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Original Article

Effects of Antenatal Lifestyle Interventions in Pregnant Women with Normal Body Mass Index

Hong Yang [1], Yun Zhao [1], Jiahui Tu [1], Yanan Chang [2], *Chanyun Xiao [1]

1. *Department of Obstetrics, Maternal and Child Health Hospital of Hubei Province, Wuhan 430070, Hubei Province, China*
2. *Department of Women's Health Care, Maternal and Child Health Hospital of Hubei Province, Wuhan 430070, Hubei Province, China*

***Corresponding Author:** Email: xiaochanyun2022@163.com

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Abstract

Background: We aimed to explore the effect of lifestyle interventions on improving lifestyle behaviors on gestational weight gain in pregnant women with normal body mass index (BMI).

Methods: The study was conducted in Maternal and Child Health Hospital of Hubei Province (Wuhan, China) between June 2020 and April 2022. A total of 355 pregnant women (<12 weeks of pregnancy) were enrolled and finally completed the program. Participants were divided into the intervention and control groups. The intervention group received an individualized lifestyle intervention focusing on healthy lifestyle, like diet, exercise, and weight monitoring as four sessions at 16–18, 20–24, 28-30 and 34 weeks' gestation. Participants in the control group received routine antenatal care. The weight of both group was recorded from pregnancy until 6-8 weeks postpartum.

Results: The participants in the intervention group with normal pre-pregnancy BMI (n = 178) had lower GWG, excessive GWG, hypertension, and neonate birth weight compared to the control group (n = 177, $P<0.01$). There were no statistically significant differences in the occurrence of gestational diabetes, premature labor, delivery mode, preterm birth, small for gestational age, macrosomia, number of neonates referred to the NICU, and postpartum weight retention.

Conclusion: Even though lifestyle intervention in pregnant women with normal BMI has a relatively limited effect, attention should still be paid to reasonable weight gain during pregnancy and the potential long-term impact of the intervention remains to be assessed.

Keywords: GWG (Gestational weight gain); BMI (Body mass index); PWR (Postpartum weight retention)

Introduction

Overweight and obesity are the major public health problems, with high rates of mortality and morbidity. The WHO has identified obesity as a global epidemic and called for urgent public health measures to address it (1). Maintaining a healthy body weight is particularly important for women of childbearing age. Maternal overweight and obesity can affect the gestational process, as well as delivery and the postpartum health of both mothers and their infants. In addition to

pre-pregnancy body weight, gestational weight gain (GWG) also plays an important role in maternal and infant health outcomes (2).

Approximately 50% of women enter pregnancy with body mass index (BMI) within the normal range (3, 4). Nevertheless, women who commence pregnancy with a normal BMI are at the greatest risk of excessive GWG (5), closely linked to pregnancy complications such as hypertension disorders, diabetes, cesarean delivery, postpartum weight retention and obesity in later life, adverse outcomes to the offspring such as being born large for gestational age, macrosomia, infant morbidity and mortality, neonatal early motoric development, even childhood obesity from both near and far perspectives (5-7). This demonstrates the need for effective preventive measures to reduce the proportion of women with normal pre-pregnancy BMI who present with excessive GWG.

Important and potential determinants of controlling GWG are maternal health behaviors, in particular diet and physical activity. Various trials of lifestyle interventions during pregnancy have attempted to limit GWG, focusing primarily on overweight and/or obese women (8-11), studies that included women in different BMI ranges did not definitively assess the effectiveness in women with normal weight. In a small sample study, among pregnant women with normal pre-pregnancy BMI, the number of GWG, the EGWG ratio and the birth weight of participants' offspring were approximately lower in the lifestyle intervention group compared to the control group, these variables were not significantly different between the intervention and control groups in the above normal pre-pregnancy BMI women (12). This study illustrates that the outcomes of lifestyle interventions for pregnant women with different pre-pregnancy BMI are different. In addition, the evidence on the effectiveness of lifestyle interventions on maternal and neonatal outcomes is inconsistent.

