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The Glycaemic Index of Foods as a Tool to Tackle Obesity Among Saudi Females

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Abstract

The recent dramatic modification in habitual eating patterns, in particular, modifying the type of carbohydrates content of the diet, is behind most health problems as a result of obesity and its complications. This study was conducted to estimate the prevalence of obesity among Saudi females and assess the effect of short-term consumption of low glycaemic index (LGI) foods on weight loss. Saudi females from Eastern province (n = 979) were recruited. Height, weight and blood pressure were initially measured and body mass index (BMI) was estimated. For the LGI study, 32 obese females have received a healthy eating advice emphasizing LGI foods over a 6-week period. Three-day dietary records before and after the program have been collected and analysed for nutrients intake. The results have revealed that 19 % participants were overweight and 10 % obese. For those who have joined the LGI diet program, body weight significantly decreased by 3.1 ± 0.24 kg ($p < 0.01$) after the 6-week period of the program. Moreover, significant reductions in the total energy intake (22 %, $p < 0.01$) and fat intake (36 %, $p < 0.01$) were observed; however, the dietary intake of fibre and vitamins A and C significantly increased ($p < 0.01$). Our results suggest that a dietary advice involving consumption LGI foods for weight loss can lead to improved daily intake of nutrients, and diminished the occurrence of obesity and its complications among females in Saudi Arabia.

Keywords: *Low GI diet; Obesity; Overweight; Saudi females; Weight loss*

Abbreviations: BMI: Body Mass Index; EE: Energy Expenditure; EI: Energy Intake; LGI: Low Glycaemic Index; MBP: Mean Blood Pressure; SEM: Standard Error of the Mean

Introduction

Obesity or overweight is one of the greatest health problems associated with excess morbidity and mortality around the worldwide. This health condition afflicts many living in affluent industrialised nations and it is apparent that the incidence of obesity is increasing. In Saudi Arabia, obesity is present in epidemic proportions and are increasing at an alarming rate, where it has reached up to 28 % of the adult population [1-2]. It has been reported that the prevalence of overweight (BMI ≥ 25 < 30) was higher among Saudi males in comparison with Saudi females, however; the prevalence of obesity (BMI ≥ 30) was higher among females than males [1-3]. One of the main causes for this phenomenon could be due to rapid changes in habitual eating patterns in terms of high consumption of refined carbohydrates as well as sedentary lifestyle. Several strategies have been investigated to prevent or alleviate the acuteness of this problem and its complications. It is evidence that interventions based on lifestyle modification are integral components in the management of obesity. However, although weight loss can be achieved through dietary restriction and/or increased physical activity, over the long term many individuals regain weight [4].

Diet-based strategies have the potential to promote satiety and moderate energy intake, which is considered as a good approach for promoting weight loss and preventing weight regain. The current public health recommendations encourage consumption of foods that are satisfying appetite for longer and helping to burn more body fats. This strategy can be achieved by applying low glycaemic index (LGI) foods on a daily basis. The glycaemic index (GI) has been developed to facilitate our understanding of the metabolic impact of different types of carbohydrate (CHO) containing foods [5-6]. Accordingly, foods have been classified into low GI foods and high GI foods. Low GI foods are digested more slowly and the CHO present is converted into glucose at a slower rate, producing a more gradual rise in blood glucose and insulin responses [7-8]. Studies have shown that low GI foods are associated with significant reductions in energy intake and body weight [9-11]. In fact, high GI foods are digested more rapidly and their CHOs are probably converted into glucose at a rapid rate, producing a higher postprandial glucose concentration and subsequently higher insulin response. Research on the health effects of different GI of foods have indicated that a high GI diet and other factors associated with increasing affluence may have assisted in creating and developing chronic disease states [12]. In spite of the beneficial effect of LGI foods on weight loss is still controversial, there is evidence that LGI foods are more satiating [13-14], more filling, and delaying hunger pangs longer in comparison to high GI foods [14-15]. In addition, LGI foods reduce energy intake during the remainder of the day and so that can induce weight loss [16]. Therefore, this study mainly aimed to study the prevalence of obesity among Saudi females. In addition, the impact of short-term consumption of LGI foods on weight among obese Saudi females has been assessed.

Materials and Methods

Prevalence of obesity

Subjects

A total number of 979 Saudi females aged 19-22 years were recruited for the study by the distribution of both e-mails and posters. All participants were full time students from different colleges at King Faisal University, come from rural and urban communities in Eastern Province, Saudi Arabia. This study was conducted at Nutrition Department, Building 53, King Faisal University, Al-Hssa 31982, POB 420, Saudi Arabia, between October 2014 and February 2015.

Anthropometric measurements

Height, weight and blood pressure were initially taken at baseline. Body mass index (BMI; kg/m^2) was estimated from weight in kilograms divided by the square of the height in meters, and the mean blood pressure (MBP) was calculated.

