Effectiveness of Balanced Diet–Iron Supplement Program among Pregnant Women with Anemia: A Quasi–Experimental Study

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Abstract: Iron deficiency anemia during pregnancy is a public health problem that may increase the risk of preterm birth with low birth weight infants and the high cost of neonatal intensive care. This quasi - experimental study in Thailand examined the effects of a balanced diet-iron supplement program on maternal and birth outcomes. The participants were pregnant women with anemia aged between 20-35 years and had a gestational age of 20-24 weeks. The experimental group (n = 40) received a balanced diet-iron supplement program in addition to usual care, whereas the control group (n = 40) received only usual care. The data collection instruments included: the personal information form, laboratory report of hematocrit, the INMUCAL-Nutrients V.3 software, iron supplement record sheet, a 3-day dietary record, a weight and height scale, and a baby weighing scale.Data were analyzed by descriptive statistics, Chi-square test, and McMemar test.

The results revealed that the proportion of participants in the experimental group had normal hematocrit, adequate dietary intake, adherence to iron supplement, and appropriate total weight gain significantly higher than those in the control group. In addition, the proportion of preterm birth and low birth weight baby in the experimental group were lower than those in the control group. The Balanced Diet-Iron Supplement Program of this study should be tested with other groups of women in different settings, but it has the good potential for nurses, midwives, and women to utilize in practice. Pregnant women with iron deficiency need assistance, knowledge, and practicing with meal plans to eat a balanced diet and adhere to iron supplements to improve maternal health and prevent adverse birth outcomes.

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Introduction

Iron deficiency anemia (IDA) in pregnant women is a public health problem worldwide.[1-3] IDA can lead to maternal health problems and the newborn with preterm birth and low birth weight,[4-9] which typically requires neonatal intensive care with its high cost and infrastructure.[4-9] In Thailand, the prevalence of IDA during pregnancy between 2018–2020 were 16.03%, 16.44%, and 15.1% respectively which

were higher than the country target of 12%.[10] Several studies revealed that inadequate dietary iron intake and insufficient iron supplements were the significant causes of IDA in pregnant women.[11-14] Furthermore, there are various causes of non-adherence to iron supplementation such as forgetfulness, suffering from the side effects of iron supplement, drug interaction between calcium tablet and iron supplement, malabsorption of iron supplement, and misunderstanding between iron supplements and food rich in iron.[11-14] Therefore, Thai government has launched a campaign to provide iron supplement to all pregnant women, who are not diagnosed with thalassemia for preventing and treatment of IDA.[10,15] However, this campaign might not be effective to prevent IDA in pregnant women.

A Balanced Diet and Iron Supplement Program (BDISP) in this study was developed based on Thai dietary reference intake guideline by the Food and Nutrition board, Ministry of Public Health,[10,15] Thailand. It was used to provide nutritional promotion and adherence to iron supplement among pregnant women with IDA[16-17] throughout pregnancy to make them recovered from IDA and to improve maternal health[18-19] and birth outcomes.[20-27] The program provided knowledge, practicing meal plan and telephone follow-up to allow the sample to really understand how to eat balanced diet and adherence to iron supplement. Generally, the treatment of IDA during pregnancy includes advice on nutrition, iron supplement, monitoring maternal health, and fetal health.[14,16] Dieticians have recommended that all pregnant women gain sufficient energy intake from nutritious foods based on the daily energy requirement.[17-18] Previous studies revealed that appropriate total weight gain is the positive outcome of adequate dietary intake based on pre-pregnancy body mass index.[28-31] Subsequently, total weight gain is a significant factor to predict a gestational age at birth and birth weight infant.[28-30] Various studies suggested that pregnant women with IDA, overweight or obese, might increase the risk of preterm birth and low birth weight.[31-33]

Most previous studies have focused on nutritional education during pregnancy and maternal outcomes[16-19] for recovering from IDA, emphasizing nutritional education,[16-19] but lacking a meal plan and monitoring of eating behaviors until delivery.Thus, this study aimed to determine the effectiveness of BDISP on maternal outcomes (normal hematocrit, adequate dietary intake, adherence to iron supplement, and appropriate total weight gain) and the birth outcomes (preterm birth and low birth weight).

Literature Review and Conceptual Framework

A balanced diet is defined as the variety of five food groups, which provides sufficient energy intake and adequate nutrients based on the daily energy requirement in each person.[15,22] A suitable diet includes carbohydrates, proteins, fats, vitamins, minerals, and water necessary for maintaining maternal health[18-19] and fetal development.[22] Particularly, the daily energy requirement in each person requires about 45 - 65% of carbohydrates, 10 - 15% of proteins, and 20 - 35% of fats.[15,20-22] Furthermore, the five food groups include: 1) rice and starches, 2) meat, eggs and milk, 3) oil and fat, 4) vegetables, and 5) fruits, all of which can provide sufficient macronutrients and micronutrients for being healthier.[15]

Substantial evidence has shown that pregnant women with IDA are statistically significant, increasing the risk of oligohydramnios, postpartum hemorrhage, placental abruption, obstetric shock, and infection.[2-4] IDA during pregnancy can be harmful to fetal growth and development, such as intrauterine growth restriction, intrauterine hypoxia, and delayed brain development.[4-8] Furthermore, studies revealed that IDA in pregnancy could lead to adverse birth outcomes, including abortion, stillbirth, preterm birth, small for gestational age, and low birth weight.[4-8] Thus, the health-promoting behaviors of pregnant women are necessary.

