



# The effectiveness of lifestyle intervention in early pregnancy to prevent gestational diabetes mellitus in Chinese overweight and obese women: A quasi-experimental study



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## ARTICLE INFO

### Article history:

Received 14 July 2015

Revised 1 October 2015

Accepted 22 October 2015

### Keywords:

Early pregnancy

Gestational diabetes mellitus

Lifestyle intervention

Overweight

Prevention

## ABSTRACT

**Purpose:** Gestational diabetes mellitus (GDM) is one of the most common complications of pregnancy and is associated with substantially elevated risk of adverse health outcomes for both mothers and offspring. This quasi-experimental trial was conducted to assess whether a lifestyle intervention in early pregnancy can reduce the incidence of GDM and excessive gestational weight (GWG) gain among Chinese overweight women.

**Methods:** Convenience samples of 74 women in gestational weeks 8–12 with a BMI  $\geq 24$  kg/m<sup>2</sup> were enrolled. They were divided into intervention (N = 37) or control group (N = 37) according to the time sequence of seeing the doctor. The intervention group was provided with exercise, dietary, weight gain counseling and detailed plans at weeks 8–12 and every month in the second trimester. In addition, each counseling session included a personalized feedback based on their 5-day-records. Follow-up phone calls or emails were conducted every week between antenatal visits. The control group was just provided with exercise, dietary and weight gain counseling at weeks 8–12, besides the usual health education provided at the O&G outpatient department.

**Results:** The lifestyle intervention resulted in a lower incidence of gestational diabetes in the intervention group (9/32, 28.1%) compared with the control group (19/34, 55.9%),  $p = 0.023$ . Women in the intervention group gained much less weight ( $6.86 \pm 2.31$  versus  $10.08 \pm 3.84$  kg,  $p = 0.000$ ) at the end of second trimester.

**Conclusion:** Lifestyle intervention in early pregnancy can reduce the incidence of GDM and prevent excessive maternal weight gain in overweight and obese pregnant women.

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## What is already known about the topic?

- Gestational diabetes mellitus is associated with substantially elevated risk of adverse health outcomes for both mothers and offspring.
- Obesity is a significant risk factor for developing GDM.
- The effects of lifestyle intervention on improving glucose tolerance and insulin sensitivity in type II diabetes mellitus (T2DM) have been confirmed, but their effects on preventing GDM differ in their design of support interventions and have provided equivocal results.

## What this research adds

- This research demonstrates that the lifestyle intervention in early pregnancy can reduce the incidence of GDM in overweight and obese pregnant women.

- This research finds that the lifestyle intervention in early pregnancy can prevent excessive maternal weight gain before 28 wk of gestation in overweight and obese pregnant women.

## 1. Introduction

Gestational diabetes mellitus (GDM) has been defined as any degree of glucose intolerance with onset or first recognition during pregnancy (American Diabetes Association, 2012). It is one of the most common complications of pregnancy in the United States. Approximately 7% of all pregnancies are complicated by GDM, resulting in more than 200,000 cases annually. The prevalence of GDM has been rapidly increasing worldwide. In China, GDM has increased 2.8 times in the past ten years from 2.4 to 6.8%, using the WHO criteria (Zhang et al., 2011). GDM usually resolves after birth. However, affected women are at increased risk of developing diabetes later in life (Bellamy, Casas, Hingorani, & Williams, 2009). Newborns of pregnancies affected by GDM are at risk of macrosomia, shoulder dystocia, birth injuries and hypoglycemia (Hartling et al., 2014; Metzger et al., 2008). It also shows to induce long-term effects in offspring. Increased incidence of T2DM in adult offspring from diabetic mothers, cardiovascular alterations,

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including hypertension, are also part of lifelong consequences of in-utero exposure to increased glucose concentrations (Dabelea, 2007; Simeoni & Barker, 2009). Two other possible long-term consequences of pregnancies complicated by GDM are the development of the metabolic syndrome and obesity in the offspring (Clausen et al., 2009; Kampmann et al., 2015).

Being overweight or obese is recognized as risk factors for developing GDM in pregnancy. A recent meta-analysis including 70 studies reported that the odds ratio (OR) of overweight, moderately obese and morbidly obese women developing GDM was 1.97 (95% CI 1.77 to 2.19), 3.01 (95% CI 2.34 to 3.87) and 5.55 (95% CI 4.27 to 7.21), compared with normal weight women (Torloni et al., 2009). Obesity is a serious public health problem that currently affects a large population worldwide, both in developed and developing countries. In China, 24.5% reproductive aged women are overweight ( $24 \leq$  body mass index (BMI)  $< 28$  kg/m<sup>2</sup>) and 9.0% are obese (BMI  $\geq 28$  kg/m<sup>2</sup>) (Li, Jiang, & Hu, 2012). Both pre-pregnancy obesity and excessive gestational weight gain (GWG) have been found to be an independent risk factor for GDM (Hedderson, Gunderson, & Ferrara, 2010; Gibson, Waters, & Catalano, 2012). However, only a third to a half of obese women achieve gestational weight gain of recommended ranges based on BMI (Nagle et al., 2013).

