An 18-mo randomized trial of a low-glycemic-index diet and weight change in Brazilian women[1–3]

Rosely Sichieri, Anibal S Moura, Virginia Genelhu, Frank Hu, and Walter C Willett

ABSTRACT

Background: Despite interest in the glycemic index diets as an approach to weight control, few long-term evaluations are available.

Objective: The objective was to investigate the long-term effect of a low-glycemic-index (LGI) diet compared with that of a high-glycemic-index (HGI) diet; all other dietary components were equal.

Design: After a 6-wk run-in, we randomly assigned 203 healthy women [body mass index (in kg/m^2): 23–30] aged 25–45 y to an LGI or an HGI diet with a small energy restriction. The primary outcome measure was weight change at 18 mo. Secondary outcomes included hunger and fasting insulin and lipids.

Results: Despite requiring a run-in and the use of multiple incentives, only 60% of the subjects completed the study. The difference in glycemic index between the diets was ≈35–40 units (40 compared with 79) during all 18 mo of follow-up, and the carbohydrate intake from energy remained at ≈60% in both groups. The LGI group had a slightly greater weight loss in the first 2 mo of follow-up (−0.72 compared with −0.31 kg), but after 12 mo of follow-up both groups began to regain weight. After 18 mo, the weight change was not significantly different ($P = 0.93$) between groups (LGI: −0.41 kg; HGI: −0.26 kg). A greater reduction was observed in the LGI diet group for triacylglycerol (difference = −16.4 mg/dL; $P = 0.11$) and VLDL cholesterol (difference = −3.7 mg/dL; $P = 0.03$).

Conclusions: Long-term weight changes were not significantly different between the HGI and LGI diet groups; therefore, this study does not support a benefit of an LGI diet for weight control. Favorable changes in lipids confirmed previous results. *Am J Clin Nutr* 2007;86:707–13.

KEY WORDS Low-glycemic-index diet, weight change, Brazilian women

INTRODUCTION

In prospective studies, a diet with a high glycemic load, the combination of a high glycemic index (HGI) and a high carbohydrate intake, has been an important risk factor for high fasting triacylglycerol concentrations (1), type 2 diabetes (2, 3), and coronary heart disease (4). However, intervention studies in healthy persons are limited. In a nonrandomized follow-up (average: 4 mo) of children attending a program of obesity treatment, children assigned to a low-glycemic-index (LGI) diet ($n = 64$) experienced a greater reduction in BMI than did those assigned to a reduced-fat, HGI diet ($n = 43$) (5). In a randomized study in healthy overweight women aged 20–40 y, ad libitum LGI and HGI diets with similar carbohydrate contents were compared, and no differences in weight and hunger were found after a 10-wk follow-up (6). The difference in the GI of the 2 diets in this study was 20 units.

The purpose of this study was to investigate the effect of a larger difference in GI of 2 diets (≈40 units)—all other dietary components held equal—on weight and satiety in healthy Brazilian women. Dried beans, a frequent component of the Brazilian diet, have an exceptionally low blood glucose response (7), which allows a larger contrast between diets and a longer trial. The trial also aimed to increase adherence to the diets, a major problem in obesity trials, by recruiting young overweight women instead of obese women, by including a run-in period, and by aiming for a small weight loss.

SUBJECTS AND METHODS

Subjects

From October 2003 to September 2004, 414 healthy women with a body mass index (BMI; in kg/m^2) of 23–29.9, who were aged 25–45 y, not pregnant, not breastfeeding, had at least one child, and did not anticipate a pregnancy in the next year, were recruited for the study. Women with physician-diagnosed thyroid disease or diabetes or who were menopausal were not eligible to participate; we also excluded those who could not eat beans on a daily basis or who had a particular dislike for them. Recruitment was conducted in 2 primary care centers of the State University of Rio de Janeiro, Brazil. The progress of the women during the study is shown in **Figure 1**.

All participants received information about the goals of the study, which aimed at a small weight loss during the follow-up. The study was approved by the Institutional Review Boards of Harvard School of Public Health and State University of Rio de Janeiro. A sample calculation made before the beginning of the

[1] From the Department of Epidemiology, Institute of Social Medicine (RS), the Department of Physiology, Institute of Biology (ASM), and the Department of Clinical and Experimental Medicine (VG), State University of Rio de Janeiro, Rio de Janeiro, Brazil; and the Department of Nutrition, Harvard School of Public Health, Cambridge, MA (FH and WCW).