This study used the health promotion model (HPM)[35] to guide the intervention. This model explains how individual characteristics and experiences, behavior-specific cognitions, and affect influence individuals' health-promoting behaviors.[35] This model also indicates that prior related behavior directly affects the present health-promoting behaviors due to habit formation or repetitive practice and indirectly affects health-promoting behavior through the perception of self-efficacy, benefits, barriers, and activity-related affects.[35] Behavior-specific cognitions and affect are perceived benefits, perceived barriers, perceived self-efficacy, activity-related affect, interpersonal influences, and situational influences.[35] Behavior-specific cognition directly affects health-promoting behavior and has an indirect effect through a commitment to a plan of action.[35] This commitment initiates a behavior through cognitive processes and involved 1) committing to carrying out a specific action at a given time and place, and 2) identification of strategies for carrying out the behavior.[32]

Previous studies focused on controlling IDA during pregnancy for 8-12weeks,[18-19] and all studies measured hematocrit levels, and the proportion of pregnant women recovering from IDA.[18] However there are few studies that have confirmed the positive outcomes in the mothers for adhering to the program and birth outcomes in the newborns.[21-22] This study focused on eating balanced diet and adhering to iron supplement behaviors among pregnant women with IDA as health-promoting behaviors. The health-promoting behaviors should be maintained throughout pregnancy. However, the results of the study were determined further than the behavior. Several studies have shown that healthy eating behavior can improve maternal[18] and birth outcomes in pregnant women with IDA.[27,31,34]

The following hypotheses were set:

1. The proportion of mothers in the experimental group would have normal hematocrit, adequate dietary intake, adherence to iron supplement, and appropriate total weight gain significantly higher than those in the control group.

2. The proportion of infants in the experimental group would have preterm birth and low birth weight (LBW) significantly lower than those in the control group.

Methods

Design: This study used a quasi-experimental pretest and posttest design with a comparison group. The Transparent Reporting of Evaluations with Non-randomized Designs (TREND) checklist was used to guide reporting of this study.

Sample and Setting: The population of this study comprised pregnant women with IDA who visited an antenatal care clinic (ANC) at a university hospital in Bangkok, Thailand. This setting provides ANC for pregnant women Monday to Friday during 8:00 – 12:00 AM.[36] The inclusion criteria were 1) being 20-35 years, 2) singleton pregnancy with gravidity not more than two, 3) gestational age between 20 – 24 weeks at the beginning of the study, 4) speaking, reading, and writing in Thai, and 5) no complications during pregnancy such as heart disease, preeclampsia, diabetes mellitus, or thalassemia. The exclusion criteria were: women did not want to take iron supplementation, a hemoglobin lower than 6 mg/dl, a blood donation recipient or having intravenous iron infusion. The termination criteria were: having complications such as vaginal bleeding, placenta previa, placental abruption, or death of a fetus after participation in the study.

The sample size was calculated using the proportion of low birth weight from previous study.[22] The proportion of low birth weight was 4 in 19 cases in the control group and 0 in 19 cases in the experimental group.[22] Estimation of sample size on a two-tailed basis yielded 66 participants based on previous study.[22] However, an additional sample to keep the risk of type II error down to 20.0% was recommended to compensate for the attrition rate (n = 14).[22,37-38] Finally, the total sample size was 80 cases, which was equally divided into the control group (n = 40) and the experimental group (n = 40).

Ethical Considerations: This study was approved by the Institutional Review Board (IRB) of the Faculty of Nursing, Mahidol University, Bangkok (COA No. IRB-NS2019/505.1005). All potential participants were informed about the purpose of the study, what participation in the study involved, confidentiality and anonymity issues and the right to withdraw without repercussion. All participants were asked to sign a consent form before joining the study. The confidentiality of participants was carefully protected. Their names and phone numbers were not posted on the questionnaires or records and kept separate during data collection. The data were kept in a secure place for at least 5 years. The study results were presented in a group.

Data collection: The instruments and equipment for data collection and the Balanced Diet-Iron Supplement Program (BDISP) are described below.

1. Demographic information form: The demographic characteristics and pregnancy-related data form was developed by the primary investigator (PI) and comprised age, education level, occupation, family income, and type of family.

2. Laboratory report of hematocrit (HCT) is following the standard guideline of pregnancy for 28-32 weeks of gestational age. There were three levels of IDA: mild anemia (HCT of 27.0 - 32.0 %), moderate anemia (HCT of 21.0-26.0%), and severe anemia (HCT less than 20.0%). Normal hematocrit level meant that the participants had HCT ≥ 33.0%.[1-3]

3. The INMUCAL-Nutrients V.3[39] is a software developed by the Institute of Nutrition, Mahidol University, to analyze dietary intake. This software includes micronutrients, macronutrients, and energy intake based on the Thai Recommended Daily Intake. This study focused on dietary intake at gestational age 34-35 weeks measured by using a 3-day dietary record (two weekdays and one weekend). Calculation of energy intake was analyzed using the INMUCAL-Nutrients V.3[39] to compare with the appropriate range of daily energy requirements based on pre-pregnancy body mass index in each person.[39-40] The dietary intake was divided into two groups, adequate dietary intake and inadequate dietary intake. Adequate dietary intake meant that the participants had an appropriate range of daily energy requirement based on pre-pregnancy body mass index including 35-40 kcal/kg/day for underweight (body mass index (BMI) less than 18.5kg/m^2), 30-35 kcal/kg/day for normal weight (BMI 18.5 - 22.9 kg/m^2), 25-30 kcal/kg/day for overweight (BMI 23.0 - 29.9 kg/m^2), and 25-30 kcal/kg/day for overweight (BMI 30.0 kg/m^2 or more).[15,39-40] Inadequate dietary intakes meant that the participants had lower or excess dietary intake from the appropriate range of daily energy requirements based on pre-pregnancy body mass index in each person.

