

Effect of low glycemic load diet with and without wheat bran on glucose control in gestational diabetes mellitus: A randomized trial

Ahmad Afaghi, Laleh Ghanei¹, Amir Ziaee¹

Qazvin Research Center for Social Determinants of Health, Qazvin University of Medical Sciences, Qazvin, ¹Qazvin Metabolic Diseases Research Center, Qazvin University of Medical Sciences, Qazvin, Iran

ABSTRACT

Background: A low-glycemic index diet is effective in blood glucose control of diabetic subjects, reduces insulin requirement in women with gestation diabetes mellitus (GDM) and improves pregnancy outcomes when used from beginning of the second trimester. However there are limited reports to examine the effect of low glycemic load (LGL) diet and fiber on blood glucose control and insulin requirement of women with GDM. Therefore, the aim of this study was to examine the effect of low glycemic load diet with and without fiber on reducing the number of women with GDM requiring insulin. **Materials and Methods:** All GDM women ($n = 31$) were randomly allocated to consume either a LGL diet with Fiber or LGL diet. **Results:** We found that 7 (38.9%) of 18 women with GDM in Fiber group and 10 (76.9%) in "Without Fiber" group required insulin treatment. **Conclusion:** The LGL diet with added fiber for women with GDM dramatically reduced the number needing for insulin treatment.

Key words: Low glycemic load diet, gestational diabetes, wheat bran

INTRODUCTION

Gestational diabetes mellitus (GDM) is defined as "carbohydrate intolerance resulting in hyperglycemia with first recognition during pregnancy. The GDM affects a substantial number of pregnancies. The overall incidence of 3-6% has steady increased over time, ranging from 2.2% in South America to 15% in the India.^[1]

Maternal hyperglycemia causes a greater transfer of glucose to the fetus, causing fetal hyperinsulinemia and an overgrowth of insulin-sensitive (mainly adipose) tissues, with excessive fetal growth, resulting in more trauma at

birth, shoulder dystocia and perinatal deaths.^[2] Carbohydrate is main dietary source for fetal brain development and at least 175 g/day of carbohydrates are recommended in the pregnant women.^[3] Carbohydrates intake with a low-glycemic index (GI) result in smaller increase in postprandial glucose concentration than after high GI diet in normal and also type 2 diabetic patients.^[4,5] Ingestion of 25 g fiber induces 10-15% reduction in 2 hr postprandial glucose level in impaired glucose tolerance subjects,^[6] and lower dietary fiber intake and higher dietary glycemic load (GL) are positively related to the incident of GDM.^[7] The medical nutrition therapy (MNT) is the cornerstone approach to treatment of women with GDM,^[8] and almost up to 80-90% cases of GDM can be effectively managed with MNT.^[1] However limited information is available to allow evidence-based recommendations regarding specific nutritional approaches such as total calories, nutrient distribution, fiber content, GI and GL to the management of GDM.

Therefore, the aim of the present study was to investigate the role of low GI-low GL diet in postprandial blood

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Corresponding Author: Dr. Laleh Ghanei, Qazvin Metabolic Diseases Research Center, Qazvin University of Medical Sciences, Qazvin, Iran.
E-mail: aafa2000@gmail.com

concentration, specifically the effect of wheat bran on blood glucose of GDM subjects and on reducing the number of women with GDM requiring insulin. We hypothesized that low GI-low GL diet ingested with wheat bran compared with low GI-low GL diet would improve postprandial blood glucose of GDM subjects and reduces the number of women with GDM requiring insulin, because of lowering GI value.

MATERIALS AND METHODS

Thirty six GDM women (aged 20-40), pre-pregnancy BMI = 18.5-29, and at their gestation age of 24-28 weeks who were referred to endocrine clinic were recruited for this study. The diagnostic criteria for GDM was based on the 'standards of medical care in diabetes' and HAPO study.^[8,9] The proposed criteria for the 75g, OGTT considered that any of the following thresholds be met or exceeded.

- Fasting plasma glucose 92 mg/dl
- One-hour plasma glucose 180 mg/dl
- Two-hour plasma glucose 153 mg/dl

The monitoring criteria for GDM considered as fasting plasma glucose \leq 90 mg/dl and 2 hr PP plasma glucose \leq 120 mg/dl.^[8]

Patients were either IFG (FBS $>$ 92, impaired fasting glucose) or IGT (FBS $<$ 92; IGT 1 h, 2 h $>$ 180, 153 mg/dl; impaired glucose tolerance). IFG patients randomly allocated to "Fiber group" and "Without Fiber" group, also IGT patients were randomized the same manner in two diet groups. There were similar number of IFG patients in each group of "Fiber" and "Without Fiber" group. Similarly the IGT patients were equal in each group. In fact we eliminated the confounding factors by allocating similar blood glucose level in each group and the difference in FBS in two groups at the beginning was not significant [Table 2].