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[3] Reprints not available. Address correspondence to R Sichieri, Department of Epidemiology, Institute of Social Medicine, State University of Rio de Janeiro, Rua São Francisco Xavier, 524,7° andar, Bloco E, Cep 20550-012, Rio de Janeiro, RJ, Brasil. E-mail: sichieri@ims.uerj.br.

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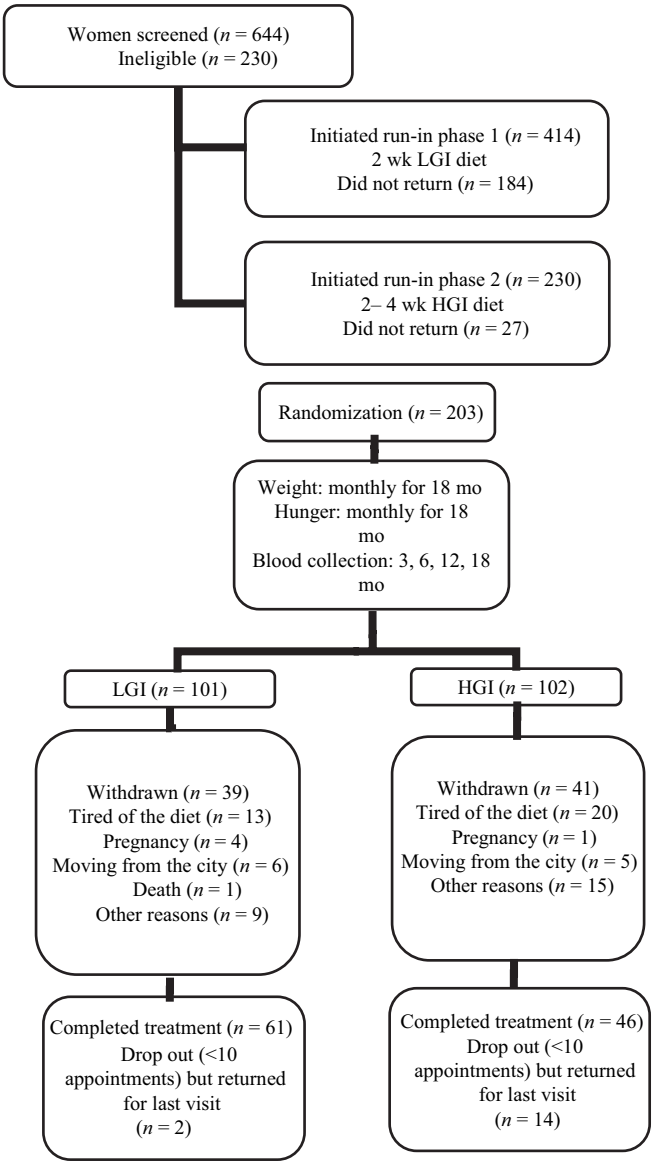

FIGURE 1. Progress of women during the study.

TABLE 1
Food in the high- and low-glycemic-index diets

High glycemic index	Low glycemic index
Breakfast and snacks	Breakfast and snacks
Milk products	Milk products
Cottage or white cheese	Cottage or white cheese
Ricotta	Ricotta
Cream cheese light	Cream cheese light
Yogurt	Yogurt
Porridge	Garbanzos cream
Breads	Breads
French bread	Whole bread (oat, fiber, bran)
White bread, crackers, and toast with jelly	Corn or oat cookies
Fruit and fruit shakes	Fruit and avocado shake
Mango, papaya, banana watermelon, grapes, pineapple, and kiwi	Plums, apple, strawberry, orange, tangerine, pear, peach, fig, and guava
Lunch and dinner	Lunch and dinner
Cereals (every day)	Cereals (every day)
Sticky rice	Parboiled rice
Rice with broccoli or other greens	Corn purée
Rice with chicken or tuna fish	Pasta
Rice with raisins	Sweet corn
Beans (twice a week)	Beans (everyday)
Beans	Beans
Peas, garbanzos, soya, or lentil	Peas, garbanzos, soya, or lentil
Green vegetables (2 portions/d)	Green vegetables all (2 portions/d)
Others vegetables	Others vegetables
Beetroots	Carrots
Chayote	Okra
Pumpkin	Zucchini
Mashed potatoes	Cauliflower
Potato pies	Eggplant
Boiled potatoes	Cabbage
Roasted potatoes	Tomato
	Sweet potatoes
	Cassava/yam
Meats, eggs, and fish	Meats, eggs, and fish
Beef or ground meat, lean	Beef or ground meat, lean
Chicken	Chicken
Baked turkey hamburger	Baked turkey hamburger
Nuggets	Nuggets
Boiled or scrambled egg	Boiled or scrambled egg
Tuna fish, cod fish, and other fishes	Tuna fish, cod fish, and other fishes
Desserts	Desserts
Diet jelly	Fruit or diet jelly, chocolate mousse, mix of soya and nuts, yogurt pudding, and nut cake
Fruit mousse	
Cakes	
Soups	Soups
Blended vegetables with or without rice	Vegetables, garbanzos, beans, peas, and lentil