4. A 3-day Dietary Record was used by the participants to write the details of all kinds of food and beverages consumed during 24-hour period for 3 days: 2 days from weekdays and 1 day from weekend. Then, it was calculated by The INMUCAL Nutrients Program Version 3[39] as energy intake.

5. The Iron Supplement Record Sheet was used to obtain the data on adherence to iron supplementation from the second trimester of pregnancy until delivery. Participants were classified into two groups: adherence and non-adherence to iron supplements. For adherence referred to participants who continually took daily iron supplements between 90 to 180 days from the second trimester of pregnancy until delivery. Non-adherence to iron supplements referred to the participants, who took daily iron < 90 days throughout pregnancy.[1-2]

6. A weight and height scale was used in kilograms and height in centimeters of pregnant women. It was calibrated to ensure reliability every 12 months. This study focused on total weight gain, of pregnant women throughout pregnancy, calculated by body weight at delivery minus pre-pregnancy weight.[40] There were four categories of total weight gain based on pre-pregnancy body mass index in each person: 12.5-18.0 kg., underweight (BMI less than 18.5kg/m^2), 11.5-16.0 kg., normal weight (BMI 18.5-22.9 kg/m^2), 7.0-11.5 kg., overweight

(BMI 23.0–29.9 kg/m^2), and 5.0–9.0 kg., obese (BMI 30.0 kg/m^2 or more).[15,39-40] The total weight gain of this study at delivery was classified into two groups: appropriate total weight gain and inappropriate total weight gain. For appropriate total weight gain, the participants had an increased weight throughout pregnancy within the acceptable range of body weight gain in each pre-pregnancy body mass index. Inappropriate total weight gain refers to participants having increased weight throughout pregnancy lower or over the pre-pregnancy body mass index range.[15,40]

7. *A baby weighing scale* was used for measuring newborns' birth weight in grams. It was calibrated to ensure reliability every 12 months. The maximum weight measurement is approximately 15 kg. This study focused on low birth weight of < 2,500 grams.[4-6]

The Balanced Diet-Iron Supplement Program (BDISP)

The PI developed this program based on literature review and used the HPM[35] guide the intervention. The three strategies included 1) providing nutritional education and iron supplement 2) practicing meal plan, by computing daily energy requirement for each person based on pre-pregnancy body mass index.[22] Then, the participants planned meals for one-day by choosing nutritious foods from a food exchange list based on five food groups and daily caloric requirements, 3) telephone follow-up to monitor their eating and iron intake. Nutritional education and iron supplement were expected to enhance the apostrophe perceived benefits and reduced barriers to eat a balanced diet and adherence to iron supplement. Practicing a meal plan was anticipated to increase the apostrophe self-efficacy and reduce perceived barriers to eat a balanced diet and iron supplement. The detail of the program was shown in **Table 1.** The BDISP was reviewed for content validity by five experts: three faculty staffs in maternal-newborn nursing, a nutritionist, and a dietitian. Recommendations from all reviewers were incorporated in the final revision.

Table 1 Content and activities for the BDISP

Week/Session	Content	Activities
Week 1	**Education and practicing**	1) Instruction
Session 1 (at ANC)	- Introduction on BDISP	2) Group education
at 20-24 weeks of	- Basic information on nutritional education	3) Picture presentation
gestation (35 minutes)	- Five food groups, food exchange list	4) Calculating daily energy requirement
	- The knowledge of IDA and iron supplement	
	- Practicing meal plan by using a one-day meal using list of foods and the Mother and Child Health Handbook	5) a 24-hour recall 6) Meal plan 7) Demonstrations 8) Daily iron supplement record
Week 4	**Follow-up and brief advice**	1) Brief advice nutritional education and iron supplement
Session 2 (at home)	- Brief advice nutritional education and iron supplement	
For telephone follow-up	- Suggestion to overcome the barriers of eating a balanced diet and adherence to iron supplement behaviors.	2) Positive feedback 3) Suggestion
(anytime); at 24-28 weeks of gestation (5-10 minutes)	- Maintaining to eat balanced diet and adherence to iron supplement behaviors.	4) Daily iron supplement record

Table 1 Content and activities for the BDISP (Cont.)