Dietary plane

The LGIs-LGLs ascribed to the foods used have been taken from international and local published data.^[10,11] The diet in the two weeks experimental period consisted of ordinary food item having GI \leq 55 and each main meal had GL \leq 20 with overall daily GL = 67-72. Subjects were received LGI-LGL or LGI-LGL plus 15g wheat bran in each main meal. This was accomplished by providing a list to each individual of the recommended daily intake of commonly used foods and a substitution list allowing exchanges within food groups. According to American Diabetes Association (ADA), we recommended a daily calorie intake of 30 kcal/kg body weight plus 340 kcal/day for women with a normal pre-pregnancy weight (BMI = 19.8-26) and 24 kcal/day (plus 340 kcal/daily) for women with

pre-pregnancy overweight (BMI = 26.1-29).^[12] The nutrients distribution were almost based on ADA^[12] guideline [Table 1] and the calorie intake was distributed in three main meals and three between meals and bed time. Subjects were ordered to do their daily routine life style during intervention. After two weeks women who achieved FBS and BS 2 hr pp blood glucose control continued their diet, otherwise commenced insulin treatment

Statistical analysis

Data are reported as mean \pm SD. Blood glucose data were analyzed by independent sample *t*-test and Chi-square test to compare blood glucose concentration before and after intervention and between two groups of "Fiber" and "Without Fiber".

Blood glucose monitoring

After two weeks dietary intervention plasma blood glucose monitored using fasting blood glucose and 2 hours postprandial plasma blood glucose.

Statement of ethics

The protocol was approved by the Qazvin University of Medical Science, Human Ethics Committee and each subjects provided informed consent prior to participation. We certify that all applicable institutional regulations concerning the ethical use of human volunteers were followed during this research.

RESULTS

Five women in "Without Fiber" group at last stage of study withdrew from study and did not complete the study. We continue the study with 18 subjects in "Fiber" group and 13 subjects in "Without Fiber" group. Based on diagnosis of GDM all participated subjects were diabetes without significant differences in fasting blood glucose of two groups at the beginning of the study (100.4 ± 16.3 and 108.0 ± 20.3 in "Fiber" and "Without Fiber" groups respectively, $P = 0.2$). In "Fiber" group fasting blood glucose concentration before intervention and after intervention were 100.4 ± 16.3 and 86.3 ± 11.3 respectively which resulted in 14% (14 mg/dl) reduction ($P = 0.001$). Similarly, these changes in "Without Fiber" group were 108.0 ± 20.3 and 96.6 ± 20.7 respectively with 12% (12 mg/dl) reduction ($P = 0.01$). Similarly 2 hr pp blood concentration in "Fiber" and "Without Fiber" group reduced by 29.6% and 21.3% respectively compare to 2 hr GTT. However comparing fasting blood glucose after two weeks period of intervention in two groups was not significant ($P = 0.1$) [Table 2].

The postprandial blood glucose in two groups of "Fiber" and "Without Fiber" after intervention were 115.1 ± 18.1

Table 1: Composition of low glycemic load diet with 1800 kcal administrated to diabetics patients*

Food	Weight (g)	Protein (g)	Fat (g)	Carbohydrate (g)	GI	GL	Energy (kcal)
Four exchange from starch list, (whole-wheat bread, rice, backed beans, sliced fried potato), all low GIs	Different	12	-	60	47	28	320
Four exchange from milk list (low fat milk, yogurt)	1000	32	20	48	30	14	480
Eight exchange from meat and meat substitutes list (lean meat, low fat cheese, egg whites)	Different	49	21	-	-	-	440
Two exchange from vegetable list (letus, cucumber, tomato)	Two cups raw vegetable	4		10	1	1	50
Four exchange from fruit list (fresh low GI fruits, apple, orange)	480	-		60	40	24	240
Six exchange from fat list (olive oil, olives, nuts, walnut)	Different		30			-	270 (15%)
Total		97 (22%)	71 (36%)	178 (42%)		67	1800

*Calorie was calculated and modified based on pre-pregnancy BMI, GI: Glycemic index, GL: Glycemic load, BMI: Body mass index

Table 2: Comparison of blood glucose concentration between "Fiber" and "Without Fiber" groups

	"Fiber" group N=18	"Without Fiber" group N=13	P
FBS before intervention (GTT 0 h) ^a	100.4±16.3	108.0±20.3	P=0.2
FBS after intervention	86.3±11.3	96.6±20.7	P=0.1
P	P<0.001	P=0.01	
GTT 2 hr	163.7±29.3	174.0±28.1	
BS 2 h PP ^c	115.1±18.1	136.9±18.7	P=0.003

^aFasting plasma sugar; ^bBlood sugar 2 hours postprandial, FBS: Fasting blood sugar, GTT: Glucose tolerance test, BS: Blood sugar, PP: Postprandial

Table 3: Crosstab, effect of low glycemic load diet with and without fiber on blood glucose of GDM* subjects

Subjects	"Fiber" group (%)	"Without Fiber" group (%)	Total (%)
Blood glucose controlled	11 (61.1)	3 (23.1)	14 (45.2)
Blood glucose not controlled	7 (38.9)	10 (76.9)	17 (54.8)
Total	18 (100)	13 (100)	31 (100)

*GDM: Gestation diabetes mellitus

and 136.9 ± 18.7 respectively, which the difference was significant ($P = 0.003$) [Table 2].