study was based on a mean (±SD) difference in BMI of 1.2 ± 2.5, assuming 90% power and a 5% significance level. The needed total sample size was 148 (8). Allowing for noncompliance in both groups (9), the estimated sample size was 172; after further adjustment for an estimated 20% loss during follow-up, the total sample size was estimated to be 206.

Study design

Dietary counseling was based on a small energy restriction (ie, 100–300 kcal), and skipping the diet 1 d/wk was allowed. Individual nutritionist counseling every month with menus and exchange lists was provided. Both diets were designed with 26–28% of energy as fat. For each meal (**Table 1**), the LGI diets were designed to maintain an average difference of 40 GI units compared with the HGI diet. Calculations were based on published GI values for healthy individuals (10), with white bread as the standard GI of 100%. The overall GI was calculated by multiplying the carbohydrate intake of each food by its GI, summing up the products for all foods and dividing the sum by the total carbohydrate intake. Because sticky rice versus parboiled rice was one of the major determinants of the difference in GI between the 2 diets, beyond the amount of beans, we determined the hydrolysis of the most-reported brand of rice consumed by the women via vitro hydrolysis analysis (11) (**Figure 2**). The difference in GI

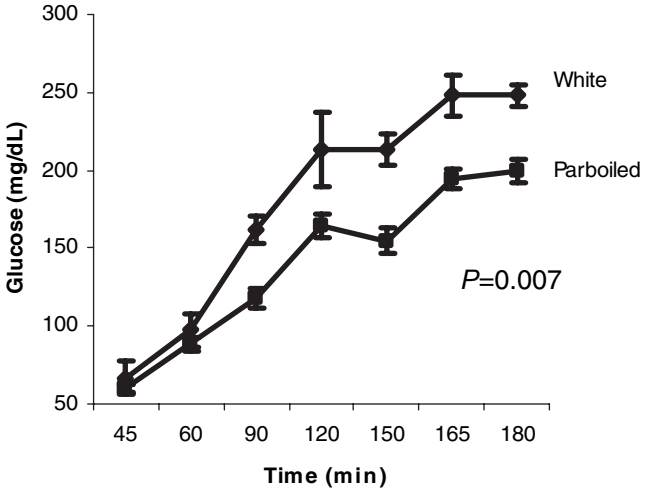

FIGURE 2. In vitro starch hydrolysis of the most reported brand of rice consumed by the women in the study. Mean (±SD) of 3 measurements. The *P* value is for the area under the curve.

between the 2 types of rice (≈25%) was of a magnitude similar to GI values previously reported (116 compared with 91, with white bread as reference) (10). In vitro analyses were also conducted for foods commonly used in Brazil for which no GI was available, such as okra, guava, cheese bread, and manioc bread.

Subjects were instructed to eat 3 meals and 3 snacks according to a 6-d menu plan. Instructions also included limiting to a minimum all candies, added sugar, and sodas, except for the weekly day free of diet. Every month, the portions of staple foods were reduced if the participants reported that they were prescribed too much food.

The initial phase of the study was a 6-wk run-in period, which consisted of 2 wk of an LGI diet followed by 4 wk of an HGI diet (Figure 1). Of the 414 women recruited, 203 completed the 2 run-in periods and were randomly assigned to an LGI or an HGI diet. The randomization list was computer-generated with blocking.