Week/Session	Content	Activities
Week 8 **Session 3 (at ANC)** at 28-32 weeks of gestation (20 minutes)	**Individual advice and monitoring** - Appropriate weight gain as the result of eating balanced diet behavior - Providing how to do a 3-day dietary record and remaining to return it at 34-35 weeks of gestation	1) Monitoring dietary intake and iron supplement 2) Data collection of the first maternal outcome.
Week 13 **Session 4 (at home) for telephone follow-up** (anytime); at 33week of gestation (5-10 minutes)	**Follow-up and brief advice** - Brief advice nutritional education and iron supplement - Suggestion to overcome the barriers of eating a balanced diet and adherence to iron supplement behaviors.	1) Brief advice 2) Positive feedback 3) Suggestion 4) Reminding to return a 3-day dietary record on the next week
Week 14 **Session 5 (at ANC)** at 34-35 weeks of gestation (15-20 minutes)	- Adequate dietary intake as the positive outcomes of balanced diet	1) Monitoring dietary intake and iron supplement 2) Data collection of the second maternal outcome.
Week 16-20 **Session 6 (at delivery)** (15-20 minutes)	-	1) Data collection of the last maternal outcomes and birth outcomes

Usual care: This consisted of routine care activities provided by nurses and physicians following the standard of care at the ANC.[36] The routine care activities included:1) health assessment and standard laboratory tests for all pregnant women, and 2) prenatal nutrition knowledge and health education during pregnancy. The participants in both groups received the usual care at the ANC.

Procedure: The PI provided the BDISP program to the experimental group at the 1st meeting (gestational age (GA) 20-24 weeks), then calculated energy requirement for each person and let them practicing meal plan. At the 2nd meeting (GA 28-32 weeks), the PI monitored participant's weight gain, HCT, feedback for eating behavior and iron supplement, and gave a 3-day dietary record and explained how to record their food and drink. At the 3rd meeting (GA 34-35 weeks), a research assistant (RA) is nutritionist, who was blinded to the study. The RA was prepared to collect data related to the 3-day dietary record, the INMUCAL-Nutrients V.3.[37] The PI used telephone follow-up twice, GA 24-28 and 33 weeks to ask about the barriers to eat balanced diet and iron supplement, then provided suggestion according to the problems.

Data collection was carried out during May-December 2019. It was conducted among 40 participants in the control group first on Wednesday through Friday. After ten weeks, the intervention program was started in the experimental group on Monday and Tuesday to prevent contamination of intervention and demoralization of the participants in the control group.The data included maternal and birth outcomes: hematocrit (GA 28-32 weeks), dietary intake (GA 34-35 weeks), iron supplement, total weight gain, gestational age at birth and birth weight (to calculate for preterm birth and low birth weight babies).

Data Analysis: Data were analyzed by the Predictive Analytics Software Statistics version 18 downloaded

@ Mahidol University License. Descriptive statistics, Chi-square test were used to compare the participants' demographic characteristics, maternal and birth outcomes between the experimental and the control groups. McNemar test was used for analyzing the pre-post-intervention within-group including normal hematocrit and adequate dietary intake. The significant level of the hypothesis testing is at 0.05.

Results

The total participants were 80, with 40 participants in each group. The demographic characteristics of participants included: age, levels of education, occupation, family income, and type of family. All these demographic characteristics were not statistically significantly different between the groups (**Table 2**).

Table 2 Comparison of demographic characteristics of the participants between the experiment and control groups (N = 80)

Demographic Data	Experimental gr. (n = 40)		Control gr. (n = 40)		χ^2	*p-value*
	n	%	n	%		
Age (year)					.922	.631
20-24	10	25.0	12	30.0		
25-29	15	37.5	17	42.5		
30-34	15	37.5	11	27.5		
	M = 27.58 (SD = 4.01)		M = 26.83 (SD = 3.98)			
Levels of education					1.464	.691
No formal education	1	2.5	3	7.5		
Primary school	6	15.0	4	10.0		
Secondary/Vocational	13	32.5	12	30.0		
Bachelor and higher	20	50.0	21	52.5		
Occupation					1.957	.581
Housewife	12	30.0	17	42.5		
Merchant/Retailer	7	17.5	8	20.0		
Labor	9	22.5	6	15.0		
Government/ private sector officer	12	30.0	9	22.5		
Family income (USD)					2.800	.247
< 480.80	18	45.0	14	35.0		
480.80 – 961.60	19	47.5	18	45.0		
≥ 961.63	3	7.5	8	20.0		
	M = 643.31 USD (SD = 223.08) (Min = 336.56, Max = 1,202.00)		M = 695.30 USD (SD = 248.43) (Min = 326.30, Max = 1153.92)			
Type of family					.202	.653
Nuclear family	23	57.5	21	52.5		
Extended family	17	42.5	19	47.5		

Note: χ^2 = Chi-square test; M = Mean;
SD = Standard deviation

The Effectiveness of the BDISP

The proportion of participants having mild to moderate anemia at pre-intervention, and adequate dietary intake, between the experiment and control groups, were not significantly different. As in the stated hypotheses, all these two outcome variables were changed in the direction as predicted. At post-intervention, an increased proportion of participants had normal hematocrit and adequate dietary intake. Also, when comparing pre-post intervention, the proportion of participants having normal hematocrit and adequate dietary intake in the experimental group was significantly higher than pre-intervention. In contrast, those in the control group were not significantly different between these two time points **(Table 3).** At the due date of delivery, the proportion of participants adhering to iron supplements in the experiment group was significantly higher than those in the control group. Moreover, the proportion of participants having appropriate total weight gain in the experiment group was significantly higher than those in the control group **(Table 4).** The same as for the newborn, at the due date of delivery, the proportion of participants having preterm birth and low birth weight in the experiment group was significantly lower than those in the control group **(Table 5).**