Regarding to blood glucose control based our study's criteria, 11 (61.1%) patients in "Fiber" group and 3 (23.1%) patients in "Without Fiber" groups achieved blood glucose control (Chi-square, $P = 0.04$) [Table 3]. In other word 7 (38.9%) in "Fiber" group and 10 (76.9%) in "Without Fiber" group required insulin treatment. In comparison with "Without Fiber" group, patients who consumed fiber demonstrated OR of 5.2 in achieving blood glucose control ($P = 0.04$)

DISCUSSION

This study revealed that, the low-glycemic load diet significantly reduces blood glucose concentration and specifically the low-glycemic load diet with added 15 gr fiber had clinically significant effect on post prandial blood glucose of GDM patients.

Our previous studies has demonstrated that the low glycemic load diet has significant effect on blood glucose reduction of diabetic subjects^[13] and wheat bran in normal diet significantly reduces postprandial glucose response of subjects with impaired fasting glucose (IFG).^[6] Although, there are limited studies about the usefulness of a low-glycemic index diet in pregnancy,^[14] one study demonstrated that consumption of a low-glycemic index diet from the beginning of the second trimester resulted in better fetal outcomes.^[15] The monitoring criteria for GDM is considered as fasting plasma glucose ≤ 90 mg/dl and 2 hr PP plasma glucose ≤ 120 mg/dl after starting the meal.^[8] This can be achieved by administration of low glycemic load diet or diet containing sufficient fiber to delay absorption of carbohydrate. In our previous study, the LGL diet significantly effect on FBS and HbA1c of diabetic patients^[13] and administration of 25 gr wheat bran to normal diet of IFG subjects resulted in 11% reduction in blood glucose response in compare to control group.^[6] Two other reports also have shown the advantages of a low-glycemic index diet for the management of subjects with type 2 diabetes.^[16,17]

In current study 15 gr wheat bran intake by GDM subjects reduced the fasting blood glucose concentration by 16.1%, which was comparable with 11.8% reduction in "LGL" control diet. Similarly 2 hrs pp blood concentration reduced by 29.6% and 21.3% in "Fiber" and "Without Fiber" group respectively compare to 2 hrs GTT. We found that 7 (38%) of 18 women in Fiber group and 10 (76%) in "Without Fiber" group needed insulin treatment. In similar study conducted in Wollongong city in Australia.^[18] Of the 31 women randomly assigned to a low-glycemic index diet, 9 (29%) required insulin, and a significant higher proportion, 19 out of 32 (59%) women who assigned to a higher glycemic index diet underwent insulin treatment. While there were similar a minimum amount of around 175 g/day LGI carbohydrate in both studies, the differences can be explained by different GDM diagnosed and monitoring criteria approached in two studies. In our study GDM diagnosis was according to guideline of the

“Standards of medical care in diabetes”,^[8] while in Wollongong study GDM diagnosis was based on the modified Australasian Diabetes in Pregnancy Society (ADIPS) criteria;^[19] fasting blood glucose level (BGL) ≥ 5.5 mmol/L (≥ 100 mg/dl), 1 hr BGL ≥ 10.0 mmol/L (≥ 181 mg/dl), or 2 hrs BGL ≥ 8.0 mmol/L (≥ 145 mg/dl) vs. 92, 181, 152 mg/dl in our study. Also in another study conducted by Louie *et al.*,^[20] in comparing LGI diet (GI ≤ 50) with high fiber diet (GI ~ 60) among 99 GDM women, 53% of first group vs. 65% in second group required insulin treatment.

The mechanism behind the fact that the LGL diet plus fiber intake was more effective in blood glucose of GDM subjects is that fiber slows carbohydrate absorption and reducing GI of meal. It is worthy to notice that the most of the GDM women in our study who were candidate for insulin treatment were unwilling to commence insulin treatment and 6 of them in “Without Fiber” group switched to “Fiber” group. Similarly, 47% of the women in the Wollongong study,^[18] in high-GI group who met the criteria for insulin commencement avoided insulin by switching to an LGI diet.