Measurements

Hunger was measured according to a Likert scale from 1 to 10 (12). Weight and hunger were measured every month, and fasting blood samples were collected at baseline and after 3, 6, 12, and 18 mo. Blood was collected after the subjects had fasted for 10 h, and all measurements were performed in the morning. Height was measured to the nearest 0.5 cm with a wall-mounted stadiometer, and body weight was measured by using the same calibrated digital scale for all participants.

Plasma lipids and glucose were measured by using GoldAnalisa kits with an intraassay CV ranging from 0.9% to 1.2% and an interassay CV ranging from 1.9% to 2.7%. LDL- and VLDL-cholesterol concentrations were calculated according to the Friedewald equation (13), based on triacylglycerol measures. Serum insulin concentration was determined by radioimmunoassay with an ImmuChem 125/RIA kit with an intraassay CV ranging from 4.2% to 8.2% and an interassay CV ranging from 6.4% to 8.8%. Relative insulin resistance [homeostasis model assessment of insulin resistance (HOMA-IR)] was estimated according to the formula [glucose (in mmol/L) × insulin (in μIU/mL)/22.5]. A HOMA-IR > 2.5 was considered to indicate insulin resistance.

Food intake, based on a food frequency questionnaire developed for and validated in the adult Brazilian population (14), was measured at the beginning of the run-in period and after 3, 6, 12, and 18 mo of follow-up.

Data analysis

The intention-to-treat analysis included all subjects, regardless of compliance. Hunger and weight changes over time for parallel groups with repeated measurements were determined by using PROC MIXED in SAS, including the baseline measure as a covariate (version 8.2; SAS Institute Inc, Cary, NC). Baseline characteristics of the 2 groups were compared by using Student's *t* test or the chi-square test. Hunger scales at each main meal and the sum of the 3 scales were compared between the 2 groups. Because of the nonlinear weight change observed, the model incorporated a quadratic term (time × time) variable. Change over time was measured by the interaction between time and type of diet. Because diet × time interactions for weight change were not significantly different, models were reduced. A secondary analysis excluded the 18-mo follow-up, when women who were not actively attending returned for the last visit. Blood lipids in this secondary analysis changed linearly; therefore, the quadratic term was not incorporated in the models. When more than one measurement was available per person per period, only the first measurement was included in the analysis.

Residual plots of all models were examined, and their distribution did not show major deviations from regression assumptions. Energy intake, average GI, average glycemic load, fiber, and selected food items related to compliance were estimated by using a food-frequency questionnaires. Baseline intake was compared by using Student's *t* test. Statistical analysis for changes during follow-up tested the time × diet variable, with time = 0 for baseline and time = 1 for follow-up.

RESULTS

The 414 women who initiated the run-in had a race distribution not significantly different from those who were ultimately randomly assigned, but were less educated. Race distribution among those who initiated the run-in was 51% white, 30% mulatto, and 18% black; 33% had <4 y of schooling. Characteristics of those women randomly assigned to the 2 diet groups are shown in **Table 2**. No significant differences in any of the characteristics were observed between groups. The LGI group reported a significantly higher glycemic load and GI during follow-up (**Table 3**). Mean values of the other dietary components were not significantly different between the LGI and HGI groups (Table 3).

Losses to follow-up during the 18-mo period were 38% in the LGI group and 41% in the HGI group; 5 losses (6%) were due to pregnancy (Figure 1). All women not showing up at scheduled appointments were called and invited to be rescheduled. The main reason given for not returning was an overly restricted diet. The average number of appointments in the 2 dietary groups was 13. Dropouts were younger (35.6 compared with 38.2 y; $P = 0.001$), lost less weight during the run-in period (0.52 compared with 1.10 kg; $P = 0.005$), were less educated ($P = 0.06$), had a lower income ($P = 0.07$), and had a greater total hunger score at baseline (11.6 compared with 10.3; $P = 0.04$). However, dropouts were not significantly different from those followed in relation to race and BMI at baseline. Adherence to treatment (completing >10 appointments) was greater in women in the LGI

TABLE 2
Demographic and anthropometric characteristics of the 203 participants at baseline by diet[1]