Meta-analyses conducted on the effects of diet- and physical activity-based interventions in reducing GWG revealed significant beneficial effects (13-15). These meta-analyses reported significant effect on mean reductions in total GWG of between 0.3 and 2.4 kg in lifestyle interventions compared with standard care. There was some evidence that dietary-only interventions or physical activity-only interventions may reduce the odds of gestational diabetes with no observed effect on other maternal or neonatal outcomes (16). In the other Meta analyses, significant reductions were found for gestational diabetes, LGA, macrosomia and cesarean section rates in the counseling and behavioral intervention group (17). Nevertheless, interventions have not been observed to impact pregnancy, delivery or neonatal outcomes (18).

Considering that validated data on prenatal dietary and lifestyle interventions for pregnant women with normal BMI are still limited, the purpose of this study was to determine the effectiveness of lifestyle interventions, to accommodate a healthy lifestyle, to develop dietary habits in pregnant women with normal BMI, to control that GWG is within the levels recommended by the 2009 institute of medicine (IOM) guideline as much as possible, to prevent excessive GWG, and to explore whether it can reduce the associated adverse pregnancy outcomes and PWR.

Methods

Design

All aspects of this research study were conducted under the approval of Maternal and Child Health Hospital of Hubei Province, Wuhan, China. Each participant was informed that his or her information would be kept confidential and promised his or her right to refuse to participate in the study or to withdraw from the study at any time.

The criteria for inclusion were as follows: 1) pre-pregnancy BMI was normal (>18.5 kg/m^2 and <24.0 kg/m^2 categorized by the recently developed Chinese BMI standard), 2) aged over 18, 3) spontaneous conception, 4) primipara, singleton pregnancy, 5) between 8–12^{+6} weeks of gestation when first contacted. The exclusion criteria were: 1) pre-existing diabetes and /or hypertension, 2) history of psychiatric illness, 3) vaginal bleeding

or with certain diseases that do not allow physical exercise, for example, placenta previa, preterm labor.

A nurse who was not involved in this study randomly divided the participants into two groups by drawing lots. The participants were unknown about the group in which they were enrolled. Data for the study were collected by researchers through face-to-face interviews, and the study was conducted from 8-12 weeks of pregnancy to 6-8 weeks postpartum. A total of 356 pregnant women (intervention group n = 178, control group n = 177) were eventually recruited for prenatal checkups at the maternity clinic and deliveries at the inpatient units of the Hubei Provincial Maternal and Child Health Hospital in sequence between June 2020 and April 2022 (Fig. 1).

Control group

Participants in the control group received routine prenatal care according to Chinese guidelines, while those in the intervention group additionally received a comprehensive and relatively delicate lifestyle intervention.

Intervention group

Detailed dietary and exercise histories of participants were obtained at the time of study inclusion, and researchers gave initial individual advice on diet, exercise, and weight gain target for each individual, with follow-up and adjustments at 16-18, 20-24, 28-30, and 34 weeks of gestation, along with routine prenatal visits. Based on Chinese dietary recommendations for pregnant women, the purpose of the dietary counseling was to help participants achieve a healthy and standardized diet. In practice, the participants were advised (19): 1) choose more high-fiber breads and other whole grains, 2) eat at least 300g of vegetables and 200g of fruits daily, 3) Choose more fat-free or low-fat milk and dairy products as well as meat and meat products, 4) eat fish at least twice a week, 5) use moderate amounts of oil in cooking and baking, 6) eat very few and only small portions of snacks high in sugar and/or fat, 7) to avoid alcohol and tobacco, 8) the relevance of critical nutrients (e.g. calcium, iron, folate, and iodine) in pregnancy was taken into account. They were given individualized information on meal planning, easy-to-prepare healthy recipes, healthy snacks and dining out options.

Recommendations for exercise are based on the guideline of the American College of Obstetricians and Gynecologists (ACOG) (20). Women were recommended to have an average of 30 minutes of moderate physical activity per day, as long as their health permitted. Exercise program was created for each participant individually during the counseling visits. Exercise like walking, and yoga were proposed which consumed the energy of the large muscle groups; women received a pedometer for self-monitoring of daily physical activity. In addition, women received personalized feedbacks on their dietary and exercise habits based on 5-day-records. Women in this group also received weekly phone call (5-10 min) or message sent by WeChat between antenatal visits on different topics such as: self-supervising, reinforcing positive lifestyle change, recording of weight gain, and the presence or absence of physical discomfort.