Our current study has strength and limitation. The strengths are that the LGL with fiber diet is not harsh treatment and is acceptable by patients. The limitation of study is that the LGL diet which contains low carbohydrate percentage is not food habits of patients and food choice limitation may not result in sufficient weight gain that is goal of pregnant women. However the diet will be ideal to GDM women with BMI > 25 which need the minimum of weight gain during pregnancy.

In summary our finding was consistence with others finding. Low glyceic index diet containing extra added fiber for women with GDM is appropriate, safe and well tolerated and a low GL diet with fiber significantly reduces the need for the use of insulin.

REFERENCES

1. Magon N, Seshiah V. Gestational diabetes mellitus: Non-insulin management. *Indian J Endocrinol Metab* 2011;15:234-53.
2. Lapolla A, Dalfrà M, Fedele D. Management of gestation diabetes mellitus. *Diabetic Metab Syndr Obes Targets Ther* 2009;2:73-82.
3. Food and Nutrition Board. Nutrition during pregnancy. Part 1: Weight gain. Part 2: Nutrient supplement. Washington DC: Institute of Medicine, National Academy of Science; 1990.
4. Afaghi A, O'Connor H, Chow CM. High-glyceic-index carbohydrate

- meals shorten sleep onset. *Am J Clin Nutr* 2007;85:426-30.
5. Rizkalla SW, Taghrid L, Laromiguere M, Huet De, Boillot J, Rigoir A, *et al.* Improved plasma glucose control, whole-body glucose utilization, and lipid profile on a low-glyceic index diet in type 2 diabetic men. *Diabetes Care* 2004;27:1866-72.
6. Afaghi A, Omidi R, Sarrestehdari M, Ghanei L, Alipour M, Azadmehr A, *et al.* Effect of wheat bran on postprandial glucose response in subjects with impaired fasting glucose. *Curr Top Nutraceutical Res* 2011;9:35-40.
7. Zhang C, Liu S, Solomon C, Hu F. Dietary fiber intake, dietary glyceic load, and the risk for gestational diabetes mellitus. *Diabetes Care* 2006;29:2223-30.
8. Care diabetesjournal.org, Standards of medial care in diabetes. *Diabetes Care* 2012:S11-63.
9. Metzger B, Lowe L, Dyer A, Trimble E, Chaovarinder U. HAPO Study cooperative research group, hyperglycemia and adverse pregnancy outcomes. *N Engl J Med* 2008;358:1991-2002.
10. Brand-Miller JC. Home of the glycaemic index, glycaemic load. Internet: Available from: <http://www.glyceicindex.com> [Last accessed on 2012 May 10].
11. Taleban FA, Esmaeili M. Glyceic index of Iranian foods: Guideline for diabetic and hyperlipidemic patients. Tehran: National nutrition and food technology of Iran, Shahid Beheshti University of Medical Science; 1999.
12. American diabetes association. Gestational diabetes mellitus (position statement) *Diabetes Care* 2004;27(Suppl 1):S88-90.
13. Afaghi A, Ziaee A. Effect of low glyceic load diet on glyated hemoglobin (HbA1c) in poorly-controlled diabetes patients. *Glob J Health Sci* 2012;4.
14. Dietary advice in pregnancy for preventing gestational diabetes mellitus. *Cochrane Database Syst Rev* 2008;2:CD006674.
15. Moses R, Luebcke M, Davis W, Coleman K, Tapsell L, Petocz P, *et al.* The effect of a low-glyceic index diet during pregnancy on obstetric outcomes. *Am J Clin Nutr* 2006;84:807-12.
16. Wolever T, Mehling C, Chiasson JL, Josse R, Leiter LA, Maheux P, *et al.* Low glycaemic index diet and disposition index in type 2 diabetes (the Canadian trial of Carbohydrates in Diabetes): A randomisedcontrolled trial. *Diabetologia* 2008;51:1607-15.
17. Jenkins DJ, Kendall CW, McKeown-Eyssen G, Josse RG, Silverberg J, Booth GL, *et al.* Effect of a low glyceic index or a high cereal fiber diet on Type 2 diabetes. *JAMA* 2008;300:2742-53.
18. Moses RG, Barker M, Winter M, Petocz P, Brand-Miller JC. Can a low-glyceic index diet reduce the need for insulin in gestational diabetes Mellitus? *Diabetes Care* 2009;32:996-1000.
19. Hoffman L, Nolan C, Wilson J, Oats J, Simmons D. Gestational diabetes mellitus management guidelines: The Australasian Diabetes in Pregnancy Society. *Med J Aust* 1998;169:93-7.
20. Louie J, Markovic T, Perera N, Foote D, Petocz P, Ross G, *et al.* A randomized controlled trial investigating the effects of a low-glyceic index diet on pregnancy outcomes in gestational diabetes mellitus. *Diabetes Care* 2011;34:2341-6.

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