	Experimental LGI diet (n = 101)	Control HGI diet (n = 102)	P
Age (y)	37.2 ± 5.4[2]	37.5 ± 5.6	0.65
Weight (kg)	67.7 ± 6.6	68.5 ± 7.5	0.11
Stature (cm)	159.7 ± 5.9	160.9 ± 6.6	0.20
BMI (kg/m^2)	26.9 ± 1.8	26.7 ± 2.1	0.49
Triacylglycerol (mg/dL)	88.3 ± 46.0	88.9 ± 44.7	0.64
Total cholesterol (mg/dL)	188 ± 35	194 ± 36	0.43
VLDL cholesterol	17.7 ± 9.0	18.2 ± 9.5	0.72
HDL cholesterol	42.5 ± 15.9	42.6 ± 15.9	0.96
Likert hunger scale mean			
Before breakfast	3.8	3.2	0.09
Before lunch	4.6	4.2	0.11
Before dinner	3.0	2.8	0.63
All	11.5	10.3	0.13
Race (%)			
White	54.5	52.0	0.44
Black	19.8	15.0	
Mulatto	25.7	33.0	
Schooling (%)			
< 8 y	24.0	28.3	0.67
9–12 y	47.0	45.4	
≥12 y	29.0	26.3	

[1] LGI, low glycemic index; HGI, high glycemic index.
[2] $\bar{x}$ ± SD (all such values).

TABLE 3
Dietary changes from baseline between the low-glycemic-index (LGI) and high-glycemic-index (HGI) diet groups[1]

	Baseline	3-mo follow-up	6-mo follow-up	12-mo follow-up	18-mo follow-up
Energy (MJ)					
LGI	14.3 ± 9.3	10.3 ± 5.9	9.6 ± 6.1	12.9 ± 9.4	11.2 ± 7.0
HGI	16.2 ± 12.9	12.1 ± 7.8	11.8 ± 6.4	14.7 ± 10.9	14.0 ± 9.1
P	0.15[2]			0.97[3]	
Carbohydrate (% of energy)					
LGI	58.9 ± 7.7	60.4 ± 6.3	58.3 ± 6.7	59.7 ± 5.8	59.5 ± 6.3
HGI	60.3 ± 6.6	61.2 ± 5.6	60.7 ± 6.4	60.7 ± 6.4	61.6 ± 6.2
P	0.18			0.98	
Lipid (% of energy)					
LGI	28.2 ± 5.9	26.8 ± 4.5	28.2 ± 5.6	27.3 ± 4.8	27.2 ± 4.6
HGI	27.6 ± 5.3	26.5 ± 4.5	26.6 ± 4.4	27.0 ± 5.2	26.1 ± 4.7
P	0.45			0.98	
Glycemic load					
LGI	288 ± 66	144 ± 97	114 ± 99	141 ± 110	104 ± 118
HGI	284 ± 71	293 ± 64	300 ± 58	294 ± 59	280 ± 60
P	0.66			0.007	
Glycemic index					
LGI	74 ± 38	46 ± 49	42 ± 52	44 ± 57	30 ± 54
HGI	64 ± 33	86 ± 47	83 ± 35	79 ± 41	72 ± 40
P	0.05			0.02	
Daily portion of beans					
LGI	1.61 ± 1.0	1.44 ± 1.1	1.44 ± 1.1	1.42 ± 0.9	1.10 ± 1.0
HGI	1.58 ± 1.3	1.30 ± 1.2	1.23 ± 0.9	0.97 ± 0.6	1.20 ± 0.6
P	0.87			0.49	
Fiber (g)					
LGI	43.5 ± 26	35.9 ± 20	30.5 ± 17	39.8 ± 25	36.0 ± 21
HGI	50.4 ± 35	39.9 ± 22	38.3 ± 22	43.3 ± 30	44.5 ± 27
P	0.12			0.86	

[1] The GI reference was white bread (10).
[2] Student's t test.
[3] Time × diet interaction.

TABLE 4
Weight changes and mean changes in hunger scale during follow-up, according to low-glycemic-index (LGI) and high-glycemic-index (HGI) diet