Table 3 Comparing the proportion of participants having adequate dietary intake, normal hematocrit level for pre-post intervention within-group and between the experimental and the control groups (N = 80)

Variables	Control gr. (n = 40)	Experimental gr. (n = 40)	Statistic	*p-value*
	n (%)	n (%)		
Pre-Intervention			χ^2=.827	.363
Mild anemia	35 (87.5)	32 (80.0)		
Moderate anemia	5 (12.5)	8 (20.0)		
Post-Intervention			χ^2=25.658	<.001
Normal hematocrit	17 (42.5)	38 (95.0)		
Mild anemia	23 (57.5)	2 (5.0)		
	χ^2_M = 1.184, p=.277^{ns}	χ^2_M = 28.033, p<.001		
Pre-Intervention			χ^2=1.257	.262
Adequate dietary intake	16 (40.0)	21 (52.5)		
Inadequate dietary intake	24 (60.0)	19 (47.4)		
Post- Intervention			χ^2=23.810	<.001
Adequate dietary intake	18 (45.0)	38 (95.0)		
Inadequate dietary intake	22 (55.0)	2 (5.0)		
	χ^2_M = 1.364, p =.804^{ns}	χ^2_M = 25.037, p<.001		

Note: χ^2 = Chi-square test; χ^2_M = McNemar test for investigating within group

Table 4 Comparing the proportion of participants having adherence to iron supplement and appropriate total weight gain for post-intervention between the experimental and the control groups (N = 80)

Variables	Control gr. (n = 40)	Experimental gr. (n = 40)	Statistic	*p-value*
	n (%)	n (%)		
Iron supplement			χ^2=7.314	<.001
Adherence	31 (77.5)	39 (97.5)		
Non-adherence	9 (22.5)	1 (2.5)		
Total weight gain			χ^2=25.658	<.001
Appropriate	24 (60.0)	36 (90.0)		
Inappropriate	16 (40.0)	4 (10.0)		

Note: χ^2 = Chi-square test

Table 5 Comparing the proportion of participants having preterm birth and low birth weight for post-intervention between the experimental and the control groups (N = 80)

Variables	Control gr. (n = 40) n (%)	Experimental gr. (n = 40) n (%)	Statistic	*p-value*
Preterm birth			$\chi^2 = 4.114$	.043
Yes	8 (20.0)	2 (5.0)		
No	32 (80.0)	38 (95.0)		
Low birth weight			$\chi^2 = 5.165$	.023
Yes	9 (22.5)	2 (5.0)		
No	31 (77.5)	38 (95.0)		

Note: χ^2 = Chi-square test

Discussion

This study suggests that the BDISP could improve maternal and birth outcomes in pregnant women with IDA. The BDISP composed of three processes: 1) Providing nutritional education and iron supplement, 2) practicing meal plans, 3) telephone follow-up. It could be explained that providing knowledge about the effects of iron deficiency anemia on maternal and fetal health and the effects of a balanced diet and iron supplement on their health should encourage them to be aware of their eating behaviors. Moreover, knowledge about five food groups, benefits of eating various kinds of foods, food enriched with iron, foods assisted iron absorption, food inhibitor of iron absorption, food exchange list, daily energy requirement, and iron supplement might make them understand how to eat healthy food and take an iron supplement regularly and could do it appropriately. According to Pender and colleagues,[35] this knowledge could make the participant perceive the benefits of eating balanced diet-iron supplements and fewer barriers.

Moreover, practicing a meal plan in the program could make them feel confident to select appropriate healthy food and had a chance to choose it by themselves. In this process, the PI computed daily energy requirements for each participant based on their pre-pregnancy BMI, then let them plan their one-day meals by choosing food from the food exchange list to have enough energy requirement with appropriate proportion of five food groups and drinking water. Therefore, this meal plan practice could enhance their self-efficacy and positive effect on eating a balanced diet and iron supplement. Then, they had a plan with a high commitment to eat healthy food. For telephone follow-up, the PI called the participant to ask about their eating obstacles and suggested that they needed or did not understand. Therefore, the proportion of participants who received the BDISP in this study had adequate dietary intake (95%) higher than those in the control group (45%) after the intervention.

Findings from this study were supported by previous studies [33] in that four sessions of nutritional education program both in group and individual could improve nutritional health behavior of the participants in the experimental group than that of the control group.[33] This is the same as another finding[34] in that nutrition education in the group (3-8 cases) three times on dietary eating pattern results in a higher daily average number of food servings participants in the experimental group than those in the control group. Furthermore, another study[34] found that nutrition education could increase appropriate daily calorie intake and nutrients (iron and folic acid) of the participants in the experimental group more than those in the control group.