Inappropriate food intake and inadequate levels of physical activity have been recognized as important contributing factors to the epidemic of type II diabetes mellitus (Ravussin, Valencia, Esparza, Bennett, & Schulz, 1994). Type II diabetes mellitus can be prevented or delayed through lifestyle changes, including increasing physical activity, improving in diet (Knowler et al., 2002; Tuomilehto et al., 2001). GDM and Type II diabetes have similarities: both are characterized by a strong family history, overweight, insulin resistance, and lacking of compensatory pancreatic insulin secretion in demanding hormonal circumstances (Jovanovic-Peterson & Peterson, 1996). Recent data show that diet and exercise interventions may be successful in reducing gestational weight gain in women with an increased risk of developing GDM, but limited effects on the incidence of GDM (Bogaerts et al., 2013; Guelinckx, Devlieger, Mullie, & Vansant, 2010; Luoto et al., 2011; Oteng-Ntim, Varma, Croker, Poston, & Doyle, 2012; Thangaratinam et al., 2012; Vinter, Jensen, Ovesen, Beck-Nielsen, & Jorgensen, 2011).

GDM is usually diagnosed between 24–28 weeks of pregnancy. Dempsey et al. (2004) found women most active within the first 20 weeks of pregnancy were half as likely to develop GDM. We therefore carried out an intervention trial in overweight and obese pregnant women.

## 2. Aim

The aim of this study was to measure the effectiveness of early intensive lifestyle intervention that is combined with closed follow-up, in preventing the incidence of GDM. The hypothesis was that women in the intervention group had fewer diagnoses of GDM than women in the control group.

## 3. Method

### 3.1. Design

Women were recruited by convenience sampling from the Obstetrics and Gynecology outpatient department of Peking Union Medical College Hospital between March 2013 and August 2013. For this quasi-experimental study, participants were assigned based on the time sequence of seeing the doctor. Pregnant women who came for the antenatal care on Monday were assigned to the intervention group and those who came on Wednesday were assigned to the control group.

### 3.2. Participants

Women were included if they met all of these criteria: (1) pre-pregnancy body mass index (BMI)  $\geq 24$  kg/m<sup>2</sup>; (2) gestational weeks between 8–12<sup>+</sup><sub>6</sub> when first contacted with O&G outpatient department; (3) with a singleton pregnancy; (4) primipara. The exclusion criteria were as follows: (1) had pre-existing diabetes; (2) at least one of the three baseline oral glucose tolerance test (OGTT) measurements was abnormal at 8–12<sup>+</sup><sub>6</sub> weeks' gestation (blood glucose  $\geq 5.1$  mmol/l at fasting,  $\geq 10.0$  mmol/l at 1-hour or  $\geq 8.5$  mmol/l at 2 hours); (3) vaginal bleeding or with severe medical conditions preventing from physical exercise; (4) treatment or clinical history of psychiatric illness. According to Quinlivan, Lam, & Fisher (2011), the lifestyle intervention could reduce the GDM rate by 23%. As the GDM rate was 26.7% among Chinese obese women (Bin, 2007), sample size was calculated assuming a GDM incidence of 26.7% in the control group and 3.7% incidence in the intervention group. Using a two-sided significance level of 0.05 and a power of 80%, and assuming a dropout rate of 20%, a sample size of 74 pregnant women was estimated to be sufficient.

### 3.3. Control group

Participants in this group received one session face-to-face education upon enrollment by the research nurse, including general information and recommendations about dietary, exercise and weight gain. An education booklet, which has information on dietary, exercise and weight gain management, was provided to the participants. During each prenatal visit, they received usual health education provided at the O&G outpatient department and their weight was measured.

### 3.4. Intervention group

In this group, the research nurse obtained a detailed dietary and exercise history of the participants upon enrollment, initial individual advice was given on each subject of dietary, exercise and weight gain followed with four sessions in the second trimesters, as described below. In addition, each session in the second trimesters included an individual component where women received personalized feedbacks on their dietary and exercise habits based on 5-day-records. Women in this group also received weekly phone call (five to ten minute) or short text message between antenatal visits on different topics such as: recording of weight gain; encouraging goal setting; reinforcing positive lifestyle change; promoting self-monitoring. Through out the implementation of the plan that offered in this study, participants were encouraged to identify barriers and used the barriers to assist them to problem solving and to developing strategies in order to achieve their successful implementation of lifestyle change.

#### 3.4.1. Dietary counseling in the intervention group

Based on Chinese dietary recommendations for pregnant women (Chinese Dietary Reference Intakes, 2001), the goal of dietary counseling was to help participants achieve a healthy diet, with 50–60% of total energy (E%) coming from carbohydrates, 20–30 E% from fats and 15–20 E% from protein. Energy requirements for each participant were individually calculated according to weight and level of activity. Recommendation for energy intake was 25–30 kcal/kg/day for overweight women. In practice, the participants were advised (1) to select mostly high fiber bread and other whole-meal products; (2) to consume at least 300 g of vegetables a day, and 200 g of fruits a day; (3) to select mostly fat-free or low fat versions of milk and milk products and of meat and meat products; (4) to eat fish at least twice per week; (5) to use moderate amounts of oil in cooking and baking; (6) to consume seldom and only in small-portions snacks containing high levels of sugar and/or fat (Luoto et al., 2011). Women were provided with individualized information, including meal plans, healthy recipes that were quick to prepare, options for healthy snacking and eating out.

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