	Follow-up (mo)								*P* for main effect[1]	
	1	2	3	6	9	12	15	18	Diet	Time
Sample size (*n*)										
LGI	89	68	60	55	47	44	49	63		
HGI	78	56	53	50	49	46	44	60		
Weight (kg)										
LGI	−0.24 ± 1.1	−0.72 ± 1.9	−0.62 ± 2.2	−0.87 ± 2.2	−1.05 ± 2.5	−1.00 ± 2.4	−1.04 ± 3.0	−0.41 ± 2.9	0.65	0.0001
HGI	−0.22 ± 1.2	−0.31 ± 3.9	−0.70 ± 1.8	−1.27 ± 2.6	−0.87 ± 2.9	−1.25 ± 3.2	−0.95 ± 3.2	−0.26 ± 3.6		
Hunger scale[2]										
LGI	−0.07 ± 3.8	−0.26 ± 4.1	−0.47 ± 4.4	−1.05 ± 5.2	−1.04 ± 5.7	−1.21 ± 5.7	−1.00 ± 5.5	−1.31 ± 6.3	0.74	0.0031
HGI	0.09 ± 3.5	−1.16 ± 1.4	0.04 ± 4.3	−1.60 ± 5.0	−0.92 ± 4.3	−0.87 ± 5.1	−0.52 ± 4.9	−0.98 ± 4.3		

[1] *P* values from a repeated-measures analysis (PROC MIXED in SAS) and adjusted for baseline weight, age, center, time, and time × time interaction. The time × diet interactions were not significant for either variable.
[2] Sum of Likert scale ratings for interaction before breakfast, before lunch, and before dinner.

group than in the HGI group (61% compared with 46%; $P = 0.0006$).

The number of women followed up at specific visits and crude mean changes in weight loss and the hunger scale from baseline are shown in **Table 4**. Mean weight loss and reduction in hunger (sum of Likert scale ratings completed before all main meals) were not significantly different between the LGI and HGI groups. Similar findings were seen for the reduction in hunger at each meal (data not shown). Estimated changes based on the crude data in Table 4 during the 18 mo of follow-up are shown in **Figure 3**. The *P* values in Figure 3 for the time × diet variable indicate changes over time, whereas the *P* values in Table 4 reflect differences at the 18-mo time point. Both analyses indicated that the effects of diet were not significantly different. Exclusion of those who were dropouts but were weighed at the last visit did not change the results substantially (weight change before exclusion: 0.31 kg compared with 0.21 kg, $P = 0.18$; weight change after exclusion: 0.68 kg compared with 0.96 kg, $P = 0.10$). Thus, in models that excluded the time × diet interaction ($P > 0.30$) and excluded women who were not actively attending, the constant difference over time between the LGI and HGI groups was −0.013 kg ($P = 0.94$).

The LGI diet reduced triacylglycerol at all measurement time points until 12 mo, but the only statistically significant effect of the diet was the lower VLDL-cholesterol concentration with the LGI diet ($P = 0.03$; **Table 5**). After the last observations were excluded, these effects were even stronger (Table 5). When fiber intake at 3 mo was included in the model and the data analysis was restricted to 12 mo, the reductions in total cholesterol and LDL cholesterol became statistically significant ($P = 0.009$ for total cholesterol and $P = 0.01$ for LDL cholesterol).

At baseline, 3.7% of the women had insulin values >20 μU/mL. No significant differences in fasting serum glucose, insulin, and HOMA-IR were observed between dietary interventions at 3 mo (**Table 6**).

DISCUSSION

In the nonobese women in the present study, an LGI diet did not facilitate long-term weight loss compared with an HGI diet. After an initial small weight loss, both dietary groups began to regain weight by 12 mo, and the LGI group had regained almost all of the weight lost by the end of the study. The magnitude of weight loss was small, possibly because the study aimed at a small slow weight loss, with the rationale that a small long-term negative energy balance would not elucidate metabolic changes for weight regain, and, as a consequence, compliance would be facilitated. However, compliance in our study was only slightly greater than adherence rates observed in trials with popular diets such as Atkins (carbohydrate restriction), Zone (macronutrient balance), Weight Watchers (calorie restriction), and Ornish (fat restriction) (15). For all 4 of these diets, self-rated adherence after 4 mo of