Therefore, providing nutritional education and iron supplement, practicing meal plans, and telephone

follow-up in the BDISP could enhance perceived benefits, perceived self-efficacy, positive affect, and reduced perceived barriers to eating a balanced diet and iron supplement in pregnant women with anemia. Then, sufficient and various nutritious food could increase weight gain appropriately.[27-32] Moreover, adherence to iron supplement intake and nutritious food could make the participants recover from anemia and positively impact birth outcomes.[15-26]

Limitations and Recommendations for Future Research

Since this study used a quasi-experimental design to complete data collection in the control group first and then followed with implementation of the intervention in the experiment group thus, threats to internal validity, especially the history, cannot be avoided.[38] Also, the generalization of the findings is limited. The participants were recruited from the ANC at only one university hospital in Bangkok Metropolitan.[36] However, despite this, the findings suggested the benefit of this BDISP. Thus, nurses and midwives can use this program to promote healthy eating behaviors throughout pregnancy until delivery. Further research should examine the effects of a balanced diet and iron supplement program on underweight or overweight pregnant women with IDA using a randomized control trial and testing this program with other samples.

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References

1. World Health Organization. Hemoglobin concentrations for the diagnosis of anemia and assessment of severity. [Internet]. 2011 [cited 2021 Jul 1]. Available from: https://apps.who.int/ iris/handle/10665/85839
2. Young MF, Oaks BM, Tandon S, Martorell R, Dewey KG, Wendt AS. Maternal hemoglobin concentrations across pregnancy and maternal and child health: a systematic review and meta-analysis. Ann NY Acad Sci. 2019; 1450 (1): 47-68. doi: 10.1111/nyas.14093.
3. Cappellini MD, Musallam KM, Taher AT. Iron deficiency anemia revisited. J Intern Med. 2020; 287 (2):153-70. doi: 10.1111/joim.13004.
4. Finkelstein JL, Kurpad AV, Bose B, Thomas T, Srinivasan K, Duggan C. Anaemia and iron deficiency in pregnancy and adverse perinatal outcomes in Southern India. Eur J Clin Nutr. 2020;74(1):112-25. doi: 10.1038/s414 30-019-0464-3.
5. Rahmati S, Delpishe A, Azami M, Hafezi-Ahmadi MR, Sayehmiri K. Maternal anemia during pregnancy and infant low birth weight: a systematic review and meta-analysis. Int J Reprod Biomed. 2017;15(3):125-32.
6. Yuan X, Hu H, Zhang M, Long W, Liu J, Jiang J, et al. Iron deficiency in late pregnancy and its associations with birth outcomes in Chinese pregnant women: a retrospective cohort study. Nutr Metab (Lond). 2019;16(1): 30. doi: 10.1186/ s12986-019-0360-9.
7. Finkelstein JL, Kurpad AV, Bose B, Thomas T, Srinivasan K, Duggan C. Anaemia and iron deficiency in pregnancy and adverse perinatal outcomes in Southern India. Eur J Clin Nutr. 2020;74(1):112-25. doi: 10.1038/s414 30-019-0464-3.
8. Zhang Q, Lu X-M, Zhang M, Yang C-Y, Lv S-Y, Li S-F, et al. Adverse effects of iron deficiency anemia on pregnancy outcome and offspring development and intervention of three iron supplements. Sci Rep. 2021;10(1):1-11. doi: 10.1038/s41598-020-79971-y.
9. Athe R, Dwivedi R, Pati S, Mazumder A, Banset U. Meta-analysis approach on iron fortification and its effect on pregnancy and its outcome through randomized, controlled trials. J Family Med Prim Care. 2020;9(2):513-9. doi: 10.4103/jfmpc.jfmpc_817_19.
10. Ministry of Public Health. The control and prevention of iron deficiency anemia project in 2021.[Internet]. 2021 [cited 2021 Jul 1]. Available from: http://doc.anamai.moph.go.th/index.php?r=str-project/view&id=4428
11. Jamnok J, Sanchaisuriya K, Sanchaisuriya P, Fucharoen, G, Fucharoen S, Ahmed F. Factors associated with anemia and iron deficiency among women of reproductive age in Northeast Thailand: a cross-sectional study. BMC Public Health. 2020;20(1):102. doi: 10.1186/s12889-020-8248-1.

