

One-day outpatient health management prevents hazardous events during fetal childbirth of gestational diabetes mellitus

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Abstract

Background: To analyze the effects of one-day outpatient health management on premature birth, macrosomia, and low-birth-weight infants in patients with gestational diabetes mellitus (GDM).

Methods: Medical records of patients with gestational diabetes mellitus in our hospital during 2019 were retrospectively collected, including basic information, family history, and pregnancy complications. The outcomes, including preterm birth, macrosomia, and low-birth-weight infants, of patients receiving one-day outpatient health management or not were observed. Logistic regression analysis was used to detect the potential relationship between one-day outpatient health management and outcomes.

Results: A total of 1393 patients with gestational diabetes mellitus presented to Guiyang Maternal and Child Health Hospital in 2019, including 104 premature births, 91 low-birth-weight infants, and 71 macrosomia infants. The mean age of the selected subjects was 33.06 ± 4.83 and the mean body mass index was $22.78 \pm 3.18 \text{ kg/m}^2$. A total of 535 (38.41%) patients with gestational diabetes mellitus volunteered to participate in the one-day outpatient health management program. This health management [odds ratio = 0.474 (95% confidence interval 0.272–0.826)] was a protective factor for macrosomia; however, it was not associated with premature birth and low-birth-weight.

Conclusions: The degree of acceptance of patients with gestational diabetes mellitus to a one-day outpatient health management program is still low. This health management program reduced the risk of macrosomia in patients with gestational diabetes mellitus by 52.6%. In the future, regular follow-up should be introduced in clinical practice to further improve the effects of one-day programs.

Background

Gestational diabetes mellitus, which causes serious damage to maternal and infant physical health, refers to pregnancy with abnormal glucose fluctuations for the first time^[1], except diabetes before childbirth. Patients with GDM suffer a higher risk of gestational hypertension, cesarean section^[2], and type II diabetes mellitus (T2DM)^[3]. Alternatively, GDM is associated with neonatal complications, such as macrosomia, premature delivery, hypoglycemia, neonatal respiratory distress, and jaundice^[4]. Therefore, GDM is an important public health issue. However, the adverse consequences of GDM could be actively prevented and reversed. Based on clinical experience, early diagnosis, and GDM treatment, opportunities can be provided for clinical intervention and the reduction of the incidence of adverse perinatal outcomes^[5].

Treatment options for GDM include pharmacological therapy and non-pharmacological interventions. Alternative drugs include oral hypoglycemic agents and insulin therapy. Although insulin therapy has traditionally been the preferred treatment of GDM, contrary opinions also exist. For example, Nicholson *et al.*^[6] recommend non-pharmacological interventions as the first-line treatment with self-care measures, including lifestyle changes (usually diet and exercise) and self-monitoring of blood glucose levels. A

meta-analysis of lifestyle intervention in treating GDM also showed that this is the main treatment strategy for such patients^[7]. As most patients control their blood glucose at normal levels through appropriate dietary regulation and exercise, researchers have evaluated the effectiveness of dietary control, physical exercise, and health education in improving the pregnancy outcomes of patients with GDM^[8]. First, several pilot studies have assessed the effectiveness of various dietary strategies, such as low-sodium diets, low-to-moderate carbohydrate diets, low-glycemic-index diets, and high-fiber diets^[9]. For example, Perichart-Perera *et al.*^[10] found that the risk of low-birth-weight infants (< 2500 g) in pregnant women with GDM who received nutritional intervention was significantly lower than that in the control group ($p = 0.041$). Second, for physical exercise, a double-blind randomized clinical trial assessed the effectiveness of routine exercise in reducing the risk of GDM-related complications^[11]. That study indicated that moderate-intensity aerobic exercise (25–30 min, three times a week) significantly reduced the incidence of macrosomia and cesarean sections. Although exercise intervention lowered blood glucose levels and provided exercise guidance for pregnant women, it was rarely used as an independent intervention and often implemented with other types of interventions^[12]. Third, effective health education strategies for pregnant women, providing key information on GDM, could increase treatment adherence of pregnant women and relieve the psychological burden, such as anxiety and depression^[13]. Health education could indirectly elevate the actual execution as a better adjuvant measure to understand dietary control and physical exercise and effective rate of other measures. Recently, to improve the effects of GDM-related health education, many teams have conducted various educational modes, such as increasing emotional support for pregnant women based on traditional nursing and suggesting that family members also receive relative education^[14]. Further, smartphone applications were used to manage blood glucose levels and deliver information on a healthy diet and physical exercise^[15, 16].