Low glycaemic index (LGI) diet study

Subjects

The overweight and obese Saudi females from above participants (n = 32) were invited to join LGI diet program by the distribution of both e-mails and posters. They were asked to comply with the dietary advice over the 6 weeks of the program. All subjects were given advice to lose weight. A daily intake of LGI foods was emphasized and consumption of five to seven portions of fruits and vegetables, whole grains and low fat products were encouraged. The aim was to provide advice rather than a supply food in order to assess compliance. The study protocol was approved by King Faisal University Ethics Committee (KFU-EC037-11-2-2013), Deanship of Scientific Research, King Faisal University, Al-Hssa 31982, POB 400, Saudi Arabia.

Anthropometric measurements

Height, weight and blood pressure were taken in the beginning of the study; and the weight was taken again at the end of the program. Body mass index (BMI) was estimated at baseline and at the end of the study.

Dietary intakes

Three-day weighed records of dietary intakes were collected by nutritionist at the beginning and at the end of the study. The subjects

were instructed to measure and record the exact amounts of food eaten by using a household measurement such as glasses, cups, table-spoons ...etc. In addition, photographs and videos of food and drink portion sizes was illustrated.

Dietary analysis of the dietary intakes was undertaken using a computerized diet package (Arabic program for Foods analysis, First version, 2007, National King Fahad Library 5716/1427, Riyadh, Saudi Arabia). The nutrients density has been calculated as a percentage of total energy intakes.

Validation of dietary intakes

The energy intake (EI) was validated against estimated energy expenditure (EE) using Schofield's equation [17]. Subjects were classified as under-reporters, when the ratio of EI to EE was less than 0.79 and as over-reporters when the ratio of EI to EE was more than 1.21 [18].

Nutrient densities were estimated as amount per 1000 kcal (4185 kJ) of energy intake.

Statistical Analysis

All statistical analysis was performed using Statistical Package for Social Sciences (SPSS for Windows, Version 21.0). All data were examined using two-tailed with a significant level of $p < 0.05$. Results were expressed as means with standard error of the mean (SEM) unless otherwise stated. Differences in the BMI, EI, EE, macronutrient and micronutrient intakes at the baseline and after consumption of LGI foods, over the 6 weeks were compared using paired t-test.

Results

The prevalence of obesity

The demographic details of participants are shown in (Table 1). Half of the participants had normal weight according to the average body mass index score. The prevalence of obesity (BMI ≥ 30) reached 10 % and overweight (BMI ≥ 25 and < 30) were 19 %. The proportion of overweight was significantly higher than obesity ($p < 0.01$). The study also found that 2 % of participants had abnormal blood pressure (See Table 2). There was a significant association between BMI and the mean blood pressure ($p < 0.01$).

Variables	Mean	SD
Age (y)	20.1	1.1
Weight (kg)	57.1	13.8
Height (cm)	158.2	5.7
Diastolic blood pressure (DBP, mmHg)	75.4	8.9
Systolic blood pressure (SBP, mmHg)	120.7	10.6

Table 1: *Characteristics of volunteers (n = 979).*

	Variables	Frequency	%
BMI			
	Underweight (BMI < 18.5)	201	20
	Normal weight (BMI ≥ 18.5 < 25)	494	51
	Overweight (BMI ≥ 25 < 30)	189	19
	Obese (BMI ≥ 30)	95	10
MBP			
	Normal blood pressure (< 110)	960	98
	Abnormal blood pressure (≥ 110)	119	2

Table 2: *The number and percentage of normal and abnormal weight and blood pressure between participants (n = 979).*

BMI: Body Mass Index; MBP = Mean Blood Pressure

The LGI diet program

The changes in weight, BMI, and total energy intake for participants who completed the LGI program are demonstrated in (Table 3). The ratio of EI to EE was 1.24 ± 0.02 and 096 ± 0.02 in the beginning and the end of the study, respectively. These figures implied that subjects were initially over-reporters, however; they were neither under-or over-reporters after the 6-week period.

Variables	Week 0		Week 6		P value
	Mean	SEM	Mean	SEM	
Weight (Kg)	84.8	2.4	81.7	2.3	0.000
BMI (Kg/m^2)	34.2	1.0	33.0	1.0	0.000
Energy intake (EI)	2086.6	36.7	1624.4	31.7	0.000
Energy expenditure (EE)	1683.5	10.6	1683.5	10.6	-
EI: EE ratio	1.24	0.02	0.96	0.02	0.000

Table 3: *Weight changes, BMI, total energy expenditure (EE) and energy intake (EI) for participants in the beginning and the end of the LGI program (n = 32).*

Dietary analysis is shown in (Figure 1) and (Table 4). We can see that macronutrients intakes were not different from the healthy eating guideline. In the end of the program there was a significant reduction in the total energy and fat intakes in comparison to the beginning of the study. In addition, there was a significant increase in the intakes of NSP and vitamins A and C after the 6-week period.