12. Thongperm W, Chaisen M, Chunchom Y, Aueduldecha S, Sarakul O. Preliminary study for the prevalence and causes of anemia in pregnant women attending an Antenatal Care Unit in different periods of gestation. JAMS [Internet]. 2018 Aug4 [cited 2021Jul.6];51(3):122-7. Available from: https://he01.tci-thaijo.org/index.php/bulletin AMS/article/view/111918
13. Iqbal S, Ekmekcioglu C. Maternal and neonatal outcomes related to iron supplementation or iron status: a summary of meta-analyses. J Matern Fetal Neonatal Med. 2019; 32(9): 1528-40. doi: 10.1080/14767058.2017. 1406915.
14. Dhaher EA. Descriptive study for pregnant women's knowledge attitude and practices regarding iron deficiency anemia and iron supplements in the Southern region of KSA. Asian Journal of Clinical Nutrition. 2020;12(1): 21-23. doi: 10.3923/ajcn.2020.21.33.
15. Committee on Thai DRI, Health Department, Ministry of Public Health, Nonthaburi. [Internet]. 2003 [cited 2021 Jul 1]. Available from: http://food.fda.moph.go.th/law/data/announ_moph/P182.pdf
16. Araban M, Baharzadeh K, Karimi M. Nutrition modification aimed at enhancing dietary iron and folic acid intake: an application of health belief model in practice. Eur J Public Health. 2017;27(2):287-92. doi: 10.1093/eurpub/ckw238.
17. Desta M, Kassie B, Chanie H, Mulugeta H, Yirga T, Temesgen H, Leshargie CT, Merkel Y. Adherence of iron and folic acid supplementation and determinants among pregnant women in Ethiopia: a systematic review and meta-analysis. Reprod Health. 2020; 16(1): 172-82. doi: 10.1186/s12978-019-0848-9.
18. Pipatkul W, Sinsuksai N, Phahuwatanakorn W. Effects of a nutrition and iron supplement promoting program on iron deficiency anemia in pregnant women. Nurs Sci J Thail [Internet]. 2015 Mar 31 [cited 2021Jul6];33(1):69-6. Available from: https://he02.tci-thaijo.org/index.php/ns/article/view/41215
19. Jaranai P, Nirattharadorn M, Buaboon N. The effect of nutrition promotion program on the nutritional health behavior and hematocrit levels of adolescent pregnant women. JNSCU. 2018;30(1):59-69.
20. Ancira MM, O'Neill MS, Rivera DJA, Batis C, Rodriguez Ramirez S, Sanchez BN, et al. Dietary patterns and diet quality during pregnancy and low birthweight: the PRINCESA cohort. Matern Child Nutr.2020;16(3): 1-11. doi: 10.1111/mcn.12972.
21. Summawan P, Sinsuksai N, Pahuwatanakorn W. Effects of a nutrition promotion program on pregnancy outcomes in adolescents. KJN. 2013;20(2):100-15.
22. Petcharapun R, Wacharasin C. Effects of nutritional promotion program on fetal growth and pregnancy weight gain among pregnant women with low body mass index in private clinic, Chon Buri Province. PHJBUU. 2015;10(1): 130-44.
23. Chia AR, Chen LW, Lai JS, Wong CH, Neelakantan N, Van Dam RM, Chong MF. Maternal dietary patterns and birth outcomes: a systematic review and meta-analysis. Adv Nutr. 2019; 10(4):685-95. doi: 10.1093/advances/nmy123.
24. Odiwuor F. Nutrition education and counselling: an essential consideration to optimize maternal nutrition and pregnancy outcomes in Kenya. AJMRD.2020;2(5):16-24.
25. Ancira-Moreno M, O Neill MS, Rivera-Dommarco JA, Batis C, Rodriguez Ramirez S, Sanchez BN, Castillo-Castrejon M, Vadillo-Ortega F. Dietary patterns and diet quality during pregnancy and low birthweight: the PRINCESA cohort. Matern Child Nutr. 2020;16(3):1-11. doi: 10.1111/mcn.12972.
26. El Bilbeisi AH, El Afifi A, Baloushah S, Alblbeisi A, Albelbeisi AH, Taleb M. Maternal dietary patterns during early pregnancy and their association with pregnancy outcome among obese women in Gaza Strip, Palestine: a prospective cohort study. Austin J Nutri Food Sci. 2020;8(1):1138.
27. McAlpine JM, McKeating DR, Vincze L, Vanderlelie JJ, Perkins AV. Essential mineral intake during pregnancy and its association with maternal health and birth outcomes in South East Queensland, Australia. Nutr Metab Insights. 2019;12:1-12. doi: 10.1177/1178638819879444.
28. Pigatti Silva F, Souza RT, Cecatti JG, Passini R, Tedesco RP, Lajos GJ, et al. Role of body mass index and gestational weight gain on preterm birth and adverse perinatal outcomes. Sci Rep. 2019; 9(1): 174-86. doi: 10.1038/s41598-019-49704-x.
29. Tran NT, Nguyen LT, Berde Y, Low YL, Tey SL, Huynh DTT. Maternal nutritional adequacy and gestational weight gain and their associations with birth outcomes among Vietnamese women. BMC Pregnancy Childbirth. 2019; 19(1): 272-93. doi: 10.1186/s12884-019-2643-6.
30. Diemert A, Lezius S, Pagenkemper M, Hansen G, Drozdowska A, Hecher K Zyriax BC. Maternal nutrition, inadequate gestational weight gain and birth weight: results from a prospective birth cohort. BMC Pregnancy Childbirth. 2016;16(1):1-9. doi: 10.1186/s12884-016-1012-y.