Data collection and measurement

Data of pre-pregnant weight were measured and provided by the pregnant women through impressions at the time of first visit in the study, calibrated mechanic weighing machines and height meters were used to measure the weight and height of women during pregnancy and before delivery. When measuring weight, shoe removal and light clothing are required. Data measurements were repeated 2 times and the average was taken. BMI was calculated as weight in kilograms divided by height in meters squared. Gestational weight gain was calculated as the difference between pre-pregnancy weight and weight at the termination weeks of gestation. IOM guidelines suggest that weight gain recommendations vary according to BMI category, with a gain of 11.5–16.0 kg advocated for women who commence pregnancy with a normal BMI (3). Women were evaluated based on whether GWG is gained within these levels recommended by

IOM guidelines. Data on maternal weight at delivery room, obstetrical and neonatal outcomes (complications, delivery mode, birth weight and birth weight-related obstetric procedures) were collected from hospital medical charts. In the 6-8 th week postpartum, postpartum examination was required to both groups, and weights were measured in order to determine the PWR.

Statistical analysis

Quantitative data were expressed in mean ± standard deviation (SD). Statistical analyses were performed using SPSS for 23.0 (IBM Corp., Armonk, NY, USA). Baseline characteristics were compared using *t*-tests for continuous variables and chi-square tests for categorical variables. The significant difference was pre-set at $P< 0.05$.

Results

Baseline characteristics of participants

Three hundred and fifty-five participants (178 in the intervention group and 177 in the control group) eventually completed the entire data collection process. The dropout and the completing groups did not differ significantly with respect to maternal baseline characteristics. The baseline characteristics of the participants are presented in Table 1. No significant differences were found between the two groups in any of the variables.

Table 1: Characteristics of participants

Variables	*Intervention group (n=178)*	*Control group (n=177)*
Age (yr)	28.42±2.74	28.34±2.96
Educational years		
> 13	134 (75.3%)	127 (71.8%)
≤ 12	44 (24.7%)	50 (28.2%)
Pregravid BMI	20.59±1.45	20.80±1.43
Length of intervention(weeks)	27.22±1.18	-
Gestational weeks	39.01±1.20	39.27±1.27

Values were expressed in mean ± SD or case/total (0%)

Maternal and obstetric outcomes

Maternal and obstetric outcomes are shown in Table 2. According to the measurement performed in the intervention and control groups in the period before delivery, the total mean GWG values were respectively 14.52±4.52 kg and 15.82±4.35 kg ($P<0.01$). The rate of EGWG were significantly lower in the intervention group than in the control group (28.7% vs. 44.6 %, $P < 0.01$). According to the measurement performed in the 6-8th postpartum week, participants expressed that they did not experience any health problem during pregnancy and in the postpartum period. No difference was observed between groups in terms of PWR in the study. High blood pressure was found more often in the control group than in the intervention group ($P<0.05$). Gestational diabetes mellitus was diagnosed in 9.6% of women allocated to the lifestyle intervention and 13.0% of women in the control group. The vaginal delivery rate was slightly higher in the intervention group (71.3%) than in the control group (61.6%), although there was no statistical difference between them. Most obstetric outcomes did not significantly differ between the two groups.

Table 2: Maternal and obstetric outcomes of pregnant women

Variables	*Intervention group (n=178)*	*Control group (n=177)*	*P values*
Gestational Weight Gain (kg)	14.52±4.52	15.82±4.35	<0.01
EGWG (2009 IOM guideline numbers %)	51 (28.7%)	79 (44.6%)	<0.01
Gestational diabetes mellitus	17(9.6%)	23(13.0%)	>0.05
Hypertension	5(2.8%)	14(7.9%)	<0.05
Delivery Mode			>0.05
Vaginal delivery	127(71.3%)	109(61.6%)	
Caesarean section	51(28.7%)	68(38.4%)	
Weight retention (kg) (6-8 weeks postpartum)	4.53±4.07	4.41±3.74	>0.05

P values in bold indicate statistical significance

Neonatal outcomes

Neonatal outcomes are summarized in Table 3. Mean birth weight and length were lower in the intervention group. The incidence of macrosomia was slightly lower in the intervention group than in the control group, but the difference was not statistically significant. The proportion of small for gestational age (SGA) did not significantly differ between the two groups. The rate of preterm births was low in both groups. The intervention did not increase the risk of complications such as preterm labor. No stillbirth or neonatal death was recorded in each group. The intervention did not lead to a significant increase in neonatal complications at birth such as neonatal asphyxia, jaundice, and hypoglycemia.

