, women received at least four sessions of IMNT. Following diagnosis at 24-28 weeks of gestation, they attended IMNT sessions at the nutrition clinic of the Maternity Care Comprehensive Outpatient, each lasting at least 40 minutes. Nurses provided dietary diaries, daily exercise records, blood glucose monitoring sheets, and educational materials on hypoglycemia management and self-monitoring procedures. The protocol included: (1) Routine assessment of dietary intake, physical activity, and fetal development based on prenatal records and patient reports; (2) Calculation of daily energy requirements based on pre-pregnancy BMI, gestational age, and physical activity level to develop individualized meal plans covering eight food categories (grains, vegetables, legumes, dairy, meat/eggs, fruits, nuts, and oils), with equivalent food exchange tables provided to facilitate dietary variety; (3) Self-monitoring of blood glucose at home with completed monitoring sheets; (4) A WeChat group for communication about diet, exercise, and glucose monitoring implementation. After one week of IMNT, women returned for a second session including urine analysis, glucose monitoring review, weight measurement, fundal height, and abdominal circumference, with individualized analysis of nutrition and exercise plans. Subsequent monthly prenatal visits included IMNT sessions where physicians adjusted meal plans and exercise based on recent glucose monitoring, weight gain, dietary/exercise diaries, urine results, complications, and fetal growth.

Observation Group: A GCBT team comprising one chief physician, one psychologist, one nutritionist, one obstetric nurse, and one exercise coach conducted two half-day GCBT sessions (total duration: 3 hours) for women and their primary caregivers, in addition to the control group protocol. GCBT content included: (1) Theory education (30 min) by the chief physician on GDM knowledge and common cognitive errors; (2) Psychosomatic adjustment (30 min) by the psychologist on coping with emotional responses to GDM diagnosis, encouraging expression of negative emotions, and promoting self-empowerment and family support; (3) Dietary guidance (30 min) by the nutritionist using food models to teach selection of low glycemic index ingredients and cooking methods, addressing concerns about dining out and common dietary misconceptions; (4) Exercise instruction (40 min) by a trained coach leading 20 minutes of indoor aerobic exercise and demonstrating resistance exercises for the third trimester with individualized guidance; (5) Blood glucose monitoring training (20 min)

by nurses on proper glucometer use; (6) Review of dietary/exercise and glucose monitoring records (30 min) with problem identification and solutions, plus establishment of a WeChat group for peer support during glucose management.

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, adverse pregnancy history, scarred uterus, and family history of diabetes; (2) Electronic medical records for pregnancy outcomes: gestational weight gain, delivery mode, gestational weeks at delivery, oligohydramnios, premature rupture of membranes, preterm infants, 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" [7]. Gestational weight gain classification followed the "Recommended Standards for Gestational Weight Gain in Women (WS/T801-2022)" [8].

Statistical Analysis

Data were analyzed using SPSS 26.0 software. Quantitative data were expressed as (x-±s) and compared using independent samples t-tests. Categorical data were expressed as frequencies and 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 selected for the propensity score model included baseline characteristics that differed between groups and were reported to affect pregnancy outcomes in women with GDM [6,10]: gravidity, parity, family history of diabetes, scarred uterus, adverse pregnancy history, area under the OGTT curve, and IVF conception. Statistical significance was defined as $P<0.05$.

Results

Comparison of Baseline Characteristics Before and After Matching

Before propensity score matching, there were no significant differences between groups in age, pre-pregnancy BMI, gravidity, parity, family history of diabetes, scarred uterus, or adverse pregnancy history ($P>0.05$). However, the observation group had significantly higher area under the OGTT curve and IVF conception rate compared to the control group ($P<0.05$). After matching, baseline characteristics were well-balanced between the 134 women in the observation group and 256 in the control group, with no significant differences in any variables ($P>0.05$) .

Comparison of Pregnancy Outcomes Before and After Matching

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

After propensity score matching, significant differences persisted in gestational weight gain distribution (P<0.05), with the observation group showing higher rates of appropriate weight gain (50.7% vs. 37.5%, P<0.05). The observation group also had longer gestational weeks at delivery (38.99$\pm$1.14*vs*.38.54$\pm$$1.73 weeks, P<0.05) and significantly lower rates of preterm infants (3.7% vs. 10.5%), macrosomia (1.5% vs. 5.9%), and low birth weight infants (2.2% vs. 9.0%) (all P<0.05). No significant differences were found in cesarean delivery, oligohydramnios, premature rupture of membranes, fetal distress, or preeclampsia rates (P>0.05) .

Discussion

Few studies have examined the effect of psychological interventions on pregnancy outcomes in women with GDM [11]. This study used propensity score matching analysis to investigate the impact of GCBT on pregnancy outcomes, finding that GCBT participation reduced the incidence of adverse outcomes including preterm infants, macrosomia, and low birth weight infants.

Health education is crucial in the "five carriages" 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 the One-Day Clinic intervention for women with GDM 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 with GDM who participated in the One-Day Clinic versus 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 have 1.5 times higher risk of preterm delivery than normal pregnancies [16], which 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 2.35% low birth weight rate among women with GDM, while Liu et al. [13] reported 7.74%, both higher than our observation group's 2.2% (3/134). This may be attributed to our GCBT program's emphasis on regular meal timing and adequate intake, correcting the misconception that glucose control requires reduced intake, thereby reducing preterm birth and

low birth weight rates. Globally, 25-40% of infants born to women with GDM are macrosomic [18], and most studies have found that One-Day Clinic interventions reduce macrosomia rates [19-21]. Zhong et al. [22] reported a 5.7% macrosomia rate, while Yuan [23] reported 6.3%, both significantly higher than our observation group's 1.5% (2/134). Our sample size is similar to these studies [22-23], suggesting that GCBT may 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 needed to validate these findings.

We found that women in the observation group had higher rates of appropriate gestational weight gain and longer gestational weeks at delivery, which may be important mediators for the lower rates of low birth weight, macrosomia, and preterm birth. Future research should explore the mediating effects of appropriate weight gain and prolonged gestation in GCBT interventions.

This study preliminarily explored the impact of GCBT on adverse pregnancy outcomes in women with GDM, demonstrating reduced rates of preterm infants, low birth weight infants, and macrosomia, providing evidence for establishing a multidisciplinary management model for GDM.

Limitations: This study included women with GDM from a single hospital, which may introduce selection bias. Future multicenter, prospective cohort studies are needed to investigate the effects of GCBT on pregnancy outcomes and long-term offspring health to provide more effective management strategies for women with GDM and improve maternal-infant outcomes.

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(Received: November 16, 2022; Revised: March 5, 2023)
(Editor: SONG Chunmei)

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