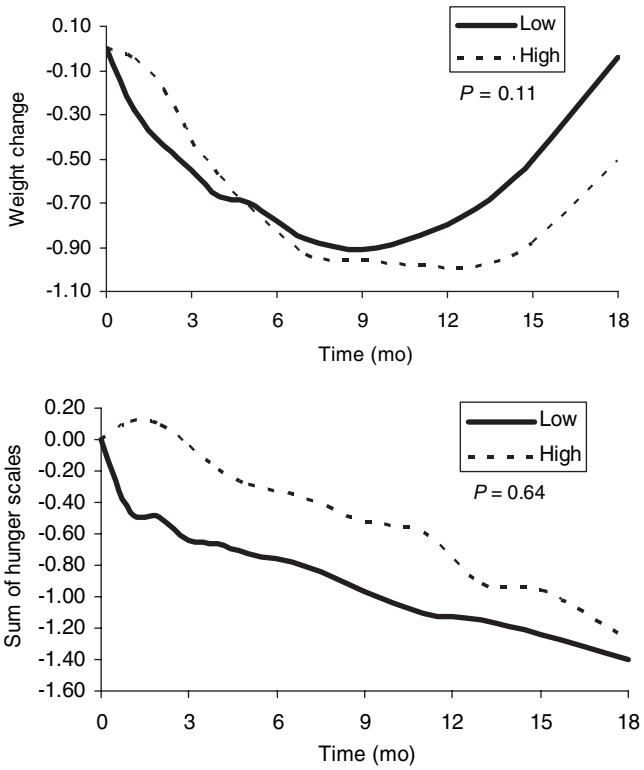

FIGURE 3. Estimated changes in weight and hunger scales based on a repeated-measurement analysis with baseline values as covariables. Models also included age, center, time, and time × time and time × diet interactions. The *P* values represent the time × diet interaction.

TABLE 5
Fasting serum blood lipids during the low-glycemic-index (LGI) and high-glycemic-index (HGI) diets in women[1]

						P^2			
	Baseline	3 mo	6 mo	12 mo	18 mo	Estimated difference	Time	Diet	Diet × time
Sample size (*n*)									
LGI	101	73	59	41	64				
HGI	102	60	60	42	53				
Triacylglycerol (mg/dL)									
LGI	88.9 ± 46.2[3]	83.2 ± 44.8	76.9 ± 36.5	88.0 ± 48.5	113.5 ± 57.2				
HGI	89.1 ± 44.2	89.6 ± 49.7	79.6 ± 36.5	111.2 ± 80.9	120.5 ± 60.4	−16.4	0.0007	0.78	0.10
						−16.9[4]	0.0003	0.89	0.06
Total cholesterol (mg/dL)									
LGI	188.8 ± 34.7	189.1 ± 33.5	184.1 ± 34.8	185.0 ± 35.4	199.9 ± 40.9				
HGI	194.1 ± 37.0	200.9 ± 43.2	186.5 ± 37.8	200.7 ± 37.1	208.7 ± 41.6	−12.6	0.0001	0.78	0.66
						−13.0[4]	0.09	0.81	0.13
VLDL cholesterol (mg/dL)									
LGI	18.0 ± 9.4	17.4 ± 9.4	15.5 ± 7.5	17.6 ± 9.7	22.6 ± 11.5				
HGI	17.8 ± 8.7	18.2 ± 10.0	16.6 ± 7.7	22.8 ± 15.9	24.1 ± 12.2	−3.7	0.009	0.76	0.03
						−4.0[4]	0.007	0.78	0.008
LDL cholesterol (mg/dL)									
LGI	127.7 ± 32.8	124.8 ± 33.6	117.3 ± 35.2	113.0 ± 33.6	125.8 ± 34.8				
HGI	133.1 ± 36.8	138.0 ± 41.3	120.7 ± 36.6	122.6 ± 37.2	132.0 ± 38.4	−7.6	<0.001	0.50	0.76
						−8.0[4]	0.001	0.83	0.27
HDL cholesterol (mg/dL)									
LGI	43.0 ± 15.4	46.9 ± 11.4	51.2 ± 12.7	54.4 ± 13.6	51.2 ± 11.5				
HGI	43.2 ± 15.9	44.7 ± 10.2	51.6 ± 12.3	55.5 ± 15.5	52.5 ± 12.4	0.5	<0.001	0.53	0.79
						−0.1[4]	<0.001	0.62	0.68

[1] Lipid values were log transformed.
[2] Repeated-measures analysis (PROC MIXED, in SAS) with baseline values included in the analysis.
[3] $\bar{x}$ ± SD (all such values).
[4] 18-mo follow-up excluded.

follow up was <50%. Also, only 65% of those on the Zone and Weight Watchers diet and only 50% of those on the other 2 diets finished 1 y of follow-up. In our study, ≈60% of the subjects finished the 18-mo follow-up for both diets, and adherence (completing >10 appointments) was greater in women in the LGI diet group.