Table 3: Neonatal outcomes of pregnant women

Variables	*Intervention group (n=178)*	*Control group (n=177)*	**P** *values*
Birth weight (g)	3225±371	3411±397	<0.01
Birth length (cm)	49.85±1.25	50.25±1.12	<0.01
Premature labor	9 (5.1%)	5 (2.82%)	>0.05
SGA	3 (1.7%)	2 (1.1%)	-
Macrosomia(≥4000g)	4 (2.2%)	10 (5.6%)	>0.05
Transfer to NICU	8 (4.5%)	12 (6.8%)	>0.05

P values in bold indicate statistical significance

Discussion

In this study, a brief lifestyle intervention provided by antenatal healthcare providers during routine prenatal care is effective in reducing the prevalence of EGWG and GWG, therefore, may be expected to improve maternal and infant health outcomes to some extent. Every kilogram gained through GWG control should be considered valuable because GWG is linked to postpartum weight (21). In the end, GWG affects women's BMI in subsequent pregnancies. Since the majority of Chinese women have a pre-pregnancy BMI in the normal range, furthermore, with the full opening of China's two- and three-child policy, such intervention would benefit the majority of women who are about to conceive, especially for primiparous women. To our knowledge, this is the first prospective study to focus specifically on the effects of women with normal BMI in China.

Gestational hypertension was diagnosed with systolic blood pressure > 140 mmHg or diastolic blood pressure > 90 mmHg at least two time points, GWG above recommendations was associated with increased risk of pregnancy hyperten-

sion (22). Women who were provided with lifestyle intervention were less likely to develop hypertensive conditions, this result is similar with the findings of a meta-analysis, that dietary interventions reduced the risk of pre-eclampsia by 33% (23). GDM was diagnosed with OGTT test. While lifestyle intervention did not lead to a reduction in GDM. This result is in line with observations from recent research, that moderate-to-high-intensity lifestyle interventions based on behavior change theory in early and mid-pregnancy did not affect the incidence of GDM (24).

Despite most maternal and neonatal outcomes being unaffected by the intervention, a few differences were observed. This study showed intervention effects on mean birth weight and length were lower in the intervention group; the estimated differences between groups were relatively small. However, there is insufficient evidence to suggest that the impact of lifestyle intervention during pregnancy has an effect on neonatal birth weight (25). The vaginal delivery rate was slightly higher in the intervention group (71.3%) than in the control group (61.6%), although there was no statistical difference between them. Since the mode of delivery was not addressed in the lifestyle intervention treatment, it seems unlikely that the specific effect of the intervention on the mode of delivery could be determined (25). Women with a total GWG above the IOM recommendations had an adjusted OR for cesarean section of 1.45 compared with women who had GWG within the IOM recommendations across all pre-pregnancy BMI categories (26). These findings indicate that efforts to control weight before and during pregnancy may help reduce the rate of cesarean section.

The present study still has many shortcomings, the sample size included was limited and the results obtained did not exclude a certain degree of bias. Implementing lifestyle interventions in combination with prenatal screening into the daily routine remains a challenge. In addition, ensuring an appropriate setting, such as designating a separate room for counseling patients while involving the husband or family members together as much as possible (27), the intervention consisted of in-person and telephone sessions on strategies (28), may help improve the quality of lifestyle interventions. A frequency of four or more maternity visits may be more probable to promote significant lifestyle changes. Finally, future research should lengthen the follow-up period to evaluate the longer-term effects of lifestyle interventions during pregnancy on maternal and child health. In general, the importance of appropriate weight gain during pregnancy in pregnant women with normal pre-pregnancy BMI should be emphasized. A larger sample size would allow us to evaluate further specific categories of BMI and GWG.

Conclusion

Although the effect of lifestyle intervention for pregnant women with normal BMI is relatively limited, attention should still be paid to the reasonable increase of weight during pregnancy. The potential long-term impact of the intervention remains to be assessed.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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