31. Sehgal R, Kriplani A, Perumal V, Kumar A, Maiti L, Kandpal S, Kumar N, Chandhok N, Jindal V, Mittal S. Impact of pre-pregnancy body mass index, anemia and gestation weight gain on neonatal outcomes. IJOG.2017; 7(4):11-20.
32. Eick, SM, Welton M, Cordero JF. Relationship between pre-pregnancy overweight, obesity, and preterm birth in Puerto Rico. Matern Child Health J.2019;23(7): 925-33. doi: 10.1007/s10995-018-02719-8.
33. Ju AC, Heyman MB, Garber AK, Wojcicki JM. Maternal obesity and risk of preterm birth and low birth weight in Hawaii PRAMS, 2000-2011. Matern Child Health J.2018; 22(6): 893-902. doi: 10.1007/s10995-018-2464-7.
34. Goodarzi-Khoigani M, Baghiani Moghadam MH, Nadjarzadeh A, Mardanian F, Fallahzadeh H, Mazloomy-Mahmoodabad S. Impact of nutrition education in improving dietary pattern during pregnancy based on Pender's Health Promotion Model: a randomized clinical trial. Iran J Nurs Midwifery Res. 2018;23(1):18-25. doi: 10.4103/ijnmr.IJNMR_198_16.
35. Pender NJ, Murdaugh CL, Parsons MA. Health promotion in nursing practice. 6thed. Upper Saddle River, NJ: Pearson Prentice Hall; 2011.
36. Vajira Hospital, Faculty of Medicine, Navamindradhiraj University. The annual report of performance statistics in 2018. [Internet]. 2018 [cited 2021 Jul 1]. Available from: https://drive.google.com/drive/ folders/0B0J/Content/41149
37. Jung SH, Chow SC, & Chi EM. A note on sample size calculation based on propensity analysis in nonrandomized trials. J Biopharm Stat. 2007;17(1):35-41. doi: 10.1080/10543400601044790.
38. Grove SK, Burns N, Gray J. The practice of nursing research: appraisal, synthesis, and generation of evidence. 7th ed. Elsevier Health Sciences; 2013.
39. Institute of Nutrition, Mahidol University, Thailand. INMUCAL-Nutrients Program. Bangkok: Institute of Nutrition, Mahidol University; 2009.
40. Institute of Medicine (US) and National Research Council (US) Committee to Reexamine IOM Pregnancy Weight Guidelines. Weight gain during pregnancy: reexamining the guidelines. Rasmussen KM, Yaktine AL, editors. Washington (DC): National Academies Press (US); 2009. PMID: 20669500.

ผลของโปรแกรมอาหารสมดุล – ยาบำรุงธาตุเหล็กในสตรีตั้งครรภ์ที่มีภาวะโลหิตจาง: การวิจัยกึ่งทดลอง

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บทคัดย่อ: ภาวะโลหิตจางจากการขาดธาตุเหล็กขณะตั้งครรภ์ เป็นหนึ่งในปัญหาสาธารณสุขที่อาจก่อให้เกิดการคลอดก่อนกำหนดร่วมกับทารกแรกเกิดน้ำหนักน้อย ทำให้เพิ่มค่าใช้จ่ายในการรักษาผู้ป่วยทารกแรกเกิดระยะวิกฤติ การวิจัยกึ่งทดลองนี้มีวัตถุประสงค์เพื่อศึกษาผลของโปรแกรมอาหารสมดุลและยาบำรุงธาตุเหล็กต่อผลลัพธ์ด้านมารดาและผลลัพธ์ด้านการคลอด กลุ่มตัวอย่างเป็นสตรีตั้งครรภ์ที่มีภาวะโลหิตจางมีอายุระหว่าง 20-35 ปี และอายุครรภ์ 20-24 สัปดาห์ โดยกลุ่มทดลอง (40 คน) ได้รับโปรแกรมอาหารสมดุลและยาบำรุงธาตุเหล็กร่วมกับการดูแลตามปกติ ส่วนกลุ่มควบคุม (40คน) ไม่ได้รับโปรแกรม เครื่องมือและโปรแกรมได้รับการตรวจสอบคุณภาพโดยผู้ทรงคุณวุฒิ 5 ท่าน เครื่องมือวิจัยประกอบด้วยแบบสอบถามข้อมูลส่วนบุคคล ผลตรวจทางห้องปฏิบัติการดูความเข้มข้นของเลือด the INMUCAL-Nutrients V.3 software แบบบันทึกการรับประทานยาบำรุงธาตุเหล็ก แบบบันทึกการรับประทานอาหาร 3 วัน เครื่องชั่งน้ำหนักและวัดความสูง และเครื่องชั่งน้ำหนักทารกแรกเกิด วิเคราะห์ผลการวิจัยด้วยสถิติเชิงพรรณนา การทดสอบไคสแควร์ และการทดสอบแมคนีมาร์

ผลการศึกษาพบว่าสัดส่วนของกลุ่มตัวอย่างในกลุ่มทดลองมีความเข้มข้นของเลือดปกติ ได้รับอาหารเพียงพอ ได้รับยาบำรุงธาตุเหล็กครบถ้วน และน้ำหนักเพิ่มขึ้นตลอดการตั้งครรภ์เหมาะสม สูงกว่ากลุ่มตัวอย่างที่อยู่ในกลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ สัดส่วนการคลอดก่อนกำหนดและทารกแรกเกิดน้ำหนักน้อยในกลุ่มทดลองต่ำกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ โปรแกรมอาหารสมดุลและยาบำรุงธาตุเหล็กนี้ควรได้รับการทดสอบในสตรีตั้งครรภ์กลุ่มอื่นๆ ในพื้นที่ที่แตกต่างกัน อย่างไรก็ตามโปรแกรมนี้มีศักยภาพที่ดีที่จะนำไปใช้ได้จริงสำหรับพยาบาล ผดุงครรภ์และสตรีตั้งครรภ์ สตรีตั้งครรภ์ที่มีภาวะขาดธาตุเหล็กต้องการความช่วยเหลือความรู้ และการฝึกวางแผนจัดมื้ออาหาร เพื่อช่วยให้สามารถรับประทานอาหารสมดุลและได้รับยาบำรุงธาตุเหล็กครบถ้วนเพื่อส่งเสริมสุขภาพมารดาและป้องกันผลลัพธ์การคลอดที่ไม่พึงประสงค์

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