A major limitation of the study was the high rate of losses to follow-up, which was greater than expected in this selected population. We anticipated a higher adherence rate because a weight-loss program was not readily available at public primary health clinics, and the diets were based on commonly used foods. After 3 mo of follow-up we incorporated group activities and rewards for those who kept appointments, but even these strategies had no further effect. Losses to follow-up may not explain the lack of long-term effect of the LGI diet given that results were unchanged when we excluded the 18-mo follow-up, which included women who had stopped active participation. Also, the difference in the GI of diets in the 2 arms of the trial was >35 units over time, according to the food-frequency questionnaires, and favorable changes in serum lipids confirmed previous results (6), which indicated that the pattern of dietary intervention proposed was maintained in both arms of the trial. Weight regain after the 12-mo follow up was associated with an increase in energy intake. This finding has been seen repeatedly in weight-loss trials.

As expected, the mean reported consumption of women in the HGI diet group had a GI and a glycemic load only slightly higher

TABLE 6
Serum fasting insulin, glucose, and homeostasis model assessment of insulin resistance (HOMA-IR) with the low-glycemic-index (LGI) and high-glycemic-index (HGI) diets

	Baseline			3-mo follow-up		Change from baseline		
	LGI (*n* = 94)	HGI (*n* = 93)	P^1	LGI (*n* = 72)	HGI (*n* = 58)	LGI (*n* = 70)	HGI (*n* = 56)	P^1
Glucose (mmol/L)	4.72 ± 0.7[2]	4.80 ± 0.9	0.53	4.71 ± 0.7	4.66 ± 0.7	−0.01	−0.29	0.13
Insulin (μU/mL)	11.6 ± 4.2	11.7 ± 4.4	0.79	12.4 ± 4.5	11.3 ± 3.3	0.42	−0.20	0.39
HOMAR-IR	2.4 ± 1.0	2.5 ± 1.0	0.69	2.6 ± 1.1	2.3 ± 0.7	0.08	−0.09	0.13

[1] Student's *t* test.
[2] $\bar{x}$ ± SD (all such values).

than the GI and the glycemic load at baseline. The LGI diet appeared to be more beneficial than did the HGI diet with regard to weight loss and appetite, measured by the Likert scale only in the first 2 mo of follow-up. Hunger increased in the HGI diet group in the first month, and, curiously, there was a statistically significant reduction in hunger over time with both diets, even after 12 mo when energy intake increased. A possible explanation is that women felt less hungry because they were eating more.

Few studies that manipulated the GI or glycemic load had isocaloric meals differing only in the GI, as in the present study. One of these isocaloric studies was a 10-wk randomized study of 45 subjects with ad libitum intake. Subjects in this study lost 1.9 kg with the LGI diet and 1.3 kg with the HGI diet, but the difference was not statistically significant. However, large favorable changes in lipids were found and insulin and HOMA showed a nonsignificant decline with both the LGI and HGI diets (6). Our results from a much larger sample indicated no significant change in insulin or HOMA. The characteristics of our study population may explain the lack of change in insulin concentrations. Obese women were excluded, and only 3.7% of women had high insulin values at baseline. Wolever and Mehling (16) showed that an LGI diet increased insulin secretion in subjects with impaired glucose tolerance, and weight loss was greater with an HGI diet after a 4-mo follow-up. These findings may explain why the initial greater change in weight observed with the LGI diet was followed by a resistance to further weight loss. Insulin is an anabolic hormone, and its increase poses an extra difficulty for weight loss.

The low frequency of insulin resistance at baseline in our study population also may explain the lack of efficacy of the LGI diet. In a small clinical trial (17), participants with high baseline insulin concentrations lost more weight with the LGI diet, and the reverse was observed in those with low insulin concentrations at baseline.

Our results do not support the hypothesis that an LGI diet enhances weight-loss success, and existing evidence of other benefits was confirmed. The possibility that LGI diets would be effective for weight control mainly among insulin-resistant individuals could not be tested and will require further study with a greater percentage of insulin-resistant individuals.

The authors' responsibilities were as follows—RS and WCW: designed the study, interpreted the results, and wrote the paper; ASM: coordinated the storage and measurement of the biochemical samples and interpreted the results; VG: provided clinical support and interpreted the results; FH: helped design the study. All authors declared that they participated in the study and that they saw and approved the submitted version of the manuscript.

All authors agreed to sign a transfer of copyright agreement and had no conflicts of interest.

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