For the scientific management of GDM, one-day outpatient health management has been applied in many hospitals and has achieved reliable results in China^[17–20]. The one-day outpatient health management for patients with GDM and their families refers to a series of and systemic measures, such as diet control, proper exercise, and blood glucose monitoring, supervised by medical staff with an interval of one-day. It is aimed at strengthening patients' self-management concepts and executive ability, and at regularly following pregnant women; this clinical service is jointly implemented by the deputy chief physician or attending physician in the departments of obstetrics, endocrinology, and nutrition, and specialist nurses in diabetes who have sufficient time; this service offsets restrictions of the limited time and physicians' qualification in the traditional methods. Different from the monotonous and unpractical management mode in previous clinical processes, one-day outpatient health management programs, using face-to-face demonstrations and hands-on experience, translated the abstract concept to concrete feelings of pregnant women, to establish an effective interaction between medical staff and pregnant women and their families, thereby enhancing the effectiveness of health education^[21]. The Guiyang Maternal and Child Health Care Hospital opened a one-day outpatient health management program in 2015. This study reviewed the data of hospital outpatient services in 2019 targeting pregnant women and

analyzed the effects of outpatient services in preventing preterm birth, macrosomia, and low-birth-weight infants in patients with GDM, to provide better medical services for such patients in the future.

1 Materials And Methods

Ethical Clearance and Informed Consent: This study was conducted under the surveillance of Guizhou University of Chinese Traditional Medicine and Women Healthcare Department of Guiyang Maternal and Child Health Hospital, in the People's Republic of China. The study protocol was approved by the ethics committee of Guiyang Maternal and Child Health Hospital. Informed consent was obtained from the women who participated.

1.1 Subjects

The data of patients, including those with GDM and without, who participated in a one-day outpatient service in our hospital from January 1 to December 30, 2019 were retrospectively collected. GDM was diagnosed according to the criteria established by Obstetrics and Gynecology (9th edition). First, blood glucose levels of women in the early stage of the third trimester were measured after fasting for one night, then OGTT was conducted (75 g glucose was dissolved in 250 ml warm water, and consumed within 5 min). The cutoff values for blood glucose levels 1 and 2 h after drinking the solution were measured. If the women's values met or exceeded the blood glucose value standards, 5.1 (empty stomach), 10.0 (at 1 h), and 8.5 (at 2 h) mmol/l, respectively, they were diagnosed to have GDM^[22]. Under the guidance of doctors, patients with GDM can voluntarily choose to participate in either the general outpatient health education program or a one-day outpatient clinical program.

1.2 Standard process

The subjects in the control group received ordinary health education, including blood glucose tests, fetal movement count, and instructions on diet and exercise by the obstetrician and nursing staff.

The experimental group (one-day outpatient health management group) received standard management as listed in Table 1. The guidance group consisted of obstetrics outpatient doctors and nurses who implemented the one-day outpatient health management plan. Subjects in this group were only interposed once daily, and a family member was allowed to accompany them.

1.3 Observed factors

Medical record data of each subject examined were collected, including pregnancy weight, height, family history (including diabetes), and whether the following conditions were present in pregnant woman: polycystic ovary syndrome (PCOS), diabetes, lipid metabolic abnormalities, gynecological tumor, and attending a one-day outpatient health management program. The outcome indicators observed included the occurrence of premature birth, macrosomia, and low-birth-weight.