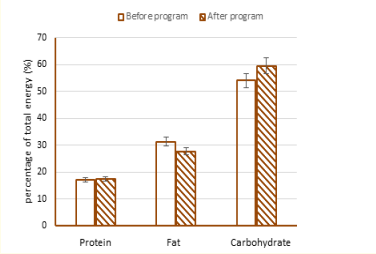

Figure 1: *The percentage of macronutrient intakes before and after the program (n = 32).*

Variables	Week 0		Week 6		*p* value
	Daily nutrient intakes	Nutrient intakes density (%)*	Daily nutrient intakes	Nutrient intakes density (%)*	
	Mean (SEM)	Mean (SEM)	Mean (SEM)	Mean (SEM)	
Total energy (Kcal)	2086.6 36.72)		1624.4 (31.70)		0.000
Carbohydrates (g)	281.7 (10.14)	54.9 (1.71)	224.4 (8.38)	57.9 (1.34)	0.011
Fat (g)	72.2 (2.94)	31.2 (1.21)	46.2 (2.17)	26.7 (0.97)	0.001
Protein (g)	88.8 (5.49)	17.0 (1.03)	64.4 (3.50)	16.7 (0.82)	0.596
Non-starch polysaccharide (g)	11.5 (0.77)	5.6 (0.41)	11.8 (0.55)	7.3 (0.36)	0.000
Iron (mg)	28.9 (4.08)	13.7 (1.82)	31.3 (2.67)	20.2 (1.65)	0.000
Calcium (mg)	667.6 (64.44)	316.6 (28.35)	579.3 (35.66)	380.8 (22.44)	0.012
Vitamin A (µg)	464.4 (53.84)	222.0 (24.95)	469.8 (44.33)	294.8 (30.27)	0.006
Vitamin C (mg)	54.0 (10.19)	25.7 (4.76)	70.8 (10.71)	46.9 (6.91)	0.000

Table 4: *Dietary nutrients intakes density for participants in the beginning and the end of the LGI program (n = 3).*

**Intakes as %total energy or per 1000 kcal.*

Discussion

This study aimed to assess the prevalence of overweight and obesity among female students in Saudi Arabia. We found that the overweight and obesity rates among females were 29%. Similar findings have been reported for both female and male students [19-22]. In this study, proportion of overweight between female students was higher than proportion of obese female students. Similar findings were reported for female student in Eastern Province of Saudi Arabia [22]. This unhealthy trend could be due to sedentary life style and major modifications in habitual eating patterns [19-21].

This study has also found that the body weight was significantly associated with blood pressure. This relationship has been documented by several intervention studies which have shown that treatment of obesity by weight loss decreases blood pressure substantially [23-25].

In addition, this study assessed the efficacy of the dietary advice for consumption LGI foods in overweight and obese females. We found that consumption LGI foods in a daily bases results in increased weight loss. This is consistent with other studies which have shown that weight loss was greater in overweight and obese people who consumed LGI foods compared to people who consumed high GI diets [10,11,16].

Despite that participants have not been advised to reduce their daily foods intakes, the study showed a significant reduction in energy intake. This could be due to the consumption of foods with high content of dietary non-starch polysaccharide (NSP). High NSP foods are more satiating and filling. They also delay hunger pangs for long time and reduce energy intake during the remainder of the day [26]. Therefore, a significant reductions in body weight has been demonstrated in this study. Also, the reduction in the body weight could be due to the low effect of these LGI foods on glycaemic response. It is obvious that lowering the glycaemic index and load of the first meal leads to consumption of less food in the subsequent meal [15,27]. The slow digestion of LGI foods could help in delaying hunger pangs, leading to eating less foods which can promote weight loss. That is, consuming LGI foods may appropriate in the treatment and prevention of obesity [28].

This study emphasized that consumption of LGI foods is associated with lower BMI which has been seen during only 6 weeks. As the most of LGI foods are high in NSP, this supports current public health recommendations encouraging consumption of whole, fruits and vegetables as part of a balanced diet. It is obvious that frequent consumption of high NSP foods places particular emphasis on the important and independent role of these foods in helping to prevent obesity.

The short period of the program was the limitation of this study and the findings need further validation by long term and clinical studies that may have public health significance for the Saudi populations.

Conclusions

The prevalence of obesity is increasing dramatically among Saudi populations. One of the main causes for this phenomenon is due to rapid changes in habitual eating patterns, in particular the quantity and quality of dietary CHOs. Several strategies have been investigated to prevent or alleviate the acuteness of obesity and its associated health problem. This study found that consumption of LGI foods resulted in significant reduction in weight over only 6 weeks. Nutritional advice, as a strategy of controlling weight, could be given to the general public and in particular overweigh and obese individuals to overcome this health problem. Experimental and observational studies have provided good evidence to support the direct effect or association of LGI foods in both the management and prevention of obesity. Long, high-quality, randomized controlled trials are needed.

Competing interests

The author declares that she has no competing interests.

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