1.4 Statistical analyses

SAS v.9.4 statistical software was used to analyze the data, and the counting data were expressed as cases (percentages). Single logistic regression was used to detect the risk factors of single outcome indicators, and factors with statistical significance were included in the multivariate logistic regression for adjustment. Finally, the relationship between the one-day outpatient health management and each outcome indicator was discussed. Comparisons were considered significantly different if $p < 0.05$.

2 Results

2.1 Basic information

A total of 1393 patients with GDM participated, including 104 premature infants, 91 low-birth-weight infants, and 71 macrosomia infants. The mean age of the patients was 33.06 ± 4.83 years. There were 488 (35.03%) pregnant women aged over 35 years, and their pre-pregnancy body mass index (BMI) was 22.78 ± 3.18 kg/m². There were 449 (31.99%) pregnant women with a pre-pregnancy BMI over 24 kg/m². A total of 535 (38.41%) pregnant women attended the one-day clinic. There were no statistically significant differences between the study and control groups with regard to age, paternal diabetes, maternal diabetes, PCOS, abnormal lipid metabolism, or gynecological tumors. However, statistically significant differences were observed in the pre-pregnancy BMI group ($p < 0.05$). The incidences of premature birth, macrosomia, and low-birth-weight infants attending the one-day outpatient service were 7.85%, 3.64%, and 7.74%, respectively, whereas the values for those who did not attend the one-day outpatient service were 7.32%, 6.57%, and 6.34%, respectively (Tables 2–4).

2.2 Preventive effects of one-day outpatient service on premature delivery

Logistic regression analyses showed that attendance of the one-day clinic did not affect the outcomes of preterm birth. After adjusting for age, pre-pregnancy BMI, parental diabetes prevalence, and PCOS, multivariate logistic regression analyses showed that attendance of the one-day clinic did not affect the outcomes of preterm delivery (Table 5).

2.3 Preventive effects of one-day clinic on macrosomia

Univariate logistic regression analysis results showed that age and attendance of the one-day clinic were statistically correlated with macrosomia. Age more than 35 years [odds ratio (OR) 2.678, 95% confidence interval (CI) 1.648–4.351] was a risk factor for macrosomia, and one-day outpatient attendance (OR 0.537, 95% CI 0.311–0.928) was a protective factor for macrosomia. After adjusting for age, pre-pregnancy BMI, and paternal diabetes, multivariate logistic regression analyses showed that age and attendance of the one-day clinic were still related factors (Table 6).

2.4 Preventive effects of one-day clinic on low-birth-weight infants

Univariate logistic regression analysis results showed that attendance of the one-day clinic did not affect the low-birth-weight infants. After adjusting for age, pre-pregnancy BMI, and paternal diabetes prevalence,

multivariate logistic regression analyses showed that attendance at a one-day clinic did not affect low-birth-weight infants (Table 7).

3 Discussion

As a retrospective study, we selected pregnant and parturient women with GDM regularly receiving antenatal care in our hospital in 2019 as the research objects. The data volume was large, with 1393 subjects included. The one-day outpatient management program was designed to improve the maternal and infant health levels of GDM and reduce short- and long-term complications. Logistic regression, which evaluated the effects of promising management, was applied to detect the association between one-day outpatient management and pregnancy risk events, including preterm birth, macrosomia, and low-birth-weight infants.

GDM, a global metabolic disorder, consists of two major types. The first type is diabetes diagnosed before pregnancy, called “diabetes combined with pregnancy,” which was excluded from our study criteria. The second type refers to elevated blood glucose levels and decreased sensitivity to insulin, resulting from the changed body structure of pregnant women, and abnormal fluctuations of placental lactogen, estrogen, progesterone, cortisol, and placental insulinase in middle and late pregnancy. However, this glycometabolic disorder could return after delivery. In this study, only the second type of GDM, identified by the International Diabetes and Pregnancy Research Group diagnostic criteria, was incorporated. According to previous epidemiological data, the morbidity of GDM in China is 5.12–33.3%, which is rising because of the increase in elderly parturient women^[23–26]. As a special type of diabetes, patients with GDM suffer a higher risk of T2DM after delivery. Also, during delivery, the risk of eclampsia increases for both mother and infant^[27]. Hyperglycemia and adverse pregnancy outcome studies also showed that the risk of adverse outcomes^[28], such as macrosomia, increases with rising blood glucose levels. Therefore, the timely detection of GDM and interventions in the lifestyle and nutrition of pregnant women are effective means by which to reduce the adverse pregnancy outcomes of GDM, especially for macrosomia.

As mentioned in the introduction, non-drug therapy is gradually being regarded as an effective means of blood glucose management in patients with GDM, which includes mainly diet management and physical exercise. In particular, the awareness of GDM management strategies to improve the implementation of these patients have a greater impact on blood glucose management. Blood glucose management consists mainly of periodic blood glucose detection and irregular propaganda and education. In clinical practice follow-up, it was found that after routine blood glucose management, pregnant women with GDM still suffered a higher risk of fasting blood glucose fluctuation. Therefore, a more effective mode should be exploited and applied to manage patients with GDM. Health professionals are constantly looking for practical methods to encourage a healthy lifestyle in patients with GDM, such as long-term guidance through Internet applications^[29]. The one-day outpatient service is a multimodal management plan conducted through the face-to-face guidance of professional doctors and personal experience of

comprehensive nursing services at one-day intervals^[30]. The one-day outpatient health management program translated the abstract concept to concrete feelings of pregnant women, to establish an effective interaction between medical staff and pregnant women families, thereby enhancing the effects of health education on the whole perinatal health management.

Our hospital started the one-day outpatient service of GDM in 2015, and the relevant management content and level have improved based on clinical practices. This retrospective analysis of the data profile in 2019 revealed that only 38.41% of patients with GDM are likely to attend the one-day outpatient clinic, indicating the low popularity of the one-day outpatient clinic, which may be because of insufficient rate of GDM management education for pregnant women at the time of the first diagnosis. A total of 535 pregnant women with GDM participated in the outpatient service in a day, with macrosomia seen in 18 cases (3.36%), most of who did not participate in the outpatient service. Moreover, 858 people were recorded in a day, with macrosomia seen in 53 cases (6.18%). From single- and multiple-factor logistic regression analyses (ORs 0.537 and 0.474, respectively, with statistical significance), one-day of outpatient service for protecting macrosomia factors can effectively prevent the occurrence of macrosomia. However, the effects on preventing premature birth and low-birth-weight infants are not significant, because the main strategy of the one-day clinic of this project was to control blood sugar, without other special measures for premature birth and low-birth-weight infants, such as anemia and malnutrition. Although many studies have shown that a one-day clinic could prevent macrosomia occurrence^[31,32], the results were less convincing owing to the small sample size. However, the data profile of our retrospective analysis is extensive and more convincing. Therefore, combined with data of other scholars, pregnant women who attended the one-day outpatient service suffered a lower occurrence of macrosomia.

Based on statistical analyses and clinical experiences regarding the one-day outpatient service in our hospital, the reasons for preventing macrosomia in the one-day outpatient service may be summarized as three points. First, it improved the compliance of pregnant women with GDM. Patients with GDM who attended the one-day outpatient management service showed higher awareness of disease prevention and compliance with medical advice than other patients with GDM. The one-day outpatient health management program further improved pregnant women's compliance, including diet control and exercise^[31]. The participation of the patient's family members, especially the improvement of their knowledge about GDM, assisted daily management efficiently. The second reason is the efficient, whole process, and professional health education of medical staff. Unlike traditional education during pregnancy, medical staff is required to accompany pregnant women all day in the process of a one-day outpatient clinic. Through interesting courses, food models, video clips, and other methods, pregnant women could grasp the general knowledge of GDM prevention in a relaxing atmosphere, and gradually master the self-management of blood sugar, which could lay a solid foundation for the home management of blood sugar in the late-pregnancy period. Studies have shown that a one-day outpatient clinic can enhance the knowledge awareness rate of GDM and improve the self-management ability at home^[33]. The third reason is the power from peer effects, namely, companions, including healthcare

workers and the pregnant women's partners. In the one-day outpatient clinic, pregnant women are accompanied by medical staff in the whole process and receive mutual encouragement and support from other pregnant women^[34]. Therefore, they are psychologically satisfied, with reduced anxiety and depression, and are more likely to accept disease prevention knowledge and improve self-management ability. Finally, we believe that the main management strategies of the one-day outpatient service should be further researched and demonstrated through clinical practice.

The main strategies of this one-day outpatient service are diet management, exercise management, blood glucose monitoring, and professional education of GDM. This involves nutritional medicine, sports medicine, diabetes, gynecology, and obstetrics. Therefore, multidisciplinary experts must devise a management strategy of a one-day outpatient service and revise it based on clinical practice. Moreover, individualized management strategies should be developed for individual patients with GDM after the one-day outpatient service to improve their knowledge of GDM management to maintain their blood glucose and weight at home.

The function of the one-day clinic in preventing premature delivery and low-birth-weight is still controversial. Barakat *et al.*^[32] found that the incidence of premature birth in the group participating in a one-day clinic was 5.60%, lower than the 7.20% in the control group; however, there was no statistical difference. Liao *et al.*^[33] found that the rate of premature birth for patients with GDM who attended the one-day clinic was 7.5%, which was significantly lower than 14.00% in the control group, similar to the incidence rate of low-birth-weight children. Yang *et al.*^[35, 36] found that the proportion of low-birth-weight children in their study group was 5.3%, which was almost the same as that in the control group. The reason for these discrepancies may be the different methods and management strategies adopted in different one-day outpatient departments. For example, GDM strategies focused mainly on blood glucose management through exercise and diet control, whereas those for preterm and low-birth-weight infants focused mainly on nutrition support therapy.

Some studies have added other methods based on the traditional one-day outpatient service, which further improved the pregnancy outcomes for GDM. For example, guiding pregnant women to join the Internet home-care platform after attending the one-day outpatient service for GDM and assigning specialized nurses to provide long-term guidance on the Internet platform. Gardsten *et al.*^[37] adopted continuous follow-up based on the one-day outpatient service and established GDM-tracking cards for relatives to solve the potential problem in a timely manner. In summary, the one-day outpatient service is a management strategy that combines multidisciplinary guidance and linkage. Thus, a professional one-day outpatient service strategy should be developed for pregnant women.

This study has two advantages. First, it has a large sample size. Although it is a retrospective study, the research data are complete and reliable. Second, multivariate logistic regression was used to control the confounding factors, such as advanced age and pre-pregnancy BMI, which initially confirmed that the one-day clinic program was an independent protective factor for macrosomia.

4 Lack Of Research

The shortcomings of this study are as follows: (1) the level of evidence in the retrospective study was low. As a public welfare project of the hospital, a one-day outpatient clinic aims to control the blood glucose level of patients with GDM. From the perspective of ethics, a randomization scheme cannot be implemented. (2) Pregnant women willing to attend the one-day clinic tended to have better compliance, personal management, and glycemic control, which could have been important confounding factors that may have influenced the study results.

5 Conclusion

The risk of macrosomia among patients with GDM was reduced by 52.6% by implementing one-day outpatient management programs for pregnant women with GDM. In the future, regular follow-up should be introduced in clinical practice to further improve the effects of one-day programs.

Declarations

Competing interests

The authors declare there are not competing interests in the present research protocol.

Authors' contributions

Zheng Dan, Luo Yan and Zheng Moumeng were involved in conception and design of the study. Zheng Dan and Lou Didong drafted the manuscript. All authors edited the manuscript and read and approved the final draft.

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Abbreviations

GDM
gestational diabetes mellitus
T2DM
type II diabetes mellitus
PCOS
polycystic ovary syndrome

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Tables

Tables 1-7 are included in the Supplementary Files section.

Supplementary Files

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